



# education

Department of  
Education  
FREE STATE PROVINCE

## **PHYSICAL SCIENCES SUMMARIES, TERMS, DEFINITIONS, ACTIVITIES**

**GRADE 10**

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**This document consists of 206 pages.**

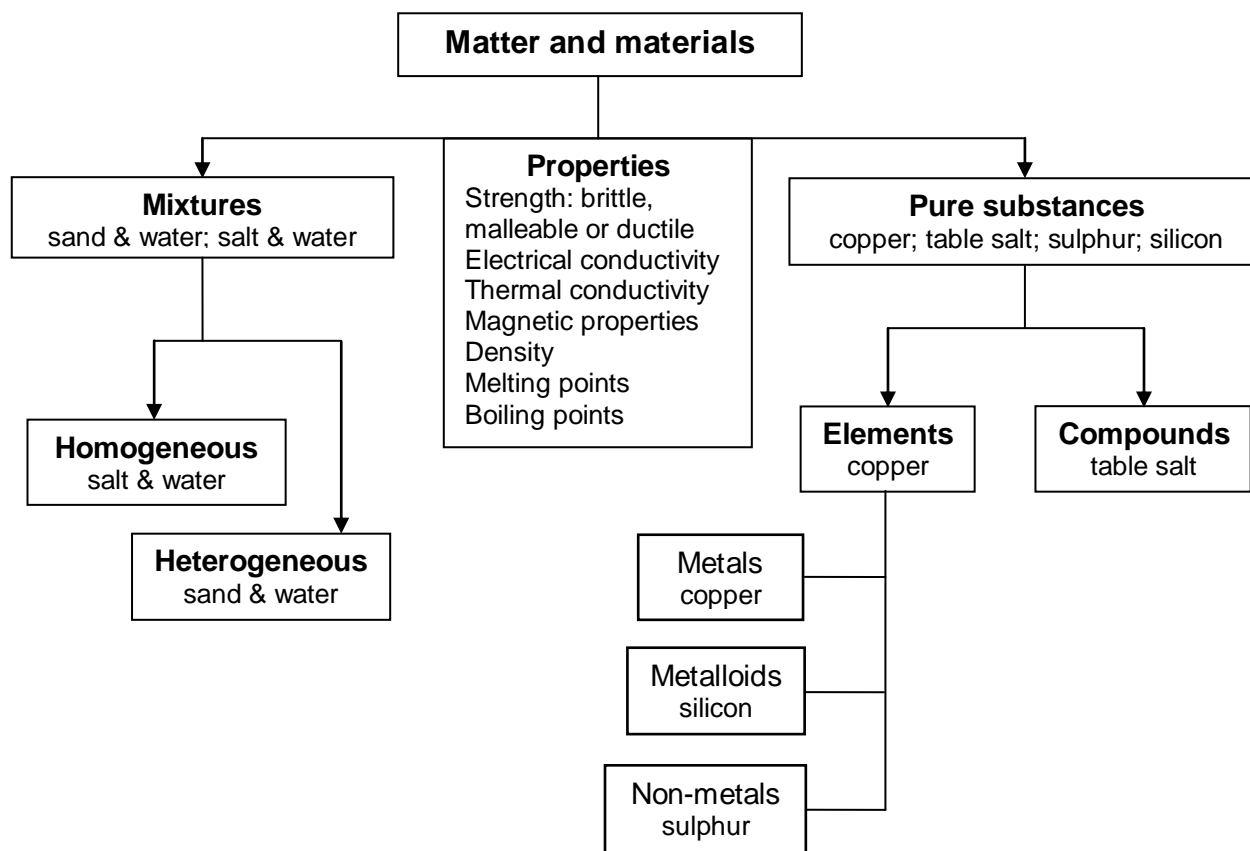
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## SUMMARIES, TERMS, DEFINITIONS AND ACTIVITIES

### Topic 1: Matter & classification



Important terms/definitions	
Pure substance	A substance (element or compound) that contains only one kind of matter.
Boiling point	The temperature of a liquid at which its vapour pressure equals the external (atmospheric) pressure.
Chromatography	A method of separating and identifying certain substances.
Compound	A pure substance consisting of two or more different elements.
Density	The mass per unit volume of a substance.
Heterogeneous mixture	A mixture in which components can be easily identified. An example is a mixture of sand and water.
Homogeneous mixture	A mixture of which the composition is uniform. An example is a solution of salt and water.
Electrical conductor	A material that allows the flow of charge.
Electrical insulator	A material that does not allow the flow of charge.
Element	A pure chemical substance consisting of one type of atom.
Metalloids/semi-metals	An element with properties intermediate between those of a metal and a non-metal.
Melting point	The temperature at which a solid changes to the liquid phase.
Pure substance	A substance that cannot be separated into simpler pieces by physical methods.
Thermal conductor	A material that allows heat to pass through easily.
Thermal insulator	A material that does not allow heat to pass through easily.

**Table 1: Chemical and everyday names of well-known compounds**

Chemical name	Everyday name	Chemical name	Everyday name
ammonium carbonate	smelling salts	carbon disulphide	carbon bisulphide
ammonium nitrate	fertiliser	hydrogen oxide	water
ammonium sulphate	fertiliser	hydrogen chloride	hydrochloric acid
calcium carbonate	marble	hydrogen sulphate	sulphuric acid
calcium sulphate	plaster of Paris	hydrogen nitrate	nitric acid
magnesium sulphate	Epsom salts	ethanoic acid	acetic acid
sodium chloride	table salt	hydrogen carbonate	carbonic acid
calcium hydroxide	slaked lime	hydrogen sulphite	sulphurous acid
sodium hydrogen carbonate	baking soda	hydrogen nitrite	nitrous acid
sodium hydroxide	caustic soda	copper(II)sulphate	blue vitriol
sodium carbonate	washing soda	calcium oxide	quicklime
potassium hydroxide	caustic potash	carbon dioxide	carbonic acid gas

**Table 2: Positive and negative ions**

POSITIVE IONS					
+1 symbol	Name	+2 symbol	name	+3 symbol	Name
H <sup>+</sup>	hydrogen	Be <sup>2+</sup>	beryllium	Al <sup>3+</sup>	aluminium
Li <sup>+</sup>	lithium	Mg <sup>2+</sup>	magnesium	Fe <sup>3+</sup>	iron(III)
Na <sup>+</sup>	sodium	Ca <sup>2+</sup>	calcium	Cr <sup>3+</sup>	chromium(III)
K <sup>+</sup>	potassium	Sr <sup>2+</sup>	strontium	As <sup>3+</sup>	arsenic(III)
Ag <sup>+</sup>	silver	Ba <sup>2+</sup>	barium	Sb <sup>3+</sup>	antimony(III)
Hg <sup>+</sup>	mercury(I)	Sn <sup>2+</sup>	tin(II)	Bi <sup>3+</sup>	bismuth(III)
Cu <sup>+</sup>	copper(I)	Pb <sup>2+</sup>	lead(II)		
NH <sub>4</sub> <sup>+</sup>	ammonium	Zn <sup>2+</sup>	zinc		
H <sub>3</sub> O <sup>+</sup>	hydronium (oxonium)	Fe <sup>2+</sup>	iron(II)		
		Hg <sup>2+</sup>	mercury(II)		
		Mn <sup>2+</sup>	manganese		
		Ni <sup>2+</sup>	nickel		
		Cd <sup>2+</sup>	cadmium		
		Cr <sup>2+</sup>	chromium(II)		
		Cu <sup>2+</sup>	copper(II)		
NEGATIVE IONS					
-1 symbol	Name	-2 symbol	Name	-3 symbol	Name
F <sup>-</sup>	fluoride	O <sup>2-</sup>	oxide	N <sup>3-</sup>	nitride
Cl <sup>-</sup>	chloride	S <sup>2-</sup>	sulphide	PO <sub>4</sub> <sup>3-</sup>	phosphate
Br <sup>-</sup>	bromide	CO <sub>3</sub> <sup>2-</sup>	carbonate		
I <sup>-</sup>	iodide	SO <sub>4</sub> <sup>2-</sup>	sulphate		
OH <sup>-</sup>	hydroxide	SO <sub>3</sub> <sup>2-</sup>	sulphite		
NO <sub>3</sub> <sup>-</sup>	nitrate	CrO <sub>4</sub> <sup>2-</sup>	chromate		
NO <sub>2</sub> <sup>-</sup>	nitrite	Cr <sub>2</sub> O <sub>7</sub> <sup>2-</sup>	dichromate		
CN <sup>-</sup>	cyanide	S <sub>2</sub> O <sub>3</sub> <sup>2-</sup>	thiosulphate		
HCO <sub>3</sub> <sup>-</sup>	hydrogen carbonate	MnO <sub>4</sub> <sup>2-</sup>	manganate		
HSO <sub>4</sub> <sup>-</sup>	hydrogen sulphate				
ClO <sub>3</sub> <sup>-</sup>	chlorate				
MnO <sub>4</sub> <sup>-</sup>	permanganate				
IO <sub>3</sub> <sup>-</sup>	iodate				
CNS <sup>-</sup>	thiocyanate				
CH <sub>3</sub> COO <sup>-</sup>	ethanoate (acetate)				



### **Daily task 1.1: Classwork/Homework**

1. Draw the following table in your workbook and classify each of the items as a pure substance, homogeneous mixture or heterogeneous mixture. In each case supply a reason for your answer.

	Item	Pure substance, homogeneous mixture or heterogeneous mixture	Reason
1.1	tap water		
1.2	stainless steel		
1.3	air		
1.4	diamond		
1.5	brick wall		
1.6	vegetable soup		
1.7	aluminium foil		
1.8	tea		
1.9	wood		
1.10	oxygen		
1.11	tea and sugar		
1.12	iodine crystals		
1.13	polystyrene		
1.14	Copper		
1.15	brass		
1.16	9 ct gold earring		
1.17	platinum ore		

### **Daily task 1.2: Classwork/Homework**

1. Write down the names of the following compounds:

1.1	KMnO <sub>4</sub>	1.2	K <sub>2</sub> CO <sub>3</sub>	1.3	KCl	1.4	FeCl <sub>2</sub>
1.5	Na <sub>2</sub> SO <sub>4</sub>	1.6	FeCl <sub>3</sub>	1.7	Na <sub>2</sub> S	1.8	Na <sub>2</sub> SO <sub>3</sub>

2. Write down the formula of each of the following compounds:

2.1	ammonium nitrate	2.2	zinc oxide	2.3	cobalt(II) chloride
2.4	zinc sulphide	2.5	magnesium chloride	2.6	calcium nitrate
2.7	copper(II) sulphate	2.8	potassium chromate	2.9	potassium nitrate

### **Daily task 1.3: Classwork/Homework/Practical investigation**

1. In your own words, explain the difference between a conductor, insulator and a semi-conductor.
2. The following materials are supplied: a piece of wire, a ruler, a pen and a pencil. Plan an investigation to indicate which of the items are conductors and which are insulators. The following steps will help you with your planning:

**Step 1: Ask an investigative question** – what do you want to determine during this investigation?

**Step 2: Hypothesis** – Make a prediction by guessing which materials are conductors and which are insulators.

**Step 3: List of apparatus** – Supply a list of all the apparatus you will need for the investigation. Explain what each of the listed items will be used for.

**Step 4: Method** – Write down how you will test the materials for conduction. Use a circuit diagram to show how you will set up the apparatus.

**Daily task 1.4: Classwork/Homework/Practical investigation**

A learner collects the materials listed in the table below in order to investigate some of their physical properties. Three of the observations made during the investigation are shown (as YES or NO) in the table, whilst others are represented by the letters (a) to (f).

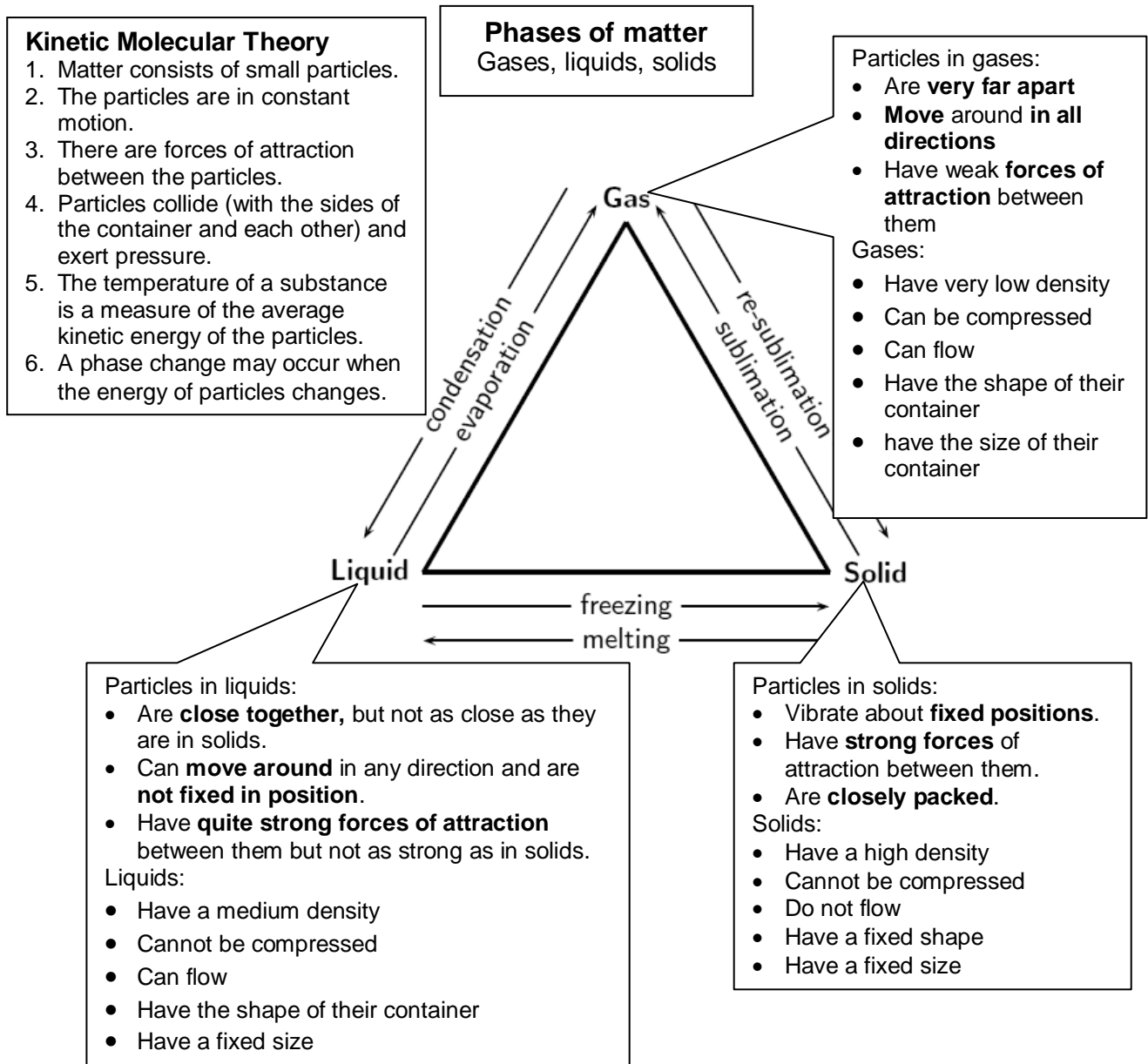
Material	Conduction of electricity	Shiny / Metallic	Ductile
Copper rod	Yes	Yes	(a)
Sodium chloride crystals		(b)	
Magnesium strip	Yes		(c)
Sulphur lump	(d)	(e)	
Carbon powder			(f)

1. To investigate the conductivity of the materials, the learner connects the materials alternately in a closed circuit containing a battery and a light bulb.

For this investigation, write down:

- 1.1 The independent variable
- 1.2 The dependent variable
- 1.3 An investigative question
2. Briefly describe how you will test whether the above materials are:
  - 2.1 Shiny or not
  - 2.2 Ductile or not
3. Write down the observations, represented by the letters (a) to (f) in the above table, that the learner should make. Copy the letter (a) to (f) into your answer book. Next to each letter, only write down YES or NO.
4. Give TWO reasons why lightning conductors are made of copper.
5. State TWO other physical properties of magnesium not investigated in this investigation.

## Topic 2: States of matter and the kinetic molecular theory



Important terms/definitions	
Boiling point	The temperature of a liquid at which its vapour pressure equals the external (atmospheric) pressure. (Typically boiling points are measured at sea level. At higher altitudes, where atmospheric pressure is lower, boiling points are lower. The boiling point of water at sea level is 100 °C, while at the top of Mount Everest it is 71 °C.
Brownian motion	The random movement of microscopic particles suspended in a liquid or gas, caused by collisions between these particles and the molecules of the liquid or gas. (This movement is named for its identifier, Scottish botanist Robert Brown (1773-1858)).
Condensation	The process during which a gas or vapour changes to a liquid, either by cooling or by being subjected to increased pressure.
Deposition (Re-sublimation)	Deposition is a process in which a gas transforms into a solid. The reverse of deposition is sublimation.
Diffusion	The movement of atoms or molecules from an area of higher concentration to an area of lower concentration.
Evaporation	The change of a liquid into a vapour at a temperature below the boiling point. (Note: Evaporation takes place at the surface of a liquid, where molecules with the highest kinetic energy are able to escape. When this happens, the average kinetic energy of the liquid is lowered, and its temperature decreases.)
Freezing	The process during which a liquid changes to a solid by the removal of heat.
Freezing point	The temperature at which a liquid (releasing sufficient heat), becomes a solid.
Melting	The process during which a solid changes to a liquid by the application of heat.
Melting point	The temperature at which a solid, given sufficient heat, becomes a liquid. (For a given substance, the melting point of its solid form is the same as the freezing point of its liquid form, and depends on such factors as the purity of the substance and the surrounding pressure.)
Sublimation	The process during which a solid changes directly into a gas without passing through an intermediate liquid phase.

### **Daily task 2.1: Classwork/Homework**

1. Matter exists as three phases: gases, liquids or solids
  - 1.1 Compare these three phases in a table with regard to the movement of the constituent particles, distance between the particles and the forces between the particles.
  - 1.2 List a few substances that occur in each of the following phases at room temperature:
    - 1.2.1 Solid
    - 1.2.2 Liquid
    - 1.2.3 Gas
2. Give one word/term for each of the following descriptions:
  - 2.1 Ice changes to water
  - 2.2 Water changes to ice
  - 2.3 Water changes to water vapour
  - 2.4 Water vapour changes to water
3. Explain each of the phase changes in Question 2 in terms of the kinetic theory.

**Daily task 2.2: Classwork/Homework/Data-interpretation**

1. The following table shows the melting and boiling point of five substances.

	Water	Ethanol	Chlorine	Bromine	Phosphorus
Melting point (°C)	0	-114	-102	-7	44
Boiling point (°C)	100	78	-34	59	280

Which of these substances:

- 1.1 Has the lowest boiling point?
  - 1.2 Are solids at room temperature (25 °C)?
  - 1.3 Are liquids at room temperature (25 °C)?
  - 1.4 Are gasses at room temperature (25 °C)?
2. Consider the metal iron.
- 2.1 Will liquid iron boil?
  - 2.2 Is the temperature at which liquid iron boils larger than the boiling point of water?
  - 2.3 Is iron still iron after it has evaporated?
  - 2.4 What can you deduce about the forces of attraction between the particles in iron (iron atoms) and the particles in water (water molecules)?
3. Explain the following use: In places where it snows, the traffic department pours salt on snow-covered roads.
4. Explain each of the following in terms of the kinetic molecular model of matter:
- 4.1 A metal power/laundry line which hang droop on a very warm day
  - 4.2 Water that vanish out of an open container
  - 4.3 The need for gaps in railway lines

**Daily task 2.3: Classwork/Homework/Data-interpretation**

Container **A** contains 1 ℓ of water and container **B** contains 1 ℓ of petrol. Both containers are left open at a temperature of 25 °C. After 50 minutes, half of the liquid in one of the containers has disappeared.

1. Identify the container in which half of the liquid has evaporated. Give a reason for your answer.
2. What happened to the liquid that disappeared?
3. How does the average kinetic energy of the molecules in container **A** compares to that of the molecules in container **B**?
4. Use the kinetic theory to explain why the liquid in one of the containers has disappeared, but not in the other. Use drawings in your explanation.
5. What can be done to prevent the liquid from disappearing?
6. If left long enough, the liquid in both containers will disappear. Explain.

### **Experiment 1A: Heating curve of water**

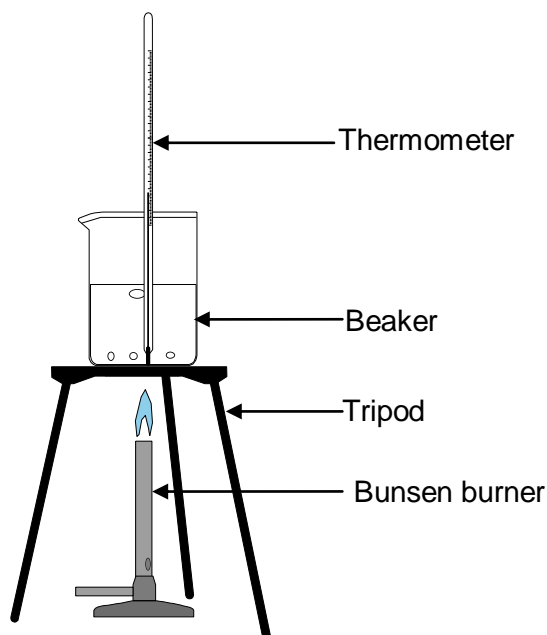
**Aim:** To obtain the heating curve of water.

#### **Apparatus:**

1. A glass beaker
2. Crushed ice
3. Thermometer
4. Burner/ heat source

#### **Method:**

1. Set up apparatus as shown in the diagram.
2. Place at least 100 g (100 ml) ice in the glass beaker.
3. Measure and record the temperature.
4. Melt the ice over a slow flame whilst stirring it continuously. Take the temperature 2 minutes until the water boils.
5. Take the temperature readings for another 4 minutes after reaching boiling point.



**Hint:** It is advisable to first test how long it takes to melt the ice and boil the water before deciding on the time interval. Depending on the heat source, intervals for taking the temperature may vary from 30 s to 2 minutes.)

#### **Results**

1. Draw the following table in your workbook and record the results in the table.

Time (s)	Temperature (°C)	Observation (What do you see in the ice mixture?)
0	0	

2. Draw a graph of temperature versus time.

#### **Questions**

1. Identify the:
  - 1.1 Dependent variable
  - 1.2 Independent variable
2. What happened to the water's temperature while the ice was melting?
3. What happened to the temperature after all the ice had melted?
4. What happened to the water's temperature while the water was boiling?
5. Water underwent different phase changes during the investigation. Redraw the following table in your workbook. Summarise all the changes in the table.

Process	Reaction equation for the phase change	Was energy released or absorbed during the change?
Melting		
Evaporation		
Condensation		

6. Use the information in the table to explain the following phenomena:
  - 6.1. On a cold morning, the car's windows mist up more quickly.
  - 6.2. Our bodies cool down faster when we sweat than when a breeze is blowing.

### **Experiment 1B: Cooling curve of water**

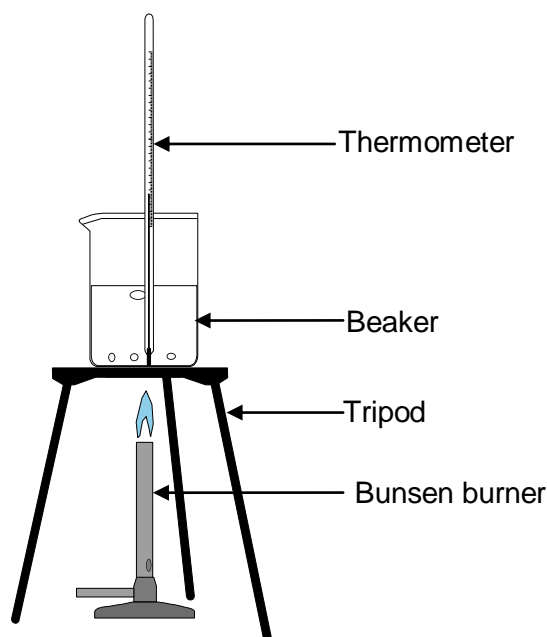
**Aim:** To obtain the cooling curve of water.

**Apparatus:**

1. A glass beaker
2. Crushed ice
3. Thermometer
4. Burner/ heat source

**Method:**

1. Set up apparatus as shown in the diagram.
2. Heat the water until it boils.
3. Remove the burner and allow the water to cool down, whilst measuring the temperature every 2 minutes.
4. Place the beaker in an ice bath (or the freezer) when it reaches room temperature.
5. Measure and record the temperature every 4 minutes until the water reaches 0 °C.



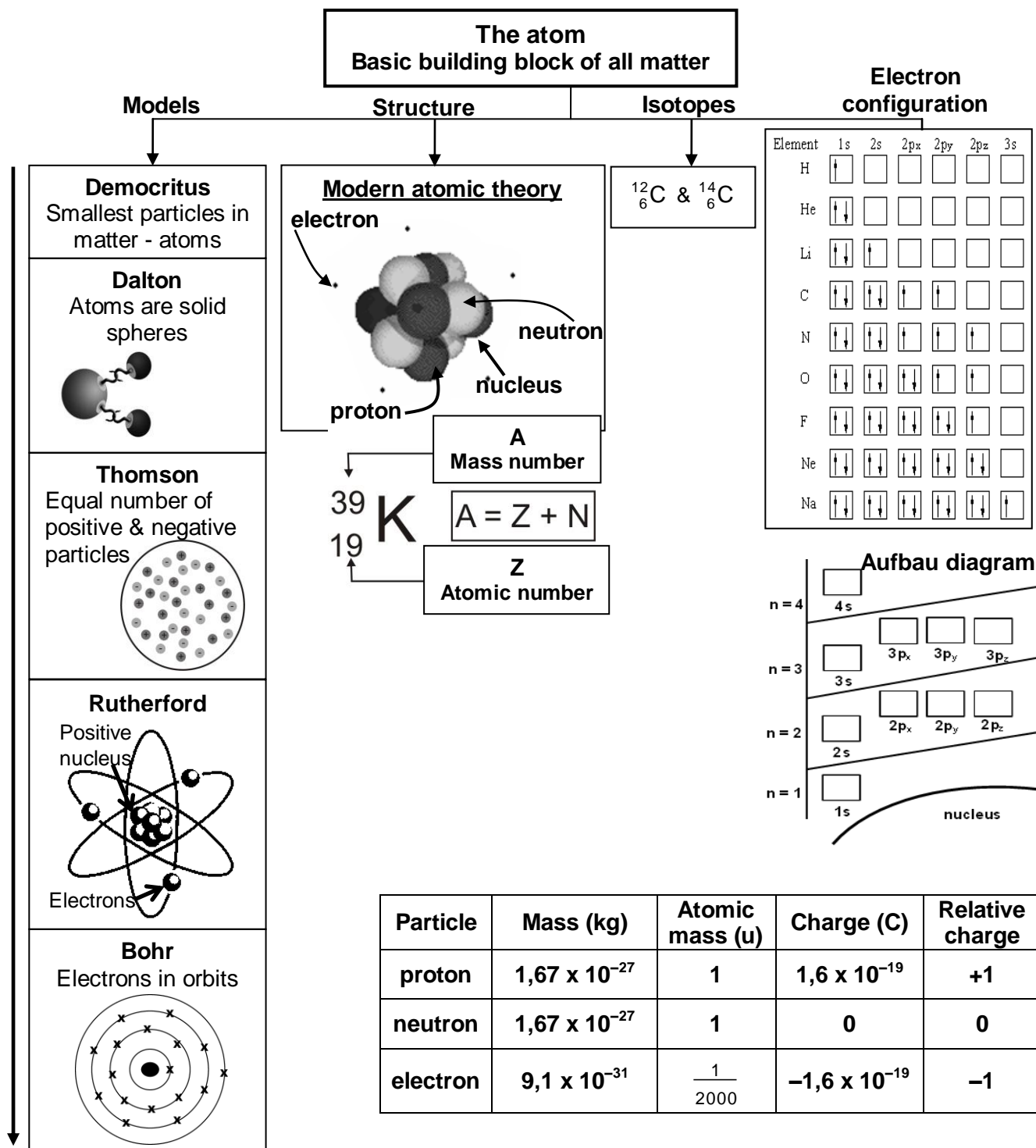
**Results**

1. Draw the following table in your workbook and note the results in the table.

Time (s)	Temperature (°C)	Observation (What do you see in the ice mixture?)

2. Draw a graph of temperature versus time.

## Topic 3: The atom: basic building block of all matter



Particle	Mass (kg)	Atomic mass (u)	Charge (C)	Relative charge
proton	$1,67 \times 10^{-27}$	1	$1,6 \times 10^{-19}$	+1
neutron	$1,67 \times 10^{-27}$	1	0	0
electron	$9,1 \times 10^{-31}$	$\frac{1}{2000}$	$-1,6 \times 10^{-19}$	-1



Important terms/definitions	
Atomic number (Z)	The number of protons in the nucleus of an atom.
Atomic orbital	The most probable region around the nucleus where electrons will be found.
Electrons	Negative particles occupying space around nucleus.
Excited state	When an electron gains energy and moves into higher energy level.
Ground state	The lowest energy state of an electron.
Hund's rule	No pairing in <i>p</i> orbitals before there is not at least one electron in each <i>p</i> orbital.
Ionisation energy	The energy needed to remove an electron(s) from an atom in the gaseous phase.
Isotope	Atoms of the same element with the same atomic number, but different mass numbers due to a difference in the number of neutrons.
Mass number (A)	The sum of protons and neutrons in the nucleus.
Neutrons	Neutral particles in the atomic nucleus.
Nucleons	The particles in the nucleus of an atom i.e. protons and neutrons.
Pauli's exclusion principle	Maximum two electrons per orbital provided that they spin in opposite directions.
Protons	Positive particles in the atomic nucleus.
Quantised energy level	An energy level that can only have specific amounts of energy.
Relative atomic mass	The mass of an atom of an element on a scale where carbon-12 has a mass of 12.
Valence electrons	Outer electrons; electrons in the highest filled energy level of an atom.

### **Daily task 3.1: Classwork/Homework**

1. Name the particles found in the atom which:
  - 1.1 Carry no electrical charge
  - 1.2 Has the smallest mass of all
  - 1.3 Carry one positive electrical charge
  - 1.4 Carry one negative electrical charge
  - 1.5 Occur in the nucleus of the atom
2. Define the following terms:
  - 2.1 Nucleons
  - 2.2 Mass number
  - 2.3 Atomic number
  - 2.4 Relative atomic mass
3. Copy the table below into your answer book and complete the open spaces.

	Element	Atomic number	Number of protons	Number of electrons	Number of neutrons	Mass Number
${}^6_{12}\text{X}$						
${}^8_{16}\text{X}$						
${}^{15}_{31}\text{X}$						
${}^{16}_{31}\text{X}$						
${}^{16}_{32}\text{X}$						

4. Use the table completed in QUESTION 3 to answer the following questions.
  - 4.1 What relationship exists between the atomic number of an element and the number of protons in a neutral atom of the element?
  - 4.2 State ONE similarity and ONE difference between the 4<sup>th</sup> and 5<sup>th</sup> elements in the table.
  - 4.3 What do we call atoms of elements with the same atomic number but different mass numbers?
  - 4.4 Use the periodic table and write down the names of the first three elements in the table.
5. Use the  ${}^A_Z\text{X}$  notation to represent each of the following atoms:
  - 5.1 Uranium-235
  - 5.2 Calcium-40

### **Daily task 3.2: Classwork/Homework**

1. Redraw the following table in your workbook. Complete all the cells with the necessary information.

Element	Symbol	Mass number	Atomic number	Nucleons	Protons	Neutrons	Electrons
Magnesium	Mg			24			12
Magnesium	Mg <sup>2+</sup>		12			12	
	O <sup>2-</sup>	16	8				
	Na <sup>+</sup>	23			11		
	S		16	32			
Potassium		39	19				
	Br <sup>-</sup>					45	36
	Fe <sup>3+</sup>	56			26		

2. The control rods in nuclear reactors often contain boron. Natural boron is composed of 20% B-10 ( ${}^{10}_5\text{B}$ ) and 80% B-11 ( ${}^{11}_5\text{B}$ ).
  - 2.1 Do a calculation to indicate that the relative atomic mass of boron is 10,8.
  - 2.2 What is the composition of the nucleus of each of these isotopes?

### **Daily task 3.3: Classwork/Homework**

1. A mass spectrum of natural uranium indicates that 1% of the uranium atoms have a mass of 235 and that 99% have a mass of 238. Use this experimental information to determine the relative atomic mass of uranium.
2. Carbon's relative atomic mass is 12,011. Determine the percentage occurrence of each of the isotopes if we assume that carbon occurs only as C-14 and C-12 (Tip: Assume that x% C-12 and y% is C-14.)
3. Naturally occurring chlorine consists of two stable isotopes 75%  $\text{Cl}^{35}_{17}$  and 25%  $\text{Cl}^{37}_{17}$ . Calculate the mass of the average chlorine atom on the relative atomic mass scale.

**Daily task 3.4: Classwork/Homework**

1. Draw Aufbau diagrams for all the elements in Period II (from Li to Ne) and Period III (Na to Ar). Indicate the following next to each of the Aufbau diagrams of the elements:
  - 1.1 Number of the highest filled energy level
  - 1.2 Number of the period in the periodic table
  - 1.3 Number of valence electrons
  - 1.4 Number of inner electrons (core electrons)
  - 1.5 Group number in the periodic table
  - 1.6 Electron configuration (sp notation)
2. Use your answers in Question 1 to answer the following questions.
  - 2.1 What is the relationship between the group number and the number of valence electrons?
  - 2.2 What is the relationship between the period number and the number of highest filled energy level?
  - 2.3 Explain the following: Elements in the same group of the Periodic Table have the same chemical properties.
  - 2.4 The noble gases are so called because they do not bond easily with other elements or with each other. Look at the electron structure of the two noble gases in Periods II and III and provide a possible explanation for this unreactivity.

## Experiment 2: Flame tests

**Aim:** To identify metals using their flame colours.

### Background

**Why do some metal cations give different characteristic flame colours?**

- The outermost electrons in some metallic elements are loosely held and can be excited to higher energy levels when heated.
- When the excited electrons (unstable state) fall down to the lower energy level to obtain stability, a characteristic light is emitted. For most group I and II metals, the range of wavelengths of these emitted light are around that of the visible spectrum. As a result the visible radiations could colour the flames in different colours when some metallic cations are heated at high temperatures in a Bunsen flame.

### Apparatus & chemicals

Looped platinum / nichrome wire OR wooden splints OR cotton swabs

Wash bottle with distilled water

Bunsen burner

Concentrated hydrochloric acid

Watch glass

Metal salts:  $\text{LiCl}$ ,  $\text{NaCl}$ ,  $\text{KCl}$ ,  $\text{CuCl}_2$ ,  $\text{BaCl}_2$  and  $\text{CaCl}_2$

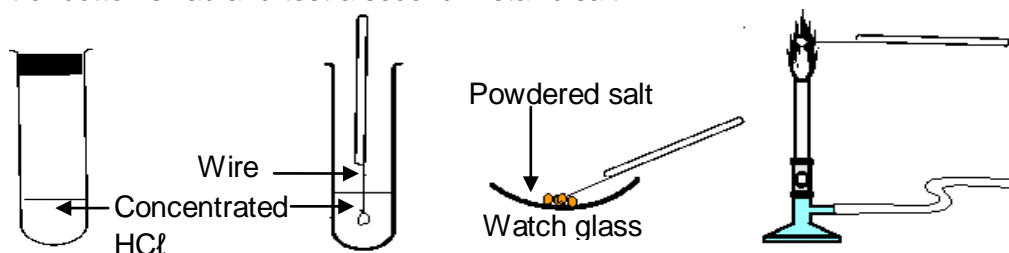
### Method

- Clean the platinum or nichrome loop. Dip the wire into hydrochloric acid, followed by rinsing with distilled water. Test the cleanliness of the loop by inserting it into a gas flame. If a burst of colour is produced, the loop is not sufficiently clean.

OR

Wooden splints or cotton swabs offer an inexpensive alternative to wire loops. Soak the wooden splints overnight in distilled water. Pour out the water and rinse the splints with clean water, being careful to avoid contaminating the water with sodium (from sweat on your hands). Take a damp splint or cotton swab through the flame. Do not hold the sample in the flame as this would cause the splint or swab to ignite.

- Dip the clean wire (or wooden splint or cotton swab) into a small amount of powdered metallic salt in a watch glass.
- Hold the wire (or wooden splint or cotton swab) in the cooler part of a non-luminous flame, i.e. the bottom of the flame. Then move the wire (or wooden splint or cotton swab) to the edge of the flame.
- Observe the characteristic colour of the flame when the wire (or wooden splint or cotton swab) is in the edge of the flame.
- Clean the wire as describe in step 1 above and test a second metallic salt OR use a new splint or cotton swab and test a second metallic salt.



### Results

Record your observation in the table below.

Metal salt	Flame colour

### Notes to the teacher

#### Limitations of the flame test

- The test cannot detect low concentrations of most ions.
- The brightness of the signal varies from one sample to another. For example, the yellow emission from sodium is much brighter than the red emission from the same amount of lithium.
- Impurities or contaminants affect the test results. Sodium, in particular, is present in most compounds and will colour the flame. Sometimes a blue glass is used to filter the yellow colour of sodium.
- The test cannot differentiate between all elements. Several metals produce the same colour. Some compounds do not change the colour of the flame at all.

#### Characteristic flame colours of metal cations

Metal ion	Flame colour	Metal ion	Flame colour
Lithium ion $\text{Li}^+$	deep red	Calcium ion $\text{Ca}^{2+}$	brick red
Sodium ion $\text{Na}^+$	golden yellow	Strontium ion $\text{Sr}^{2+}$	Blood red
Potassium ion $\text{K}^+$	Lilac	Barium ion $\text{Ba}^{2+}$	apple green
Rubidium ion $\text{Rb}^+$	Bluish red	Copper(II) ion $\text{Cu}^{2+}$	bluish green
Caesium ion $\text{Cs}^+$	blue		

## Topic 4: Periodic Table

**Periodic Table**

Elements arranged in ascending atomic number.

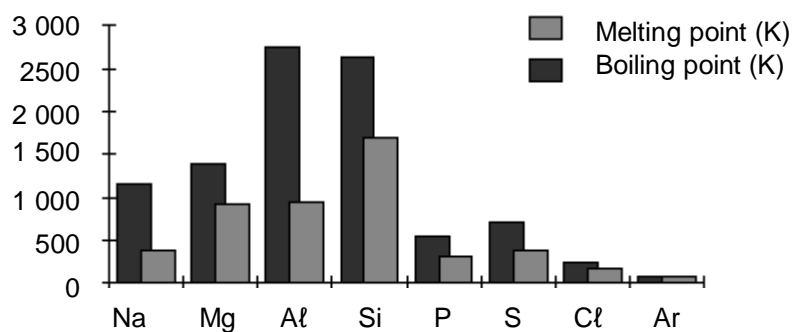
Period number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	I	II											III	IV	V	VI	VII	VIII (0)
1	1 H																	2 He
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
6	55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn
7	87 Fr	88 Ra	89 Ac	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds								
Lanthanides	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu				
Actinides	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr				

**Metals**      **Metalloids**      **Non-metals**

Decreasing electronegativity, ionisation energy & electron affinity  
 Increasing atomic radius

Increasing electronegativity, ionisation energy & electron affinity  
 Decreasing atomic radius

**Melting point & boiling points of elements in period 3**



<b>Important terms/Definitions:</b>	
Atomic number	Number of protons in the nucleus of an atom.
Atomic radius	Radius of an atom. (The distance from the atomic nucleus to the outermost stable electron in an atom.)
Boiling point	The temperature of a liquid at which its vapour pressure equals the external (atmospheric) pressure.
Density	The mass per unit volume of a substance.
Electron affinity	The energy released when an electron is attached to an atom or molecule to form a negative ion.
Electronegativity	The tendency of an atom in a molecule to attract bonding electrons closer to itself.
First ionisation energy	Energy needed to remove the first electron from an atom in the gaseous phase.
Group	Vertical columns in the periodic table. Some groups have names.
Ion	A charged particle made from an atom by the loss or gain of electrons.
Ionisation energy	Energy needed to remove an electron(s) from an atom in the gaseous phase.
Melting point	The temperature at which a solid, given sufficient heat, becomes a liquid.
Period	Horizontal rows in the periodic table.
Periodicity	The repetition of similar properties in chemical elements, as indicated by their positioning in the periodic table. (With increasing atomic number, the electron configuration of the atoms displays a periodic variation.)

#### **Daily task 4.1: Classwork/Homework**

Consider the first 18 elements in the periodic table. From these elements, choose the element that matches the following requirements:

1. The most reactive metal
2. A non-metal that can form four bonds
3. A yellow solid that is a non-metal
4. A noble gas with two protons
5. The lightest alkali metal
6. A member of the alkali earth metals with 12 neutrons
7. A metalloid in group III
8. A gas in period 2 that is used in combustion reactions
9. A semiconductor in period 3
10. A noble gas with the electron configuration  $1s^2 2s^2 2p^6 3s^2 3p^6$
11. Its diatomic molecules forms the most abundant gas in the atmosphere
12. A halogen in period 3
13. A yellowish gas that forms an ion with a -1 charge
14. A light, silvery metal with a valency of 3
15. An element with 4 protons
16. The element with the smallest atoms
17. An element with the notation  ${}^{31}_{15}\text{Q}$
18. A non-metal that is a liquid at room temperature

### **Daily task 4.2: Classwork/Homework**

The letters **A** to **H** in the table below represents eight elements from period 3 in the periodic table. Study the information in the table below and answer the question that follow.

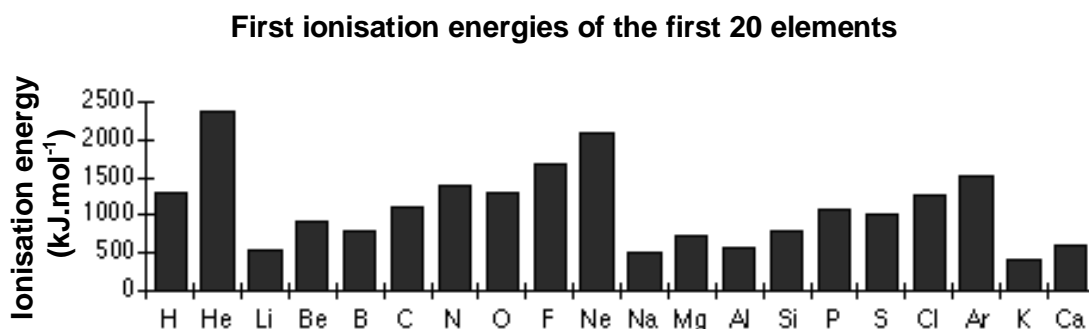
Element	Physical properties	Melting point (°C)	Electrical conductivity
A	Hard, greyish shiny solid	1 410	Semiconductor
B	Very light silver metal	660	Good conductor
C	Colourless gas	-189	Non conductor
D	Very reactive yellow solid	590	Non conductor
E	Extremely soft, silver metal	98	Good conductor
F	Soft, yellow solid	114	Non conductor
G	Yellow-green gas	-101	Non conductor
H	Slightly hard silver metal	650	Good conductor

1. Write down the letter of the element that represents:
  - 1.1 The metalloid
  - 1.2 An unreactive non-metal
  - 1.3 A very reactive metal
2. Describe the trend in electrical conductivity across period 3.
3. Elements **E** and **H** react with oxygen to form oxides. Write down the respective chemical formulae of these oxides.
4. Arrange the elements **A** to **H** in the sequence that they appear in period 3 in the periodic table.



### **Daily task 4.3: Classwork/Homework/Data-interpretation**

1. The graph below shows the first ionisation energies of the first 20 elements in the periodic table.

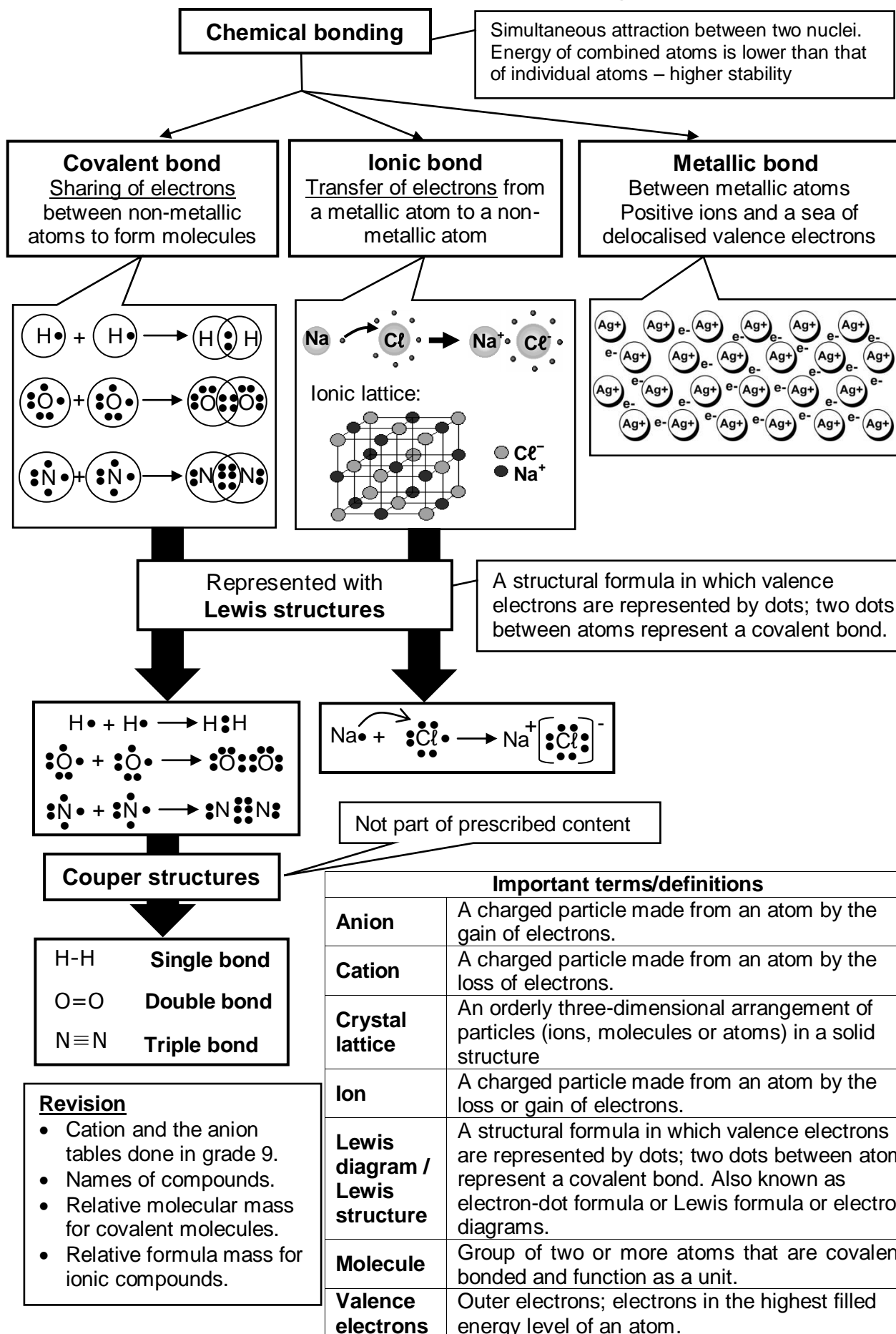


- 1.1 Define the term *first ionisation energy*.
  - 1.2 What does *periodicity* of ionisation energy mean?
  - 1.3 Which three elements have the lowest first ionisation energies? In which group of the periodic table do these elements occur?
  - 1.4 Which group's elements have the highest first ionisation energy?
  - 1.5 Arrange the elements on the graph in order of decreasing tendency to lose electrons.
  - 1.6 Which of the metals or non-metals will preferably form positive ions? Justify your answer with data from the graph.
2. Refer to the table below which gives the melting and boiling points of a number of elements.

Element	Melting point (°C)	Boiling point (°C)
copper	1 083	2 567
magnesium	650	1 107
oxygen	-218,4	-183
carbon	3 500	4 827
helium	-272	-268,6
sulphur	112,8	444,6

- 2.1 Write down the symbol of each element and next to it the phase in which each element occurs at room temperature.
- 2.2 Which of these elements has the strongest forces between its atoms? Give a reason for your answer.
- 2.3 Which of these elements has the weakest forces between its atoms? Give a reason for your answer.

## Topic 5: Chemical bonding



### **Daily task 5.1: Classwork/Homework**

- Draw Lewis structures for each of the following elements:
 

1.1 H	1.2 He	1.3 Na	1.4 Ne
1.5 Cl	1.6 S	1.7 C	1.8 O
1.9 K	1.10 Mg	1.11 Si	1.12 Br
- Water exists as the  $\text{H}_2\text{O}$  molecule. Use Aufbau diagrams for oxygen and hydrogen, as well as Lewis structures to explain the existence of the  $\text{H}_2\text{O}$  molecule.
- $\text{PH}$ ,  $\text{PH}_2$  or  $\text{PH}_3$ ? Use Aufbau diagrams and predict which one of the three is the correct formula. Explain the formation of the correct molecule with a Lewis structure.
- What is the valency of carbon? Illustrate the formation of the methane molecule ( $\text{CH}_4$ ) using Lewis structures.

### **Daily task 5.2: Classwork/Homework**

- Draw a Lewis structure and a Couper structure for each of the following molecules:
 

1.1 carbon dioxide	1.2 chlorine
1.3 hydrogen chloride	1.4 ammonia
- Potassium bromide is a white crystalline solid.
  - Which two elements make up potassium bromide?
  - What are the relative positions of these two elements on the periodic table?
  - How many valence electrons does each of these elements have?
  - What is the valency of each of these two elements?
  - What type of bond will form between these two elements?
  - Illustrate the formation of this bond using Lewis structures. Briefly explain how the bond will form.
- Explain the difference between an ionic bond and a covalent bond.
- Name the type of bonds that hold particles together in each of the following:
 

4.1 Na(s)	4.2 $\text{CuSO}_4(\text{s})$	4.3 iron
4.4 potassium chloride	4.5 A water molecule	

### **Daily task 5.3: Classwork/Homework**

- Write down the names of the following compounds:
 

1.1 $\text{K}_2\text{Cr}_2\text{O}_7$	1.2 $\text{Na}_2\text{CO}_3$	1.3 $\text{KClO}_3$
1.4 $\text{FeSO}_4$	1.5 $\text{Ca}_3(\text{PO}_4)_2$	1.6 $\text{CrCl}_3$
1.7 $\text{NH}_4\text{NO}_3$	1.8 $\text{Pb}(\text{NO}_3)_2$	1.9 $\text{Na}_2\text{S}_2\text{O}_3$
- Write down the formula of each of the following compounds:
 

2.1 ammonium sulphate	2.2 mercury(II) oxide	2.3 nickel chloride
2.4 sodium sulphite	2.5 sodium sulphide	2.6 potassium nitrite
2.7 iron(III) sulphate	2.8 potassium nitrate	
- Use Aufbau diagrams to explain why argon does not bond chemically, while chlorine always occurs as a compound in which it is bonded either to itself or to other elements.
- Calculate the relative molecular mass of:
 

4.1 $\text{H}_2\text{O}$	4.2 $\text{HCl}$	4.3 $\text{NH}_3$	4.4 $\text{H}_2$
--------------------------	------------------	-------------------	------------------
- Calculate the relative formula mass of:
 

5.1 NaCl	5.2 $\text{CuSO}_4$	5.3 $\text{K}_2\text{Cr}_2\text{O}_7$	5.4 $\text{Fe}(\text{NO}_3)_2$
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**Daily task 5.4: Homework project**

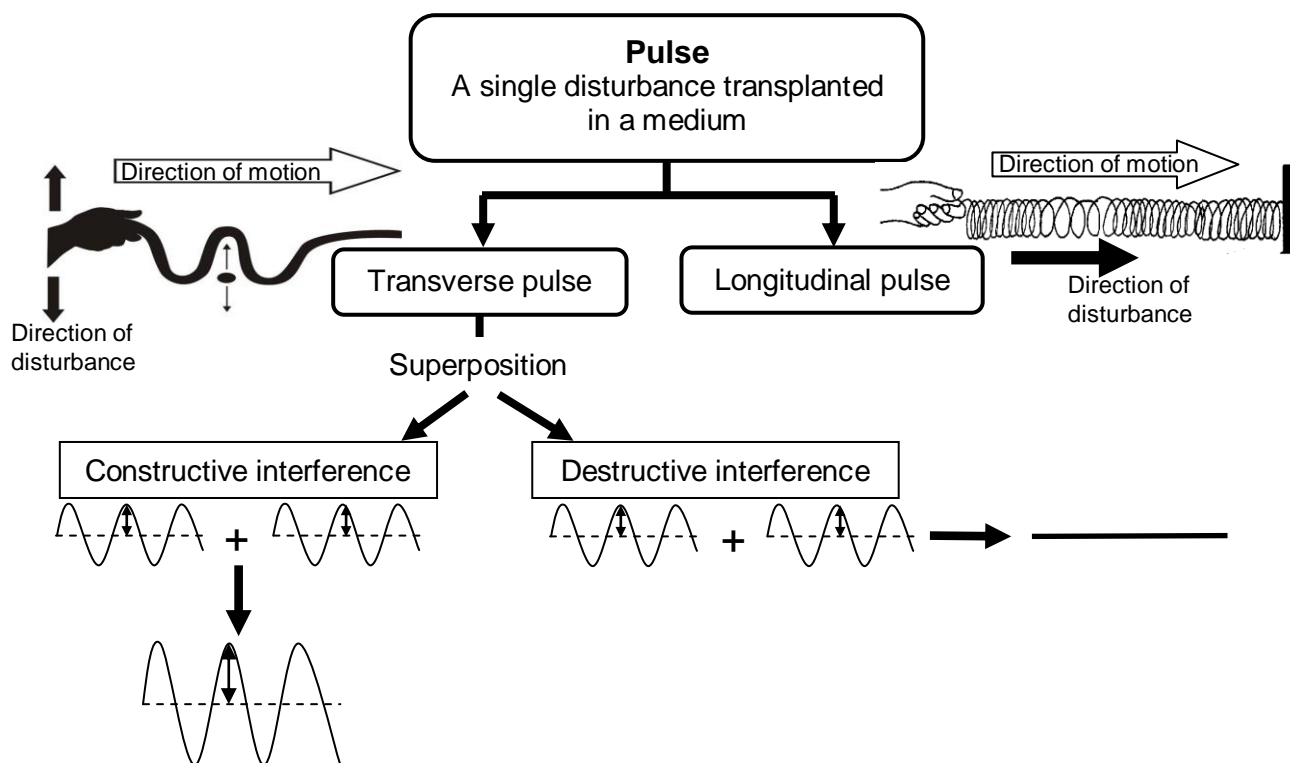
Build a model to represent each of the molecules listed below. Use any suitable materials to depict the atoms in the molecules. Polystyrene balls, jelly tots or marshmallows will work well as 'atoms'. Toothpicks or wires may be used to indicate the bonds between the atoms. Be creative!

List of molecules:  $\text{H}_2\text{O}$ ;  $\text{NH}_3$ ;  $\text{HCl}$ ;  $\text{O}_2$ ;  $\text{N}_2$ ;  $\text{CH}_4$ ;  $\text{Cl}_2$

Before handing in the project, take note of the following:

- Mount the structures onto cardboard or wood or any suitable background.
- Write the formula, the name and the Lewis structure of the molecule at each structure.
- Make sure that your name is also on the cardboard or wood.
- Correctness, punctuality, neatness and originality will be used as criteria for this project.

## Topic 6: Transverse pulses on a string or spring



Important terms/definitions	
Amplitude	The maximum displacement of a particle from its equilibrium position.
Constructive interference	A phenomenon where the crest of one wave overlaps with the crest of another wave to produce a wave of increased amplitude.
Destructive interference	A phenomenon where the crest of one wave overlaps with the trough of another, resulting in a wave of reduced amplitude.
Interference	A phenomenon where similar waves with a regular phase relationship pass through the same region at the same time.
Longitudinal pulse	A pulse whose particles vibrate parallel to the direction of the pulse's motion.
Pulse	A single disturbance in a medium.
Superposition	The algebraic sum of the amplitudes of two pulses that occupy the same space at the same time.
Transverse pulse	A pulse whose particles vibrate perpendicular to the direction of the pulse's motion.

**Daily task 6.1: Classwork/Homework**

1. Define each of the following terms:

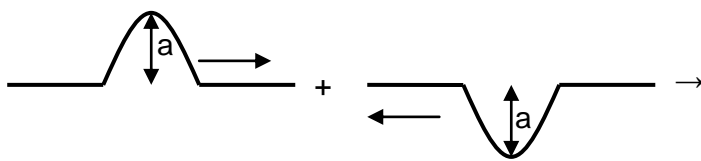
- 1.1 Pulse
- 1.2 Transverse pulse
- 1.3 Transverse wave
- 1.4 Amplitude
- 1.5 Interference.

2. Differentiate between:

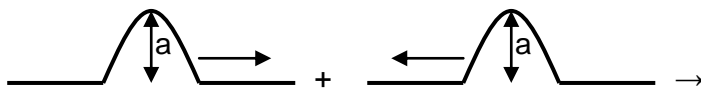
- 2.1 Constructive interference.
- 2.2 Destructive interference.

3. Copy and complete the diagrams below to show how two pulses that reach the same point in the same medium superpose.

3.1



3.2



### **Experiment 3: Constructive and destructive interference**

**Aim:** Observation of the interference of circular waves coming from two vibrating point sources.

#### **Apparatus**

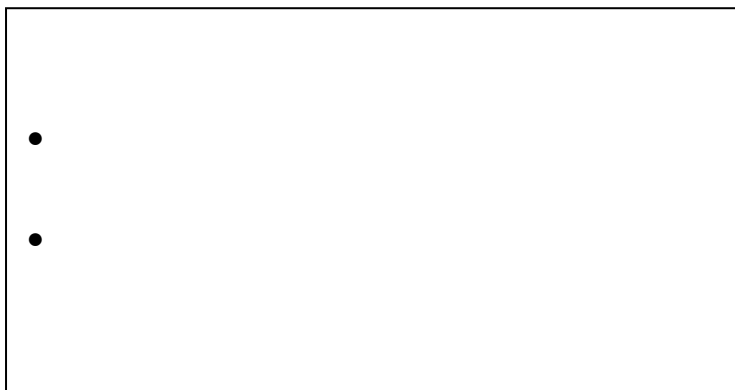
Ripple tank

#### **Method**

Raise the vibrating beam so that the beads just touch the water in the ripple tank.

#### **Results**

1. Draw the pattern observed when the beads are vibrating.

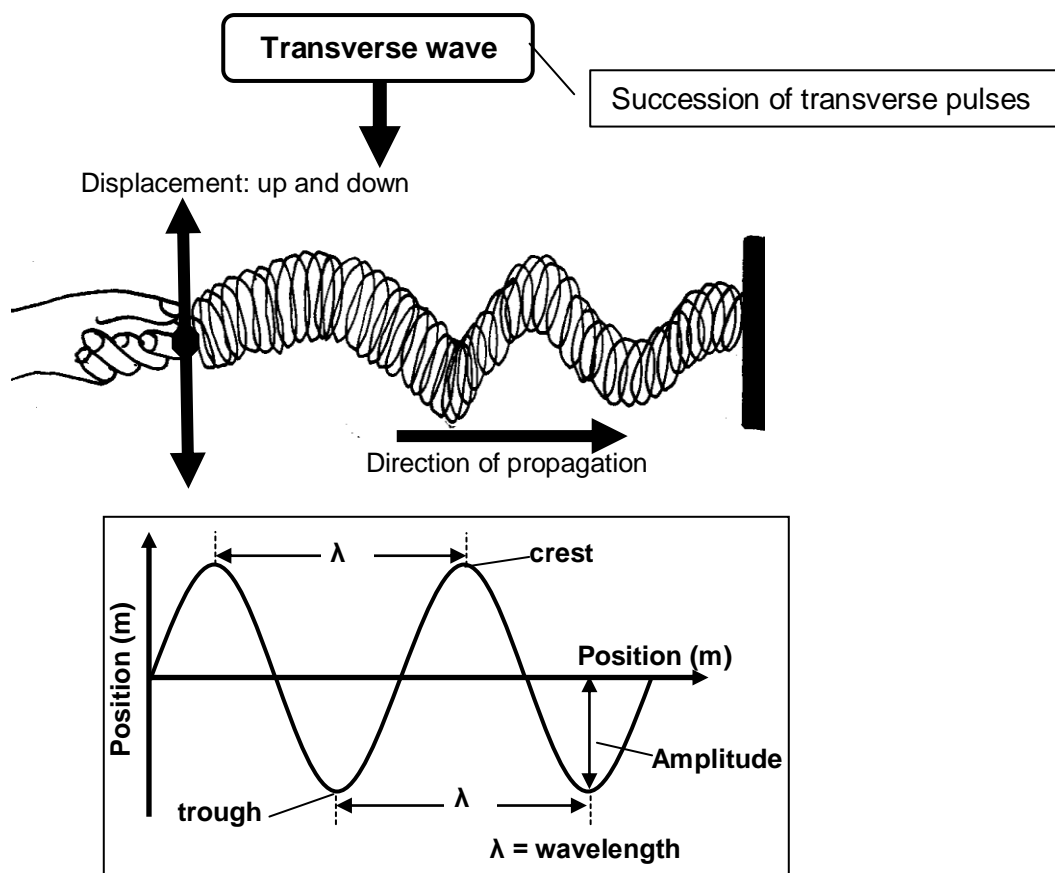


Label the nodal lines (lines joining points of destructive interference) and the light lines or antinodes (lines joining points where constructive interference takes place.) This pattern is called an interference pattern.

#### **Questions**

1. How will the number of nodal lines change if the distance between the two sources is increased?
2. How will the number of nodal lines change if the frequency of the vibrating beads is increased?
3. What will happen to the interference pattern if the two beads are not vibrating in time with each other?

## Topic 7: Transverse waves

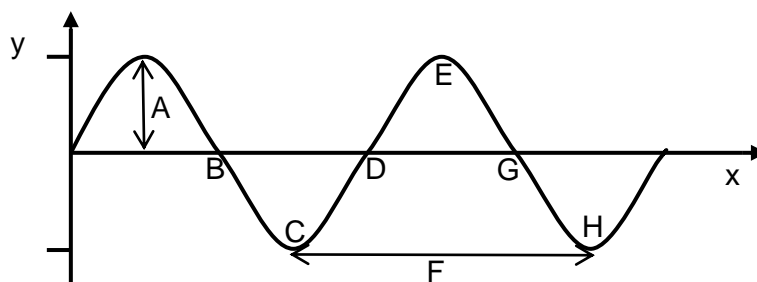


Important terms/definitions	
Crest	The highest point (peak) on a (sine) wave.
Frequency	The number of cycles/vibrations per unit time.
Period	The time taken for one complete cycle of an oscillation or vibration.
Point in phase	Two points on a wave that move exactly in the same way at the same time e.g. two crests or two troughs.
Transverse wave	A wave in which the disturbance is at right angles to the direction of propagation (motion) of the wave.
Trough	The lowest point (valley) on a (sine) wave.
Wavelength	The distance between two successive points in phase.
Wave speed	The distance travelled by a point on a wave per unit time.



### **Daily task 7.1: Classwork/Homework**

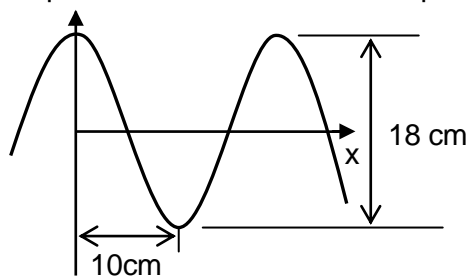
1. Define each of the following terms:
  - 1.1 Wavelength
  - 1.2 Frequency of a wave
  - 1.3 Period
  - 1.4 Crest
  - 1.5 Trough
  - 1.6 Wave speed
2. Differentiate between two points on a wave that are:
  - 2.1 In phase
  - 2.2 Out of phase
3. Study the diagram of a transverse wave below and answer the questions that follow.



- 3.1 Label the parts A, C, E and F
- 3.2 Use the letters A to H to indicate two points on the wave that are:
  - 3.2.1 In phase
  - 3.2.2 Out of phase

### **Daily task 7.2: Classwork/Homework**

1. Calculate the period of a wave whose frequency is 50 Hz.
2. Calculate the frequency of a wave if its period is 0,5 s.
3. Calculate the speed of a periodic wave disturbance that has a frequency of 3,5 Hz and a wavelength of 0,7 m.
4. The speed of a transverse wave in a string is  $15 \text{ m}\cdot\text{s}^{-1}$ . If the source's frequency is 6 Hz, calculate its wavelength.
5. Calculate the speed of a wave, wavelength 0,015 m, if 40 peaks pass a certain point in 20 s.
6. Five pulses are generated in a tank of water every 0,1 s. Calculate the speed of propagation of the wave if the wavelength of the surface wave is 1,2 cm.
7. A cork on the surface of a pond bobs up and down two times per second on ripples having a wavelength of 8,5 cm. If the cork is 10 m from the shore, how long does it take a ripple passing the cork to reach the shore?
8. A wave travelling in the positive x-direction has a frequency of 25 Hz. The wave is shown in the figure below.



Calculate its:

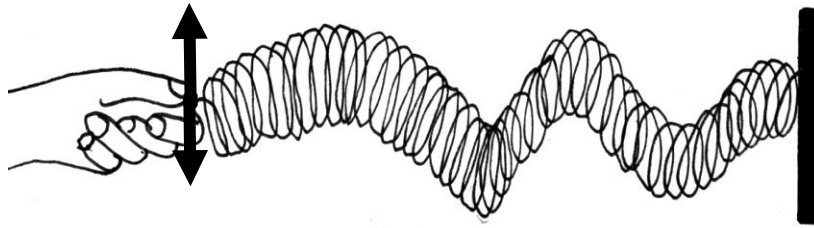
- |               |                |            |           |
|---------------|----------------|------------|-----------|
| 8.1 Amplitude | 8.2 Wavelength | 8.3 period | 8.4 speed |
|---------------|----------------|------------|-----------|

#### **Experiment 4: Generation of transverse pulses/waves in a slinky**

**Aim:** To generate transverse pulses in a slinky.

##### **Method**

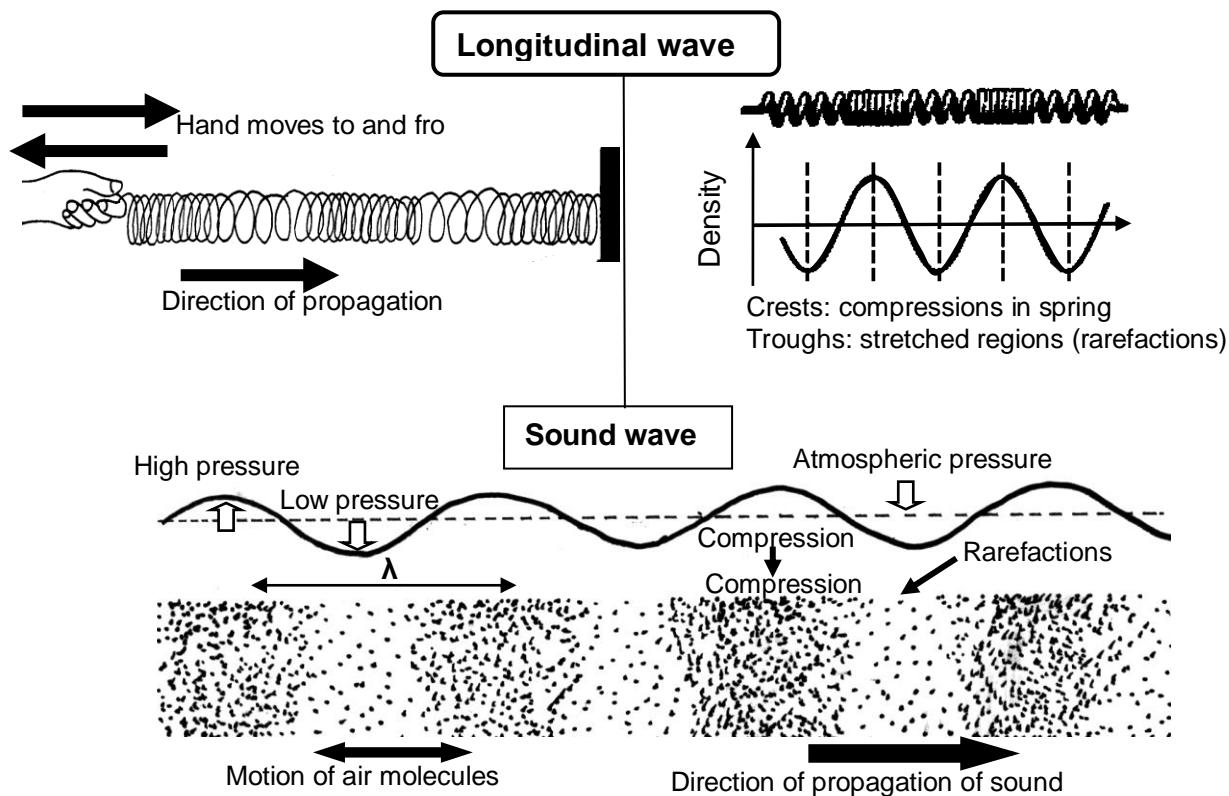
1. Place a slinky on the floor or on the table.
2. Connect one end of the slinky to a fixed end.
3. Tie a coloured ribbon to one of the coils. The ribbon represents a particle of the slinky where the wave moves through.
4. Now move the spring up and down as illustrated below.



##### **Questions**

1. In which direction does the ribbon move?
2. In which direction does the wave move?
3. Formulate a definition for a transverse wave.

## Topic 8: Longitudinal waves



Important terms/definitions	
Amplitude	The maximum displacement of a particle from its equilibrium position.
Compression	The region of high pressure in a longitudinal wave.
Frequency	The number of vibrations/oscillations per unit time (one second).
Longitudinal wave	A wave in which the disturbance/displacement (from the position of rest) is parallel to the direction of propagation (motion) of the wave.
Period	The time taken for one complete cycle of an oscillation or vibration.
Rarefaction	The region of low pressure in a longitudinal wave.
Wavelength	The distance between two successive points in phase.
Wave speed	The distance travelled by a point on a wave per unit time.

### **Daily task 8.1: Classwork/Homework**

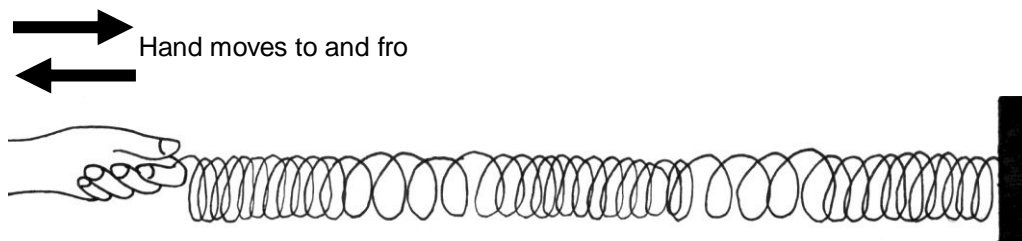
1. The speed of sound in air at  $20^{\circ}\text{C}$  is  $343\text{ m}\cdot\text{s}^{-1}$ . Calculate the wavelength of a sound wave with a frequency of 18 Hz.
2. Calculate the frequency of sound waves of wavelength 3 m. Take the speed of sound in air to be  $330\text{ m}\cdot\text{s}^{-1}$ .
3. Longitudinal waves in a spring have a wavelength of 25 cm. If the frequency of vibration of the spring is 50 Hz, calculate the speed of the waves.

### **Experiment 5: Generation of longitudinal pulses/waves in a slinky**

**Aim:** To generate longitudinal pulses in a slinky.

#### **Method**

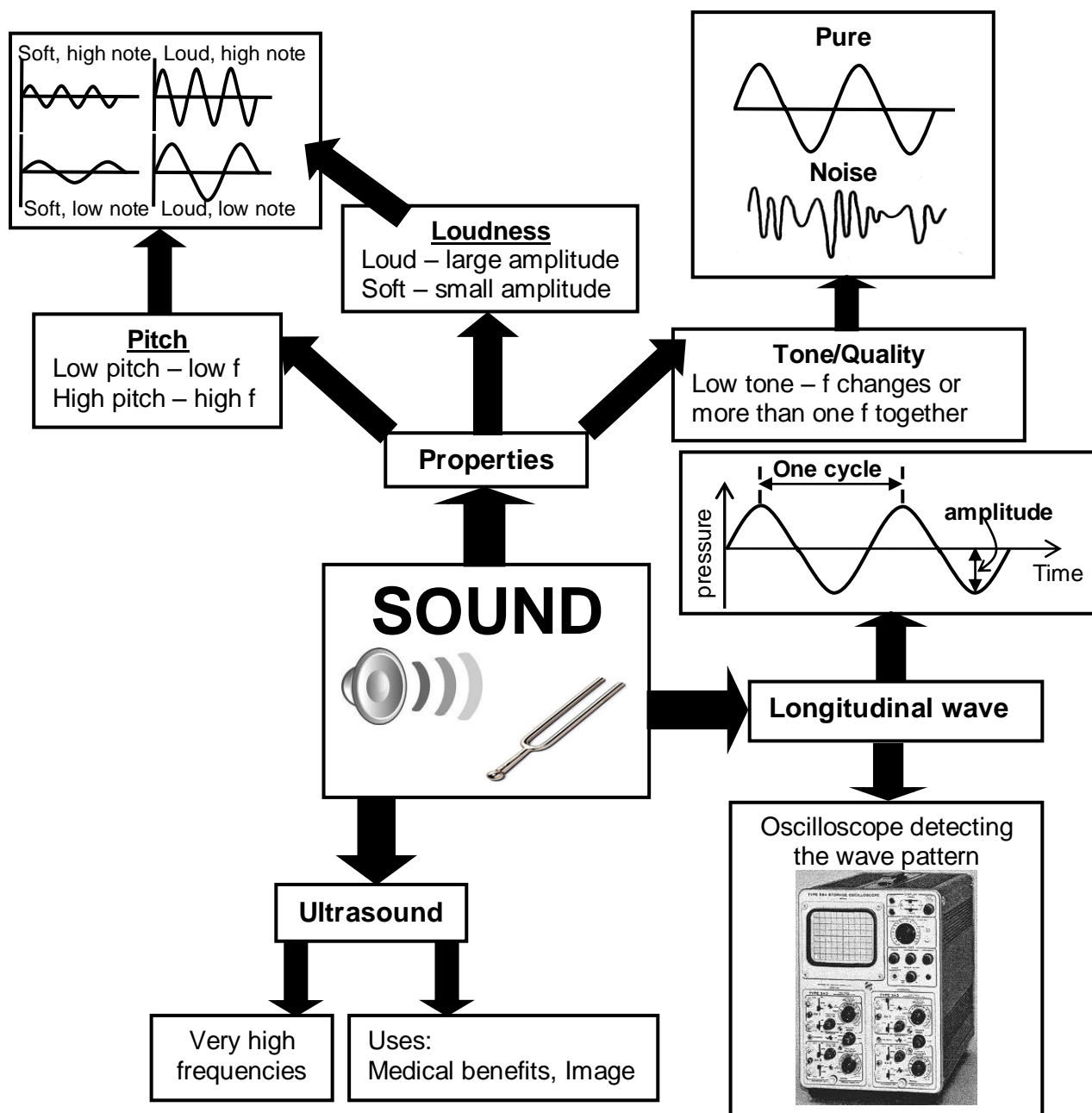
1. Place a slinky on the floor or on the table.
2. Connect one end of the slinky to a fixed end.
3. Tie a coloured ribbon to one of the coils. The ribbon represents a particle of the slinky where the wave moves through.
4. Now move the spring to and fro as illustrated below.



#### **Questions**

1. In which direction does the ribbon move?
2. In which direction does the wave move?
3. Formulate a definition for a longitudinal wave.

## Topic 9: Sound



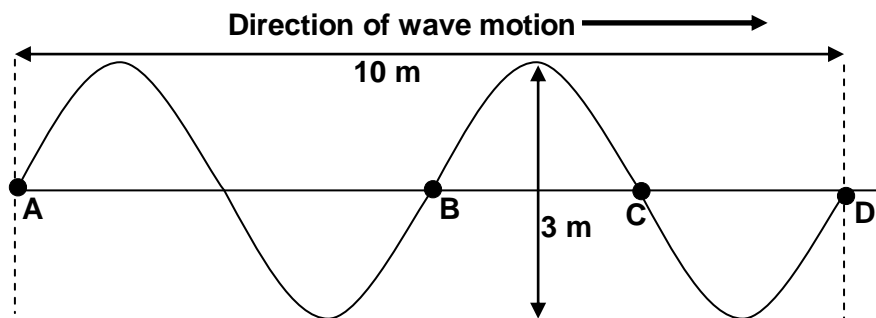
Important terms/definitions	
Amplitude	Maximum displacement from the position of rest.
Frequency	Number of vibrations produced by a vibrating body in one second. The SI unit of frequency is Hertz (Hz).
Loudness	A subjective term describing the strength of the ear's perception of a sound. Loudness is directly proportional to amplitude.
Pitch	The effect produced in the ear due to the sound of a particular frequency. Pitch is directly proportional to frequency.
Ultrasound	Ultrasonic vibrations have frequencies higher than 20 000 Hz.
Wavelength	Distance between two consecutive points in phase.

**Daily task 9.1: Classwork/Homework**

1. The lower limit of frequency that can be heard by the average human is about:  
A 2 Hz  
B 20 Hz  
C 200 Hz  
D 2 000 Hz
2. Which ONE of the following materials transplants sound the best?  
A Air  
B Steel  
C Water
3. An airtight bell-jar is inverted on a platform connected to a vacuum pump. An electric bell fitted into the jar is operating, but its sound cannot be heard. This is because sound cannot travel through:  
A Vacuum  
B Air  
C Glass
4. The number of sound vibrations per second is the:  
A Period  
B Frequency  
C Amplitude  
D Wavelength
5. Which ONE of the following will produce sound with the highest pitch?  
A A mosquito  
B Women  
C Men  
D A lion
6. Echoes are often heard when talking in empty rooms.
  - 6.1 What is meant by *echo*?
  - 6.2 What are the conditions necessary for an echo to be heard?
  - 6.3 Why do echoes produced in an empty auditorium usually decrease when it is full of audience?
7. A boy fires a gun and hears the echo 2 seconds later. If he is 480 m away from a wall, calculate the speed of sound in air.
8. A girl claps and hears the echo after reflection from a cliff which is 660 m away. If the velocity of sound in air is  $330 \text{ m s}^{-1}$ , calculate the time taken for the echo to travel to the girl.

### Daily task 9.2: Classwork/Homework

1. Refer to the following sketch of a longitudinal wave, where the frequency of the wave is 50 Hz. **A**, **B**, **C** and **D** are points on the wave.

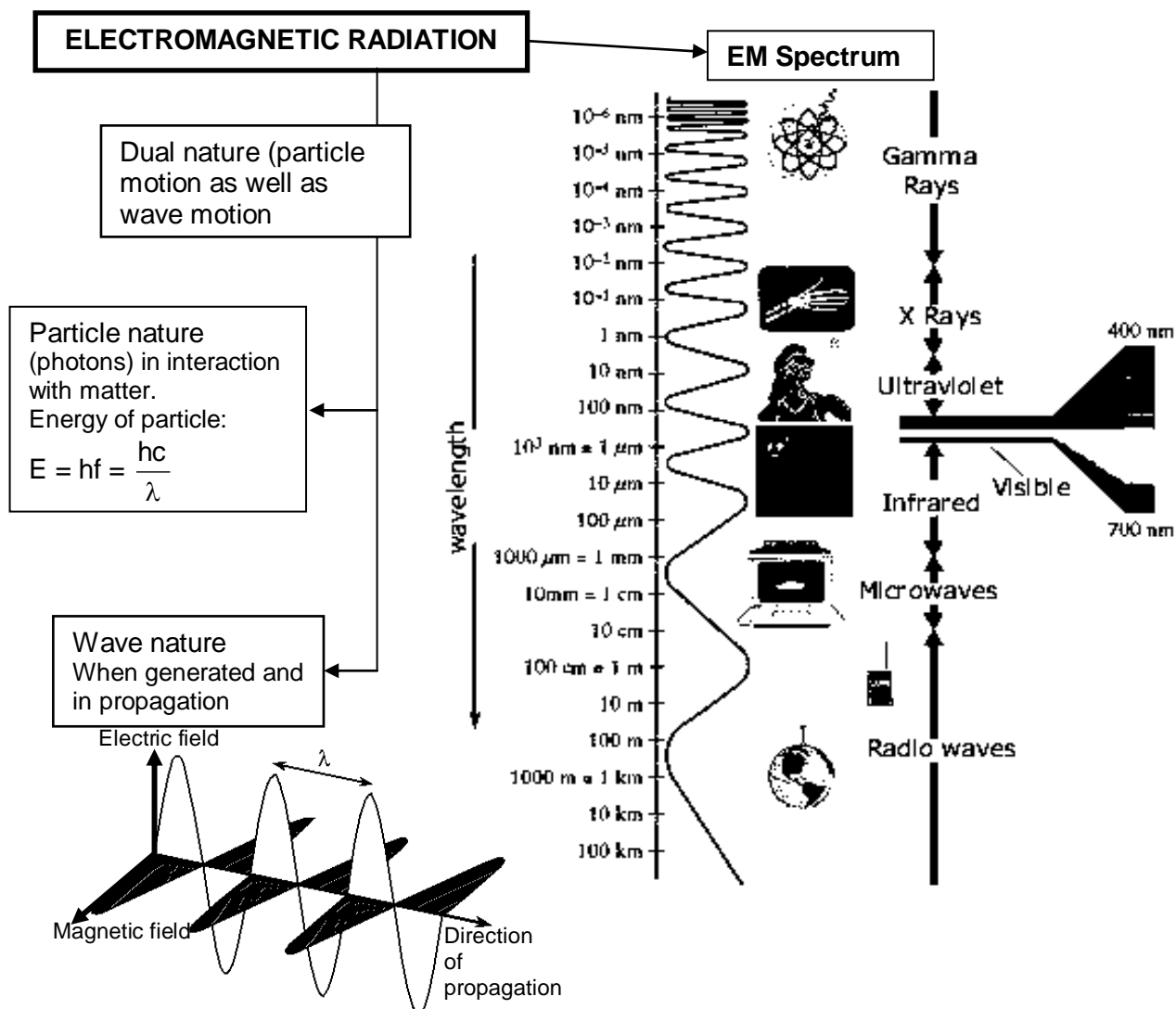


- 1.1 Calculate the time that the wave takes to travel the distance AB.
  - 1.2 Calculate the wavelength of this wave.
  - 1.3 Calculate the amplitude of this wave.
  - 1.4 Are points A and B on the wave in phase? Explain your answer
  - 1.5 Calculate the speed of this wave.
2. Find the word/term in column **B** that completes the word/term in column **A**. Only write down the symbol representing the word/tem in column **B** next to the question number.

	COLUMN A		COLUMN B
2.1	Sound	A	Has a frequency greater than 20 000 Hz
2.2	The speed of a sound wave	B	Needs a medium to transplant
2.3	Ultra sound	C	Is an echo
2.4	Reflection of sound	D	Is directly proportional to the pitch of the sound
2.5	Frequency of sound	E	Increases in a denser medium

- 3 The pulse rate of Lance Armstrong during the Tour de France cycle race was found to be 45 beats in one minute. Calculate the:
- 3.1 Frequency of his heartbeat
  - 3.2 Period of his heartbeat.
4. A rifle shot is fired in a valley between two parallel walls. The echo from one wall is heard 3 s later and the echo from the other wall is heard 8,3 s later. The velocity of sound at 0 °C is 330 m s<sup>-1</sup> and the temperature in the valley is 10 °C. For every 1 °C rise in temperature, the velocity of sound increases by 0,61 m·s<sup>-1</sup>. Calculate the width of the valley.
- 5.
- 5.1 A fundamental/harmonic/overtone note is the lowest note obtained on blowing gently across the top of a test-tube.
  - 5.2 True or False: Sound can be reflected as well as refracted.
  - 5.3 Echoes are caused by \_\_\_\_\_ of sound.
  - 5.4 The loudness of sound depends on the \_\_\_\_\_.
  - 5.5 The effect produced in the ear due to the sound of a particular frequency is called the \_\_\_\_\_.
  - 5.6 The maximum displacement of a vibrating body from its mean position is called \_\_\_\_\_.
  - 5.7 The pitch of a note depends on the \_\_\_\_\_ of the vibrations.

## Topic 10: Electromagnetic radiation



Important terms/definitions	
Photons	Packets of energy of which light is composed.
<b>Properties of electromagnetic radiation</b>	
Electromagnetic waves:	
<ul style="list-style-type: none"> <li>• Originate from oscillating electric charges</li> <li>• Propagate as electric and magnetic fields that are perpendicular to each other</li> <li>• Can travel through a vacuum</li> <li>• Have a speed of <math>3 \times 10^8 \text{ m}\cdot\text{s}^{-1}</math></li> </ul>	



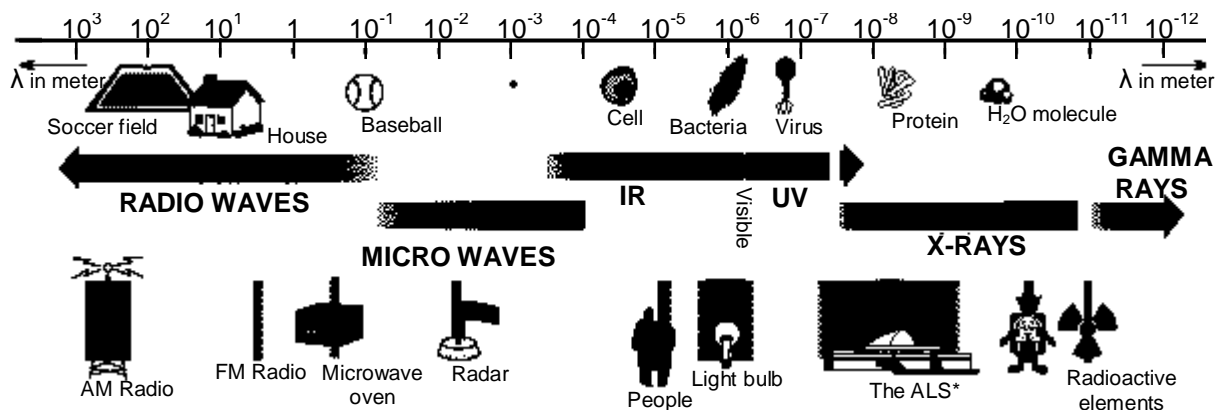
### Daily task 10.1: Classwork/Homework/Data-interpretation

Use the above of the electromagnetic spectrum to answer the following questions.

1. Which type of EM radiation has the:
  - 1.1 Longest wavelength?
  - 1.2 Shortest wavelength?
  - 1.3 Highest energy?
  - 1.4 Lowest frequency?
2. Give one word for each of the following descriptions.
  - 2.1 The type of radiation that can travel through flesh, but not through bones. It therefore casts a shadow of bones.
  - 2.2 The type of radiation that causes the skin to become brown.
  - 2.3 Visible light with the longest wavelength.
3. Use the wave equation  $v = f\lambda$  to answer the following questions.
  - 3.1 Calculate the highest frequency that radio waves can have.
  - 3.2 Calculate the lowest frequency that gamma rays can have. ( $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$ )
  - 3.3 What is the main difference between radio waves and gamma rays?
  - 3.4 Radio waves tend to move around objects, while gamma rays tend to move through objects. Give a possible explanation for this phenomenon.
4. What frequencies of light are visible to the human eye? ( $1 \text{ nm} = 1 \times 10^{-9} \text{ m}$ )
5. Calculate the highest energy associated with X rays.

### Daily task 10.2: Classwork/Homework/Data-interpretation

1. The electromagnetic spectrum covers a wide range of wavelengths and photon energies. Light used to "see" an object must have a wavelength about the same size as or smaller than the object. Study the picture of the electromagnetic spectrum. See if you can find answers to the questions.



- 1.1 What kind of electromagnetic radiation has the shortest wavelength? And the longest?
- 1.2 What kind of electromagnetic radiation could be used to "see" molecules? And a cold virus?
- 1.3 Why can't you use visible light to "see" molecules?
- 1.4 Some insects, like bees, can see light of shorter wavelengths than humans can see. What kind of radiation do you think a bee sees?
2. List at least four properties that all EM waves have in common.
3. How do the different types of EM radiation differ?
4. Which type of EM radiation can be considered the most harmful to people? Explain your choice.

\* ALS The Advanced Light Source, a division of Berkeley Lab, is a national user facility that generates intense light for scientific and technological research.

### **Can Animals Sense Earthquakes and Tsunamis?**

Animals often seem to know things that people don't. So far there have been few reports of animals sensing the devastating earthquake and tsunami that struck Japan in 2011, but with the thousands of missing people and looming threat of nuclear disaster, the focus has understandably not been on animals. In time, we might learn more about how the animals of Japan reacted to this recent geological nightmare.

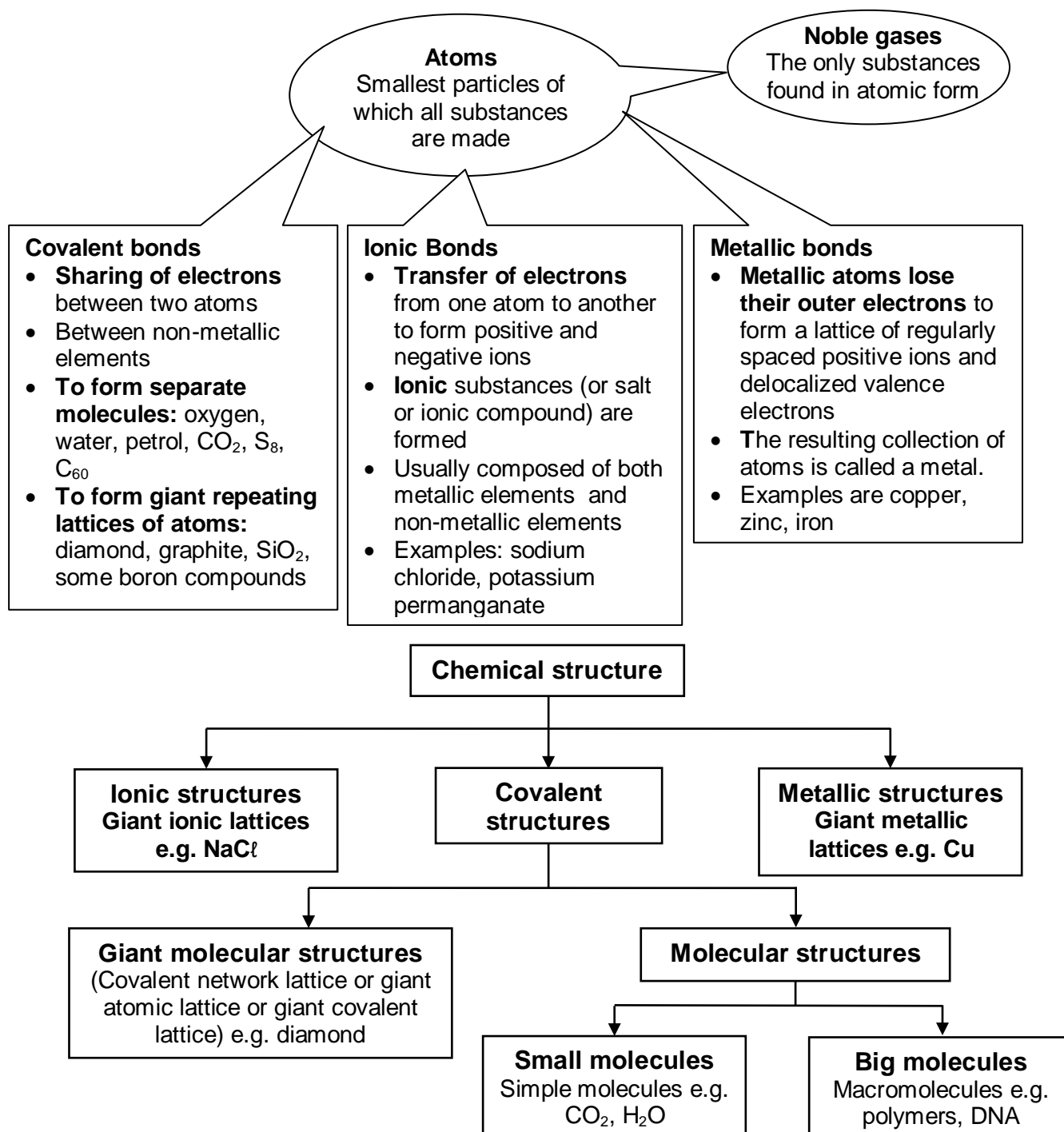
We do know that animals in areas affected by the 2004 Indian Ocean tsunami most certainly did seem to sense that something disastrous and dangerous had happened. Witnesses report wild animals such as elephants and monkeys moving towards higher ground as well as anxiety and distress in cattle, dogs and other domestic animals. Given the destructiveness of that disaster, surprisingly few dead animals were recovered.

Can animals predict natural disasters? While this might seem odd, if you think about the fact that many species naturally have senses that far more acute than those possessed by humans, it seems less strange. Elephants can respond to and produce infrasound — sound at a lower frequency than human beings can hear. Other mammals with a similar capability include certain types of whales. Wild animals in particular need to have excellent senses of smell, sight, hearing and even the ability to sense minute vibrations, because those senses help them survive. Many species perceive and use electromagnetic fields that are imperceptible to humans to navigate or find prey.

As odd as this seems, whether it's simply the acuteness of the five known senses or a sixth sense that we humans don't possess, there's nothing paranormal or unnatural about it. In fact, some researchers are studying the abilities of animals to sense such disasters so they can be used as an early warning system.

*From: Animal planet blogs.discovery.com/animal\_oddities/2011/03/can-animals-sense-earthquakes-and-tsunamis.htm*

## Topic 11: Particles substances are made of



Chemical structure	Particles	Chemical Bonding
<b>Giant ionic lattice</b>	Ions	Ionic bonding
<b>Giant molecular lattice</b> (Giant covalent, covalent network or giant atomic lattice if preferred)	Atoms	Covalent bonding
<b>Giant metallic lattice</b>	Metal ions with delocalized valence electrons	Metallic bonding
<b>Molecular lattice</b> (Simple covalent - small & big molecules)	Molecules	Covalent bonding between atoms to form molecules and Intermolecular forces between molecules

Important terms/definitions	
Allotrope	Different crystal structures (forms) of the same element. Example: buckyballs, graphite and diamond are all allotropes (allotropic forms) of carbon.
Buckminsterfullerene (buckyballs)	A form of carbon that contains molecules having 60 carbon atoms arranged at the vertices of a polyhedron with hexagonal and pentagonal faces (like a soccer ball). (It occurs naturally in soot.)
Covalent bonding	A chemical bond formed when electrons are shared between two atoms.
Crystal lattice	Orderly three-dimensional arrangement of particles (ions, atoms, molecules) in a solid structure.
Diamond	A crystal structure of carbon in which each carbon atom is the center of a tetrahedron formed by its nearest neighbours.
Empirical formula	A chemical formula that indicates the composition of a compound in terms of the relative numbers and kinds of atoms in the simplest ratio.
Glass	Hard substance, usually brittle and transparent, composed mainly of silicates and an alkali fused at high temperature.
Graphite	A blackish soft allotropic form of carbon in hexagonal crystalline form. (Used in pencils, crucibles, and electrodes, as a lubricant, as a moderator in nuclear reactors, and, in a carbon fibre form, as a tough lightweight material for sporting equipment.)
Ion	A charged particle made from an atom by the loss or gain of electrons.
Ionic bond	A chemical bond formed when electrons are transferred from one atom to another resulting in an electrostatic attraction between positive and negative ions.
Matter	Anything that has mass and occupies space.
Metallic bond	A chemical bond formed due to the electrostatic attraction between positive ions and delocalised valence electrons in a metal.
Molecular formula	A chemical formula that indicates the actual numbers and kinds of atoms in a molecule, but not the chemical structure.
Molecule	A group of two or more atoms that are covalently bonded and act as a unit in chemical reactions.
Quartz	Second most abundant mineral in the Earth's crust, present in many rocks. It consists of silica, or silicon dioxide ( $\text{SiO}_2$ ).

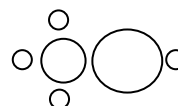
### **Daily task 11.1: Classwork/Homework**

1. Give one word/term for each of the following descriptions:
  - 1.1 The type of chemical bond that is usually formed between metallic and non-metallic elements
  - 1.2 The elements that do not react because atoms have complete outer energy levels
  - 1.3 Forces of attraction between molecules
  - 1.4 Forces of attraction between atoms within a molecule
  - 1.5 The type of chemical bond formed between metallic atoms
  - 1.6 An equal sharing of two electrons by two non-metallic atoms
  - 1.7 Electrons in a metal that are no longer attached to the metallic atoms
  - 1.8 A bond formed when one atom gains control of the electron pair so that the two atoms become oppositely charged
  - 1.9 An orderly three-dimensional arrangement of particles
  - 1.10 An unequal sharing of two electrons by a pair of bonding atoms
2. Explain the difference between each of the following concepts:
  - 2.1 An atom and an ion
  - 2.2 A molecule and an ion
  - 2.3 A molecule and a compound

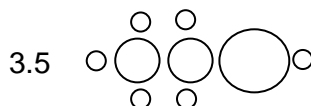
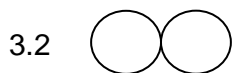
### **Daily task 11.2: Classwork/Homework**

1. Use fluorine ( $F_2$ ) and potassium bromide (KBr) to explain the difference between a covalent bond and an ionic bond.
2. What type of bond (covalent, ionic or metallic) will be present in each of the following substances?
  - 2.1 Potassium chloride
  - 2.2 A lump of lead
  - 2.3 Magnesium oxide
  - 2.4 Carbon dioxide
  - 2.5 A copper wire

3. In the accompanying diagram, circles of different sizes are used to represent the atoms in  $CH_3OH$ .



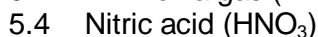
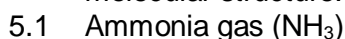
Using the above diagram as key, write down the formula represented by each of the following:



4. Use circles of different sizes to represent the following molecules with diagrams.



5. Consider the substances below. Classify each as a giant molecular, an ionic, a metallic or a molecular structure.



### **Daily task 11.3: Practical investigation**

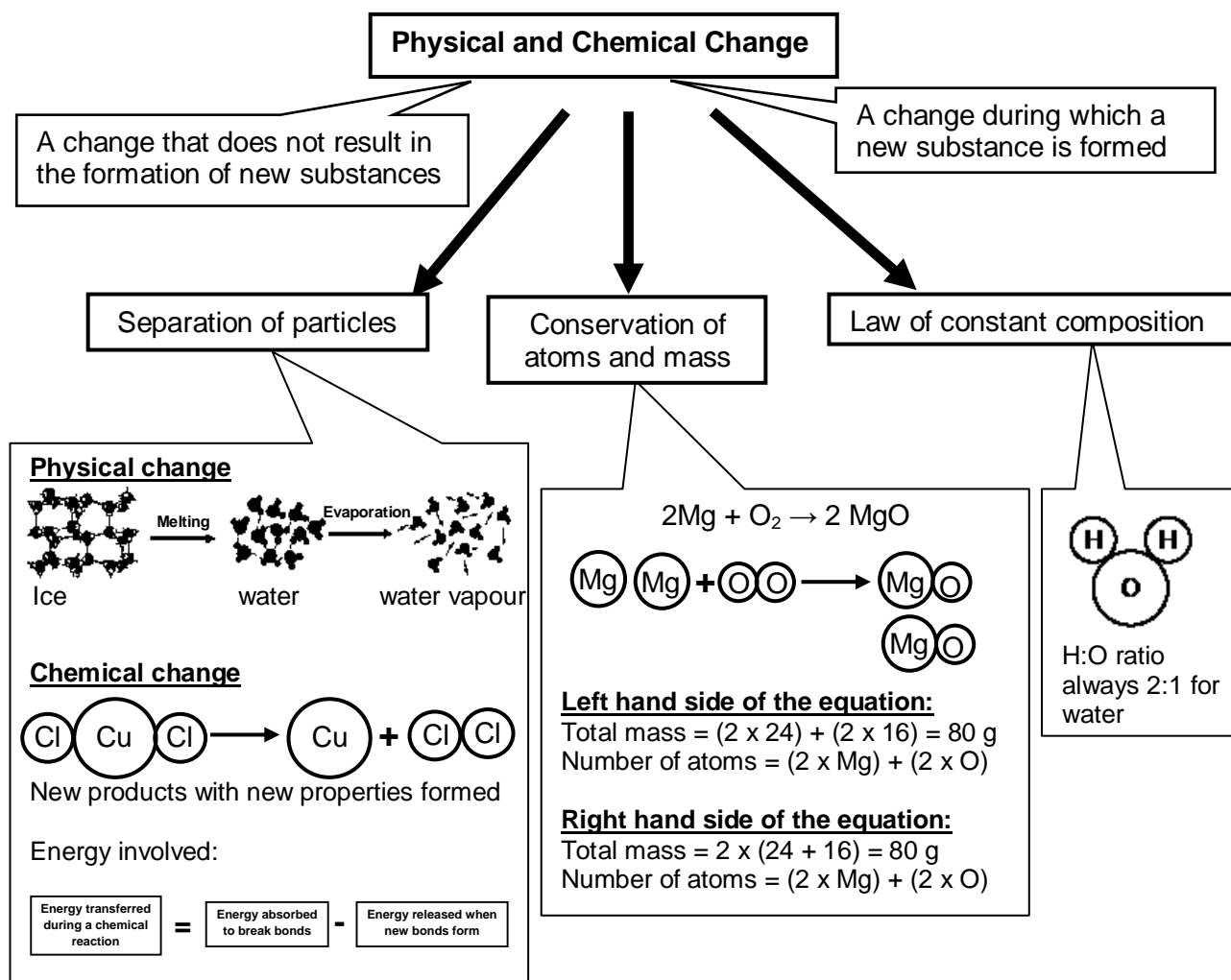
Thabiso places grey iron filings and yellow sulphur powder in a cup and stir it thoroughly for a few minutes. She then holds a magnet close to the mixture and observes that all the grey matter is attracted to the magnet, whilst the yellow powder stays in the cup.

1. Write down an investigation question for this investigation.
2. List all the apparatus that Thabiso needs.
4. Write down the method that Thabiso uses.
5. Is the separation method used by Thabiso a physical or a chemical change? Give a reason for your answer.
6. Classify the above mixture as homogeneous or heterogeneous.

Thabiso again mixes the iron filings and sulphur powder in a test tube and heats the mixture until the contents glow red hot. She then allows the test tube and its contents to cool down. When investigating the contents of the test tube, she finds a solid lump of grey matter that is not attracted to the magnet.

7. Write an investigation question for this investigation.
8. List all the apparatus needed.
9. Write down a method that Thabiso can follow when conducting this investigation.
10. Give a reason why the new product is non-magnetic.
11. What evidence is there to show that a chemical reaction occurred?

## Topic 12: Physical and Chemical Change



Important terms/definitions	
Atom	The smallest particle which matter consists of.
Catalyst	A substance that speeds up the rate of a chemical reaction without undergoing a change itself.
Chemical change	A change during which a new substance with new properties is formed.
Decomposition reaction	A chemical reaction during which a reactant forms two or more products.
Endothermic reaction	A chemical reaction that absorbs energy.
Exothermic reaction	A reaction that releases energy.
Law of conservation of mass	Matter cannot be created or destroyed in a chemical reaction. The total mass of reactants equals total mass of products.
Law of conservation of energy	Energy can be created or destroyed, but it can only be transformed from one form to another.
Law of constant composition	A particular compound always has the same elements joined together in the same proportions by mass.
Mass	The amount of matter in a body.
Physical change	A change that does not result in the formation of new products.
Synthesis reaction	A chemical reaction during which two or more simple reactants combine to form a more complex product.

### **Experiment 6: Heating of iron and sulphur**

**Aim:** To investigate the properties of substances before and after a chemical reaction

#### **Apparatus & chemicals**

- Iron filings
- Sulphur (powder or flowers of sulphur)
- Magnet
- Test tube
- Bunsen burner or hot plate or stove
- Spatula

#### **Method**

1. Prepare a mixture containing iron powder and sulphur powder in the ratio 7:4 by mass. Do this by weighing out 7 g of iron powder and 4 g of finely powdered sulphur onto separate pieces of filter paper.
2. Mix the two powders by pouring repeatedly from one piece of paper to the other.
3. Note the appearance of the pure elements and the mixture.
4. Wrapping the end of a small bar magnet in a paper tissue and dip it into a teaspoon-sized heap of the mixture on a watch glass. Record your observations.
5. Place about 2 g of the mixture into a test-tube.
6. Insert a plug of mineral wool (mineral fibre) into the mouth of the test-tube. Clamp the test-tube as shown in the diagram.
7. Heat the powder mixture at the base of the test-tube – gently at first and then more strongly (use a blue flame throughout).
8. Heat until an orange glow is seen inside the test-tube. Immediately stop heating. Observe what happens inside the test tube.
9. Allow the tube to cool down. Once cool, it is possible to break open the test-tube to show the appearance of the product. It is advisable to wear protective gloves.
10. Bring the magnet close to the product. Record your observations.

#### **Results**

1. Redraw the following table into your work book, record your observations and complete the rest of the table.

	Iron filings	Sulphur powder	Product after heating
Magnetic or non-magnetic			
Appearance			
Metal or non-metal			
Formula/Symbol			
Element/compound			

2. The test tube is heated until an orange glow is visible. What do you observe immediately after removal of the heat?

#### **Questions**

1. Briefly describe how the mixture of iron filings and sulphur can be separated. Is this a physical or a chemical change?
2. Write down a balanced equation for the reaction that takes place after heating the mixture in the test tube.
3. Write down the name of the product formed in the reaction.
4. Is this reaction exothermic or endothermic? Give a reason for your choice.
5. Is this reaction a physical or a chemical change? Give a reason for your answer.
6. Classify the reaction that takes place as either a synthesis or a decomposition.

### **Experiment 7: Reaction of lead(II) nitrate and potassium iodide**

**Aim:** To observe the product formed when lead(II) nitrate reacts with potassium iodide

#### **Apparatus & chemicals**

- Eye protection (goggles)
- Test tube
- Trough with water
- Spatula
- Lead(II) nitrate (toxic, dangerous for the environment)
- Potassium iodide (low hazard)

#### **Method 1**

1. Add one spatula of lead(II) nitrate into the test tube.
2. Add one spatula of potassium iodide to the lead(II) nitrate in the test tube.
3. Close the test tube with a stopper and shake vigorously.

#### **Method 2**

1. Add one spatula of lead(II) nitrate into the test tube and add enough water to make a clear solution.
2. Add one spatula of potassium iodide into the test tube and add enough distilled water to make a clear solution.
3. Pour the contents of one test tube into other.

#### **Results**

Record all observations made in the table below.

Method 1	Method 2

#### **Questions**

1. Which procedure results in the faster reaction? Refer to the kinetic theory to explain this observation.
2. Lead(II) iodide is a yellow insoluble solid. Write down a balanced equation for the reaction that takes place in both procedures.
3. Is the above reaction a physical or chemical change? Give a reason for your answer.
4. Briefly describe how the solid product formed in Method 2 can be retrieved from the solution.
5. How will the total mass of the reactants compare to that of the products? Briefly explain.

### **Daily task 12.1: Classwork/Homework**

1. Explain the difference between the following concepts in your own words.
  - 1.1 A chemical and a physical change
  - 1.2 Exothermic and endothermic reactions
2. Classify, with reason, each of the following changes as chemical or physical.
  - 2.1 With pressure and heat graphite becomes a diamond.
  - 2.2 An egg is cooked.
  - 2.3 A tree dies.
  - 2.4 Lightning makes ozone (O<sub>3</sub>) from oxygen (O<sub>2</sub>). The ozone then reverts to oxygen.
3. Copy the following table in your workbook and classify each of the following changes as a physical or a chemical change.

Change	Chemical or physical?
Digesting an apple	
Burning wood	
Bad odour released by a skunk	
Making a volcano with baking soda and vinegar	
Freezing water	
Rusting of a nail	
Carbon dioxide dissolves in water	
Table salt dissolves in water	



### **Experiment 8: Preparation of oxygen from $\text{H}_2\text{O}_2$** (Teacher demonstration)

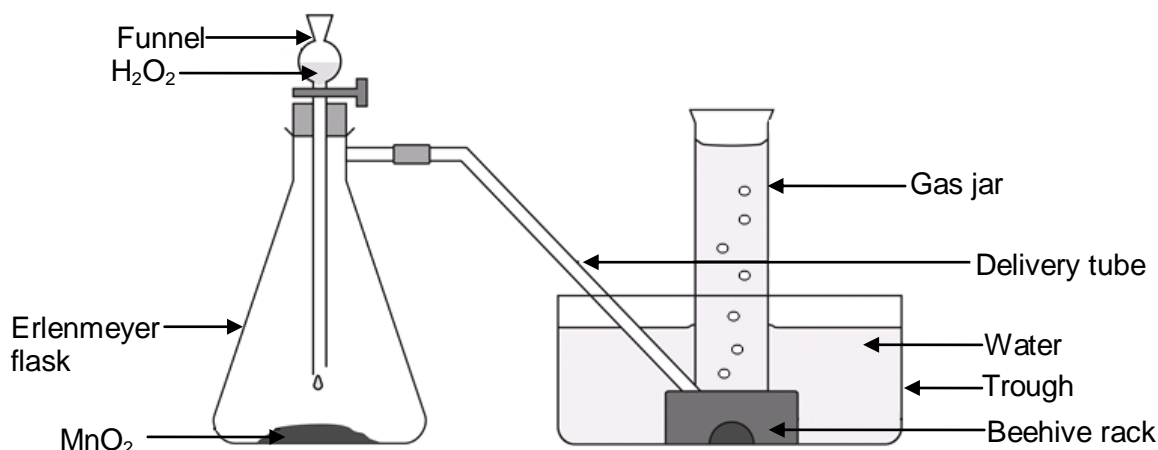
**Aim:** To prepare oxygen and collect it by the downward displacement of water

#### **Apparatus & chemicals**

- 20% - 30% hydrogen peroxide solution ( $\text{H}_2\text{O}_2$ )
- Manganese dioxide ( $\text{MnO}_2$ )
- Round-bottomed flask or Erlenmeyer flask with a rubber stopper with two holes fitting tightly
- Delivery tube
- Gas jar
- Beehive rack
- Trough with water
- Spatula

#### **Method**

1. Place one teaspoon (approximately 10 g) of manganese dioxide in a 500  $\text{cm}^3$  flask.
2. Add 10  $\text{cm}^3$  of water.
3. Use a rubber stopper with two holes, through which a thistle funnel (or dropping funnel) and a delivery tube have been fitted, to close the flask. Alternatively a flask with a side-arm can be used as shown in the diagram below.
4. Fill the funnel with 20% to 30% hydrogen peroxide solution. (Use a fresh solution.)
5. Fill a clean gas jar with water from the glass trough and invert it over the beehive rack.
6. Carefully allow the hydrogen peroxide to run from the funnel so that the oxygen can be collected in the gas jar. **Be careful:** If  $\text{O}_2$  is released too quickly the stopper will shoot out.



#### **Results**

1. Oxygen is a colourless gas. Write down an observation that you can make in order to know that a gas is indeed released.
2. Describe a test that you can perform to identify the gas as oxygen.

#### **Questions**

1. Write down a balanced equation for the reaction that takes place.
2. Is the above reaction a physical or chemical change? Give a reason for your answer.
3. After completion of the reaction, all the manganese dioxide is still present. What was the role of manganese dioxide in this reaction?
4. Which other substance remained in the flask after the reaction is completed? Assume that all the hydrogen peroxide has reacted.
5. Oxygen is collected by the downward displacement of water. Briefly explain the meaning of this statement.
6. Show with a calculation that mass is conserved during the decomposition of hydrogen peroxide.
7. Classify this reaction as either a synthesis or a decomposition reaction.

### **Experiment 9: The reaction of hydrochloric acid and sodium hydroxide**

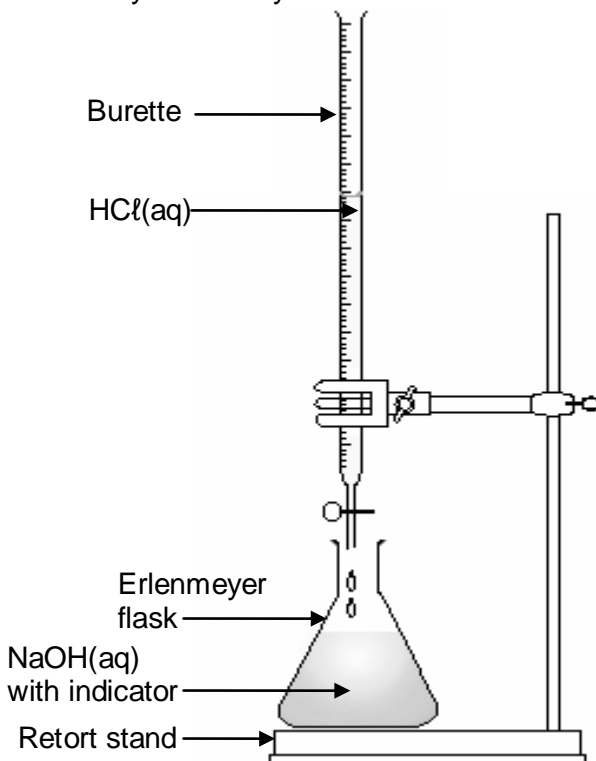
**Aim:** To investigate the reaction of hydrochloric acid and sodium hydroxide

#### **Apparatus & chemicals**

- Hydrochloric acid solution (Add 20 cm<sup>3</sup> of concentrated hydrochloric acid to 60 cm<sup>3</sup> of distilled water.)
- Sodium hydroxide solution (Dissolve 12 g of sodium hydroxide crystals in 100 cm<sup>3</sup> of distilled water.)
- Retort stand
- Measuring cylinder
- Burette
- Erlenmeyer flask
- Thermometer
- Bromothymol blue indicator

#### **Method**

1. Rinse the burette with a little bit of the hydrochloric acid solution. Fill it to the zero mark with hydrochloric acid. Use a funnel when filling the burette.
2. Use a pipette to place 20 cm<sup>3</sup> of the sodium hydroxide solution in the Erlenmeyer flask.
3. Add 5 – 7 drops of the bromothymol blue to the sodium hydroxide solution in the Erlenmeyer flask.
4. Measure the temperature of the solution in the flask.
5. Slowly run 3 cm<sup>3</sup> of acid from the burette into the flask whilst stirring the solution with the thermometer. Record the temperature after addition of the 3 cm<sup>3</sup> of acid.
6. Repeat the procedure by adding further quantities of 3 cm<sup>3</sup> acid until the indicator changes colour. Measure the temperature after the addition of each 3 cm<sup>3</sup> of acid.
7. Add another three quantities of 3 cm<sup>3</sup> acid after the colour change and record these temperatures.



#### **Results**

1. Copy the table below into your work book and record your results.

Volume of HCl(aq) added (cm <sup>3</sup> )	Colour of solution with indicator	Temperature (°C)
0		

2. Draw a graph of temperature versus volume of acid added. Use a graph paper. Choose an appropriate scale on each axis and label the axes. Plot the point and draw the graph.
3. Calculate the total change in temperature.

#### **Questions**

1. This is an example of the reaction between an acid and a base to form a salt and water. Write down a balanced equation for the reaction that takes place.
2. Is this reaction exothermic or endothermic? Give a reason for your answer.
3. Briefly describe the shape of the graph. Give reasons for the change in shape after at a certain volume of acid added.
4. Was there any change in temperature after the indicator changes colour? Give a reason for this observation.
5. Write down the name of the salt formed in this reaction.
6. Show with a calculation that mass is conserved in this chemical reaction.

## Topic 13: Representing chemical change

### Chemical equations

A chemical equation is a way to describe what happens during a chemical reaction. Chemical equations are written as follows:

- Symbols indicate elements, ionic or covalent compounds, aqueous solutions, ions, or particles.
- An arrow points to the right to indicate the action of the reaction.
- There are also reversible reactions, i.e. reactions during which the products reassemble to form the original reactants. Reversible reactions are symbolised in chemical equations by a double arrow ( $\rightleftharpoons$ ).
- The substances to the left of the arrow are the reactants, i.e. the substances that are going to react.
- The substances to the right of the arrow are the products, i.e. the substances that have been produced by the reaction.
- The phases of the reactants and products are indicated in brackets after the formula of the compound. Solids are indicated as (s), liquids as (l), gases as (g) and solutions in water as (aq).

### Steps for balancing of chemical equations

**Step 1:** Write down a word equation for the reaction.

Nitrogen + hydrogen  $\rightarrow$  ammonia

**Step 2:** Write down the correct molecular formulae.

$\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$

**Step 3:** Balance by adding coefficients in the equation (if necessary).

$\text{N}_2 + 3 \text{H}_2 \rightarrow 2 \text{NH}_3$

**Step 4:** Add state symbols.

$\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$

### Daily task 13.1: Classwork/Homework

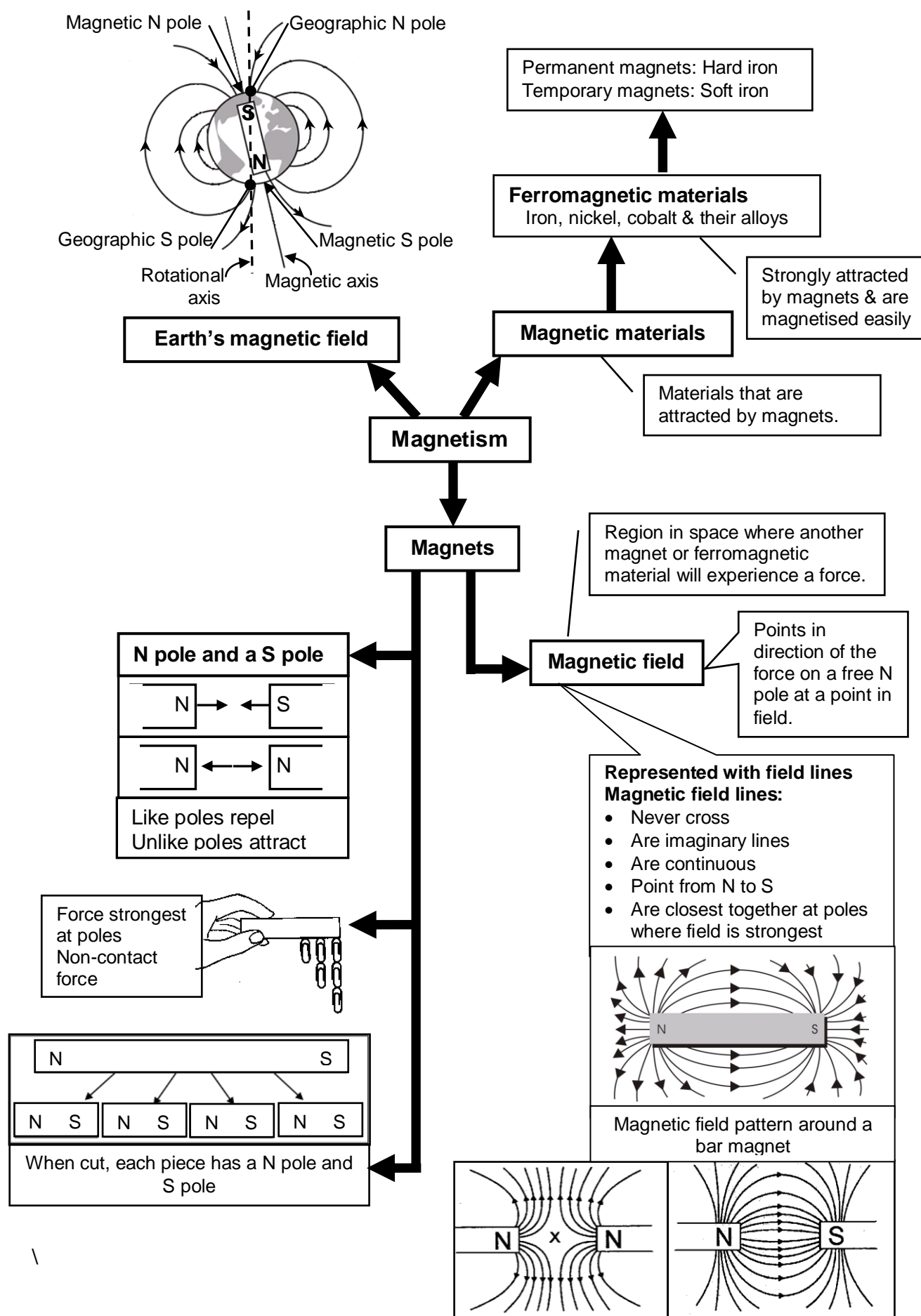
1. Consider the reaction  $\text{Ag}(\text{s}) + \text{H}_2\text{S}(\text{g}) \rightarrow \text{Ag}_2\text{S}(\text{s}) + \text{H}_2(\text{g})$ .
  - 1.1 State the law of conservation of mass.
  - 1.2 Show with calculations that mass is conserved in this reaction.
  - 1.3 Are atoms conserved in this reaction? Give a reason for your answer.
  - 1.4 Are molecules/formula units conserved in this reaction? Give a reason for your answer.
  - 1.5 Use the formula of silver sulphide to explain what is meant by *The Law of Constant Proportions*.
2. Balance each of the following chemical reactions.
  - 2.1  $\text{Mg} + \text{O}_2 \rightarrow \text{MgO}$
  - 2.2  $\text{Zn} + \text{CuSO}_4 \rightarrow \text{ZnSO}_4 + \text{Cu}$
  - 2.3  $\text{H}_2\text{SO}_4 + \text{Mg} \rightarrow \text{MgSO}_4 + \text{H}_2$
  - 2.4  $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + \text{NaCl}$
  - 2.5  $\text{P}_4 + \text{O}_2 \rightarrow \text{P}_2\text{O}_5$
  - 2.6  $\text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2$
  - 2.7  $\text{Fe} + \text{O}_2 \rightarrow \text{Fe}_2\text{O}_3$
  - 2.8  $\text{HgO} \rightarrow \text{Hg} + \text{O}_2$
  - 2.9  $\text{Cu} + \text{AgNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + \text{Ag}$
  - 2.10  $(\text{NH}_4)_2\text{Cr}_2\text{O}_7 \rightarrow \text{Cr}_2\text{O}_3 + \text{N}_2 + \text{H}_2\text{O}$
3. Use relative atomic masses to prove that the balanced chemical equations above adhere to the *law of conservation of mass*.

**Daily task 13.2: Classwork/Homework**

Write balanced chemical equations for the following equations:

1. hydrogen + oxygen  $\rightarrow$  water
2. methane + oxygen  $\rightarrow$  carbon dioxide + water
3. silver nitrate + sodium chloride  $\rightarrow$  silver chloride + sodium nitrate
4. sulphur dioxide + oxygen  $\rightarrow$  sulphur trioxide
5. nitric acid + copper  $\rightarrow$  copper(II) nitrate + nitrogen dioxide + water
6. iron(III) oxide + carbon monoxide  $\rightarrow$  iron + carbon dioxide

## Topic 14: Magnetism



<b>Important terms/definitions</b>	
Angle of declination	Angle between the magnetic N pole and geographic N pole (true north) of the earth.
Aurora Borealis (Northern lights)	An atmospheric phenomenon consisting of bands of light at the N pole caused by charged solar particles following the earth's magnetic lines of force.
Ferromagnetic material	Materials that are strongly attracted by magnets and easily magnetised. Iron, cobalt, nickel and their alloys.
Geographic north pole	Point in the northern hemisphere where the rotation axis of the earth meets the surface.
Magnetic axis	The straight line joining the N pole and the S pole of a magnet.
Magnetic field	A region in space where another magnet or ferromagnetic material will experience a force.
Magnetic north pole	The point where the magnetic field lines of the earth enters the earth. It is direction in which the N pole of a compass points.
Magnetic south pole	The point where the magnetic field lines of the earth leaves the earth.
Magnetic storms	A disturbance in the Earth's outer magnetosphere, usually caused by streams of charged particles given off by solar flares.
Magnetosphere	A region surrounding the earth (extending from about one hundred to several thousand kilometres above the surface) in which charged particles are trapped and their behaviour is dominated by the earth's magnetic field.
Non-contact force	A force exerted on an object without touching the object.
Solar wind	A stream of radioactive and charged particles send into space at high speeds due to reactions on the sun.

### **Experiment 10: The magnetic field around a bar magnet**

**Aim:** To investigate the magnetic field around a bar magnet

#### **Apparatus**

- Two bar magnets
- Iron filings
- Sheet of paper
- Small compasses

#### **Method & results**

1. Magnetic field around a bar magnet

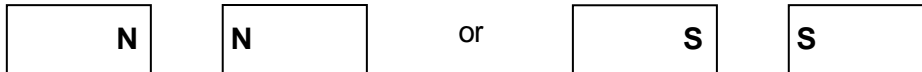
- 1.1 Place a sheet of paper on top of a bar magnet.
- 1.2 Sprinkle iron filings evenly over the sheet of paper.
- 1.3 Tap the paper lightly with your finger until a clear pattern can be observed.
- 1.4 Draw the outlines of the bar magnet and the pattern of the iron filings in the form of curved lines in your workbook.

2. Direction of the field lines

- 2.1 Place the small compasses at various positions on the sheet of paper on top of the magnet.
- 2.2 In which direction do the field lines point, with reference to the south pole and the north pole of the magnet as indicated by the compass? Indicate the direction of the magnetic field lines on the sketch in your workbook.

3. Magnetic field between two north poles and two south poles

- 3.1 Place two bar magnets with their north poles or their south poles near each other.



- 3.2 Place a sheet of paper on top of the magnets.
- 3.3 Sprinkle iron filings evenly over the sheet of paper.
- 3.4 Tap the paper lightly with your finger until a clear pattern can be observed.
- 3.5 Draw the outlines of the bar magnets and the pattern of the iron filings in the form of curved lines in your workbook.

4. Magnetic field between a north pole and a south pole

- 4.1 Place two bar magnets with the north pole of one magnet and the south pole of the other magnet near each other.



- 4.2 Place a sheet of paper on top of the magnets.
- 4.3 Sprinkle iron filings evenly over the sheet of paper.
- 4.4 Tap the paper lightly with your finger until a clear pattern can be observed.
- 4.5 Draw the outlines of the bar magnets and the pattern of the iron filings in the form of curved lines in your workbook.

**Daily task 14.1: Classwork/Homework**

1. What is meant by *the N pole of a magnet*?
2. Define the term *magnetic field*.
3. Explain what will be observed in each of the following cases:
  - 3.1 The N pole of a magnet is brought close to the N pole of another magnet
  - 3.2 The S pole of a magnet is brought close to the N pole of another magnet
4. Draw the magnetic field lines for the following arrangement of two bar magnets.



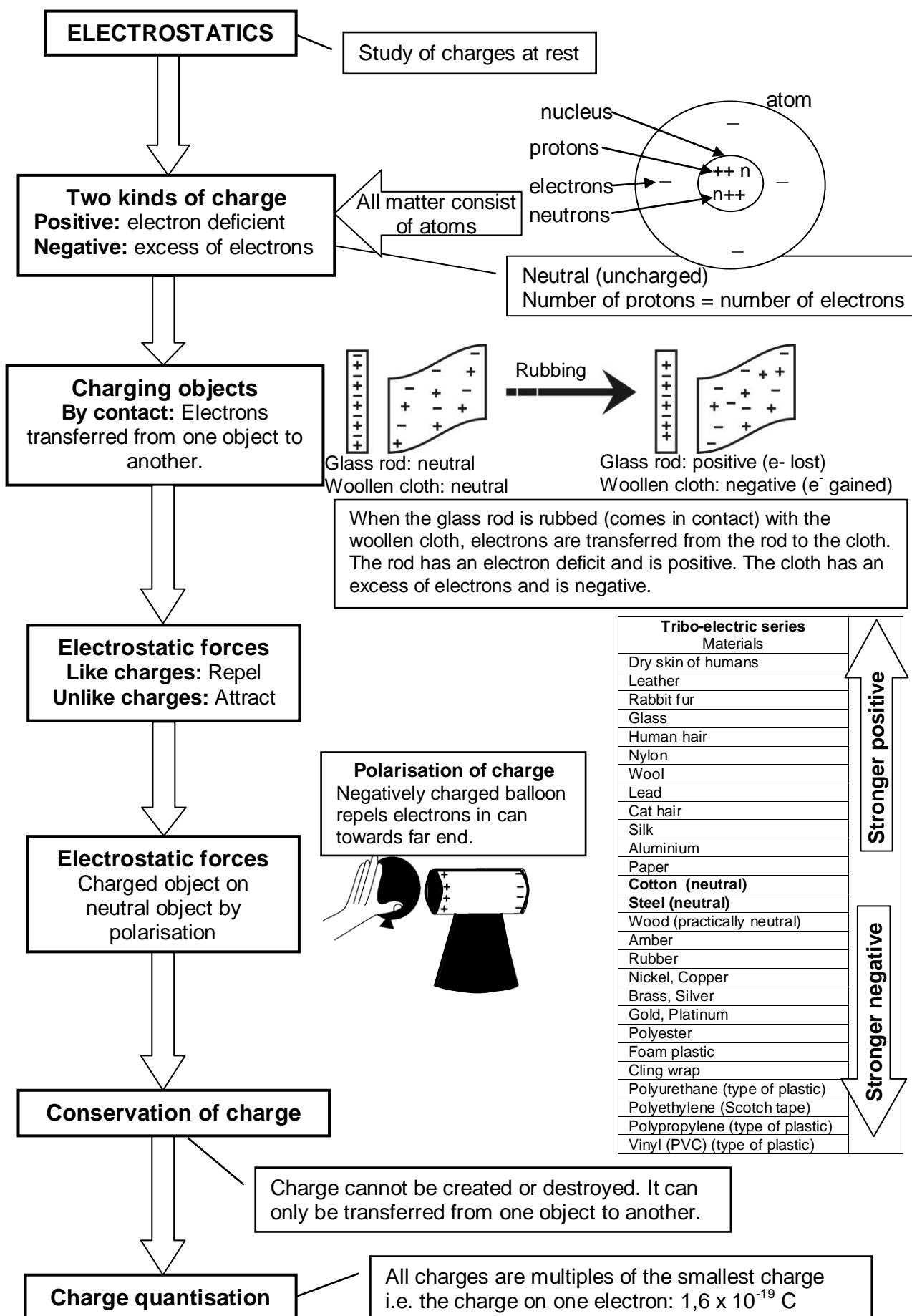
5. Which of the following objects will be attracted by a magnet?
  - 5.1 R2 coin
  - 5.2 Glass
  - 5.3 Graphite in a pencil
  - 5.4 Copper wire
  - 5.5 Iron nail
  - 5.6 Wooden block
6. Some materials are known as ferromagnetic materials.
  - 6.1 Define the term *ferromagnetic material*.
  - 6.2 Write down the names of the three ferromagnetic materials that occur on the periodic table.

**Daily task 14.2: Classwork/Homework**

1. You are supplied with a metal rod which you are told is a magnet. You are requested to find out which side of the rod is the N pole of the magnet.
  - 1.1 Name one other apparatus that you will need.
  - 1.2 Briefly describe how you will use the apparatus to determine the N pole of the magnet.
  - 1.3 Give the names of TWO substances that could be used to make a magnet.
2. Which of the following materials could be used to make the needle of a pocket navigating compass?  
Magnesium; soft iron; aluminium; steel; brass
3. Explain the difference between a hard magnetic material and a soft magnetic material.
4. The earth's magnetosphere is important for life on earth.
  - 4.1 Define the term *magnetosphere*.
  - 4.2 Explain how the magnetosphere helps to maintain life on earth.



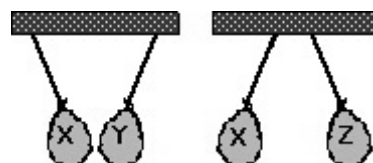
## Topic 15: Electrostatics



Important terms/definitions	
Electrons	Negative particles occupying space around nucleus.
Elementary charge	An indivisible unit of charge i.e. $1,6 \times 10^{-19}$ C.
Neutrons	Neutral particles in the atomic nucleus.
Protons	Positive particles in atomic nucleus.
Polarisation (of charge)	The partial or complete polar separation of positive and negative electric charge in a system.
Quantization (of charge)	Division of charge in smaller units
Principle of conservation of charge	Charge cannot be created or destroyed. It can only be transferred from one object to another.
Principle of charge quantization	Every stable and independent object has a charge that is an integer multiple of the elementary charge.
Triboelectric charging (Triboelectric effect)	A type of contact electrification in which certain materials become electrically charged after they come into contact with another different material and are then separated (such as through rubbing). The polarity and strength of the charges produced differ according to the materials.

### Daily task 15.1: Classwork/Homework

- Balloons **X**, **Y** and **Z** are hanging as shown. If balloon **X** is positively charged, balloon **Z**:
  - Must be positively charged
  - Must be negatively charged
  - Must be neutral
  - Could be either negatively charged or neutral
  - Could be either positively charged or neutral



- Two small IDENTICAL metal spheres, **P** and **R**, on insulated stands carry charges of  $+5 \times 10^{-9}$  C and  $-3 \times 10^{-9}$  C respectively.



- Which sphere has a(n):
  - Excess of electrons
  - Shortage of electrons
- Calculate the number of electrons that was transferred during charging of sphere **P**. Were these electrons removed from or added to sphere **P**?
- The spheres are now brought into contact and then separated again.
  - State the principle of conservation of charge in words.
  - Calculate the new charge on each sphere after separation.

## Experiment 11: Charging by contact

**Aim:** To use an electroscopes to indicate charge and to indicate type of charge.

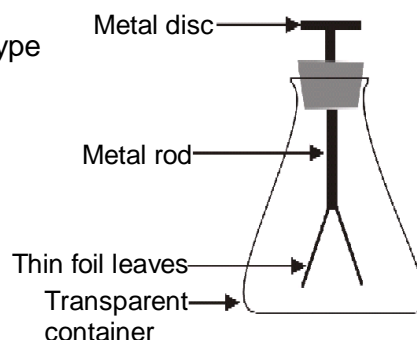
### Apparatus

Electroscope

Glass or Perspex rod

Woollen cloth

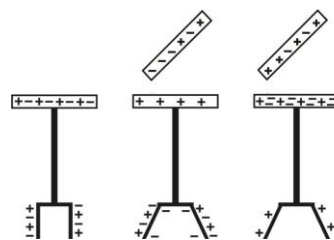
(Use the triboelectric series to select materials available to obtain the desired charge)



### Method, Results & Conclusion

#### 1. Neutral electroscope

- 1.1 Charge a glass rod by rubbing it with a woollen cloth.
- 1.2 Hold a positively charged rod near the disc of the electroscope. What do you observe?  
Sketch your observation (similar to the accompanying diagram for a negative rod held close to a neutral electroscope).
- 1.3 Remove the charged glass rod. What do you observe?
- 1.4 Repeat the procedure with a negatively charged rod.
- 1.5 What was the function of the electroscope in this experiment?



#### 3. Positively charged electroscope

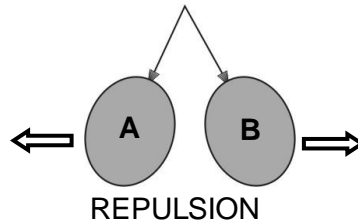
- 2.1 Charge an electroscope by touching it with a positively charged glass rod. It may be necessary to drag the glass rod across the disc. Explain how the electroscope obtained a positive charge. Sketch your observation after the glass rod has been removed.
- 2.2 Charge a glass rod by rubbing it with a woollen cloth and hold it near the disc of the charged electroscope. What do you observe? Sketch your observation.
- 2.3 Explain your observation in step 2.2.
- 2.4 What effect do two positively charged objects have on each other?
- 2.5 Rub a PVC rod with a woollen cloth and hold it near to the disc of a positively charged electroscope. What do you observe? Sketch your observation.
- 2.6 What is the charge on the PVC rod? Explain your answer.
- 2.7 How can this electroscope be used to indicate the charge on an object with an unknown charge?

### Questions

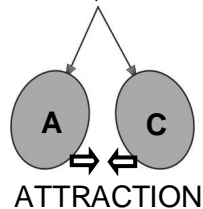
1. Give TWO functions of an electroscope.
2. Why are the disc, rod and leaves of the electroscope made from metal?
3. Explain how you would charge an electroscope negatively by means of contact. Use the Triboelectric Series to choose materials that will result in a negative charge on the rod. Illustrate your explanation with the necessary sketches.
4. What do you predict will happen when a charged glass rod is held near to negatively charged electroscope? Explain your answer.
5. What do you predict will happen when a charged PVC rod is held near the disc of an electroscope? Explain your answer.
6. Your teacher will now demonstrate this experiment. Test your predictions by observing the demonstration.

**Daily task 15.2: Classwork/Homework**

1. A glass rod is positively charged by rubbing it with a silk cloth. During the charging process, ...
  - A electrons are transferred from the glass rod to the silk cloth.
  - B electrons are transferred from the silk cloth to the glass rod.
  - C protons are transferred from the glass rod to the silk cloth.
  - D protons are transferred from the silk cloth to the glass rod.
2. Learners investigate two types of charges and the effect these charges have on each other. They rub two inflated balloons, **A** and **B**, with a woollen cloth. When holding the two balloons close to each other, the balloons REPEL each other, as shown below.

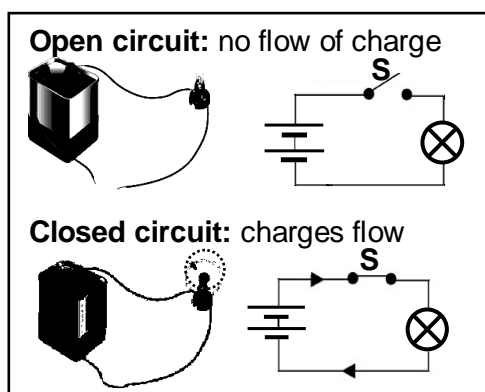


They then rub a third balloon, **C**, with cling wrap and hold it close to balloon **A**. They observe that the two balloons ATTRACT each other, as shown below.



- 2.2 How did the balloons become charged?
- 2.2 Write down a conclusion that the learners can draw concerning the charge(s) on:
  - 2.2.1 Balloon **A** and balloon **B**
  - 2.2.2 Balloon **A** and balloon **C**

## Topic 16: Electric circuits



### Current:

Rate of flow of charge:  $I = \frac{Q}{\Delta t}$

Unit: ampere (A)

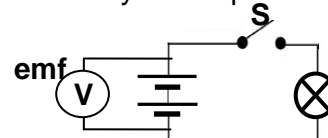
Measuring instrument:

ammeter - connected in series

Conventional current:

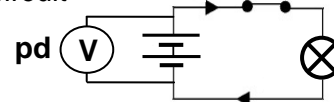
from positive to negative

**Emf of battery:** potential difference across battery in an open circuit



**Potential difference of battery:**

Potential difference across battery in a closed circuit



**Potential difference**

Unit: volt (V)

Measuring instrument:

voltmeter - connected in parallel

### Resistance

Opposition to flow of charge

Unit: ohm ( $\Omega$ )

Resistance is the ratio of potential difference across a resistor to the

current through it:  $R = \frac{V}{I}$

### Electric circuits

#### Parallel circuit

More than one pathway for charges  
One or more branches

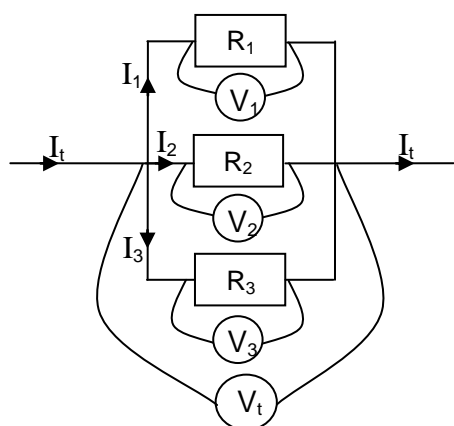
#### Resistors in parallel

1. Current dividers

$$I_t = I_1 + I_2 + I_3$$

$$2. \frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$$

3. Potential difference everywhere the same:  $V_t = V_1 = V_2 = V_3$



#### Series circuit

Only one pathway for charges  
No branches

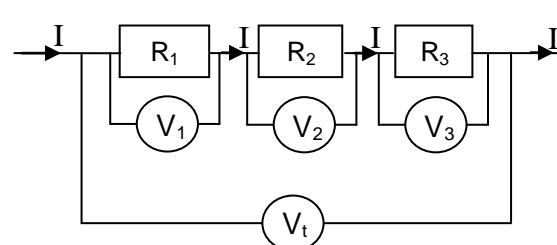
#### Resistors in series

1. Potential dividers

$$V_t = V_1 + V_2 + V_3$$

2.  $R_{\text{total}} = R_1 + R_2 + R_3$

3. Current everywhere the same



Important terms/definitions	
ampere (A)	The unit of measurement of electric current.
coulomb (C)	The unit of measurement of electric charge. Definition: The current is one ampere when a charge of one coulomb passes a given point in a conductor one second.
Electric current	The rate of flow of charge. ( $I = \frac{Q}{\Delta t}$ )
Emf	The potential difference (voltage) measured across the terminals of a battery when no charge flows through the battery.
ohm ( $\Omega$ )	Unit of measurement of resistance. Definition: One ohm is one volt per ampere.
Potential difference	The potential difference between the ends of a conductor is equal to the energy transferred (from electrical to other forms of energy) per unit electric charge flowing through it. ( $V = \frac{W}{Q}$ )
Resistance	Resistance is the ratio of the potential difference across a resistor to the current in the resistor.
volt (V)	The unit of measurement of potential difference.
Voltmeter	The instrument used to measure potential difference. A voltmeter is connected in parallel and has a very high resistance.
Ammeter	The instrument used to measure electric current. An ammeter is connected in series and has a very low resistance.

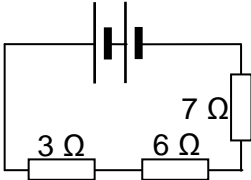
### **Daily task 16.1: Homework/Classwork**

- Which ONE of the following statements regarding conventional current is TRUE?
  - The direction of the current is the same as the direction of the flow of electrons.
  - The direction of the current is perpendicular to the flow of electrons.
  - The direction of the current is opposite to the direction of flow of electrons.
- Which ONE of the following is the unit of measurement of electric current?
  - volt
  - coulomb
  - ohm
  - ampere
- A charge of 5 C passes through a conductor in 3 s. Calculate the current in the conductor. Give the answer to two decimal places.
- The current in a wire is 3 A. Calculate the charge that flows through the wire in 1 minute.
- Calculate the time that 84 C must flow through a copper wire to register a current of 7 A.
- A variable resistor and a battery are connected in a circuit. How will the current in the circuit change if the resistance of the circuit is doubled?
  - Doubles
  - Halves
  - Remains the same
- Which ONE of the following statements is NOT true?
  - Potential difference (voltage) is inversely proportional to resistance.
  - Potential difference (voltage) is directly proportional to current.
  - Current is inversely proportional to resistance.

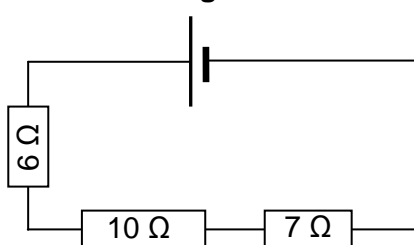
### **Daily task 16.2: Homework/Classwork**

1. Which ONE of the following will produce the highest resistance?  
 A Two 1 ohm resistors in series  
 B Two 2 ohm resistors in series  
 C Three 3 ohm resistors in parallel  
 D Two 1 ohm resistors in parallel
2. Which ONE of the following correctly describes the resistance of a circuit?

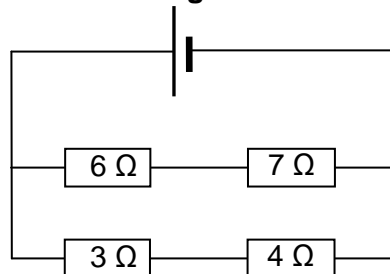
Resistance is the:

- A Rate at which charge flow through a wire
  - B Product of current and potential difference (voltage)
  - C Opposition that the conductor have to flow of charge
  - D Force of gravity applied on a wire
3. Calculate the total resistance of the circuit represented by the circuit diagram alongside.
- 
4. A learner connects a battery, a wire, a voltmeter and an ammeter to form a circuit. The reading on the voltmeter is 4 V and the reading on the ammeter is 3 A.
- 4.1 How must the learner connect the ammeter in the circuit?
  - 4.2 How must the learner connect the voltmeter to measure the potential difference between the ends of the wire?
  - 4.3 Calculate the total resistance of the circuit.
5. Study the circuit diagrams given below.

**Diagram 1**

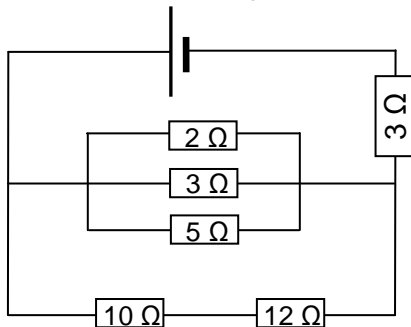


**Diagram 2**



Calculate the total resistance of the circuit in:

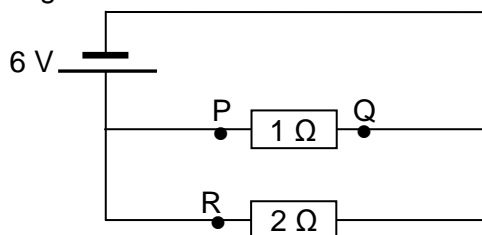
- 5.1 Diagram 1
  - 5.2 Diagram 2
6. Calculate the total resistance in the circuit represented in the diagram below.



### Daily task 16.3: Homework/Classwork

Answer QUESTIONS 1 and 2 by referring to diagram 1 alongside.

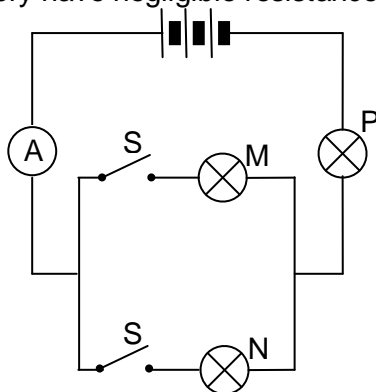
Diagram 1



1. Which ONE of the following correctly shows the potential per coulomb charge at each of points P, Q, and R?
 

A 6 J; 6 J; 6 J	B 3 J; 3 J; 0 J
C 6 J; 0 J; 6 J	D 1 J; 2 J; 3 J
2. Which ONE of the following correctly represents the electric current at each of points P, Q, and R?
 

A 4,5 A; 4,5 A; 4,5 A	B 6 A; 6 A; 3 A	C 6 A; 3 A; 4,5 A	D 2,5 A; 1,5 A; 6,5 A
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3. In the circuit diagram below, three identical bulbs are connected as shown. The ammeter, connecting wires and battery have negligible resistance. Study the diagram and then answer the questions that follow



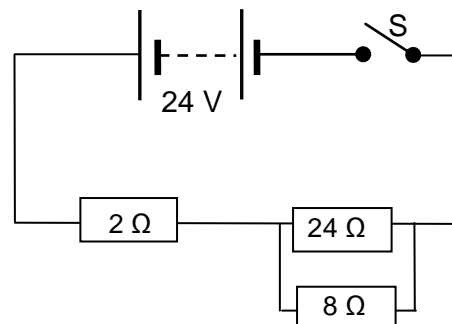
- 3.1 Switches  $S_1$  and  $S_2$  are open. Which bulbs, if any, will light up?
- 3.2 Switch  $S_1$  is closed and  $S_2$  is open. Compare the brightness of bulbs M, N and P.
- 3.3 Switches  $S_1$  and  $S_2$  are closed. Compare the potential differences across bulbs M, N and P.

For QUESTIONS 3.4 and 3.5, choose the correct answer from those given in the brackets.

- 3.4 Adding bulbs in parallel causes the:
  - 3.4.1 Resistance of the circuit to (increase/decrease/remain the same)
  - 3.4.2 Potential difference across the battery to (increase/decrease/ remain the same)
- 3.5 Parallel circuits can be regarded as (current/potential) dividers.

4. Consider the following circuit diagram.

- 4.1 Copy the circuit diagram into your workbook, but add symbols to show how to connect a voltmeter to measure the potential difference across the battery and how to connect an ammeter to measure the current through the battery. Show the direction of the current passing through the battery using a labelled arrow.



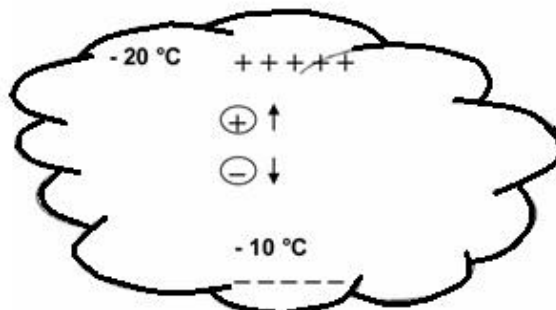
- 4.2 Calculate the equivalent resistance of the resistors connected in parallel.
- 4.3 Calculate the total resistance of the circuit.
- 4.4 If the potential difference across the  $2\Omega$  resistor is 6 V, deduce the potential difference across the parallel combination.
- 4.5 A charge of 18 C flows through the battery in 6 s.
  - 4.5.1 Calculate the current that passes through the battery.
  - 4.5.2 Deduce the current passing through the  $8\Omega$  resistor if the current passing through the  $24\Omega$  resistor is 0,75 A.



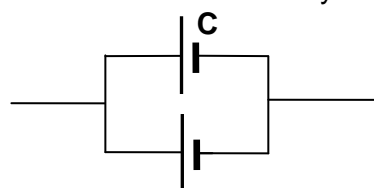
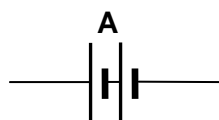
### Daily task 16.4: Homework/Classwork

1. During a thunderstorm, strong air currents inside clouds rub ice crystals against each other. This results in a separation of charge and hence a potential difference. The potential difference between the top and the bottom of a storm cloud can be millions of volts. Friction leaves the top of the cloud positively charged and the bottom of the cloud negatively charged. Generally, low lying clouds have a temperature of  $-10^{\circ}\text{C}$  at the bottom and  $-20^{\circ}\text{C}$  at the top.

When lightning strikes, negative charge from the air to the ground. A lightning flash usually consists of another. The temperature inside a flash can be

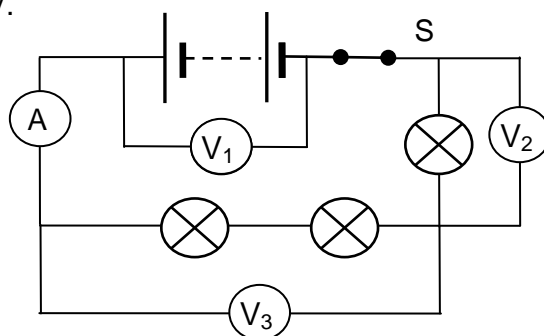


- 1.1 Define the following terms:
    - 1.1.1 Electric current
    - 1.1.2 Potential difference
  - 1.2 Explain why ice crystals are formed in the cloud
  - 1.3 In one of the lightning flashes  $75\text{ A}$  of electric current passes from the bottom of the cloud to the ground below in  $1,5\text{ s}$ . Calculate the amount of charge that passes from the cloud to the ground in the lightning flash.
  - 1.4 The potential difference between the bottom of the cloud and the ground is  $2\,000\,000\text{ V}$ . Use your answer from QUESTION 4.3 to calculate the amount of heat energy produced during the lightning flash.
2. The diagrams (A, B and C) below show identical cells connected in different ways.



Which diagram represents the cells that:

- 2.1 Will let a bulb glow the brightest
  - 2.2 Last the longest
3. In the accompanying circuit diagram, the three bulbs are identical and the reading on voltmeter  $V_1$  is  $12\text{ V}$ .



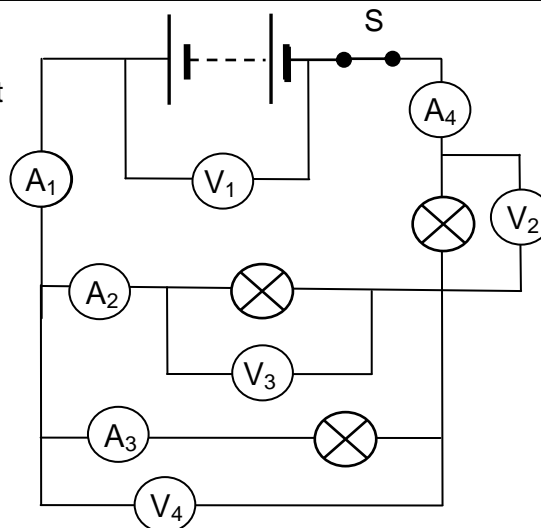
Determine the reading on voltmeter:

- 3.1  $V_2$
- 3.2  $V_3$

**Daily task 16.5: Homework/Classwork**

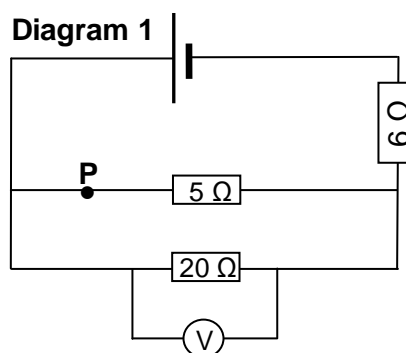
1. Three identical bulbs are connected in a circuit as shown alongside.  
Compare the readings on:

- 1.1  $A_1$ ,  $A_2$  and  $A_3$
- 1.2  $A_1$  and  $A_4$
- 1.3  $A_2$  and  $A_3$
- 1.4  $V_1$  and  $V_4$
- 1.5  $V_1$ ,  $V_3$  and  $V_4$
- 1.6  $V_1$ ,  $V_2$  and  $V_4$
- 1.7  $V_1$ ,  $V_2$  and  $V_3$
- 1.8  $V_3$  and  $V_4$



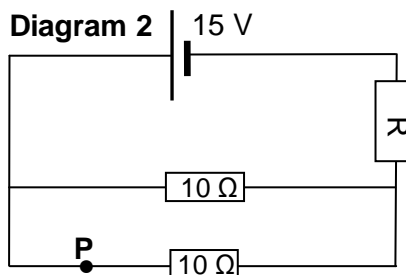
2. Consider diagram 1 alongside.

The current at point **P** is measured to be 1,6 A.  
Determine the potential difference (voltage) of the battery.



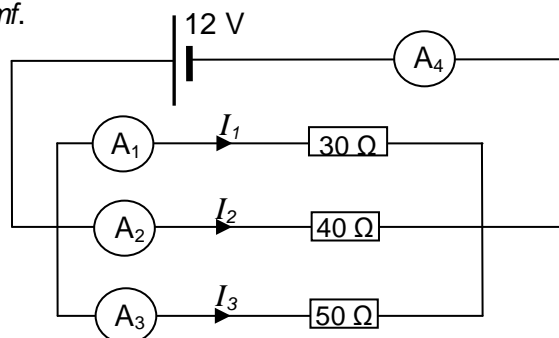
3. Consider diagram 2 alongside.

The current at point **P** is measured as 0,5 A.  
Determine the resistance of **R**.



4. The accompanying circuit diagram shows three resistors connected to a cell.

- 4.1 The emf of the cell is 12 V. Define the term *emf*.
- 4.2 Are the resistors connected in series or in parallel?
- 4.3 Calculate the:
  - 4.3.1 Total resistance of the circuit
  - 4.3.2 Current through the 30 Ω resistor
  - 4.3.3 Current through the 40 Ω resistor
  - 4.3.4 Current through the 50 Ω resistor
- 4.4 Calculate the total current in the circuit.



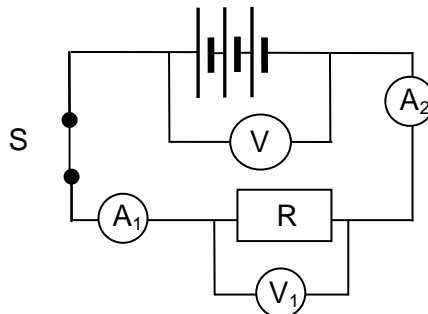
5. A circuit consists of a 10 ohm resistor and carries a current of 5 A. Calculate the potential difference (voltage) across the resistor.
6. A 6 V power source is connected to a conductor with resistance of 4 Ω. Calculate the current in the conductor.

### **Experiment 12: A circuit with an ammeter in series and a voltmeter in parallel**

**Aim:** Set up a circuit to measure the current through and the potential difference across a light bulb or resistor.

#### **Apparatus**

- Three 1,5 V cells
- A resistors
- Two voltmeters or else one voltmeter can be moved to different positions in the circuit
- One or two ammeters
- Conducting wires
- Switch
- Circuit board if available



#### **Method**

1. Set up the circuit as shown in the accompanying diagram.
2. Connect a voltmeter (V) across the three cells and take the reading.
3. Connect the other voltmeters ( $V_1$ ) as shown in the diagram. Take the reading on each voltmeter. Alternatively one voltmeter can be moved from one position to the other.
4. Move the ammeter to different positions in the circuit or else connect a second ammeter on the opposite side of the cell as shown in the diagram. Take the readings on the ammeter(s) in two different positions in the circuit.

#### **Results/Observations**

Redraw the following table in your practical book and record the results obtained.

Voltmeter reading V (V)	Voltmeter reading $V_1$ (V)	Ammeter reading $A_1$ (A)	Ammeter reading $A_2$ (A)

#### **Interpretation/Conclusion**

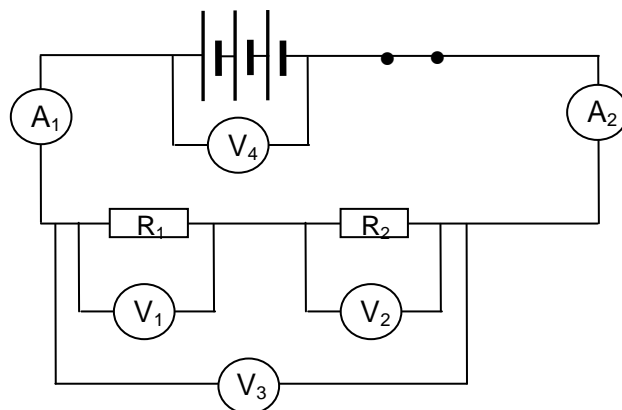
1. How do the ammeter readings compare when the switch is closed? What conclusion can be drawn regarding the current in a series circuit?
2. How do the voltmeter readings compare when the switch is closed? What conclusion can be drawn from these readings?
3. How do we connect an ammeter in a circuit?
4. How do we connect a voltmeter in a circuit?

### Experiment 13: Resistors in series

**Aim:** To compare the potential differences across two resistors in series with the sum of the potential differences across each of the two resistors and to compare the currents measured at different positions in the circuit.

#### Apparatus

- Three 1,5 V cells
- Two resistors
- Four voltmeters or else one voltmeter can be moved to different positions in the circuit
- One or two ammeters
- Conducting wires
- Switch
- Circuit board if available



#### Method:

1. Set up the circuit as shown in the accompanying diagram.
2. Connect a voltmeter ( $V_4$ ) across the three cells and take the reading.
3. Connect the other three voltmeters ( $V_1$ ,  $V_2$  and  $V_3$ ) as shown in the diagram. Take the reading on each voltmeter. Alternatively one voltmeter can be moved from one position to the other.
4. Move the ammeter to different positions in the circuit or else connect a second ammeter on the opposite side of the cell as shown in the diagram. Take the readings on the ammeter(s) in two different positions in the circuit.
5. Repeat the procedure. If available, two different resistors may be used.

#### Results/Observations

Redraw the following table in your practical book and record the results obtained.

	Voltmeter reading $V_4$	Voltmeter reading $V_1$	Voltmeter reading $V_2$	Voltmeter reading $V_3$	Ammeter reading $A_1$	Ammeter reading $A_2$
<b>Trial 1</b>						
<b>Trial 2</b>						

#### Interpretation/Conclusion

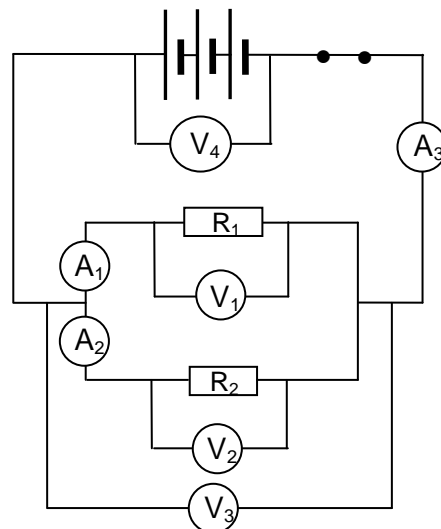
1. For this investigation, write down the:
  - 1.1 Investigative question
  - 1.2 Hypothesis
2. How does the ammeter readings compare? What conclusion can be drawn regarding the current in a series circuit from these readings?
3. How do the voltmeter readings compare? What conclusion can be drawn from these readings?

### **Experiment 14: Resistors in parallel**

**Aim:** To compare the potential differences across resistors in parallel with the potential differences across each of the resistors in parallel and to compare the current in each branch with the main current in the circuit.

#### **Apparatus**

- Three 1,5 V cells
- Two resistors
- Four voltmeters or else one voltmeter can be moved to four different positions
- Three ammeters or else one ammeter can be moved to three different positions
- Conducting wires
- Switch
- Circuit board if available



#### **Method:**

1. Set up the circuit as shown in the accompanying diagram.
2. Connect the four voltmeters as shown or else move one voltmeter to the different positions in the circuit. Voltmeter  $V_4$  measures the potential difference across the three cells, voltmeters  $V_1$  and  $V_2$  measure the potential difference across resistors  $R_1$  and  $R_2$  respectively, and voltmeter  $V_3$  measures the potential difference across the combination of resistors  $R_1$  and  $R_2$ .
3. Connect an ammeter ( $A_1$  and  $A_2$ ) in each of the parallel branches to measure the current in each branch. Alternatively one ammeter can be moved from one position to another. Connect an ammeter ( $A_3$ ) to measure the total current in the circuit.
4. Repeat the procedure. If available, two different resistors may be used.

#### **Results/Observations**

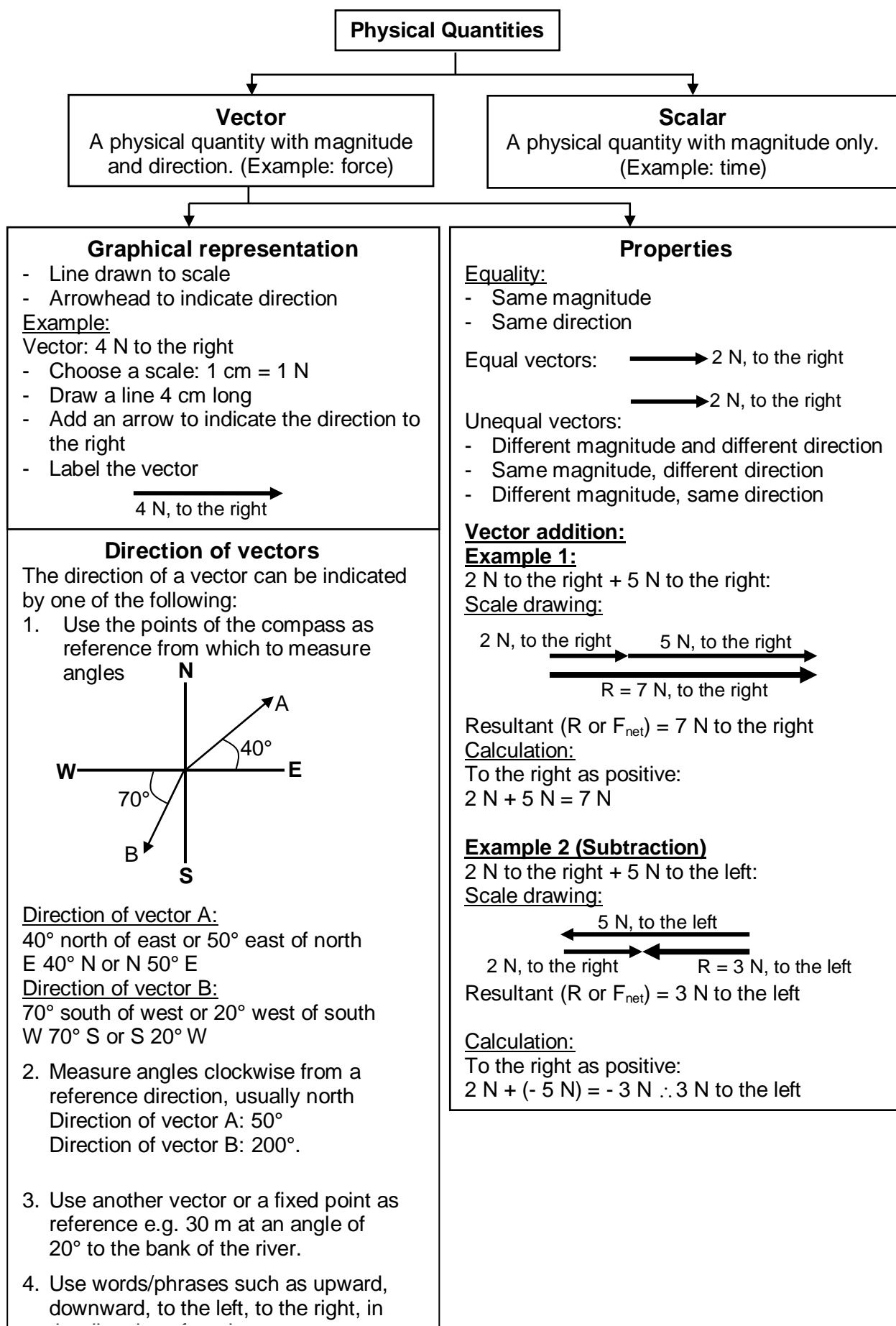
Redraw the following table in your practical book and record the results obtained.

	Voltmeter reading $V_4$	Voltmeter reading $V_1$	Voltmeter reading $V_2$	Voltmeter reading $V_3$	Ammeter reading $A_1$	Ammeter reading $A_2$	Ammeter reading $A_3$
<b>Trial 1</b>							
<b>Trial 2</b>							

#### **Interpretation/Conclusions:**

1. For this investigation, write down the:
  - 1.1 Investigative question
  - 1.2 Hypothesis
2. How does the ammeter readings compare? What conclusion can be drawn regarding the current in a parallel circuit?
3. How do the voltmeter readings compare? What conclusion can be drawn from these readings?

## Topic 17: Vectors and scalars



<b>Important terms/definitions</b>	
Displacement	The change in position of an object from a point of reference. (Length and direction of the straight line drawn from the beginning to the endpoint.)
Distance	The total path length travelled by an object.
Force	Any influence which tends to change the motion of an object.
Mass	The amount of matter in an object.
Resultant	A single vector having the same effect than two or more vectors acting together.
Scalar	A physical quantity with magnitude only.
Tail-to-head method	Used to determine the resultant of two or more vectors - draw the first vector anywhere you wish, and then draw the second vector with its tail at the head of the first vector. If there are more vectors to be added draw each one with its tail at the head of the preceding one. The resultant is a vector drawn from the tail of the first vector to the head of the last vector. It does not matter in which order you add them
Vector	A physical quantity with magnitude and direction.
Weight	The force of attraction of the earth on an object.

<b>LIST OF VECTORS</b>		
<b>Physical quantity</b>	<b>Symbol</b>	<b>Unit of measurement</b>
Force	F	newton (N)
Weight	w	newton (N)
Acceleration	a	metre per second squared ( $\text{m}\cdot\text{s}^{-2}$ )
Velocity	v	metre per second ( $\text{m}\cdot\text{s}^{-1}$ )
Displacement (change in position in straight line )	x/y	metre (m)

<b>LIST OF SCALARS</b>		
<b>Physical quantity</b>	<b>Symbol</b>	<b>Unit of measurement</b>
Temperature	T	kelvin (K) / degrees celcius ( $^{\circ}\text{C}$ )
Mass	m	kilogram (kg)
Time	t	second (s)
Volume	V	cubic decimetre ( $\text{dm}^3$ )
Distance	D	metre (m)

**The head-to-tail method to determine the sum of two or more vectors**

1. Choose a scale and indicate it on a sheet of paper, e.g. SCALE: 1 cm = 20 m. The best choice of scale is one that will result in a diagram that is as large as possible, yet fits on the sheet of paper.
2. Pick a starting location and draw the first vector *to scale* in the indicated direction. Label the magnitude and direction of the vector on the diagram.
3. Starting from where the head of the first vector ends, draw the second vector *to scale* in the indicated direction. Label the magnitude and direction of this vector on the diagram.
4. Repeat steps 2 and 3 for all vectors that are to be added
5. Draw the resultant from the tail of the first vector to the head of the last vector. Label this vector as **Resultant** or simply **R**.
6. Using a ruler, measure the length of the resultant and determine its magnitude by converting to real units using the scale (e.g. if the length is 4,4 cm:

$$4,4 \text{ cm} \times \frac{20 \text{ m}}{1 \text{ cm}} = 88 \text{ m}).$$

**Daily task 17.1: Homework/Classwork**

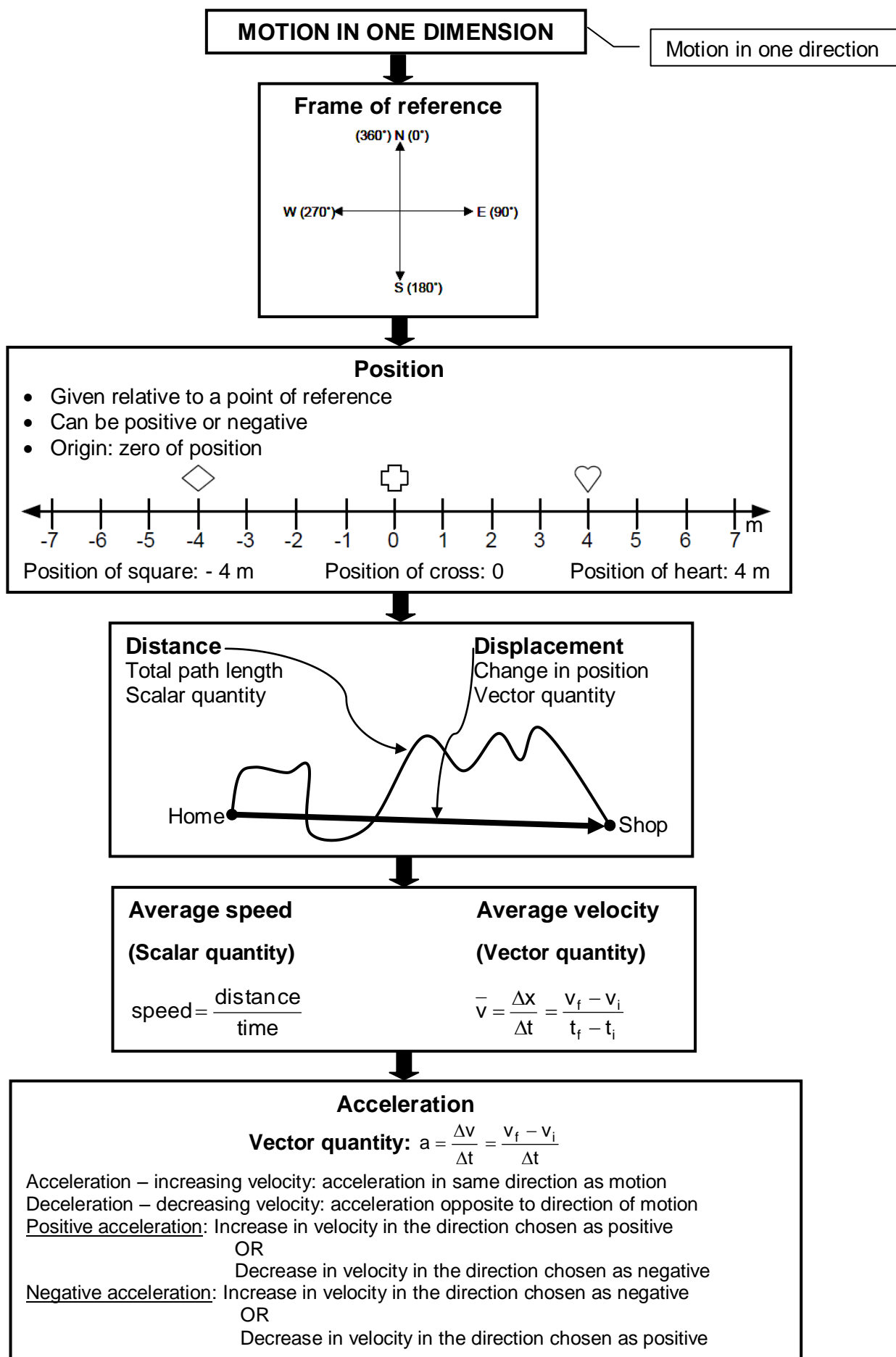
1. Define the following terms:
  - 1.1 Vector
  - 1.2 Scalar
  - 1.3 Resultant
2. Distinguish between displacement and distance in words and with the aid of a sketch.
3. Which ONE of the following terms does not fit with the rest?  
A distance                      B force                      C time                      D speed
4. Two forces K and P act on an object which does move. Which statement is correct?  
  
The two forces:  
A Are equal                      B Act in the same direction  
C Act in opposite directions                      D Are equal and act in opposite directions
5. Choose a relevant scale to represent the following vectors graphically:
  - 5.1 10 N, 30°
  - 5.2 35 N, N50°W
  - 5.3 94 N, 20° north of east
  - 5.4 43 N to the left
  - 5.5 223 N east

**Daily task 17.2: Homework/Classwork**

1. Use a calculation to determine the resultant of the following pairs of forces:
  - 1.1 25 N, 0° and 34 N, 180°
  - 1.2 54 N to the right and 60 N to the right
2. Use the tail-to-head method to determine the resultant of the following pairs of forces:
  - 2.1 25 N, 0° and 34 N, 180°
  - 2.2 54 N to the right and 60 N to the right
  - 2.3 60 N, 90° and 80 N, 30°
3. Four forces of magnitudes 10 N, 8 N, 6 N and 4 N act on the same point on an object. The directions of the forces are 0°; 90°; 135° and 270° respectively. Use the tail-to-head method to determine the resultant of these forces.

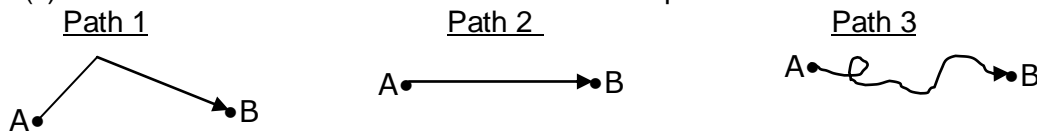


## Topic 18: Motion in one dimension

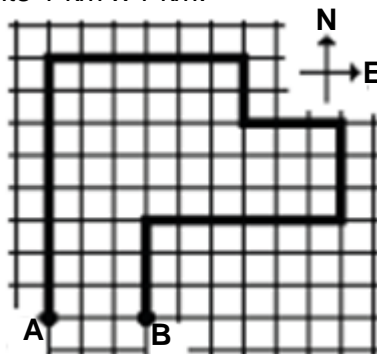


### Daily Task 18.1: Homework/Classwork

1. Classify the following quantities as vectors or scalars:  
*displacement, distance, speed, velocity, acceleration, time*
2. Classify the following statement as TRUE or FALSE.  
*An object can move for 10 seconds and still have a zero displacement.*  
If true, give an example. If false, give a reason.
3. Suppose you run along three different paths from position A to position B. Along which path(s) would the distance travelled differ from the displacement?

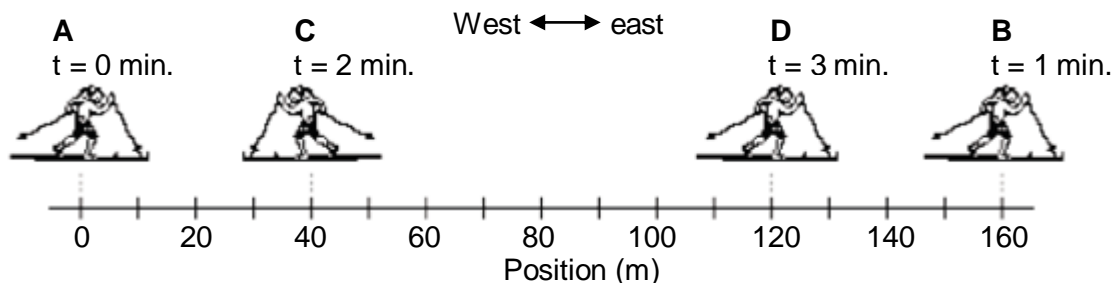


4. You run from your house to a friend's house that is 3 kilometres away. From there, you walk back home.
  - 4.1 What distance did you travel?
  - 4.2 What was the displacement for the entire trip?
5. Consider the diagram below. A person starts at A and walks along the path shown in bold to B. Each square represents 1 km x 1 km.



Determine the:

- 5.1 Distance walked by the person
- 5.2 Displacement of the person
6. A cross-country skier moves from position **A** to position **B**, then from position **B** to position **C** and then from position **C** to position **D** as illustrated below. Each leg of the back-and-forth motion takes 1 minute to complete. The total time taken in moving from position **A** to position **D** is 3 minutes.

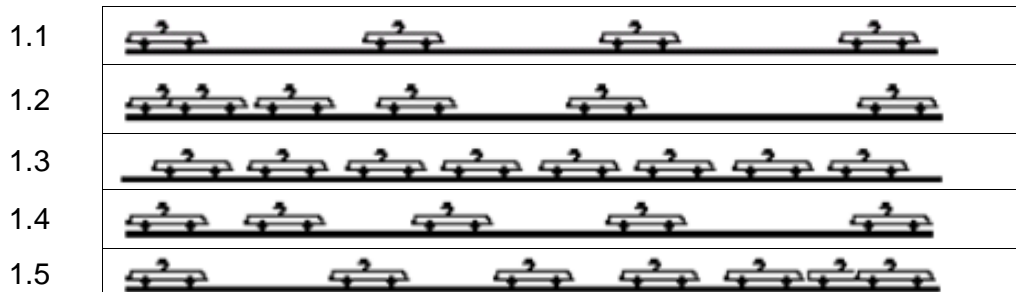


Calculate the:

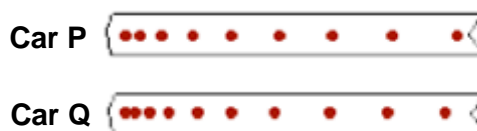
- 6.1 Total distance travelled by the skier during the three minutes
- 6.2 Displacement of the skier during the three minutes
- 6.3 Displacement during the second minute (from 1 min. to 2 min.)
- 6.4 Displacement during the third minute (from 2 min. to 3 min.)

### Daily Task 18.2: Homework/Classwork/Data-interpretation

1. The motion of a car in an amusement park is illustrated below. The position of the car is shown at regular time intervals. For each of the diagrams (7.1 to 7.5), write down whether the car is accelerating or moving with constant velocity. If accelerating, indicate the direction (right or left) of acceleration. Support your answer with reasoning.



2. The diagram below shows the oil drop pattern left by two cars, **P** and **Q**, on a road.



Based on the oil drop pattern for the two cars, classify each of the following statements as TRUE or FALSE.

- A: Both cars have a constant velocity.  
 B: Both cars have an accelerated motion.  
 C: Car P is accelerating; car Q is not.  
 D: Car Q is accelerating; car P is not.  
 E: Car P has a greater acceleration than car Q.  
 F: Car Q has a greater acceleration than car P.

1. Puleng's car has an oil leak and leaves a trace of oil drops on the streets as she drives through Senekal. A study of Senekal's streets reveals the following traces.

Diagram 1:

Diagram 2:

Diagram 3:

Match the diagram (1, 2 or 3) with the verbal descriptions (3.1. to 3.3) given below. For each match, verify your reasoning.

- 1.1 Puleng was driving at a slow constant speed and then decreased speed and came to rest. The car remained at rest for 30 seconds after which she then drove again at a slow constant speed.  
 1.2 Puleng decreased speed from a very high speed until the car came to rest. The car then accelerated until it reached a moderate speed.  
 1.3 Puleng drove at a moderate speed and then accelerated.

4. The table below shows data obtained for the motion of an object.

time (s)	0	1	2	3	4	5
position (s)	0	20	50	130	150	200

- 4.1 Draw the position-time graph for the motion of the object.  
4.2 From the graph, determine the:  
4.2.1 Average speed during the first 2 seconds  
4.2.2 Average speed between the 2<sup>nd</sup> and the 3<sup>rd</sup> second  
4.2.3 Average speed for the whole trip  
4.3 Determine the tangent of the graph between the 2<sup>nd</sup> and the 3<sup>rd</sup> second.  
4.4 How does the answer to QUESTION 4.2.2 compare to the answer of QUESTION 4.3?

**Daily Task §18.3: Homework/Classwork**

1. The speed of sound in air is about  $330 \text{ m}\cdot\text{s}^{-1}$ . A lightning bolt strikes a tree that is 1,5 km away from you.
  - 1.1 Calculate the time from the moment that you see the lightning flash until you hear the thunder that accompanies it.
  - 1.2 Give a reason why you see the lightning flash before you hear the thunder.
2. A car accelerates from rest to  $90 \text{ km}\cdot\text{h}^{-1}$  in 8,8 s. Calculate the average acceleration of the car in  $\text{m}\cdot\text{s}^{-2}$ .
3. A jet aircraft landing on an aircraft carrier is brought to a complete stop in 2,7 seconds from a velocity of  $215 \text{ km}\cdot\text{h}^{-1}$ . Calculate the average acceleration in  $\text{m}\cdot\text{s}^{-2}$ .
4. A certain car accelerates constantly at  $2,4 \text{ m}\cdot\text{s}^{-2}$ . If it starts from rest, how long (in seconds) will the car require to obtain a velocity of  $90 \text{ km}\cdot\text{h}^{-1}$ ?
5. A car starts from rest and accelerates at  $2 \text{ m}\cdot\text{s}^{-2}$  for 3 seconds. Calculate the car's velocity at  $t = 3 \text{ s}$ .
6. A bicyclist travels at an average velocity of  $15 \text{ km}\cdot\text{h}^{-1}$  north for 20 minutes. Calculate his displacement during this time.
7. A car moves 20 km east and then 60 km west in 2 hours. Calculate its average velocity.
8. A car moves at  $20 \text{ m}\cdot\text{s}^{-1}$  for 15 minutes. Calculate the distance travelled.

### **Experiment 14: Measurement of average velocity**

**Aim:** To determine the average velocity of a moving object

#### **Apparatus**

Ball

Measuring tape

Stopwatch

#### **Method**

1. Allow a ball to roll in a straight line across the floor from one marked point to another.
2. Use the stop watch to measure the time it takes the ball to roll from the one point to the other.
3. Measure the distance between the two points.
4. Record the results.

#### **Results**

Redraw the table below in your practical books, record the measured data and calculate the average velocity.

Distance between two points (m)	
Time (s)	
Average speed ( $\text{m} \cdot \text{s}^{-1}$ )	

#### **Questions**

1. Explain the difference between:
  - 1.1 Distance and displacement
  - 1.2 Speed and velocity
2. Which ONE of the following represents the car that moves at a higher average speed?  
A: A car that travels 150 km in 3 hours  
B: A car that travels 40 km in 0,5 hours  
C: A car that travels 250 km in 8 hours
3. In the 2008 Olympics, Jamaican Usain Bolt became the fastest man in history by winning a Gold Medal for running the 100 m dash in a World Record time of 9,69 s (*while seemingly not even trying for the last 15 meters!*).
  - 3.1 What was his average speed (in  $\text{m} \cdot \text{s}^{-1}$ ) during this race?
  - 3.2 Several days later Bolt also won Gold and broke another World Record in the 200 m dash with a time of 19,30 s In which race did he have a higher average speed?

### **Experiment 15: Uniform velocity**

**Aim:** To investigate the uniform velocity of a moving trolley.

#### **Apparatus**

Ticker timer  
Ticker tape  
Power source  
Trolley  
Trolley track

#### **Method**

1. Attach a long strip of paper tape to the trolley and pass the tape through the ticker timer.
2. Connect the ticker timer to the power source.
3. Raise the one end of the runway sufficiently so that the trolley moves down the runway at constant speed. (This adjustment which compensates for friction is most important for the success of this investigation.)
4. Cut off the beginning and end portions of the tape where the motion was not uniform, and keep only the portion of the tape where the dots are evenly spaced.
5. Measure the length of the tape and count the number of spaces. Record the results in Table 1.
6. Now mark the tape in lengths of 10 spaces (0,20 s if the frequency of the timer is 50 Hz) each. Measure the displacement (from the first chosen dot) for successive time intervals, i.e. for  $t = 5$  time intervals, displacement = the total length of tape for 50 spaces. For each 10 space interval, calculate the *average velocity* during that interval by dividing the length of the interval (10 spaces), in meters, by 0,20 s (the time for 10 spaces). Record all results in Table 2.

#### **Results**

1. Copy Table 1 into your practical book. Record the length of the tape as well as the number of spaces as determined in step 5 of the method. The frequency of the ticker timer depends on the power source used. If connected to 220 V AC, the frequency is 50 Hz.

<b>TABLE 1</b>	
Length of tape (s) m	
No. of spaces ( $n$ )	
Frequency of timer ( $f$ )	50 Hz
Period of timer ( $T$ )	
Total time ( $n \times T$ )	
Average velocity ( $\frac{s}{t}$ )	

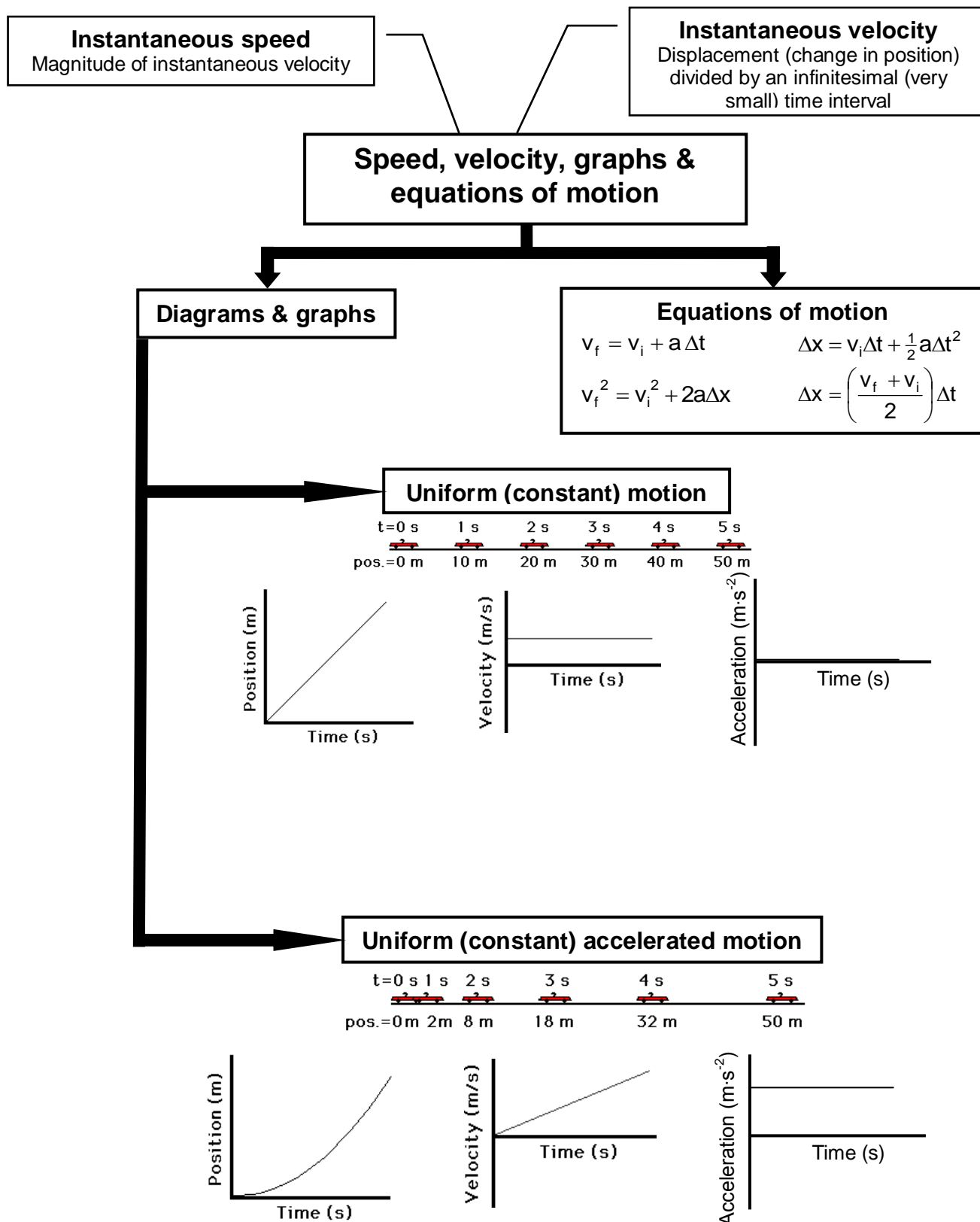
2. Copy Table 2 into your practical book and then complete the open cells.

<b>TABLE 2</b>				
1 Time $t$ (s)	2 $\Delta t$ (s)	3 Displacement (m)	4 $\Delta s$ (m)	5 $\Delta v = \frac{\Delta s}{\Delta t}$ ( $m \cdot s^{-1}$ )
0	0,20			
0,20	0,20			
0,40	0,20			
0,60	0,20			
0,80	0,20			
1,00	0,20			
1,20	0,20			
1,40	0,20			

### **Conclusion and questions**

1. What is the main reason for failure when performing this experiment? How can you try to compensate for that?
2. What is the meaning of the phrase *frequency of the timer*?
3. What is the meaning of the *period* of the timer?
4. Is it necessary to use the whole length of the tape for your calculations? Explain.
5. Show by a calculation that the time for one interval is 0,2 s.
6. Plot a graph of displacement vs. time on a graph paper. What is the shape of the graph?
7. What do you conclude from this regarding the relationship between s and t?
8. Calculate the gradient of the graph ( $\frac{\Delta y}{\Delta x}$ ) in  $\text{m}\cdot\text{s}^{-1}$ .
9. How do these results compare with the answers obtained in column 5 of Table 2?
10. What does the gradient of a displacement versus time graph represent?
11. Plot a graph of velocity vs. time. What is the shape of the graph?
12. Draw a perpendicular from the end of the graph to the time axes. Calculate the area enclosed by the graph, the perpendicular and the two axes.  
How does this compare with the total displacement during the same time?
13. What does the area under a velocity vs. time graph represent?
14. What is the magnitude of the gradient of this graph?
15. How does this compare with the acceleration of the object?
16. What does the gradient of a velocity vs. time graph represent?

## Topic 19: Instantaneous speed & velocity and the equations of motion





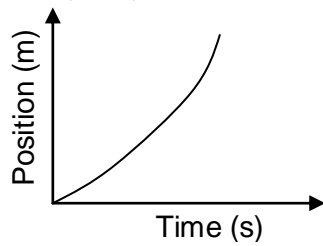
Important terms/definitions	
Acceleration	The rate of change of velocity.
Average speed	The total distance travelled per time.
Average velocity	The total displacement per time.
Displacement	The change in position of an object from a point of reference. (Length and direction of the straight line drawn from the beginning to the endpoint.)
Distance	The total path length travelled by an object.
Frame of reference	A set of axes from which position or motion can be measured.
Gradient of a graph	
Instantaneous speed	The speed at a specific moment.
Instantaneous velocity	The velocity at a specific moment.
Motion in one dimension	Motion of an object in one plane only and in a straight line.
Position	The place occupied by an object - a measurement of a location with reference to an origin.
Speed	The rate of change of distance.
Velocity	The rate of change of position.

### **Daily Task 19.1: Homework/Classwork**

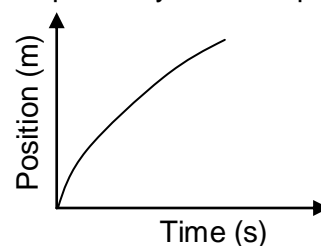
- Which one of the following is not a vector quantity?  
A Velocity  
B Acceleration  
C Time  
D Displacement
- Which ONE of the following can be used to calculate the velocity from a displacement versus time graph?  
A Area under the graph.  
B Gradient of the graph  
C Addition of all values given on graph
- Moving from rest implies:  
A A final velocity of zero  
B An initial velocity of zero  
C No acceleration
- A car moves at an initial velocity of  $40 \text{ m}\cdot\text{s}^{-1}$ . It then accelerates until it reaches a velocity of  $55 \text{ m}\cdot\text{s}^{-1}$ . It takes the car 15 s to reach this new velocity. Calculate the acceleration of the car.
- Thabo is cycling at  $20 \text{ m}\cdot\text{s}^{-1}$  when he sees a hole in the road. He applies brakes and stops after 4 s. Calculate his acceleration.
- Draw the velocity time graph for the motion described below:  
A lift accelerates from rest for 2 s and then moves at a constant velocity for 5 s before it slows down and comes to a standstill in 2 s.

7. Describe the motion of the objects depicted by the graphs given below. In your description, include such information as the direction of the velocity vector (i.e., positive or negative), whether there is a constant velocity or an acceleration, and whether the object is moving slow, fast, from slow to fast or from fast to slow. Be complete in your description.

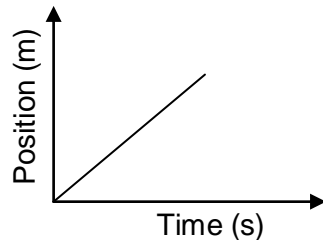
7.1



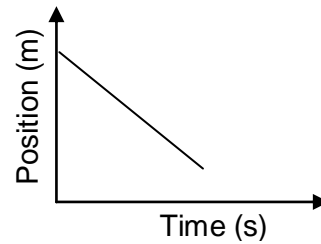
7.2



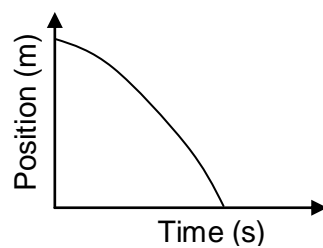
7.3



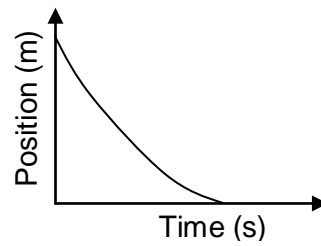
7.4



7.5

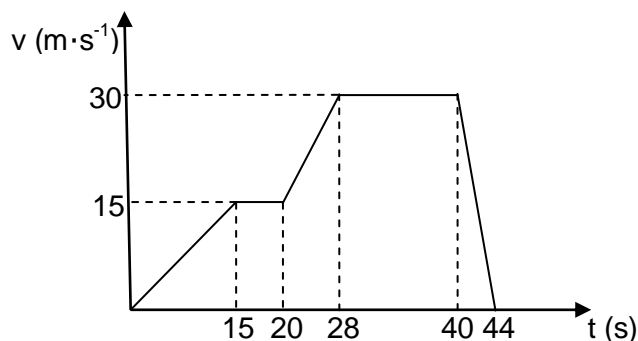


7.6



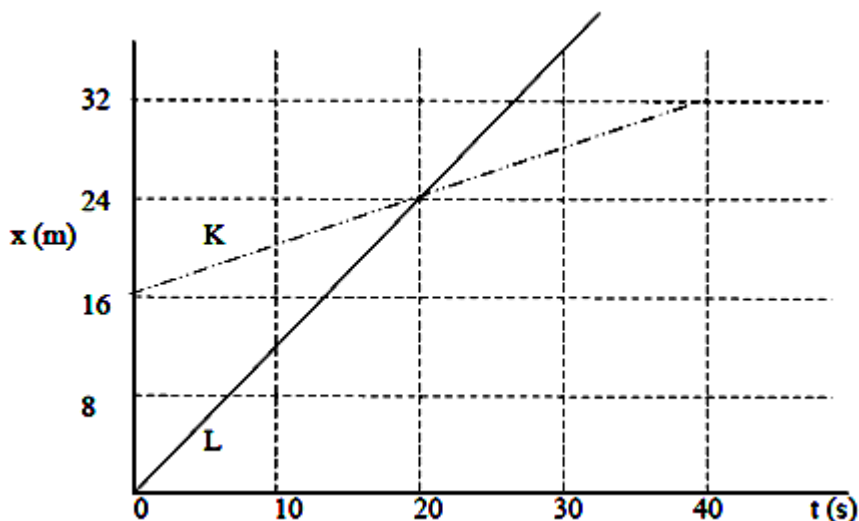
### Daily Task 19.2: Homework/Classwork

1. The following graph represents the motion of a train.



- 1.1 Describe the motion of the train.
- 1.2 Calculate the acceleration of the train between 20 and 28 s.
- 1.3 Calculate the distance travelled in the 44 s.
- 1.4 Draw an acceleration time graph from this velocity time graph.

2. The position – time graph below represents the motion of two cars, **K** and **L**. The position of each car was marked at the instant  $t = 0$  s.



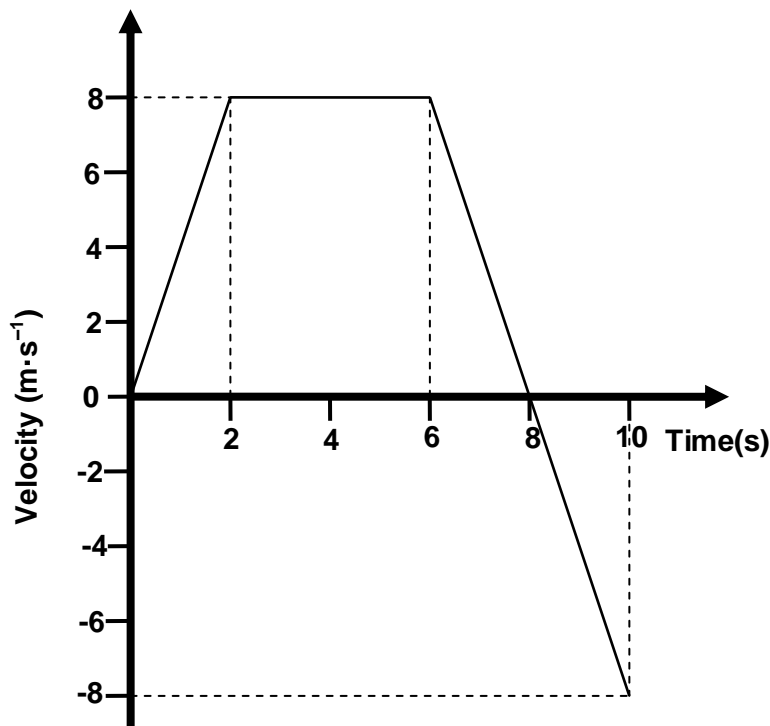
- 2.1 Identify the car with the greatest velocity.
  - 2.2 How far apart are the two cars at  $t = 0$  s?
3. The following table provides the displacement of a car during a period of 10 seconds. Initially, the car moves in a northerly direction.

Time (s)	Displacement (m)
0	0
2	14
4	28
6	28
8	20
10	12

- 3.1 Draw an accurate displacement-time graph to represent the motion of the car.
- 3.2 Use the graph to determine the velocity of the car after 3 seconds.
- 3.3 What was the car's velocity after 5 seconds? Justify your answer.
- 3.4 Use the graph to determine the car's velocity after 9 seconds.
- 3.5 In words, describe the motion of the car during the 10 seconds.

### Daily Task 19.3: Homework/Classwork

1. Study the velocity-time graph for the motion of an object in a straight line. Initially the object moves in an easterly direction.



- 1.1 Describe the motion of the object in words. Refer to the magnitude and the direction of the velocity, in your description.
- 1.2 Use the graph to determine the acceleration of the object over the following periods:
  - 1.2.1 Between 0 and 2 s
  - 1.2.2 Between the 2<sup>nd</sup> and 6<sup>th</sup> second
  - 1.2.3 In the 8<sup>th</sup> second
- 1.3 Determine the total displacement of the object.
- 1.4 Determine the total distance covered by the object. A car accelerates uniformly in 12 s from 10 m·s<sup>-1</sup> to a speed of 18 m·s<sup>-1</sup>. Calculate the distance travelled by the car while it is accelerating.
2. An aeroplane with a velocity of 45 m·s<sup>-1</sup> comes in to land at the start of the runway and brakes at - 5 m·s<sup>-1</sup>. Will it be able to stop in time if the runway is 275 m long? Use the necessary calculations to explain our answer.
3. A motorcycle moving at 30 m·s<sup>-1</sup> due west on a straight road, brakes and comes to a standstill after 6 s. Calculate the acceleration of the motorcycle.
4. Sipho is cycling at 5 m·s<sup>-1</sup> on a gravel road when he spots a bull 20 m ahead of him. It takes him 30 seconds before he starts to apply the brakes. If he stops after 3 minutes, will he stop before he collides with the bull?
5. A car accelerates from rest at 2,5 m·s<sup>-2</sup>. Calculate the:
  - 5.1 Distance covered after 10 s
  - 5.2 Velocity after 10 s
  - 5.3 Average velocity during the first 10 s
  - 5.4 Distance covered when the car reaches a velocity of 33 m·s<sup>-1</sup>
6. A train moves at 22 m·s<sup>-1</sup>. The velocity of the train decreases to 12 m·s<sup>-1</sup> over a distance of 500 m. Calculate the acceleration of the train.
7. A car moves at 33 m·s<sup>-1</sup> on a straight road. The motorist sees an obstruction in the road and brings the car to a stop over a distance of 150 m. Calculate the:
  - 7.1 Acceleration of the car
  - 7.2 Time it takes the car to stop

### **Experiment 16: Uniform accelerated motion**

**Aim:** To investigate the motion of a trolley running down an inclined plane.

#### **Apparatus**

Ticker timer  
Ticker tape  
Power source  
Trolley  
Trolley track

#### **Method**

1. Attach a long strip of paper tape to the trolley and pass the tape through the ticker timer.
2. Connect the ticker timer to the power source.
3. Raise the one end of the runway sufficiently so that the trolley moves down the runway at increasing speed.
4. Cut off the beginning and end portions of the tape where the dots cannot be clearly distinguished.
5. Mark the tape in lengths of 10 spaces (0,20 s if the frequency of the timer is 50 Hz) each. Measure the displacement (from the first chosen dot) for successive time intervals, i.e. for  $t = 5$  time intervals, displacement = the total length of tape for 50 spaces. For each 10 space interval, calculate the *average velocity* during that interval by dividing the length of the interval (10 spaces), in meters, by 0,20 s (the time for 10 spaces). Record all results in the table.

#### **Results**

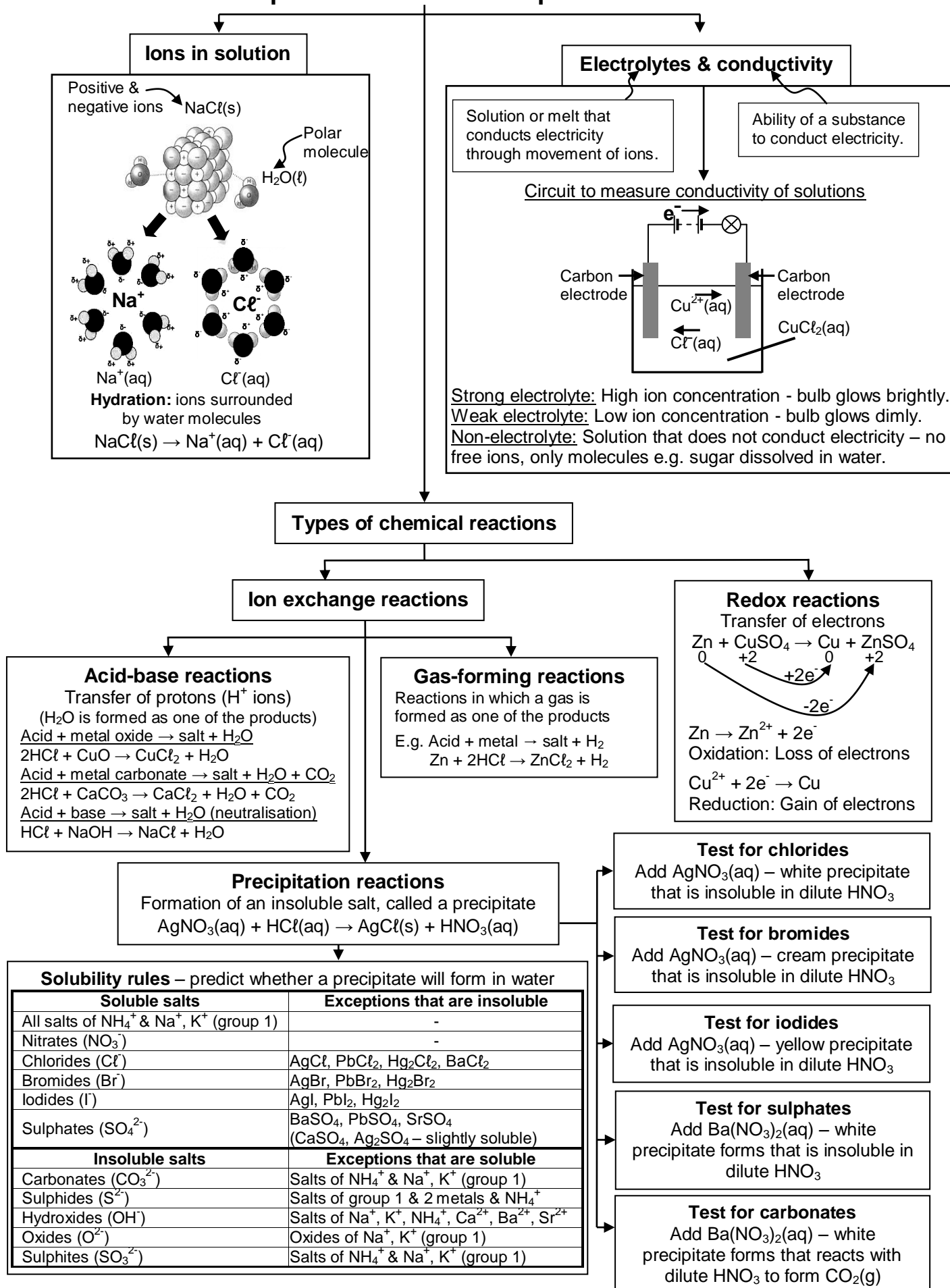
Copy the table below into your practical book.

Time $t$ (s)	Displacement $s$ (m)	Change in displacement $\Delta s$ (m)	Change in time $\Delta t$ (s)	$\bar{v} = \frac{\Delta s}{\Delta t}$ ( $\text{m} \cdot \text{s}^{-1}$ )	$\Delta v$ ( $\text{m} \cdot \text{s}^{-1}$ )	$a = \frac{\Delta v}{\Delta t}$ ( $\text{m} \cdot \text{s}^{-2}$ )
0						
0,1						
0,2						
0,3						
0,4						
0,5						
0,6						
0,7						
0,8						
0,9						
1,0						

#### **Conclusion and questions**

1. **Displacement-time graph**
  - 1.1 Draw an accurate displacement-time graph for the motion of the trolley.
  - 1.1 What shape is the graph? What can you deduce from the shape concerning the velocity of the car?
2. **Velocity-time graph**
  - 2.1 Draw an accurate velocity-time graph for the motion of the trolley.
  - 2.2 What shape is the graph? What can you deduce from this?
  - 2.3 Use the velocity-time graph to determine the acceleration of the trolley. How does this value compare with the calculated value for acceleration in the table?
  - 2.4 Use the velocity-time graph to determine the displacement of the trolley after 3 s. How does this answer compare with the value of displacement after 3 s, as indicated in the table?
3. **Acceleration-time graph**
  - 3.1 Draw an accurate acceleration-time graph for the motion of the trolley.

## Topic 20: Reactions in aqueous solution



### Solubility rules – predict whether a precipitate will form in water

Soluble salts	Exceptions that are insoluble
All salts of $\text{NH}_4^+$ & $\text{Na}^+$ , $\text{K}^+$ (group 1)	-
Nitrates ( $\text{NO}_3^-$ )	-
Chlorides ( $\text{Cl}^-$ )	$\text{AgCl}$ , $\text{PbCl}_2$ , $\text{Hg}_2\text{Cl}_2$ , $\text{BaCl}_2$
Bromides ( $\text{Br}^-$ )	$\text{AgBr}$ , $\text{PbBr}_2$ , $\text{Hg}_2\text{Br}_2$
Iodides ( $\text{I}^-$ )	$\text{AgI}$ , $\text{PbI}_2$ , $\text{Hg}_2\text{I}_2$
Sulphates ( $\text{SO}_4^{2-}$ )	$\text{BaSO}_4$ , $\text{PbSO}_4$ , $\text{SrSO}_4$ ( $\text{CaSO}_4$ , $\text{Ag}_2\text{SO}_4$ – slightly soluble)
Insoluble salts	Exceptions that are soluble
Carbonates ( $\text{CO}_3^{2-}$ )	Salts of $\text{NH}_4^+$ & $\text{Na}^+$ , $\text{K}^+$ (group 1)
Sulphides ( $\text{S}^{2-}$ )	Salts of group 1 & 2 metals & $\text{NH}_4^+$
Hydroxides ( $\text{OH}^-$ )	Salts of $\text{Na}^+$ , $\text{K}^+$ , $\text{NH}_4^+$ , $\text{Ca}^{2+}$ , $\text{Ba}^{2+}$ , $\text{Sr}^{2+}$
Oxides ( $\text{O}^{2-}$ )	Oxides of $\text{Na}^+$ , $\text{K}^+$ (group 1)
Sulphites ( $\text{SO}_3^{2-}$ )	Salts of $\text{NH}_4^+$ & $\text{Na}^+$ , $\text{K}^+$ (group 1)

**Test for chlorides**  
 Add  $\text{AgNO}_3(\text{aq})$  – white precipitate that is insoluble in dilute  $\text{HNO}_3$

**Test for bromides**  
 Add  $\text{AgNO}_3(\text{aq})$  – cream precipitate that is insoluble in dilute  $\text{HNO}_3$

**Test for iodides**  
 Add  $\text{AgNO}_3(\text{aq})$  – yellow precipitate that is insoluble in dilute  $\text{HNO}_3$

**Test for sulphates**  
 Add  $\text{Ba}(\text{NO}_3)_2(\text{aq})$  – white precipitate forms that is insoluble in dilute  $\text{HNO}_3$

**Test for carbonates**  
 Add  $\text{Ba}(\text{NO}_3)_2(\text{aq})$  – white precipitate forms that reacts with dilute  $\text{HNO}_3$  to form  $\text{CO}_2(\text{g})$

Important terms/definitions	
Acid-base reaction	A chemical reaction during which protons ( $H^+$ ions) are transferred.
Aqueous solution	A solution in which the solvent is water.
Concentration	The amount of substance present per volume of a solution.
Conductivity	The ability of a material to conduct electricity.
Dissolution process	The process by which a solid, liquid or gas forms a solution in a solvent.
Dissociation	The process by which solid ionic crystals are broken up into ions.
Electrolyte	A solution/melt that conducts electricity through the movement of ions.
Gas-forming reaction	A reaction during which a gas is formed as one of the products. The formation of the gas is the driving force for these reactions.
Hydration	The process in which ions are surrounded by water molecules in a solution.
Intermolecular forces	Forces between molecules.
Ion	An atom or molecule in which the total number of electrons is not equal to the total number of protons, giving it a net positive or negative charge.
Neutralisation	The reaction of an acid and a base to form a salt and water.
Oxidation	A loss of electrons during a chemical reaction.
Polar molecule	A molecule that has two oppositely charged poles. Also called a dipole.
Precipitate	The insoluble product formed when certain solutions are mixed.
Precipitation reaction	A reaction during which an insoluble product forms when solutions are mixed.
Redox reaction	A chemical reaction during which electrons are transferred.
Reduction	A gain of electrons during a chemical reaction.
Solubility	The maximum amount of a substance (the solute) that may be dissolved in another (the solvent).
Solute	The dissolved substance in a solution. (usually the substance present in lesser amount)
Solution	A homogenous mixture of two or more substances.
Solvent	The substance in a solution in which the solute is dissolved. (usually the substance present in greater amount)

### **Daily task 20.1: Homework/Classwork**

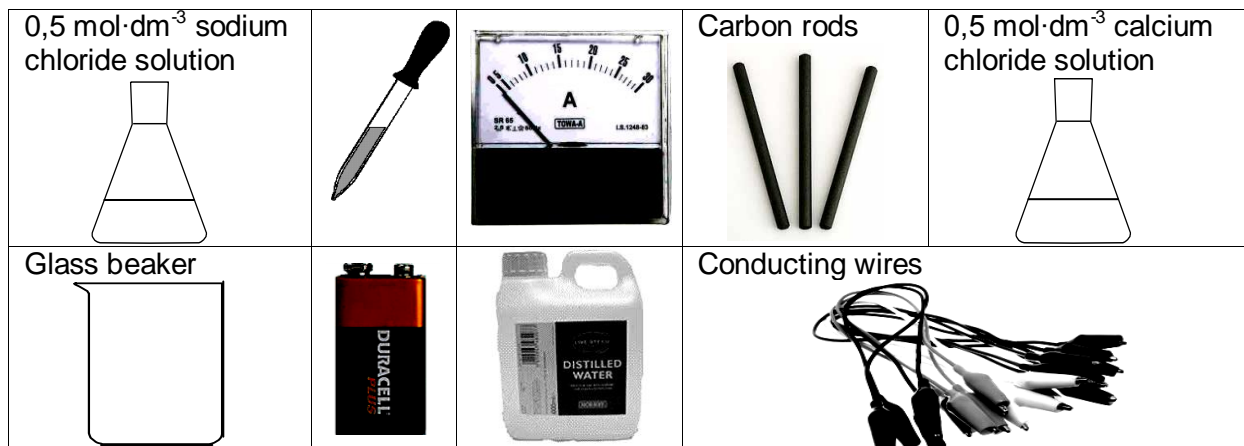
- Represent the dissolution of each of the following salts in water with a balanced equation. Indicate the phases of all compounds and ions.
 

1.1 $NaCl(s)$	1.2 $CuCl_2(s)$	1.3 $Mg(NO_3)_2(s)$
1.4 $K_2SO_4(s)$	1.5 $CaCl_2(s)$	1.6 $KNO_3(aq)$
1.7 $CuSO_4(s)$	1.8 $MgSO_4(s)$	1.9 $Na_2SO_4(s)$
1.10 $Pb(NO_3)_2$		
- Briefly describe the dissolution process of table salt in water.
- Define the following terms:
 

3.1 Electrolyte	3.2 Ionic compound
3.3 Conductivity	3.4 Dissociation
3.5 Ion	3.6 Hydration
3.7 Solution	3.8 Solvent
3.9 Solute	3.10 Strong electrolyte

### Daily task 20.2: Homework/Classwork

A learner wants to determine the relationship between conductivity and concentration of ions in an aqueous solution. The following chemicals and apparatus are supplied.



**NOTE:** The unit of electrical conductivity is not the ampere. However, in this experiment the ammeter reading is taken as a MEASURE of the relative conductivity of the two solutions.

- Identify the:
  - Dependent variable
  - Independent variable
  - Two controlled variables
- Write down an investigative question for this investigation.
- Write down a hypothesis for this investigation.
- Draw a labelled diagram to show how the learner can use some of the above apparatus and chemicals to conduct the investigation.
- The steps below describe the method that must be followed to conduct the investigation. The steps are not in the correct sequence. Arrange the steps in the correct sequence. Only write down the letters representing each step in the correct sequence in your practical book.
  - Add a second drop of the 0,5 mol·dm<sup>-3</sup> NaCl solution, swirl the beaker and again measure the ammeter reading.
  - Pour 50 cm<sup>3</sup> distilled water into a glass beaker.
  - Repeat the procedure until 10 drops of NaCl solution are added to the water.
  - Use connecting wires to connect the two carbon electrodes in series with a battery and an ammeter.
  - Use the medicine dropper and add one drop of the 0,5 mol·dm<sup>-3</sup> NaCl solution to the water in the beaker and stir the solution.
  - Repeat the above steps with the CaCl<sub>2</sub> solution and the 1 mol·dm<sup>-3</sup> NaCl solution.
  - Place the two carbon rods in the solution (without touching each other) and measure the ammeter reading.
- The results obtained are shown in the table below.

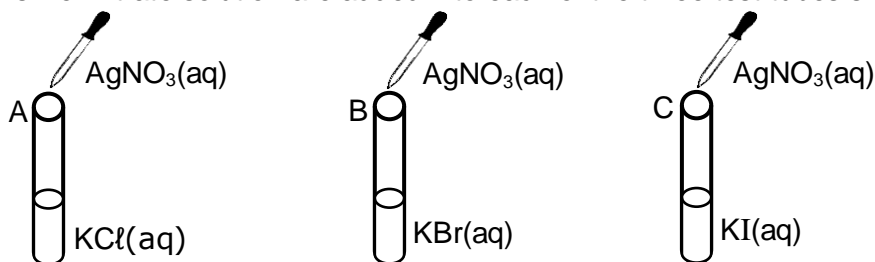
Number of drops	0	1	2	3	4	5	6	7	8	9	10
Conductivity of NaCl(aq) (mA)	0,18	0,34	0,55	0,74	0,92	1,10	1,29	1,47	1,47	1,65	1,84
Conductivity of CaCl <sub>2</sub> (aq) (mA)	0,18	0,55	0,91	1,29	1,47	1,84	2,21	2,21	2,39	2,39	2,57

- On the same set of axes, draw graphs of conductivity versus number of drops (i.e. concentration) for both solutions.
- Describe the change in conductivity as the concentration was increased by the addition of NaCl drops.
- Write down the mathematical relationship between conductivity and concentration.
- Write down equations to represent the dissociation of NaCl(s) and CaCl<sub>2</sub>(s) in water.
- What causes the difference in slope between the two graphs?
- Draw a conclusion from the results obtained.



### Daily task 20.3: Homework/Classwork

1. The three test tubes (**A**, **B** and **C**) contain solutions of potassium halides as shown. A few drops of silver nitrate solution are added into each of the three test tubes shown below.



After making observations, a few drops of nitric acid are added to each solution.

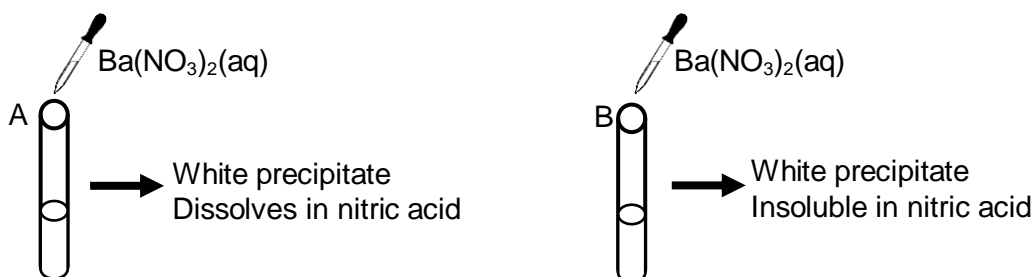
- 1.1 Write chemical equations to show how the following salts dissociate in water: (Include the phases of all compounds and ions.)
- 1.1.1 Potassium chloride                      1.1.2 Potassium bromide
- 1.1.3 Potassium iodide                      1.1.4 Silver nitrate
- 1.2 Complete the table below. Only write down the answer next to the question number.

Test tube	<b>A</b>	<b>B</b>	<b>C</b>
Colour of halide solution	1.2.1	1.2.2	1.2.3
Observation when $\text{AgNO}_3(\text{aq})$ is added	1.2.4	1.2.5	1.2.6
Observation when $\text{HNO}_3(\text{aq})$ is added	1.2.7	1.2.8	1.2.9

- 1.3 Write balanced chemical equations for the reaction of each of the following halide solutions with a silver nitrate solution. Include the phases of all reactants and products.
- 1.3.1 Potassium chloride                      1.3.2 Potassium bromide                      1.3.3 Potassium iodide
- 1.4 Classify the three reactions as REDOX, ACID-BASE, GAS FORMING or PRECIPITATION.
- 1.5 Formulate a test for each of the above three halides.

2. You are supplied with two unknown sodium salts. It is known that the one salt is a sulphate and the other one a carbonate.

In order to identify the two salts, a small amount of each salt is dissolved in distilled water in two test tubes marked **A** and **B**. A few drops of barium nitrate are added to each solution. A white precipitate forms in each test tube. After addition of nitric acid, the precipitate in test tube **A** dissolves to release a gas, whilst the precipitate in test tube **B** remains.



- 2.1 Write down the test for sulphates.
- 2.2 Write down the test for carbonates.
- 2.3 Identify the two sodium salts, **A** and **B**. Write down the name and formula of each sodium salt.
- 2.4 Write down balanced chemical equations for the two reactions that take place in test tube **A**. Indicate the phases of all reactants and products.
- 2.5 Write down the name of the precipitate that forms in test tube **A**.
- 2.6 Write down a balanced chemical equation for the reaction that explains the formation of the precipitate in test tube **B**. Indicate the phases of all reactants and products.
- 2.7 Write down the name of the precipitate that forms in test tube **B**.

### **Daily task 20.4: Homework/Classwork**

1. Define each of the following terms:

- |                        |                 |                    |
|------------------------|-----------------|--------------------|
| 1.1 Redox reaction     | 1.2 Oxidation   | 1.3 Reduction      |
| 1.4 Acid-base reaction | 1.5 Precipitate | 1.6 Neutralisation |

2. Complete and balance each of the following equations. Indicate the phases of all products. Then classify each reaction as a PRECIPITATION, GAS-FORMING, ACID-BASE or REDOX reaction.

- 1.1  $\text{Zn(s)} + \text{H}_2\text{SO}_4\text{(aq)} \rightarrow \text{_____} + \text{_____}$   
 1.2  $\text{Zn(s)} + \text{CuSO}_4\text{(aq)} \rightarrow \text{_____} + \text{_____}$   
 1.3  $\text{KBr(aq)} + \text{AgNO}_3\text{(aq)} \rightarrow \text{_____} + \text{_____}$   
 1.4  $\text{Na}_2\text{SO}_4\text{(aq)} + \text{BaCl}_2\text{(aq)} \rightarrow \text{_____} + \text{_____}$   
 1.5  $\text{CaCO}_3\text{(s)} + \text{HCl(aq)} \rightarrow \text{_____} + \text{_____} + \text{_____}$   
 1.6  $\text{H}_2\text{SO}_4\text{(aq)} + \text{NaOH(aq)} \rightarrow \text{_____} + \text{_____}$   
 2.7  $\text{CuO(s)} + \text{HCl(aq)} \rightarrow \text{_____} + \text{_____}$

2. Silver nitrate is added to the five solutions shown in the table below.

- 2.1 Predict whether a precipitate will form. Redraw the table in your work book. Make a tick (✓) in the open space below each solution to indicate the formation of a precipitate or a cross (✗) if no precipitate is formed. Also write down the formula of all precipitates that are formed.

	NaCl(aq)	NaBr(aq)	NaI(aq)	Na <sub>2</sub> SO <sub>4</sub> (aq)	Na <sub>2</sub> CO <sub>3</sub>
Add AgNO <sub>3</sub> (aq)					
Formula of precipitate					

- 3.2 Write down balanced equations in ionic form for all reactions that take place. Indicate the phases of all reactants and products.

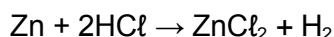
3. Barium nitrate is added to the five solutions shown in the table below.

- 3.1 Predict whether a precipitate will form. Redraw the table in your work book. Make a tick (✓) in the open space below each solution to indicate the formation of a precipitate or a cross (✗) if no precipitate is formed. Also write down the formula of all precipitates that are formed.

	NaCl(aq)	NaBr(aq)	NaI(aq)	Na <sub>2</sub> SO <sub>4</sub> (aq)	Na <sub>2</sub> CO <sub>3</sub>
Add BaCl <sub>2</sub> (aq)					
Formula of precipitate					

- 4.2 Write down balanced equations in ionic form for all reactions in which precipitates are formed. Indicate the phases of all reactants and products.

4. The reaction between an acid and a metal is an example of a gas-forming reaction as well as a redox reaction. An example of such a reaction is given below.



- 4.1 Rewrite the above equation in your work book and include the phases of all reactants and products.  
 4.2 Explain the difference between a gas-forming and a redox reaction.  
 4.3 Give a reason why the above reaction can be classified as a gas-forming reaction.  
 4.4 How does the charge on the zinc atom change during this reaction?  
 4.5 How does the charge on the hydrogen ion in HCl change during this reaction?  
 4.6 Use the answers to QUESTIONS 5.4 and 5.5 to explain why this reaction can also be classified as a redox reaction.

### **Experiment 17: Solubility tests**

**Aim:** To investigate the solubility of different salts.

#### **Apparatus & chemicals**

- 10 test tubes
- 2 test tube racks
- Distilled water
- Group 1: NaCl, NaBr, NaI, Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>
- Group 2: NaCl, NaNO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>CO<sub>3</sub>, MgSO<sub>4</sub>

#### **Method**

1. Pour 20 cm<sup>3</sup> distilled water to each of the ten test tubes.
2. Use a spatula and add a pinch of each of the salts listed above into separate test tubes to obtain ten solutions.
3. Add a few drops of silver nitrate to each of the solutions in Group 1. Record your observations in the table shown below.
4. Add a few drops of barium nitrate to each of the solutions in Group 2. Record your observations in the table shown below.
5. Add a few drops of dilute nitric acid to each precipitate. Record your observations in the table.
6. Identify the precipitate formed in each test tube.

#### **Results**

Redraw the following table in your practical book. In the open cells:

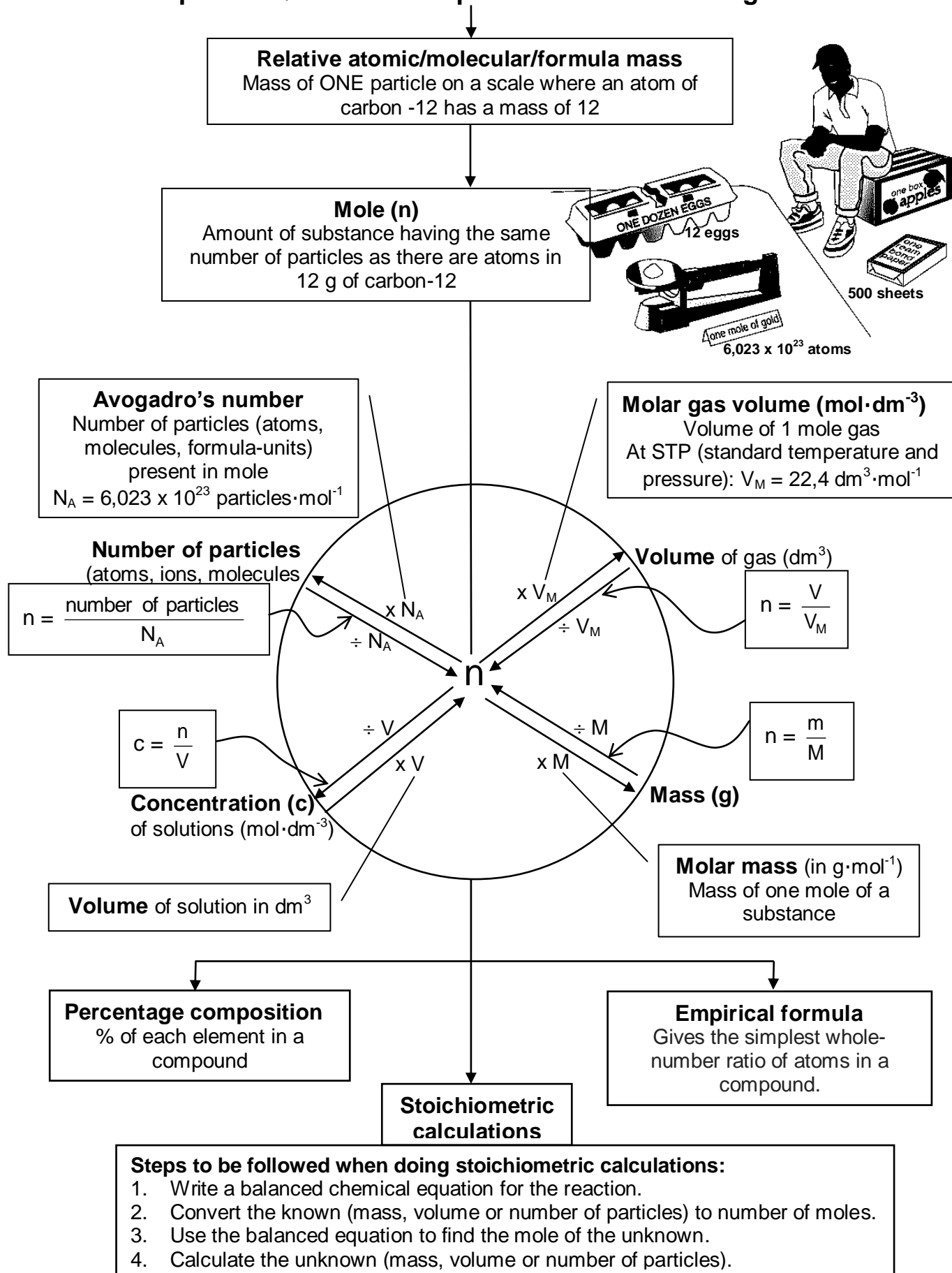
- Make a ✓ if a precipitate is formed or a ✗ if no precipitate is formed when AgNO<sub>3</sub>(aq) is added to solutions in group 1 and when Ba(NO<sub>3</sub>)<sub>2</sub>(aq) is added to solutions in group 2
- Use a ✓ to indicate if the precipitate is soluble in concentrated nitric acid or a ✗ if insoluble
- Write down the formula of each precipitate formed

<b>Group 1</b>					
	NaCl(aq)	NaBr(aq)	NaI(aq)	Na <sub>2</sub> CO <sub>3</sub> (aq)	Na <sub>2</sub> SO <sub>4</sub> (aq)
AgNO <sub>3</sub> (aq) added					
Colour of precipitate					
Conc. HNO <sub>3</sub> added					
Formula of precipitate					
<b>Group 2</b>					
	NaCl(aq)	NaNO <sub>3</sub> (aq)	Na <sub>2</sub> SO <sub>4</sub> (aq)	Na <sub>2</sub> CO <sub>3</sub> (aq)	MgSO <sub>4</sub> (aq)
Ba(NO <sub>3</sub> ) <sub>2</sub> (aq) added					
Colour of precipitate					
Conc. HNO <sub>3</sub> added					
Formula of precipitate					

#### **Conclusion and questions**

1. For group 1, write down balanced ionic equations to explain the formation of all precipitates when silver nitrate is added. Include phases of all reactants and products.
2. Write down the name of the precipitate in group 1 that is soluble in dilute nitric acid. Write down a balanced ionic equation to represents its formation. Include phases of all reactants and products.
3. Use the results obtained from salts in group 1 and formulate a tests for:
  - 3.1 Chlorides
  - 3.2 Bromides
  - 3.3 Iodides
4. For group 2, write down balanced ionic equations to explain the formation of all precipitates. Include phases of all reactants and products.
5. Write down the name of the precipitate in group 2 that is soluble in dilute nitric acid. Write down a balanced ionic equation to represents its formation. Include phases of all reactants and products.
6. Use the results obtained from salts in group 2 and formulate a test for:
  - 6.1 Sulphates
  - 6.2 Carbonates.

## Topic 21: Quantitative aspects of chemical change



Important terms/definitions	
Actual yield	The quantity physically obtained from a chemical reaction.
Anhydrous	Without water - A substance is anhydrous if it contains no water.
Avogadro's law	One mole of any gas occupies the same volume at the same temperature and pressure. At STP: $V_M = 22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Avogadro's number ( $N_A$ )	Number of particles (atoms, molecules or formula units) present in one mole of a substance. $(N_A) = 6,023 \times 10^{23} \text{ particles} \cdot \text{mol}^{-1}$
Empirical formula	A formula that gives the simplest whole-number ratio of atoms in a compound.
Hydrate	Solid ionic compounds in which water molecules are captured.
Limiting reactant	The reactant that is completely consumed in a chemical reaction.
Molar concentration	The number of moles of solute per liter of solution.
Molar mass (M)	The mass of one mole of a substance. Unit: $\text{g} \cdot \text{mol}^{-1}$
Molar volume ( $V_M$ )	The volume of one mole of a gas.
Mole (n)	The amount of substance with the same number of particles as there are atoms in 12 g carbon-12.
Molecular formula	A formula that indicates the ratio of atoms in a compound as well as the actual number of atoms of each element in the compound.
Percentage composition	The mass of each atom present in a compound expressed as a percentage of the total mass of the compound. (A pure sample of a given compound always has exactly the same composition.)
Relative atomic mass	The relative atomic mass of an element is the weighted average of the masses of its isotopes on a scale on which a carbon-12 atom has a mass of exactly 12 units. (A "weighted" average allows for the fact that there won't be equal amounts of the various isotopes of an element.)
Relative formula mass	The relative formula mass of a substance is the weighted average of the masses of the formula units (e.g. $\text{NaCl}$ ) on a scale on which a carbon-12 atom has a mass of exactly 12 units.
Relative molecular mass	The relative molecular mass of a substance (e.g. $\text{H}_2\text{O}$ ) is the weighted average of the masses of the molecules on a scale on which a carbon-12 atom has a mass of exactly 12 units.
Solute	The dissolved substance (usually the substance present in lesser amount)
Solution	A homogeneous mixture of two or more substances.
Solvent	The substance in which the solute is dissolved (usually the substance present in greater amount)
Stoichiometric calculations	Calculations involving the mole ratios of reactants and products in a chemical reaction. (Molar masses and mole ratios, together with other factors, are used to determine information about one reactant or product in a chemical reaction from known information about another.)
Stoichiometry	The branch of chemistry that deals with the relative quantities of reactants and products in chemical reactions.
STP	Standard Temperature and Pressure $T = 273 \text{ K}$ ( $0^\circ \text{C}$ ) and $p = 101,3 \text{ kPa}$
Theoretical yield	Calculated yield of a product in a chemical reaction.
Water of crystallisation	Water that is stoichiometrically bound into a crystal e.g. the $\text{H}_2\text{O}$ in $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .

### **Steps for determining percentage composition**

- Calculate the molar mass of the given compound.
- Determine the contribution (to the total molar mass of the compound) of each element present in the compound and express it as a percentage of the molar mass of the compound.

#### **EXAMPLE:**

Determine the percentage composition of methane (CH<sub>4</sub>).

#### **Step 1:**

$$M(\text{CH}_4) = 16 \text{ g} \cdot \text{mol}^{-1}$$

#### **Step 2:**

$$\%C = \frac{12}{16} \times 100 = 75\%$$

$$\%H = \frac{4}{16} \times 100 = 25\%$$

### **Steps for determining empirical formulae**

- Express percentages as masses.
- Convert the mass of each element to number of moles.
- Determine the ratio of the different elements in the compound by dividing the number of moles of each element by the smallest number of moles.
- Express these ratios as the smallest whole number. These values are the subscripts of atoms in the empirical formula.
- Determine the molar mass represented by the empirical formula. If they are the same, the empirical formula and the molecular formula is the same.
- IF NOT THE SAME, divide the molar of the compound by the empirical formula. This value indicates the amount of empirical formula units in the molecular formula.

#### **EXAMPLE:**

Octane contains 84,2% carbon and 15,8% hydrogen by mass. Its relative molecular mass is 114. Determine the molecular formula of octane.

#### **Step 1:**

84,2 g C & 15,8 g H

#### **Step 2:**

$$n(\text{C}) = \frac{m}{M} = \frac{84,2}{12} = 7,0167 \text{ mol}$$

$$n(\text{H}) = \frac{m}{M} = \frac{15,8}{1} = 15,8 \text{ mol}$$

#### **Step 3:**

$$n(\text{C}) \text{ is the smallest, thus: } n(\text{C}) : n(\text{H}) = \frac{7,0167}{7,0167} : \frac{15,8}{7,0167} = 1 : 2,25$$

#### **Step 4:**

$$1 : 2,25 = 4 : 9$$

Empirical formula is C<sub>4</sub>H<sub>9</sub>

#### **Step 5:**

$$M_r(\text{C}_4\text{H}_9) = 57 \text{ g} \cdot \text{mol}^{-1}$$

$$\frac{M(\text{octane})}{M(\text{C}_4\text{H}_9)} = \frac{114}{57} = 2$$

Molecular formula: C<sub>8</sub>H<sub>18</sub>

### **Steps for determining the formula of a hydrate**

- Calculate the number of moles of water.
- Calculate the number of moles of the anhydrous salt.
- Calculate the mole ratio - water : anhydrous salt
- Write down the formula for the hydrate.

#### **EXAMPLE:**

2,5 g hydrated copper(II) sulphate (CuSO<sub>4</sub>·xH<sub>2</sub>O) is heated. After heating the mass of white anhydrous copper(II) sulphate (CuSO<sub>4</sub>) is determined as 1,59 g. Determine the formula of the hydrate.

#### **Step 1:**

$$m(\text{H}_2\text{O}) = 2,5 - 1,59 = 0,91 \text{ g}$$

$$n(\text{H}_2\text{O}) = \frac{m}{M} = \frac{0,91}{18} = 0,05 \text{ mol}$$

#### **Step 2:**

$$n(\text{CuSO}_4) = \frac{m}{M} = \frac{1,59}{159,5} = 0,0097 \text{ mol}$$

#### **Step 3:**

$$n(\text{H}_2\text{O}) : n(\text{CuSO}_4) = \frac{0,05}{0,0097} = 5,15$$

#### **Step 4:**

x = 5, thus the formula is: CuSO<sub>4</sub>·5H<sub>2</sub>O

### **Daily task 21.1: Homework/Classwork**

1. Determine the relative atomic mass of:
 

1.1 silver	1.2 Cu	1.3 H	1.4 O
1.5 Fe	1.6 mercury	1.7 Cl	1.8 Br
2. Calculate the relative molecular mass of:
 

2.1 water	2.2 chlorine	2.3 H <sub>2</sub>	2.4 O <sub>2</sub>
2.5 NH <sub>3</sub>	2.6 SO <sub>2</sub>	2.7 NO <sub>2</sub>	2.8 bromine
3. Calculate the relative formula mass of:
 

3.1 iron(III) chloride	3.2 sodium chloride	3.3 KNO <sub>3</sub>	3.4 MgSO <sub>4</sub>
3.5 K <sub>2</sub> SO <sub>4</sub>	3.6 lead(II) nitrate	3.7 Na <sub>2</sub> CO <sub>3</sub>	3.8 CuSO <sub>4</sub> ·5H <sub>2</sub> O

### **Daily task 21.2: Homework/Classwork**

1. Define the following terms:
 

1.1 Mole	1.2 Molar mass
1.3 Relative formula mass	1.4 Avogadro's number
2. Calculate the molar mass of:
 

2.1 Water	2.2 Chlorine	2.3 HOCl
2.4 O <sub>2</sub>	2.5 NH <sub>4</sub> Cl	2.6 SO <sub>2</sub>
2.7 Nitrogen(II) oxide	2.8 Br <sub>2</sub>	2.9 FeCl <sub>2</sub>
2.10 Potassium chloride	2.11 Barium nitrate	2.12 Na <sub>2</sub> SO <sub>4</sub>
2.13 Silver sulphide	2.14 Pb(NO <sub>3</sub> ) <sub>2</sub>	2.15 CuSO <sub>4</sub> ·5H <sub>2</sub> O

### **Daily task 21.3: Homework/Classwork**

1. Calculate the number of moles in:
 

1.1 320 g of magnesium oxide	1.2 21,6 g of silver
1.3 6,4 g SO <sub>2</sub>	1.4 0,46 g sodium
1.5 10 g potassium sulphate	1.6 3 g iron sulphide
1.7 12 g sodium sulphite	1.8 5 g ammonia
2. Calculate the mass of:
 

2.1 2 moles of water	2.2 0,5 moles of iodine, I <sub>2</sub>
2.3 1,2 moles of sodium chloride	2.4 0,125 moles of oxygen, O <sub>2</sub>
2.5 10 moles of HCl	2.6 0,6 moles of sulphur dioxide
2.7 1 mole sodium hydroxide	2.8 0,25 moles of silver nitrate
3. Calculate the number of moles at STP in:
 

3.1 56 dm <sup>3</sup> xenon	3.2 10 dm <sup>3</sup> oxygen, O <sub>2</sub>
3.3 2,24 dm <sup>3</sup> of chlorine, Cl <sub>2</sub>	3.4 2,24 dm <sup>3</sup> sulphur dioxide
3.5 2,24 m <sup>3</sup> nitrogen	3.6 12 m <sup>3</sup> neon
4. Calculate the volume at STP occupied by:
 

4.1 5 moles of carbon dioxide	4.2 3 moles of ammonia
4.3 2 moles of oxygen, O <sub>2</sub>	4.4 64 moles of sulphur dioxide
4.5 2 moles of hydrogen, H <sub>2</sub>	4.6 0,01 moles of nitrogen, N <sub>2</sub>
5. Calculate the number of:
 

5.1 Molecules in 2 moles of carbon dioxide	5.2 Atoms in 4 moles of sodium
5.3 Molecules in 0,5 moles of water	5.4 Formula units in 10 moles of sodium chloride

### **Daily task 21.4: Homework/Classwork**

1. 1 mole of sodium carbonate ( $\text{Na}_2\text{CO}_3$ ) contains 2 moles of sodium atoms, 1 mole of carbon atoms and 3 moles of oxygen atoms. In the same way, write down the number of moles of each atom present in 1 mole of:
 

1.1 $\text{PbO}$	1.2 $\text{NH}_4\text{NO}_3$	1.3 $\text{Ca(OH)}_2$
1.4 $\text{CH}_3\text{COOH}$	1.5 $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$	1.6 $\text{Pb}_3\text{O}_4$
2. Calculate the:
 

2.1 Mass of $44,8 \text{ dm}^3$ carbon dioxide at STP	2.2 Mass of $3,0115 \times 10^{24}$ silver atoms
2.3 Volume of 20 g $\text{H}_2$ at STP	2.4 Number of formula-units in 2 g $\text{NaCl}$
2.5 Number of atoms in 12 g $\text{Mg}$	2.6 Volume of 32 g oxygen at STP
2.7 Number of $\text{Mg}$ atoms in 20 g $\text{MgSO}_4$	2.8 Number of $\text{K}$ atoms in 20 g $\text{K}_2\text{SO}_4$
2.9 Number of oxygen atoms in 10 g $\text{AgNO}_3$	2.10 Mass of $30 \text{ dm}^3$ ammonia at STP

### **Daily task 21.5: Homework/Classwork**

1. Calculate the volume of a:
  - 1.1  $0,4 \text{ mol} \cdot \text{dm}^{-3}$  salt solution that contains 0,1 mol of salt
  - 1.2  $0,4 \text{ mol} \cdot \text{dm}^{-3}$  solution of X that contains 2 moles of X
2. Calculate the number of moles of solute in:
  - 2.1  $500 \text{ cm}^3$  of a solution of concentration  $2 \text{ mol} \cdot \text{dm}^{-3}$
  - 2.2 2 liters of a solution of concentration  $0,5 \text{ mol} \cdot \text{dm}^{-3}$
3. Calculate the concentration of a solution containing:
  - 3.1 11,7 g of  $\text{NaCl}$  in  $500 \text{ cm}^3$  solution
  - 3.2 2,54 g of  $\text{I}_2$  in tetrachloromethane to give a  $100 \text{ cm}^3$  solution
  - 3.2 53 g sodium carbonate dissolved in 1 litre of water
  - 3.4 62,5 g  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$  dissolved in 1 litre of water
4. Calculate the mass of sodium hydroxide present in:
  - 4.1  $500 \text{ cm}^3$  of a  $1 \text{ mol} \cdot \text{dm}^{-3}$  solution
  - 4.2  $25 \text{ cm}^3$  of a  $0,5 \text{ mol} \cdot \text{dm}^{-3}$  solution

### **Daily task 21.6: Homework/Classwork**

1. Define the following terms:
  - 1.1 Percentage composition
  - 1.2 Empirical formula
2. Fertilisers contain nitrogen needed by plants to grow. Ammonium nitrate is used as fertiliser. It has the formula  $\text{NH}_4\text{NO}_3$ . Calculate the:
  - 2.1 Percentage of nitrogen in ammonium nitrate
  - 2.2 Mass of nitrogen in a 20 kg bag of fertiliser
3. Calculate the percentage of copper in each of the following copper compounds:  
 $\text{CuCl}_2$ ;  $\text{Cu(NO}_3)_2$ ;  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
4. Calculate the empirical formula of each of the compounds having the following percentage compositions:
  - 4.1 31,8% K; 29% Cl; 39,2% O
  - 4.2 30,5% N; 69,6% O
  - 4.3 53% Al; 47% O
  - 4.4 45,3% O; 43,4% Na; 11,3% C
  - 4.5 40% S; 60% O
5. 56 g of iron combine with 32 g of sulphur to form iron(II) sulphide. Find its empirical formula.



**Daily task 21.7: Homework/Classwork**

1. A compound contains 92,2% C and 7,7% H. The molar mass of the substance is  $104 \text{ g} \cdot \text{mol}^{-1}$ . Determine this compound's:
  - 1.1 Empirical formula
  - 1.2 Molecular formula
2. Vinegar is a dilute form of ethanoic acid with a molar mass of  $60 \text{ g} \cdot \text{mol}^{-1}$ . The percentage composition of ethanoic acid is as follows: 39,9% C; 6,7% H and 53,4% O  
For ethanoic acid, determine its:
  - 2.1 Empirical formula
  - 2.2 Molecular formula
3. 1,628 g of hydrated magnesium iodide is heated to remove the crystal water. Its mass is reduced to 1,072 g when all the crystal water is removed. Determine the formula of hydrated magnesium iodide.
4. Determine the formula of a hydrate that is 85,3% barium chloride and 14,7% water?
5. A 4,89 g sample of calcium sulfate was heated. After the water was driven off, 3,87 g of the anhydrous calcium sulfate remained. Determine the formula of this hydrate.

**Daily task 21.8: Homework/Classwork**

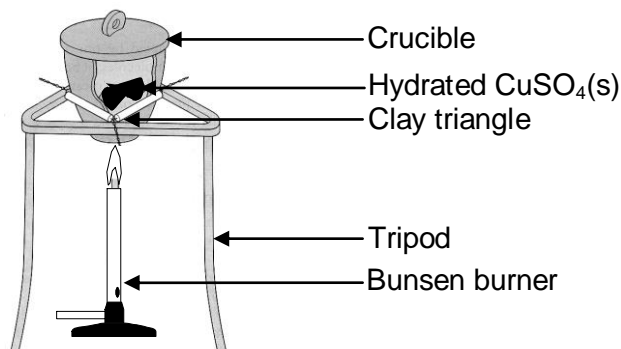
1. Consider the following balanced equation:  $\text{N}_2 + 3\text{H}_2 \rightarrow 2\text{NH}_3$   
How many moles of:
  - 1.1  $\text{N}_2$  will react with 3 moles of  $\text{H}_2$
  - 1.2  $\text{H}_2$  will react with 3 moles of  $\text{N}_2$
  - 1.3  $\text{NH}_3$  will be formed from 11 moles of  $\text{H}_2$
  - 1.4  $\text{NH}_3$  will be formed from 11 moles of  $\text{N}_2$
2. Consider the following balanced equation:  $3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2$   
How many moles of:
  - 3.1  $\text{Fe}_3\text{O}_4$  will be formed from 12 moles of Fe
  - 3.2 Fe are needed to produce 16 moles of  $\text{H}_2$
  - 3.3  $\text{H}_2$  will be formed if 40 moles of  $\text{Fe}_3\text{O}_4$  are formed
  - 3.4  $\text{H}_2\text{O}$  are needed to react with 14,5 moles of Fe
3. Calculate the mass of carbon that reacts with 7,95 g of copper(II) oxide. The balanced equation for the reaction is:  $2\text{CuO} + \text{C} \rightarrow 2\text{Cu} + \text{CO}_2$
4. Calcium metal reacts with water to form an insoluble suspension of calcium hydroxide and hydrogen gas. Calculate the mass of hydrogen produced from 10 g of calcium.
5. Calculate the volume of hydrogen produced at STP from  $1 \text{ dm}^3$  of ammonia in the following reaction:  $2\text{NH}_3 \rightarrow \text{N}_2 + 3\text{H}_2$
6. Calculate the mass of sodium that will react with 230 g of oxygen to form sodium oxide.
7. Hydrogen burns in oxygen to form water. Calculate the mass of:
  - 7.1 Oxygen needed to burn 1 g of hydrogen
  - 7.2 Mass of water produced from 1 g of hydrogen
8. Calcium carbonate reacts completely with  $30 \text{ cm}^3$  hydrochloric acid of concentration  $0,5 \text{ mol} \cdot \text{dm}^{-3}$ .
  - 8.1 Write down a balanced equation for this reaction.
  - 8.2 Calculate the number of moles of acid that has reacted.
  - 8.3 Calculate the mass of calcium carbonate that has reacted.
  - 8.4 Calculate the volume of gas that will be formed at STP.
  - 8.5 Calculate the number of calcium carbonate formula units that have reacted.

### **Experiment 18: Water of crystallisation**

**Aim:** To determine the formula of hydrated copper(II) sulphate i.e. solve for x in the formula  $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ .

#### **Apparatus & chemicals**

- Tripod
- Clay triangle
- Crucible
- Spatula
- Hydrated copper(II) sulphate
- Bunsen burner
- Chemical balance



#### **Method**

1. Determine the mass of crucible and record it in the table.
2. Half fill the crucible with hydrated copper(II) sulphate.
3. Determine the mass of the crucible and its contents and record the mass in the table.
4. Place the crucible on the clay triangle and heat using a clean blue flame.
5. Heat strongly for about five minutes until no further change is observed.
6. Remove the crucible from the flame and allow it to cool down.
7. Determine the mass of the crucible and its contents again.
8. Repeat the heating until the mass of the crucible and its contents remain constant. Record this constant mass in the table.

#### **Results**

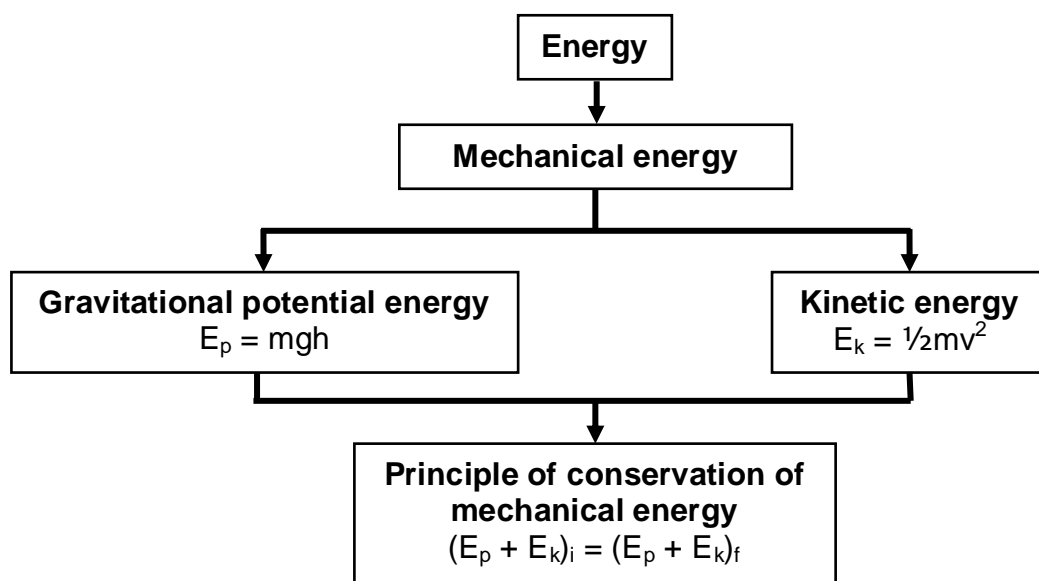
Redraw the following table in your practical book. Record all the masses in the table and calculate the mass of water of crystallisation.

1	Mass of crucible (g)	
2	Mass of crucible and hydrated $\text{CuSO}_4$ (g)	
3	Mass of hydrated $\text{CuSO}_4$ (g) [2 – 1]	
4	Mass of crucible and anhydrous $\text{CuSO}_4$ (g)	
5	Mass of anhydrous $\text{CuSO}_4$ (g) [4 – 1]	
6	Mass of crystal water [3 – 5]	

#### **Conclusion and questions**

1. Define the following terms:
  - 1.1 Water of crystallisation
  - 1.2 Hydrated salt
  - 1.3 Anhydrous salt
2. What do you initially see happening when the crystals are heated?
3. How do you know when all the water of crystallisation has been lost?
4. What is the colour of:
  - 4.1 Hydrated copper(II) sulphate
  - 4.2 Dehydrated copper(II) sulphate
5. What is the formula of a water molecule? Calculate the molar mass of water.
6. Use the results obtained to calculate the number of moles of water of crystallisation in hydrated copper(II) sulphate.
7. Write down the formula of anhydrous copper(II) sulphate. Calculate its molar mass.
8. Use the results obtained to calculate the number of moles of anhydrous copper(II) sulphate.
9. Calculate the ratio of the number of moles of water of crystallisation to the number of moles of anhydrous copper(II) sulphate.
10. Express your answer to Question 9 as a whole number and write down the formula of hydrated copper(II) sulphate.

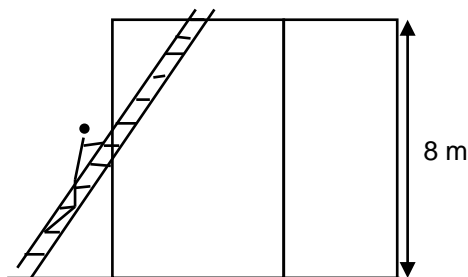
## Topic 22: Energy



Important terms/definitions	
Gravitational potential energy ( $E_p$ )	The energy that an object has due to its position in the earth's gravitational field relative to a reference point.
Isolated system (Closed system)	A system on which no external forces (e.g. friction) acts.
Kinetic energy ( $E_k$ )	The energy of an object due to of its motion.
Law of conservation of energy	Energy cannot be created or destroyed – it can only be transferred from one form to another.
Mechanical energy ( $E_m$ )	The sum of the gravitational potential energy and the kinetic energy of an object.
Principle of conservation of mechanical energy	The total mechanical energy in an isolated system remains constant.

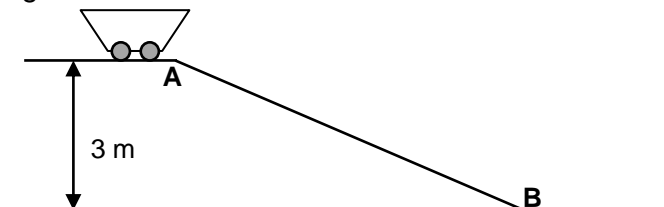
**Daily Task 22.1: Homework/Classwork**

1. Define the following terms:
  - 1.1 Gravitational potential energy
  - 1.2 Kinetic energy
  - 1.3 Mechanical energy
2. A car of mass 1 000 kg and a truck of mass 40 000 kg are travelling side by side along a straight road at  $30 \text{ m} \cdot \text{s}^{-1}$ . Calculate the kinetic energy of the:
  - 2.1 Car
  - 2.2 Truck
4. State, in words, the:
  - 3.1 Law of conservation of energy
  - 3.2 Principle of conservation of mechanical energy
5. A 70 kg man climbs up a ladder to the top of a building which is 8 m high.



Calculate the potential energy of the man at the top of the building.

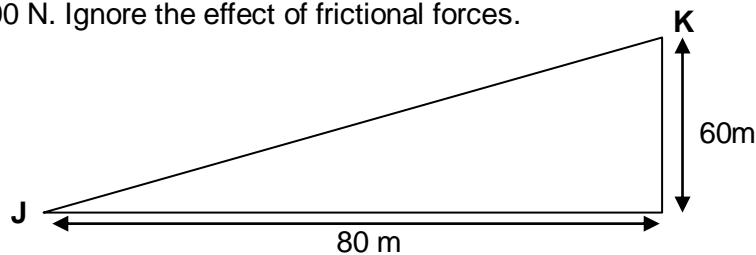
6. A cart of mass 20 kg is hoisted 3 m to the top of a ramp. It is then allowed to run freely from rest down the slope. Ignore the effects of friction.



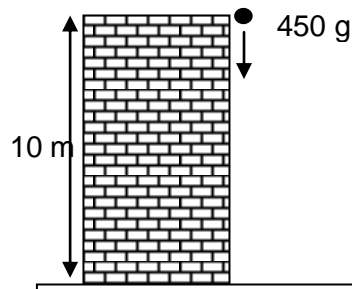
- 6.1 Calculate the total mechanical energy of the cart at position **A**.
- 6.2 Write down the magnitude of its mechanical energy at position **B**.
- 6.2 Calculate the magnitude of its kinetic energy at position **B**.
- 6.3 Calculate its speed at position **B**.

### Daily Task 22.2: Homework/Classwork

1. A car moves up a hill of height 60 m. The force exerted to push the car along the slope from J to K is 6000 N. Ignore the effect of frictional forces.



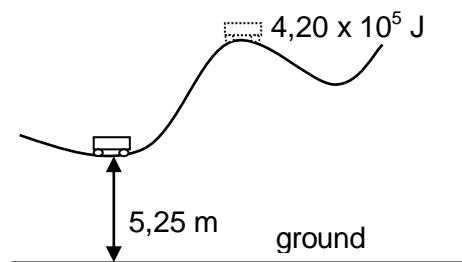
- 1.1 Calculate the:
- 1.1.1 Distance that the car moves uphill along slope JK
  - 1.1.2 Work done by the car's engine to drive the car from J to K
  - 1.1.3 Potential energy gained by the car at the top of the slope
  - 1.1.4 Car's weight
  - 1.1.5 Car's mass
- 1.2 If the car freewheels from the top of the hill to the bottom, calculate its maximum kinetic energy at the bottom.
- 1.3 Calculate the speed of the car at the bottom of the hill.
2. A ball of mass 450 g is dropped from a height of 10 m above the ground.



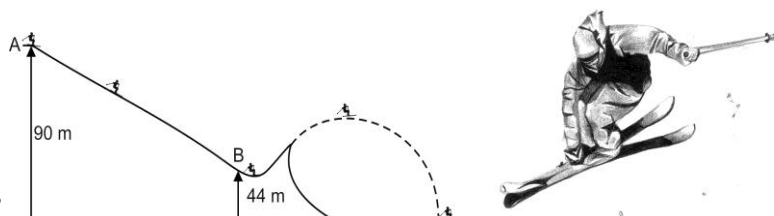
Calculate the:

- 2.1 Kinetic energy of the ball after it has fallen 5 m from the top of the building
  - 2.2 Speed of the ball after falling 5 m from the top of the building.
  - 2.3 Speed at which the ball strikes the ground
  - 2.4 Total mechanical energy the moment when the ball strikes the ground
3. A roller coaster car begins its journey 5,25 m above the ground. As the motor tows it to the top of the first hill, it gains  $4,20 \times 10^5$  J of gravitational potential energy.

If the mass of the car and its passengers is 875 kg, calculate the height of the hill above the ground.

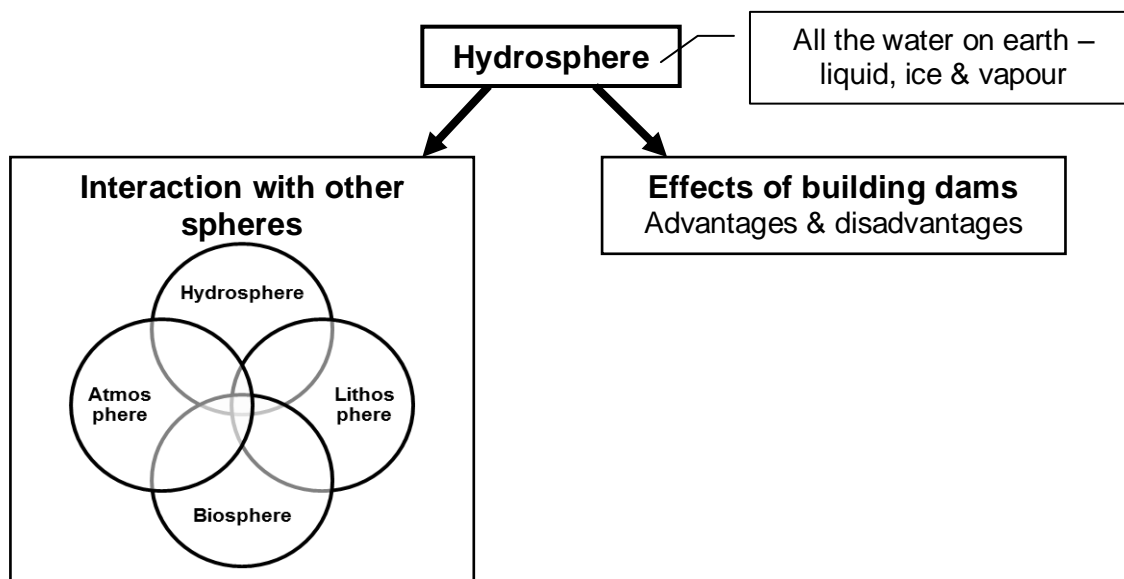


4. A ski jumper, with a mass of 70 kg, starts from rest at the top of a ski jump (A). On reaching the take-off point (B), his kinetic energy is 31,556 kJ. Ignore the effects of friction and air resistance.



- 4.1 Calculate the gravitational potential energy of the ski jumper at the top of the ski jump.
- 4.2 How much work was done by the ski jumper to reach the top of the ski jump?
- 4.3 How much kinetic energy does the ski jumper have at the top of the ski jump?
- 4.4 Calculate his gravitational potential energy at the take-off point.
- 4.5 Calculate his speed at the take-off point.
- 4.6 Determine the sum of  $E_p$  and  $E_k$  at position A as well as position B. What relationship is there between the sum of these two energies at positions A and B?

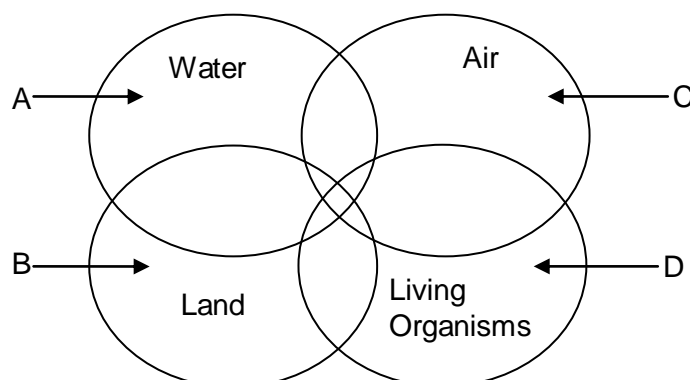
## Topic 23: The hydrosphere



Important terms/definitions	
Anions	Atoms with a net negative charge (negative ions).
Atmosphere	The gaseous layer that surrounds Earth.
Biosphere	The plant and animal life on Earth.
Ecology	The study of the relations of organisms to one another and to their physical surroundings and the interaction of humans with the environment.
Hydrosphere	All the water on Earth
Lithosphere	Earth's crust and the upper rigid layer of the mantle
pH	Measure of the concentration of hydrogen ions in solution./Measure of the acidity of a solution.
Precipitate	The insoluble product formed when certain ions in solution combine.

### Daily task 23.1: Homework/Classwork


- Identify the different systems (A to D) on earth in the following diagram:



- What is meant by *hydrosphere*?
- Tabulate advantages and disadvantages that the building of dams has for humans and the environment.

## EXAMPLE QUESTION PAPERS AND MARKING GUIDELINES

### QUESTION PAPER: JUNE 2018

 <p><b>education</b> Department of Education FREE STATE PROVINCE</p>
<p><b>EXAMINATION</b></p>
<p><b>GRADE 10</b></p>
<p><b>PHYSICAL SCIENCES</b></p>
<p><b>JUNE 2018</b></p>
<p><b>MARKS: 150</b></p>
<p><b>TIME: 3 HOURS</b></p>
<p>This paper consists of 13 pages and two data sheets.</p>
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Grade 10

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#### INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 10 questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

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**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1–1.10) in your ANSWER BOOK.

1.1 Which one of the following is an example of a metal?

- A Sodium
- B Oxygen
- C Carbon
- D Neon (2)

1.2 Consider the atom represented by  $^{222}_{86}\text{Rn}$ . There are ... electrons, ... protons and ... neutrons in this atom.

- A 222 ; 86 ; 86
- B 136 ; 136 ; 222
- C 86 ; 86 ; 222
- D 86 ; 86 ; 136 (2)

1.3 Which one of the following electronic configurations give a stable ion with a charge of 2+?

- A  $1s^2 2s^2 2p^6 3s^1$
- B  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2$
- C  $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$
- D  $1s^2 2s^2 2p^6 3s^2 3p^4$  (2)

1.4 The number of outer electrons in a magnesium atom is exactly the same as those in a/an ...

- A neon atom.
- B argon atom.
- C sodium atom.
- D calcium atom. (2)

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1.5 Which one of the following elements DOES NOT occur in nature in its elemental form?

- A Zinc
- B Silver
- C Sodium
- D Copper (2)

1.6 What is the correct chemical name of  $\text{CuCl}_2$ ?

- A Copper chloride
- B Copper(I) chloride
- C Copper(II) chloride
- D Copper(III) chloride (2)

1.7 Waves in which the particles of the medium vibrate PERPENDICULAR to the direction in which the waves move are known as ... waves.

- A longitudinal
- B transverse
- C horizontal
- D vertical (2)

1.8 If a note that is played on a piano has the same PITCH as one played on a guitar, the two notes have the same ...

- A quality.
- B amplitude.
- C loudness.
- D frequency. (2)

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- 1.9 Which one of the following shows the different types of electromagnetic radiation in order of INCREASING frequency?
- A Infrared rays; visible light; ultraviolet rays; X-rays
  - B Infrared rays; X-rays; visible light; ultraviolet rays
  - C X-rays; ultraviolet rays; infrared rays; visible light
  - D X-rays; ultraviolet rays; visible light; infrared rays (2)
- 1.10 Materials that are strongly attracted by magnets and which are easily magnetised are called ...
- A magnetic storms.
  - B magnetospheres.
  - C ferromagnetic.
  - D magnets. (2)
- [20]

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## QUESTION 2

It is sometimes necessary to separate mixtures into their components. Four separation methods are summarised in the table below.

<b>Method A</b>	Filtering of a muddy-water mixture.
<b>Method B</b>	Distillation of a water-ethanol mixture to remove the water. Ethanol boils at 78°C and water boils at 100°C at sea level. (Distillation is the process by which a liquid is heated to produce a vapour which is then condensed.)
<b>Method C</b>	Separation of salt and iron filings by using a magnet.
<b>Method D</b>	Separation of a water-sunflower oil mixture by using a separating funnel. The sunflower oil is LESS dense than water.

- 2.1 Classify each of the following mixtures as HETEROGENEOUS or HOMOGENEOUS:
- 2.1.1 Muddy-water (1)
  - 2.1.2 Ethanol and water (1)
  - 2.1.3 Water and sunflower oil (1)
- 2.2 Consider method B.
- 2.2.1 Which phase change take place when water boils? (2)
  - 2.2.2 Which one of water or ethanol has the weaker forces of attraction between their molecules? Give a reason for your answer. (2)
- 2.3 Consider method C. Which property of the components in this mixture make the separation method possible? (2)
- 2.4 Consider method D.
- 2.4.1 Which liquid forms the top layer in the water-sunflower oil mixture? Give a reason for your answer. (2)
  - 2.4.2 Which one of 250 ml water or 250 ml sunflower oil has the greater mass? Explain your answer by referring to density. (4)
- [15]

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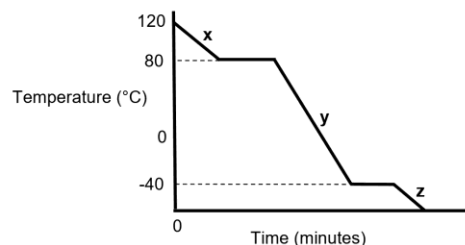
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### QUESTION 3

- 3.1 Define the term *sublimation*. (2)
- 3.2 When you take a block of butter out of the fridge, it is hard. However, after 15 minutes at room temperature it is soft enough to spread. Use the kinetic molecular theory to explain this observation. (2)
- 3.3 The diagram below, not drawn to scale, shows the physical changes of a substance at atmospheric pressure.



- 3.3.1 Is this diagram a COOLING or a HEATING curve? Explain your answer. (2)
- 3.3.2 Write down the BOILING point, FREEZING point and MELTING point (IN THIS ORDER) for the substance. (6)
- 3.4 In what PHASE is the substance:
- 3.4.1 at 85°C; (2)
- 3.4.2 at room temperature (25°C); (2)
- 3.4.3 during the period represented by **z**; and (1)
- 3.4.4 during the period represented by **y**? (1)
- 3.5 What happens to the temperature of the substance during a PHASE CHANGE? Write down only INCREASES, DECREASES or REMAINS THE SAME and GIVE A REASON for your answer. (3)

[21]

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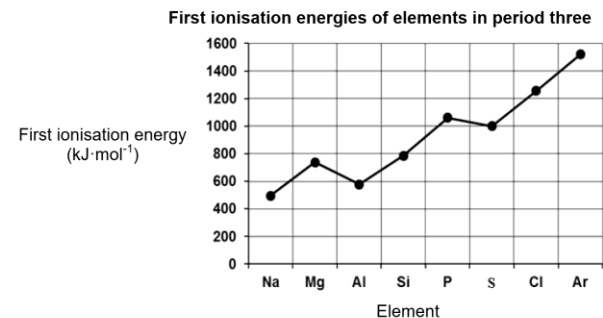
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### QUESTION 4

The graph below shows the first ionisation energies of elements in period three on the periodic table.



- 4.1 Define the term *element*. (2)
- 4.2 Use the list of elements on the graph and write down the following:
- 4.2.1 A noble gas (1)
- 4.2.2 A metalloid (1)
- 4.2.3 A halogen (1)
- 4.2.4 The electron configuration in sp-notation for aluminium (3)
- 4.2.5 The NAME of the group in which magnesium is found. (1)
- 4.3 Define the term *first ionisation energy*. (3)
- 4.4 Describe the general trend in the ionisation energies from sodium to argon as shown in the above-mentioned graph. (2)
- 4.5 Determine the first ionisation energy of sulphur from the graph. (1)
- 4.6 Write down the NAME of the element in period three with a first ionisation energy of 1 576 kJ·mol<sup>-1</sup>. (1)
- 4.7 When a sodium atom loses an electron, a sodium ion is formed.
- 4.7.1 How many valence electrons does this ION have? (1)
- 4.7.2 Which ORBITAL in the sodium atom loses the electron? (1)

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### QUESTION 5

Many elements occur in nature as *isotopes*. For example, hydrogen occurs as  ${}^1_1\text{H}$ ,  ${}^2_1\text{H}$  and  ${}^3_1\text{H}$ .

- 5.1 Define the term *isotope*. (2)
- 5.2 Write down TWO similarities in atomic structure of these three hydrogen atoms. (2)
- 5.3 Write down TWO differences in atomic structure of these three hydrogen atoms. (2)
- 5.4 How do the chemical properties of these three hydrogen atoms compare? Give a reason for your answer. (2)
- 5.5 The element silicon is found in nature in the form of three isotopes, with the percentages in which they occur, indicated below.

${}^{28}\text{Si}$	${}^{29}\text{Si}$	${}^{30}\text{Si}$
92,23%	4,67%	3,10%

- 5.5.1 Define the term *atomic number*. (2)
- 5.5.2 Which one of these isotopes is the heaviest? Give a reason for your answer. (2)
- 5.5.3 Calculate the relative atomic mass of silicon. (5)

[17]

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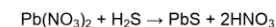
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Grade 10

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### QUESTION 6

- 6.1 Butane gas ( $\text{C}_4\text{H}_{10}$ ) is used as fuel in cigarette lighters. When butane is ignited, it reacts with the OXYGEN GAS in the atmosphere to form CARBON DIOXIDE and WATER.
  - 6.1.1 Butane has a covalent molecular structure. Which other substance(s) mentioned above is/are also classified as covalent molecular structures? (1)
  - 6.1.2 Draw a Lewis diagram of a water molecule. (2)
  - 6.1.3 Write down a balanced chemical equation for the above-mentioned reaction. (4)
- 6.2 Consider the following balanced equation of a chemical reaction:



- 6.2.1 Calculate the total relative atomic mass of the reactants. (2)
- 6.2.2 Calculate the total relative atomic mass of the products. (2)
- 6.2.3 Which law is demonstrated by your calculations in questions 6.2.1 and 6.2.2? (1)

[12]

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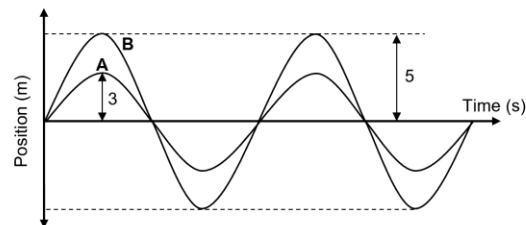
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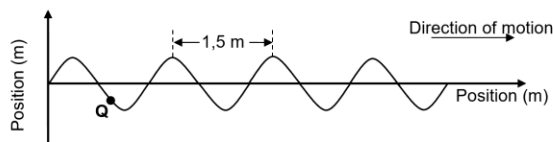
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### QUESTION 7

- 7.1 The diagram below shows two waves, **A** and **B**, of the same wavelength but different amplitudes, crossing each other.



- 7.1.1 Define the term *amplitude*. (2)
- 7.1.2 Draw the shape of the **RESULTING** wave of **A** and **B**. Show the resulting amplitude on your diagram. (2)
- 7.1.3 Which wave property or principle is illustrated by your diagram in question 7.1.2? (2)
- 7.2 In the sketch below, not drawn to scale, **Q** represents an object on the surface of the water in a dam. A person standing on a bridge observes that object **Q** is moving up and down and reaches the highest point every 5 s.



- 7.2.1 Define the term *wavelength*. (2)
- 7.2.2 In which direction is object **Q** moving? (1)
- 7.2.3 Calculate the frequency of the wave. (3)
- 7.2.4 Calculate the speed of the wave. (3)
- [15]**

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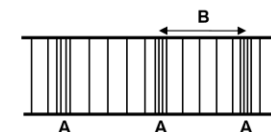
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### QUESTION 8

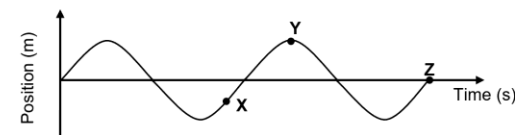
Diagram 1 represents a sound wave that is produced by a musical instrument.

DIAGRAM 1



- 8.1 What is represented by the sections marked with:
- 8.1.1 **A** (1)
- 8.1.2 **B** (1)
- 8.2 The position-time graph in DIAGRAM 2 represents the same sound wave produced by the musical instrument.

DIAGRAM 2



- 8.2.1 Which ONE of points **X**, **Y** or **Z** in DIAGRAM 2 corresponds to the section labelled **A** in DIAGRAM 1? (2)
- 8.2.2 The same note is now played on the instrument, but much **LOUDER** than before. How will this change affect the graph in DIAGRAM 2? Refer to an aspect that remains the same and an aspect that will be different. (2)
- 8.3 A sound wave travels from Peter toward a mountain cliff which is 250 m high and 225 m away from him. After a while, he hears the echo. Calculate how long it takes for Peter to hear the echo if the speed of sound in air is  $340 \text{ m.s}^{-1}$ . (4)
- [10]**

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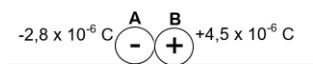
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### QUESTION 9

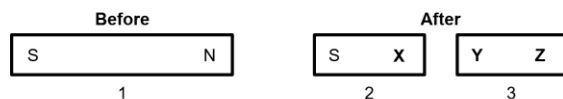
Two small, identical metal spheres, **A** and **B**, on an insulated surface, carry charges of  $-2,8 \times 10^{-6} \text{ C}$  and  $+4,5 \times 10^{-6} \text{ C}$  respectively. The spheres are brought into contact with each other and is then released.



- 9.1 It is observed that the spheres move apart when they are released. Explain this observation. (4)
- 9.2 Calculate the new charge on sphere **A** after they have moved apart (assume that no charge was lost). (3)
- 9.3 Calculate the number of electrons transferred from one sphere to the other during contact. (3)
- [10]**

### QUESTION 10

Sello was carrying a bar magnet, like the one shown below (before), when it accidentally fell and broke into two equal pieces (after). When he tried to bring the two pieces together, they REPELLED each other.



- 10.1 Define the term *magnetic field*. (2)
- 10.2 Identify the poles labelled **X** and **Y** and explain your choice for the pole at **X**. (4)
- 10.3 Draw the magnetic field pattern for the magnet BEFORE it fell. (3)
- 10.4 Draw the magnetic field pattern BETWEEN the two smaller magnets (between **X** and **Y**). (3)

**[12]**  
**GRAND TOTAL: 150**

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### DATA FOR PHYSICAL SCIENCES GRADE 10 GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 10

**TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIIESE KONSTANTES**

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Speed of light in a vacuum Spoed van lig in 'n vakuum	c	$3,0 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Planck's constant Planck se konstante	h	$6,63 \times 10^{-34} \text{ J} \cdot \text{s}$
Charge on electron Lading op elektron	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass Elektronmassa	$m_e$	$9,11 \times 10^{-31} \text{ kg}$

**TABLE 2: FORMULAE / TABEL 2: FORMULES**


### WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG

$v = \lambda f$	$E = hf = h \frac{c}{\lambda}$
$Speed = \frac{distance}{time}$	$T = \frac{1}{f}$ OR/OF $f = \frac{1}{T}$
$Speed = \frac{afstand}{tyd}$	

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## QUESTION PAPER: JUNE 2019



**education**  
Department of  
Education  
FREE STATE PROVINCE

**EXAMINATION**

**GRADE 10**

**PHYSICAL SCIENCES**

**JUNE 2019**

**MARKS: 150**

**TIME: 3 HOURS**

This paper consists of 15 pages and two information sheets.

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Grade 10

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FS/June 2019

### INSTRUCTIONS AND INFORMATION

1. Write your name and other information in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of NINE questions. Answer ALL questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave one line between two sub-questions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable pocket calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places where applicable.
11. Give brief motivations, discussions, et cetera where required.
12. Write neatly and legibly.

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Grade 10

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**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write down only the letter A, B, C or D next to the question number (1.1-1.10) in your ANSWER BOOK.

- 1.1 Which one of the following is NOT a property of metals?
- A Brittle
  - B Malleable
  - C Shiny
  - D Generally denser than ice. (2)
- 1.2 What do we call the movement of atoms or molecules from an area of higher concentration to an area of lower concentration?
- A Brownian motion
  - B Sublimation
  - C Diffusion
  - D Dilution (2)
- 1.3 Which one of the following scientists was responsible for the discovery of the neutron?
- A Thompson
  - B Bohr
  - C Dalton
  - D Chadwick (2)
- 1.4 Which one of the following is true for elements in GROUP TWO on the periodic table?
- A The chemical reactivity increase from top to bottom.
  - B The chemical reactivity increase from bottom to top.
  - C Number of energy levels stays the same down the group.
  - D Number of energy levels increase from bottom to top. (2)

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- 1.5 In which one of the following substances do we find COVALENT BONDS between the particles?
- A Helium
  - B Aluminium
  - C Chlorine
  - D Table salt (2)
- 1.6 What are the elements in GROUP TWO called?
- A Noble gases
  - B Halogens
  - C Earth-alkaline metals
  - D Alkali metals (2)
- 1.7 The electron distribution in the LEWIS STRUCTURE of sulphur is the same as that of ...
- A chlorine.
  - B oxygen.
  - C aluminium.
  - D germanium. (2)
- 1.8 Which one of the following is an example of a longitudinal wave?
- A A Mexican wave
  - B A note played on a violin.
  - C Waves on water
  - D Light waves (2)

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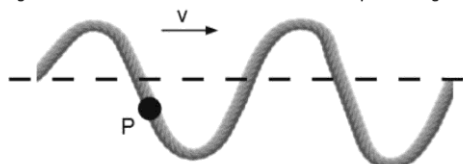
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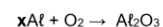
1.9 The diagram below shows a transverse wave in a rope moving to the RIGHT.



In which direction does point **P** move at the instant shown above?

- A Left
  - B Right
  - C Up (to the top of the page)
  - D Down (to the bottom of the page)
- (2)

1.10 What value must **x** have to balance the following chemical equation?



- A 1
  - B 2
  - C 3
  - D 4
- (2)  
[20]

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## QUESTION 2

The table below shows the phases and solubility of some substances in water at room temperature, which is about 22°C.

Substance	General name	Phase at room temperature	Soluble in water?
Si	Silicon	Solid	No
H <sub>2</sub> O	Water	Liquid	Yes
Al	Aluminium	Solid	No
Ne	Neon	Gas	No
NaCl	Table salt	Solid	Yes

- 2.1 Define the following:
    - 2.1.1 An element (2)
    - 2.1.2 A homogeneous mixture (2)
  - 2.2 Which of these substances will form a homogeneous mixture when they are mixed? (2)
  - 2.3 Explain why all the substances in the table are pure substances. (2)
  - 2.4 Write down the chemical name for the compound NaCl. (1)
  - 2.5 Write down the name or formula of the following from the table:
    - 2.5.1 A metalloid (2)
    - 2.5.2 Any substance that can conduct electricity. (2)
    - 2.5.3 The substance in which the greatest distances between its particles occur at room temperature. (2)
    - 2.5.4 A substance that has a melting point below room temperature and a boiling point above room temperature. (2)
- [17]

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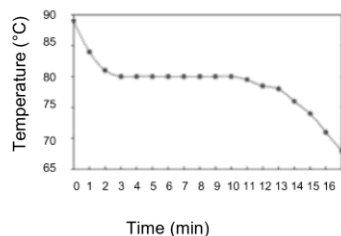
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### QUESTION 3

A graph of the change in temperature versus the change in time for naphthalene is shown below. The boiling point of naphthalene is 218°C.



- 3.1 Define *freezing point*. (2)
- 3.2 Determine the freezing point of naphthalene from the graph if naphthalene is a solid at 75°C. (2)
- 3.3 How did you determine your answer to question 3.2? (2)
- 3.4 In what phase is naphthalene during the last three minutes of the experiment? (2)
- [8]**

### QUESTION 4

- 4.1 Use the attached periodic table to answer the following questions. Write down only the SYMBOLS to answer the questions.
- 4.1.1 A non-metal in group 1 (1)
- 4.1.2 The element with the smallest atomic radius (1)
- 4.1.3 An inert gas in the third period (1)
- 4.1.4 A gas with six valence electrons (1)
- 4.1.5 A halogen in period two (1)
- 4.1.6 The element that has same number of electrons as a chlorine ion ( $\text{Cl}^-$ ) (1)

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- 4.2 Refer to SODIUM (Na) in the periodic table to answer the following questions:

- 4.2.1 Write down the atomic number of sodium. (1)
- 4.2.2 Calculate the number of neutrons in one sodium atom. (2)
- 4.2.3 Use the sp-notation to write down the electron configuration of one sodium atom. (2)
- 4.2.4 Which one of sodium or lithium has the largest atomic radius? Refer to energy levels to explain your answer. (2)
- 4.2.5 Define the term *isotope*. (2)
- 4.2.6 Sodium occurs naturally as sodium-22 and sodium-23. Use the  ${}^A_Z\text{X}$  notation to represent these two isotopes of sodium. (3)

- 4.3 Calculate the relative atomic mass of silver if it is known that  ${}^{107}_{47}\text{Ag}$  has a 51,8% occurrence in nature and  ${}^{109}_{47}\text{Ag}$  has a 48,2% occurrence. (4)
- [22]**

### QUESTION 5

- 5.1 The first ionisation energy of phosphorus is equal to 1 012 kJ·mol<sup>-1</sup>.
- 5.1.1 Define the term *ionization energy*. (2)
- 5.1.2 Do you expect the first ionisation energy of NITROGEN to be LESS THAN, the SAME AS or GREATER THAN 1 012 kJ·mol<sup>-1</sup>? (2)
- 5.1.3 Draw the Aufbau diagram for phosphorus. (3)
- 5.2 Give the chemical name for:
- 5.2.1  $\text{NH}_4\text{OH}$  (2)
- 5.2.2  $\text{Al}_2\text{O}_3$  (2)
- 5.3 Write down the formula of the CATION in calcium nitrate. (2)
- 5.4 Give the chemical formula for:
- 5.4.1 Calcium nitrate (2)
- 5.4.2 Nitrogen gas (2)

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- 5.5 A piece of magnesium ribbon is burned in oxygen gas. Magnesium oxide, a white powder is formed.

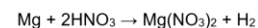
5.5.1 Write down the name of the chemical bond found in:

- (i) Magnesium ribbon (1)  
(ii) Magnesium oxide (1)

- 5.5.2 Is the reaction an example of a chemical or physical change? Give a reason for your answer. (2)

- 5.5.3 Write down a balanced equation for the reaction. (3)

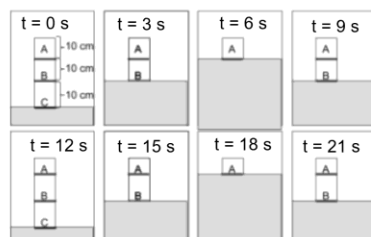
- 5.6 Consider the following balanced chemical reaction:



Calculate the relative atomic mass of the REAGENTS and the PRODUCTS and prove that mass is conserved. (4)  
[28]

#### QUESTION 6

- 6.1 A vertical pole with three marks, **A**, **B** and **C**, stands in water and a wave flushes past the points on the pole. The sketches below represent a series of photographs taken every THREE seconds.



- 6.1.1 Are water waves longitudinal or transverse? (1)  
6.1.2 Motivate your answer to question 6.1.1 with a brief explanation. (2)  
6.1.3 What is the magnitude of the amplitude of the wave? (2)  
6.1.4 What is the magnitude of the period of the wave? (2)

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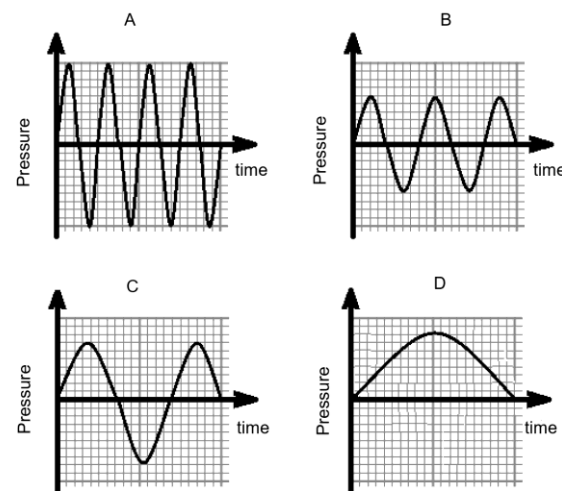
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- 6.1.5 Calculate the frequency of the wave. (3)

- 6.1.6 Calculate the wavelength of the wave if it has a speed of  $2 \text{ m} \cdot \text{s}^{-1}$ . (3)

- 6.2 The graphs **A**, **B**, **C** and **D** below shows the relationship between pressure and time for sound waves.



Answer the following questions by writing down ONLY THE LETTER that represents the sound wave with the:

- 6.2.1 Highest frequency (2)  
6.2.2 Longest wavelength (2)  
6.2.3 Loudest note (1)  
6.2.4 Smallest amplitude (1)  
6.2.5 Lowest pitch (1)

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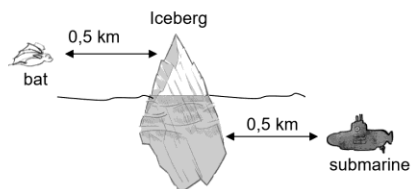
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- 6.3 A submarine is 0,5 km from an iceberg and at the same instant a bat is also 0,5 km from the iceberg as shown below.



- 6.3.1 Explain how both the bat and the submarine use sound to determine how far away they are from the iceberg. (3)
- 6.3.2 Both the bat and the submarine release sound simultaneously. Which sound reached the iceberg first? (1)
- 6.3.3 Give a reason for your answer to question 6.3.2. (2)
- [26]**

#### QUESTION 7

- 7.1 Examples of electromagnetic waves are given below

UV rays	infrared	radio waves
X-rays	gamma rays	microwaves

Choose the electromagnetic wave which best fits the description below:

- 7.1.1 Used in TV remote controls. (1)
- 7.1.2 Used in hospitals to sterilise instruments. (1)
- 7.1.3 Used for the radiation treatment of cancer. (1)
- 7.1.4 Used for TV broadcasting. (1)
- 7.2 Calculate the energy of a photon if it has a wavelength of  $2,1 \times 10^{-9}$  m. (4)
- 7.3 Write down TWO properties of electromagnetic waves. (2)
- [10]**

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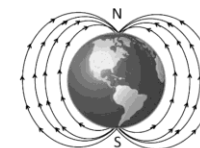
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#### QUESTION 8

The earth acts just like a very large magnet and creates a magnetic field



- 8.1 Explain how the magnetic field around the earth can be used to determine direction on earth. (2)
- 8.2 Explain the difference between geographic north and the earth's magnetic north pole. (2)
- 8.3 Why can the magnetosphere be regarded as a protective layer around the earth? (1)
- 8.4 Write down the name of a spectacular north pole phenomenon due to the protection provided by the magnetosphere. (1)
- [6]**

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**QUESTION 9**

A NEUTRAL plastic ball, **N**, is suspended from an insulating string. An identical ball, **P**, is attached to a similar string and ball **P** has a charge of  $+9 \times 10^{-9} \text{ C}$ .



- 9.1 Are there any charged particles on ball **N**? Answer either YES or NO and explain your answer. (2)
- 9.2 Calculate the number of electrons that were removed from **P** to give it the positive charge. (3)
- 9.3 Ball **P** is brought closer and closer to **N** until a visible effect is observed in the case of ball **N**. What happens to **N**? (1)
- 9.4 Ball **P** is allowed to TOUCH ball **N** and then TAKEN AWAY from **N**.
- 9.4.1 Describe the movement of the charged particles when **P** and **N** are in contact. Refer to the type of charge and the direction in which they move. (2)
- 9.4.2 Calculate the charge on ball **N** after it has touched **P** and was separated again. (3)
- 9.5 Ball **P** is once again brought closer and closer to **N** until a visible effect is observed for ball **N**.
- 9.5.1 What happens to ball **N** this time? (1)
- 9.5.2 Explain your answer to question 9.5.1. (1)

[13]

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**DATA FOR PHYSICAL SCIENCES GRADE 10  
GEGEWENS VIR FISIIESE WETENSAPPE GRAAD 10**

**TABLE 1: PHYSICAL CONSTANTS / TABEL 1: FISIIESE KONSTANTES**

NAME / NAAM	SYMBOL / SIMBOOL	VALUE / WAARDE
Speed of light in a vacuum Spoed van lig in 'n vakuum	c	$3,0 \times 10^8 \text{ m} \cdot \text{s}^{-1}$
Planck's constant Planck se konstante	h	$6,63 \times 10^{-34} \text{ J} \cdot \text{s}$
Charge on electron Lading op elektron	e	$-1,6 \times 10^{-19} \text{ C}$
Electron mass Elektronmassa	$m_e$	$9,11 \times 10^{-31} \text{ kg}$

**TABLE 2: FORMULAE / TABEL 2: FORMULES**


**WAVES, SOUND AND LIGHT / GOLWE, KLANK EN LIG**

$v = \lambda f$	$E = hf = h \frac{c}{\lambda}$
$Speed = \frac{distance}{time}$	$T = \frac{1}{f}$ OR/OF $f = \frac{1}{T}$
$Spoed = \frac{afstand}{tyd}$	

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## QUESTION PAPER: NOVEMBER 2018 PAPER 1



**basic education**  
Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 10**

**PHYSICAL SCIENCES: PHYSICS (P1)**  
**NOVEMBER 2018**

**MARKS: 150**  
**TIME: 2 hours**

This question paper consists of 17 pages, 2 data sheets and 1 answer sheet.

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Physical Sciences/P1

2  
CAPS – Grade 10

DBE/November 2018

### INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
3. Hand in the ANSWER SHEET with the ANSWER BOOK.
4. Start EACH question on a NEW page in the ANSWER BOOK.
5. Number the answers correctly according to the numbering system used in this question paper.
6. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
7. You may use a non-programmable calculator.
8. You may use appropriate mathematical instruments.
9. You are advised to use the attached DATA SHEETS.
10. Show ALL formulae and substitutions in ALL calculations.
11. Round off your final numerical answers to a minimum of TWO decimal places.
12. Give brief motivations, discussions, etc. where required.
13. Write neatly and legibly.

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Physical Sciences/P1

3  
CAPS – Grade 10

DBE/November 2018

**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 D.

- 1.1 An object is positively charged if it has more ...  
A electrons than protons.  
B electrons than neutrons.  
C protons than electrons.  
D protons than neutrons. (2)
- 1.2 A car is travelling at a speed of  $30 \text{ m}\cdot\text{s}^{-1}$  on a straight road. What would be the speed of the car in  $\text{km}\cdot\text{h}^{-1}$ ?  
A  $8,33 \text{ km}\cdot\text{h}^{-1}$   
B  $30 \text{ km}\cdot\text{h}^{-1}$   
C  $108 \text{ km}\cdot\text{h}^{-1}$   
D  $130 \text{ km}\cdot\text{h}^{-1}$  (2)
- 1.3 The UNIT in which the rate of flow of charge is measured, is called ...  
A ampere.  
B coulomb.  
C volt.  
D watt. (2)
- 1.4 The gradient of a velocity versus time graph is equivalent to the ...  
A acceleration.  
B displacement.  
C position.  
D total distance covered. (2)

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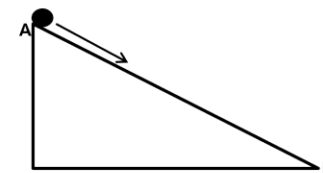
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4  
CAPS – Grade 10

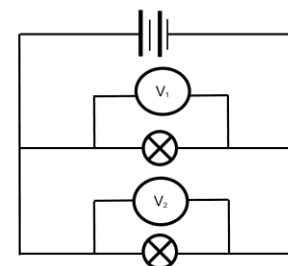
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- 1.5 An object is released from the top of a frictionless inclined plane, **AB**, as shown below.



Which ONE of the following statements regarding the total mechanical energy of the object is CORRECT?

- A  $(E_p + E_k)_A > (E_p + E_k)_B$   
B  $(E_p + E_k)_A < (E_p + E_k)_B$   
C  $(E_p + E_k)_A = (E_p + E_k)_B$   
D  $(E_p + E_k)_A = - (E_p + E_k)_B$  (2)
- 1.6 Two identical light bulbs are connected in parallel, as shown in the circuit diagram below. Voltmeters  $V_1$  and  $V_2$  are connected across each light bulb.



Which ONE of the following voltmeter readings is CORRECT?

- A  $V_1 = V_2$   
B  $V_1 = 2V_2$   
C  $V_1 = \frac{1}{2}V_2$   
D  $V_1 = \frac{1}{4}V_2$  (2)

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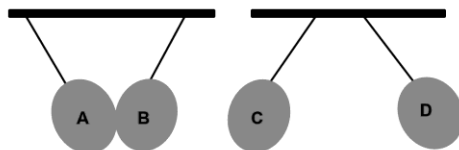
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- 1.7 Four identical balloons, each carrying a charge, are suspended from a ceiling, as shown in the diagram below.



Balloon **B** is negatively charged.

Which combination is CORRECT regarding the charges on the balloons?

	SIGN OF CHARGE ON A	SIGN OF CHARGE ON C	SIGN OF CHARGE ON D
A	-	+	-
B	+	+	+
C	-	-	-
D	+	+	-

(2)

- 1.8 Two cyclists are cycling in opposite directions along the side line of a rectangular field. It is observed that they covered the same distance over a time interval of 3 s. Which ONE of the following physical quantities is the SAME regarding the cyclists over the interval of 3 s?

- A Acceleration  
B Average speed  
C Average velocity  
D Displacement

(2)

- 1.9 Red light of frequency  $f$  and wavelength  $\lambda$  shines on an object. The red light is then replaced by light of a higher energy. How do the frequency and the wavelength of light shining on the object now compare with that of red light?

	FREQUENCY	WAVELENGTH
A	Greater than $f$	Remains the same ( $\lambda$ )
B	Less than $f$	Greater than $\lambda$
C	Greater than $f$	Less than $\lambda$
D	Remains the same ( $f$ )	Less than $\lambda$

(2)

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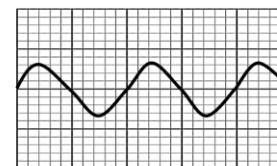
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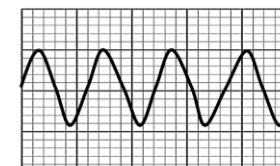
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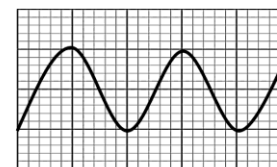
- 1.10 Study the following wave patterns:



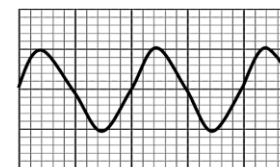
1



2



3



4

Which COMBINATION is the CORRECT representation of the wave patterns with the same pitch?

- A 1 and 2  
B 1 and 3  
C 1 and 4  
D 2 and 4

(2)  
[20]

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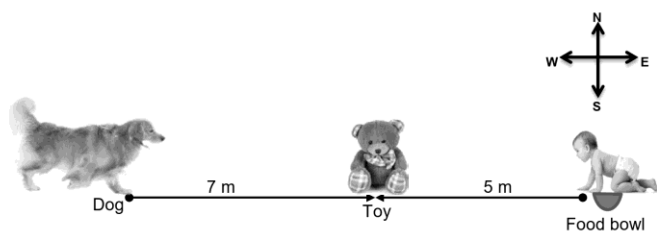
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**QUESTION 2 (Start on a new page.)**

A baby leaves a bowl of food on the floor and crawls westwards to fetch a toy placed 5 m away. At the same time a dog walks eastwards towards the baby. It takes the baby 30 s to reach the toy. The dog walks past the toy to eat the baby's food in the bowl.



- 2.1 Define the term *displacement* in words. (2)
  - 2.2 Determine the position of the dog relative to the baby before they both moved. (2)
  - 2.3 Calculate the average velocity of the baby. (4)
  - 2.4 If the average speed of the dog is TWICE that of the baby, calculate how long it would take the dog to reach the food bowl from the moment the dog started moving. (4)
- [12]**

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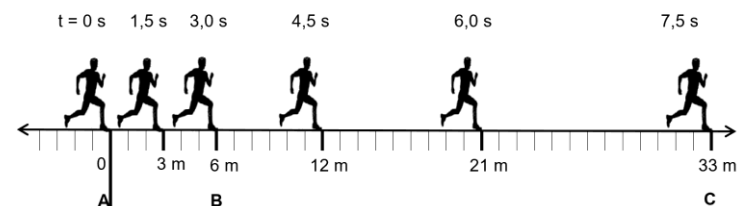
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**QUESTION 3 (Start on a new page.)**

The diagram below shows the positions of an athlete at different time intervals during a race.



- 3.1 Distinguish between *motion with uniform velocity* and *uniformly accelerated motion*. (4)
  - 3.2 What type of motion (motion with uniform velocity or uniformly accelerated motion) is represented by the following intervals?
    - 3.2.1 A to B (1)
    - 3.2.2 B to C (1)
  - 3.3 Use the information in the diagram above to draw an accurate position versus time graph on the graph paper on the attached ANSWER SHEET. (5)
  - 3.4 Define the term *instantaneous velocity* in words. (2)
  - 3.5 On the graph drawn for QUESTION 3.3, show how you would determine the instantaneous velocity. (2)
  - 3.6 Calculate the velocity of the athlete at 3 s. (4)
- [19]**

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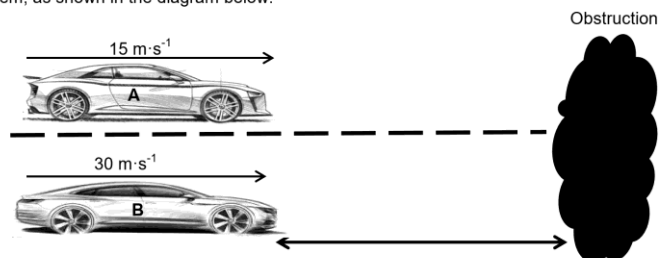
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**QUESTION 4 (Start on a new page.)**

Two cars, **A** and **B**, are moving at speeds of  $15 \text{ m}\cdot\text{s}^{-1}$  and  $30 \text{ m}\cdot\text{s}^{-1}$  in the same direction. They are side by side when both drivers observe an obstruction ahead of them, as shown in the diagram below.



Both drivers apply their brakes and accelerate at  $-4,5 \text{ m}\cdot\text{s}^{-2}$  until both cars come to rest. Ignore the reaction time of the drivers.

- 4.1 Define the term *acceleration* in words. (2)
- 4.2 Calculate the:
  - 4.2.1 Time it takes car **A** to come to rest (4)
  - 4.2.2 Stopping distance of car **A** (4)
- 4.3 Which car (**A** or **B**) has the longer stopping distance? Support the answer with a calculation. (6)
- 4.4 What conclusion can be made about the relationship between speed and stopping distance? (2)

[18]

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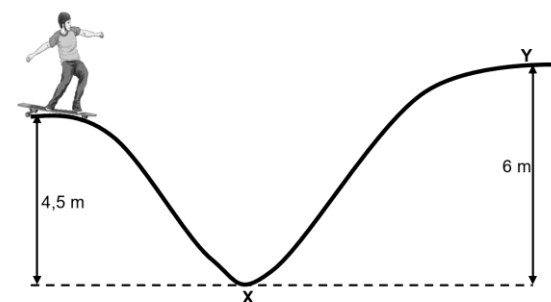
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**QUESTION 5 (Start on a new page.)**

A skateboarder, starting from the top of a ramp  $4,5 \text{ m}$  above the ground, skates down the ramp, as shown in the diagram below. The mass of the skateboarder and his board is  $65 \text{ kg}$ . Ignore the effects of friction.



- 5.1 Define the term *gravitational potential energy* in words. (2)
- 5.2 Calculate the gravitational potential energy of the skater just before he skates down the ramp. (3)
- 5.3 State the *principle of conservation of mechanical energy* in words. (2)
- 5.4 Use the principle stated in QUESTION 5.3 to calculate the magnitude of the velocity of the skateboarder when he reaches the ground at point **X**. (4)
- 5.5 Will the skateboarder be able to reach point **Y** if he were to remain on his skateboard? Write YES or NO and support the answer with a relevant calculation. (5)

[16]

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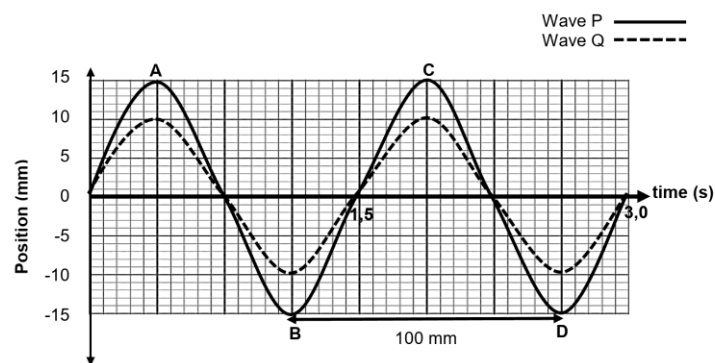
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**QUESTION 6 (Start on a new page.)**

Study the two transverse waves, **P** and **Q**, as shown below.



- 6.1 Write down ONE difference and ONE similarity between wave **P** and wave **Q**. (2)
- 6.2 For wave pattern **P**, write down:
- 6.2.1 Two points that are out of phase (1)
- 6.2.2 The amplitude of the wave (1)
- 6.3 Define the term *frequency of the wave* in words. (2)
- 6.4 For wave pattern **Q**, calculate the:
- 6.4.1 Frequency of the wave (3)
- 6.4.2 Speed of the wave (3)

[12]

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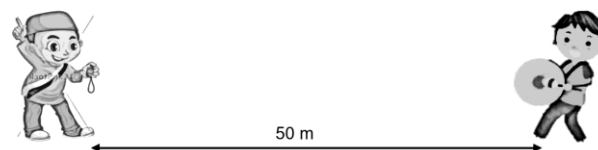
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**QUESTION 7 (Start on a new page.)**

Experiments were done to investigate the effect of temperature on the speed of sound. One person beat a drum while another person, who was standing 50 m away from the sound source, recorded the time travelled by the sound.



They performed the experiment at different temperatures at different times of the day. They recorded their findings in the table below.

TEMPERATURE (°C)	TIME (s)
0	0,151
5	0,150
10	0,148
15	0,147
20	0,146
25	0,145

- 7.1 For the investigation, write down the:
- 7.1.1 Investigative question (2)
- 7.1.2 Independent variable (1)
- 7.1.3 Dependent variable (1)
- 7.2 Calculate the speed of sound at 20 °C. (3)
- 7.3 Write down a conclusion for the investigation. (2)
- The person who beat the drum, noticed that the sound reflected back after a while.
- 7.4 Name the term used to describe the reflection of sound waves. (1)

[10]

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**QUESTION 8 (Start on a new page.)**

The types of electromagnetic radiation are arranged according to frequency in the table below.

TYPE OF RADIATION	FREQUENCY (Hz)
Radio waves	$10^5 - 10^{10}$
Microwaves	$10^{10} - 10^{11}$
Infrared	$10^{11} - 10^{14}$
Visible light	$10^{14} - 10^{15}$
Ultraviolet	$10^{15} - 10^{16}$
X-rays	$10^{16} - 10^{18}$
Gamma rays	$10^{18} - 10^{21}$

- 8.1 How are electromagnetic waves generated? (1)
- 8.2 What type of electromagnetic radiation has the highest energy? (1)
- 8.3 Explain the answer to QUESTION 8.2. (2)
- 8.4 A certain type of electromagnetic radiation has a wavelength of  $600 \times 10^{-10}$  m.
- 8.4.1 Identify the type of electromagnetic radiation by performing a calculation. (4)
- 8.4.2 State ONE application of the type of radiation identified in QUESTION 8.4.1. (1)
- [9]**

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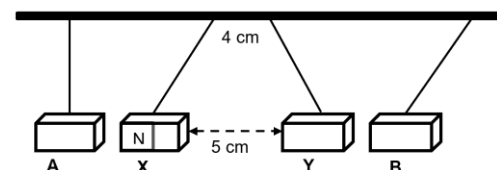
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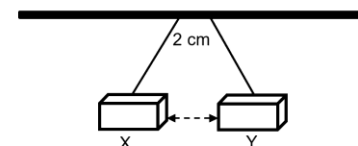
**QUESTION 9 (Start on a new page.)**

Four metallic bars, suspended freely from a ceiling, interact, as shown in the diagram below. The points of attachment of **X** and **Y** on the ceiling are 4 cm apart.



The two bars in the middle are **bar magnets** (**X** and **Y**) and the distance between them is 5 cm. One of the bars (**A** or **B**) is made of iron and the other is made of gold.

- 9.1 Write down the term describing a material that is easily magnetised. (1)
- 9.2 Which ONE of the bars (**A** or **B**) is made of iron? (1)
- 9.3 Determine the polarity of bar **B** closest to bar magnet **Y**. Write only NORTH or SOUTH. (1)
- 9.4 Explain the answer to QUESTION 9.3. (2)
- 9.5 Sketch the magnetic field pattern around bar magnet **X**. (3)
- 9.6 Bars **A** and **B** are now removed and the points of attachment are now 2 cm, as shown in the diagram below.



- 9.6.1 How will the change in the position of the attachment affect the final distance of separation between the bars? Write only GREATER THAN 5 cm, LESS THAN 5 cm or REMAINS at 5 cm. (1)
- 9.6.2 Explain the answer to QUESTION 9.6.1. (2)
- [11]**

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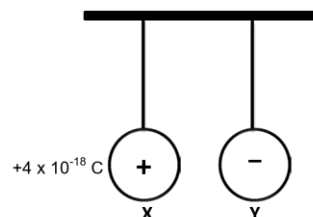
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**QUESTION 10 (Start on a new page.)**

Two identical insulated spheres, **X** and **Y**, suspended by threads from a ceiling, are held at a small distance apart, as shown in the diagram below.



Sphere **X** carries a charge of  $+4 \times 10^{-18} \text{ C}$ , while sphere **Y** has an excess of 30 electrons.

10.1 Calculate the magnitude of the charge on sphere **Y**. (3)

The spheres are now released and they move towards each other.

10.2 Give a reason why spheres **X** and **Y** move towards each other. (2)

The spheres are allowed to touch each other. After touching, they move away from each other.

10.3 State the *principle of conservation of charge* in words. (2)

10.4 Calculate the charge on each sphere after they have separated. (4)  
[11]

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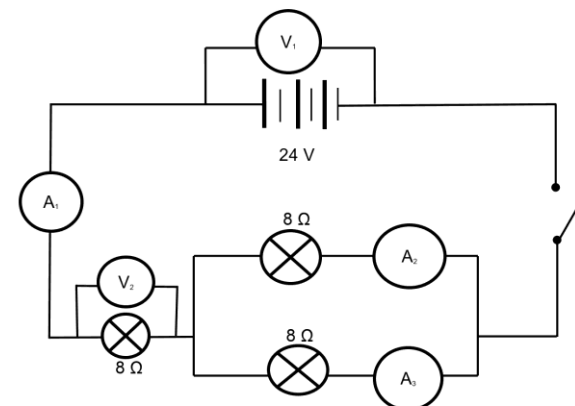
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**QUESTION 11 (Start on a new page.)**

11.1 Consider the circuit diagram below.



Switch **S** is OPEN.

11.1.1 Write down the reading on the following:

- (a) Voltmeter ( $V_1$ ) (1)
- (b) Ammeter ( $A_1$ ) (1)

Switch **S** is now CLOSED.

11.1.2 Calculate the equivalent resistance of the circuit. (4)

11.1.3 Calculate the reading on voltmeter  $V_2$ . (3)

11.1.4 How do the readings on ammeters  $A_2$  and  $A_3$  compare with each other? (1)

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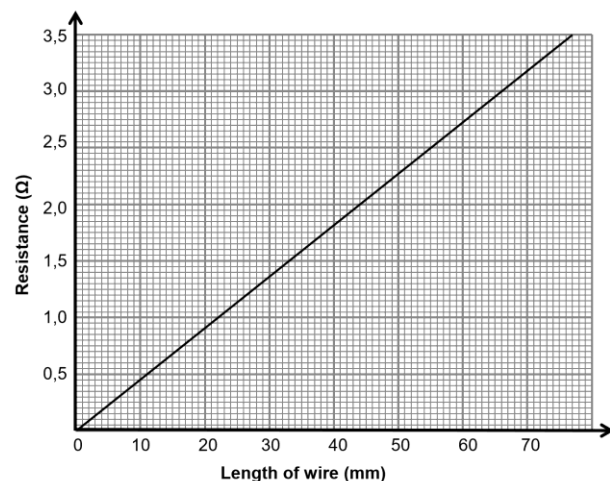
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- 11.2 The graph below shows the relationship between the resistance and the length of the conducting wire.



- 11.2.1 Write down the relationship between the resistance and the length of the conducting wire. (1)
- 11.2.2 Determine the resistance of wire with a length of 30 mm. (1)  
[12]
- TOTAL: 150**

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**DATA FOR PHYSICAL SCIENCES GRADE 10  
PAPER 1 (PHYSICS)  
GEGEWENS VIR FISIIESE WETENSAPPE GRAAD 10  
VRAESTEL 1 (FISIKA)**

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 x 10 <sup>8</sup> m·s <sup>-1</sup>
Planck's constant <i>Planck se konstante</i>	h	6,63 x 10 <sup>-34</sup> J·s
Charge on electron <i>Lading op elektron</i>	e	-1,6 x 10 <sup>-19</sup> C
Electron mass <i>Elektronmassa</i>	m <sub>e</sub>	9,11 x 10 <sup>-31</sup> kg

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

**MOTION/BEWEGING**

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

**WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING**

$U = mgh$ or/of $E_p = mgh$	$K = \frac{1}{2}mv^2$ or/of $E_k = \frac{1}{2}mv^2$
$E_M = E_k + E_p$ or/of $E_M = K + U$	

**WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG**

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/of $E = h\frac{c}{\lambda}$	

**ELECTROSTATICS/ELEKTROSTATIKA**

$n = \frac{Q}{e}$	$Q = \frac{Q_1 + Q_2}{2}$
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**ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE**

$Q = I \Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$R_s = R_1 + R_2 + \dots$	$V = \frac{W}{q}$

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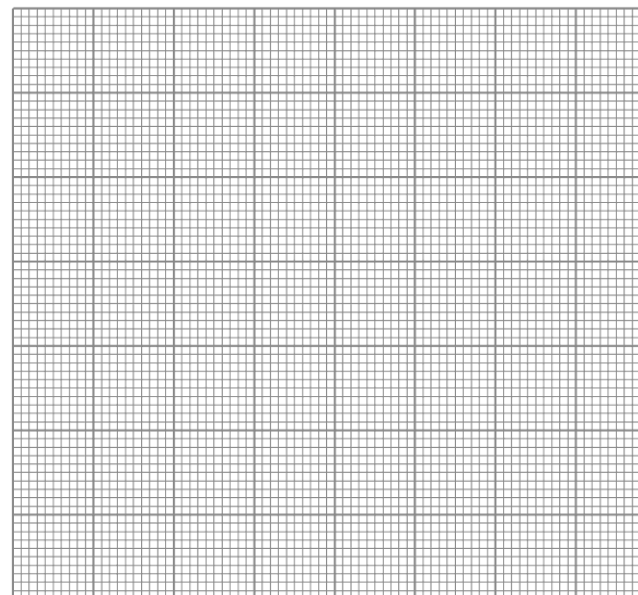
**ANSWER SHEET**

Hand in this ANSWER SHEET with the ANSWER BOOK.

**NAME:** \_\_\_\_\_

**CLASS:** \_\_\_\_\_

**QUESTION 3.3**




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## QUESTION PAPER: NOVEMBER 2018 PAPER 2



**basic education**  
Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

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SENIOR CERTIFICATE**


**GRADE 10**

**PHYSICAL SCIENCES: CHEMISTRY (P2)**  
**NOVEMBER 2018**

**MARKS: 150**  
**TIME: 2 hours**

This question paper consists of 14 pages and 2 data sheets.

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Physical Sciences/P2

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DBE/November 2018

### INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of TEN questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your final numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

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Physical Sciences/P2

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**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1. 11 D.

- 1.1 Which ONE of the following substances is NOT a pure substance?
- A Iron
  - B Sugar
  - C Steel
  - D Graphite (2)
- 1.2 The CORRECT chemical formula for potassium nitrate is ...
- A  $K_3N$
  - B  $PNO_3$
  - C  $KNO_3$
  - D  $K_2NO_3$  (2)
- 1.3 Different isotopes of the same element have different ...
- A atomic numbers.
  - B numbers of neutrons.
  - C numbers of protons.
  - D numbers of electrons. (2)
- 1.4 Which ONE of the following ionisation equations represents the second ionisation of magnesium?
- A  $Mg(g) + \text{energy} \rightarrow Mg^+ + e^-$
  - B  $Mg^+(s) + \text{energy} \rightarrow Mg^{2+} + 2e^-$
  - C  $Mg^+(g) + \text{energy} \rightarrow Mg^{2+} + 2e^-$  Best answer is C, but number of electrons is incorrect. Should be 1e<sup>-</sup>.
  - D  $Mg(s) + \text{energy} \rightarrow Mg^+ + e^-$  (2)

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- 1.5 Which PAIR of elements is most likely to have a similar arrangement of outer electrons and similar chemical behaviour?
- A Boron and aluminium
  - B Helium and fluorine
  - C Carbon and nitrogen
  - D Chlorine and oxygen (2)
- 1.6 Which ONE of the following statements is INCORRECT about the properties of a physical change?
- A When a physical change occurs, the compounds may rearrange themselves, but the bonds in between the atoms will not break.
  - B Physical change in matter is reversible.
  - C Energy is absorbed when matter changes from a solid to a liquid.
  - D Molecules are not conserved during a physical change. (2)
- 1.7 In the compound,  $H_2O$ , the ratio of the MASS of hydrogen to oxygen is always ...
- A 1 : 2.
  - B 2 : 1.
  - C 1 : 8.
  - D 1 : 16. (2)
- 1.8 One mole of  $H_2SO_4$  contains ...
- A 7 atoms.
  - B 1 molecule.
  - C  $6,02 \times 10^{23}$  molecules.
  - D  $42,14 \times 10^{23}$  molecules. (2)

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Physical Sciences/P2

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1.9 Which ONE of the following solutions will NOT form a precipitate if added to a solution of silver nitrate?

- A NaCl(aq)
- B MgBr<sub>2</sub>(aq)
- C KI(aq)
- D Mg(NO<sub>3</sub>)<sub>2</sub>(aq)

(2)

1.10 The sphere in which minerals are found is known as ...

- A atmosphere.
- B biosphere.
- C lithosphere.
- D stratosphere.

(2)  
[20]

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**QUESTION 2 (Start on a new page.)**

The diagram below shows three different substances, **P**, **Q** and **R**.

SUBSTANCE P	SUBSTANCE Q	SUBSTANCE R	
KEY			
	Hydrogen		Chlorine
	Oxygen		Sulphur
	Sodium		Iron

2.1 Define the term *element*. (2)

Use the diagram and the key provided to answer the questions that follow.

2.2 Write down a LETTER that represents the following:

- 2.2.1 Pure substance (1)
- 2.2.2 Homogeneous mixture (1)
- 2.2.3 Heterogeneous mixture (1)

2.3 Indicate whether the pure substance identified in QUESTION 2.2.1 is an element or a compound. (1)

2.4 Which physical method would you use to separate substance **Q** into its components? (1)

2.5 Write down the physical property upon which the separation techniques are based to separate the following substances into their individual components:

- 2.5.1 **Q** (1)
- 2.5.2 **R** (1)

[9]

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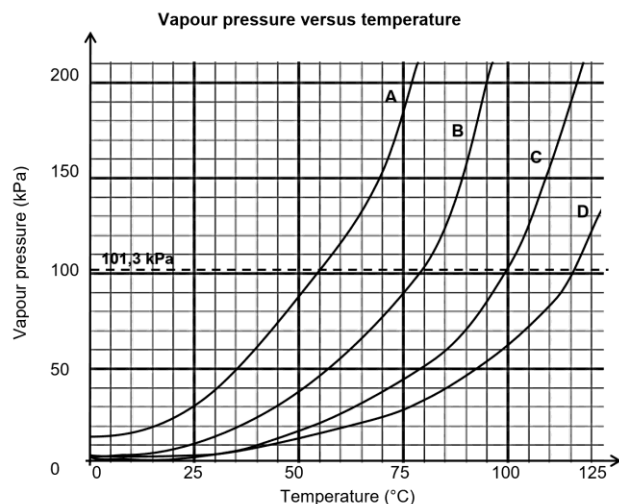
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**QUESTION 3 (Start on a new page.)**

The vapour pressure versus temperature graph below was obtained for four unknown liquids (A, B, C and D). Atmospheric pressure is measured as 101,3 kPa.



- 3.1 Define the term *boiling point*. (2)
- Use the information given in the graph to answer the questions that follow.
- 3.2 Write down the:
  - 3.2.1 Boiling point of liquid B (1)
  - 3.2.2 Liquid which remains a liquid at 115 °C (1)
  - 3.2.3 Liquid that is most likely to be water (1)
- 3.3 State the PHASE CHANGE that takes place at the stage when the vapour pressure is equal to atmospheric pressure. (1)
- 3.4 What happens to the temperature of a liquid during a phase change? Write down only INCREASES, DECREASES or REMAINS THE SAME. (1)
- 3.5 Explain the answer to QUESTION 3.4. (2)
- 3.6 Which liquid (A, B, C or D) has the weakest intermolecular forces? Give a reason for the answer. (3)
- 3.7 What is the relationship between vapour pressure of the liquid and temperature? (2)

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**QUESTION 4 (Start on a new page.)**

Study the table below and answer the questions that follow.

ELEMENT/ION	NUMBER OF PROTONS	NUMBER OF NEUTRONS	NUMBER OF ELECTRONS
P	11	12	11
Q	14	16	14
R	16	16	18

- 4.1 Define the term *atomic number*. (2)
- 4.2 Write down the:
  - 4.2.1 Chemical symbol of element Q using the notation  ${}^A_ZX$  (2)
  - 4.2.2 Element (P, Q or R) that is an alkali metal (1)
  - 4.2.3 Chemical symbol of R (2)
- 4.3 Element P reacts with oxygen to form the compound with the chemical formula  $P_2O$ .
  - 4.3.1 Predict the chemical formula that element Rb in the periodic table will form when it reacts with oxygen. (2)
  - 4.3.2 Explain the answer to QUESTION 4.3.1. (2)
- 4.4 What is the trend in ionisation energy as you move from element P to element R? Write down only INCREASES, DECREASES or REMAINS THE SAME. Explain the answer. (4)
- 4.5 How many electrons does an ION of element P have? Draw the Aufbau diagram of this ion. (3)
- 4.6 When orbitals of identical energy are available, electrons are placed in individual orbitals before they are paired. Give the name of this rule. (1)
- 4.7 Element Y occurs as these isotopes in the following proportions:  
Y – 28(92,23%); Y – 29(4,68%); Y – 30(3,09%)  
Calculate the relative atomic mass of element Y. (3)

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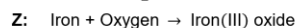
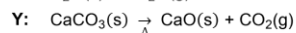
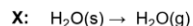
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**QUESTION 5 (Start on a new page.)**

Study the physical and chemical processes below and answer the questions that follow.



5.1 Define the term *physical change*. (2)

5.2 Write down the LETTER of the process that represents the following:

5.2.1 Physical change (1)

5.2.2 Decomposition reaction (1)

5.3 Give the name of the physical change stated in QUESTION 5.2.1. (1)

5.4 State TWO properties of a reaction that indicate that a chemical change has taken place. (2)

5.5 For process **Z**, write down:

5.5.1 What the symbol  $\Delta$  represents The triangle went missing; in Y it moved. (1)

5.5.2 A BALANCED CHEMICAL EQUATION (Show the phases of ALL reactants and products.) (4)

5.6 A 20 g sample of  $\text{CaCO}_3(\text{s})$  in process **Y** decomposes to form 11,2 g of  $\text{CaO}$ . In a second sample, 30 g decomposes to form  $x$  g of  $\text{CO}_2$ .

5.6.1 State the *law of constant composition*. (2)

5.6.2 Use the law in QUESTION 5.6.1 to calculate mass  $x$  of the  $\text{CO}_2$  formed. (4)

**[18]**

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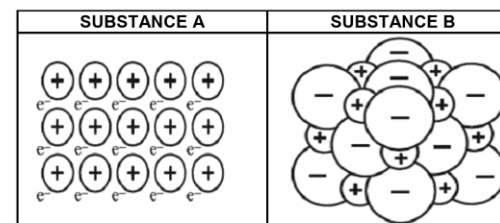
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**QUESTION 6 (Start on a new page.)**

Study the diagram below showing structures of two different substances (**A** and **B**) and answer the questions that follow.



6.1 Choose the substance (**A** or **B**) that describes the following:

6.1.1 Metallic structure (1)

6.1.2 Structure of magnesium chloride (1)

6.2 Explain how the type of bond in substance **A** forms. (2)

6.3 Name the type of bond that exists in substance **B**. (1)

6.4 Magnesium and chlorine react to form compound magnesium chloride.

6.4.1 Define the term *compound*. (2)

6.4.2 Write down the NAME of the group to which magnesium belongs. (1)

6.4.3 Write down the valency of a chlorine atom. (1)

6.4.4 Use the Lewis dot diagram to show the formation of magnesium chloride. (3)

**[12]**

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**QUESTION 7 (Start on a new page.)**

A group of learners prepare a  $0,25 \text{ mol-dm}^{-3}$  solution of sodium carbonate by dissolving a 14,2 g sample of hydrated sodium carbonate ( $\text{Na}_2\text{CO}_3 \cdot x\text{H}_2\text{O}$ ) in  $200 \text{ cm}^3$  of water.

- 7.1 Explain the meaning of the term *hydrated*. (1)
- 7.2 Write down a **BALANCED CHEMICAL EQUATION** to show how sodium carbonate dissociates in water. (2)
- 7.3 Learners then take  $10 \text{ cm}^3$  of the prepared solution and allow it to react completely with  $5 \text{ cm}^3$  of dilute hydrochloric acid, according the following balanced chemical equation:
- $$\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$$
- 7.3.1 Define the term *a mole of a substance*. (2)
- 7.3.2 What type of chemical reaction is represented by the chemical equation above? (1)
- 7.3.3 Calculate the number of moles of hydrochloric acid in  $5 \text{ cm}^3$  of hydrochloric acid if its concentration is  $1 \text{ mol-dm}^{-3}$ . (3)
- 7.4 Calculate the mass of sodium chloride formed in the reaction in QUESTION 7.3. (5)
- [14]**

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**QUESTION 8 (Start on a new page.)**

Learners investigate how the type of substance affects electrical conductivity of the substance. They conduct three experiments using three different substances under the same conditions, as shown in the table below.

EXPERIMENT	MASS OF SUBSTANCE (g)	TYPE OF SUBSTANCE	TEMPERATURE (°C)
1	2	Solution of $\text{CaCl}_2$	25
2	2	Solution of KCl	25
3	2	Solution of sugar	25

- 8.1 Define the term *electrolyte*. (2)
- 8.2 For the investigation, write down the:
- 8.2.1 Investigative question (2)
- 8.2.2 Dependent variable (1)
- 8.2.3 Independent variable (1)
- 8.2.4 Controlled variable (1)
- 8.3 For the investigation, predict with reasons the substance that will yield the following:
- 8.3.1 The highest conductivity (2)
- 8.3.2 Zero conductivity (2)
- 8.4 The substance tested in Experiment 3 was analysed. It was found to contain 40% carbon, 6,67% hydrogen and 53,33% oxygen.
- Determine the molecular formula if the molar mass is  $180 \text{ g-mol}^{-1}$ . (7)
- [18]**

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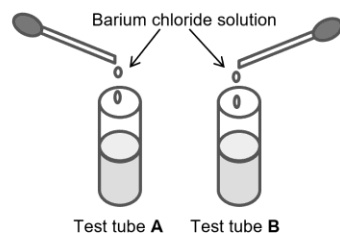
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**QUESTION 9 (Start on a new page.)**

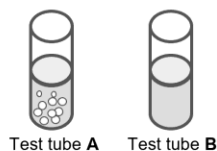
Two test tubes, **A** and **B**, both contain a sodium salt solution. After a small amount of barium chloride is added, the solution in both test tubes forms a white precipitate.



9.1 Write down the type of reaction that takes place in the test tubes. (1)

9.2 A concentrated nitric acid solution is then added into each test tube to establish which one contains carbonate ions and which one contains sulphate ions.

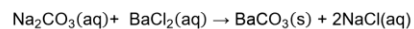
Bubbles are formed in test tube **A**. There is no reaction in test tube **B**.



9.2.1 Identify which IONS (CARBONATE or SULPHATE) are present in test tube **B**. (1)

9.2.2 Write down a BALANCED CHEMICAL EQUATION that represents the reaction between nitric acid and the precipitate formed in test tube **A**. (3)

9.3 A solution of sodium carbonate was prepared by dissolving 5 g of the powder in 100 cm<sup>3</sup> of water. The solution reacted with a barium chloride solution, according to the following balanced chemical equation:



9.3.1 Calculate the mass of barium carbonate that should form in this reaction. (5)

It was found that only 8,3 g precipitate formed.

9.3.2 Calculate the percentage yield. (2)  
[12]

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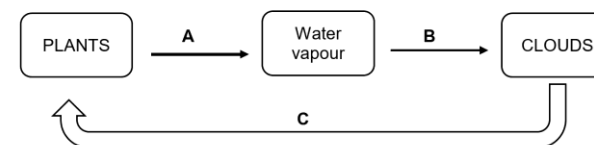
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**QUESTION 10 (Start on a new page)**

The diagram below shows how the hydrosphere is linked to the biosphere. Study the diagram and answer the questions that follow.



10.1 Differentiate between the *hydrosphere* and *biosphere*. (2)

10.2 Write down the name of process:

10.2.1 **A** (1)

10.2.2 **B** (1)

10.2.3 **C** (1)

10.3 Describe the energy changes during processes **A** and **B**. Write down only ENERGY GAINED or ENERGY LOST. (2)

10.4 Describe the interaction between the hydrosphere and plants. (4)  
[11]

**TOTAL: 150**

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**GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 10  
VRAESTEL 2 (CHEMIE)**

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	p°	1,013 x 10 <sup>5</sup> Pa
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	V <sub>m</sub>	22,4 dm <sup>3</sup> ·mol <sup>-1</sup>
Standard temperature <i>Standaardtemperatuur</i>	T°	273 K
Charge on electron <i>Lading op elektron</i>	e	1,6 x 10 <sup>-19</sup> C

TABLE 2: FORMULAE/TABEL 2: FORMULES

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$



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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

KEY/SLEUTEL																	
Atomic number Atoomgetal																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
(I)	(II)											(III)	(IV)	(V)	(VI)	(VII)	(VIII)
1 H	2 He	3 Li	4 Be	5 B	6 C	7 N	8 O	9 F	10 Ne	11 Na	12 Mg	13 Al	14 Si	15 P	16 S	17 Cl	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe
55 Cs	56 Ba	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	72 Hf
87 Fr	88 Ra	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	104 Rn
Electronegativity Elektronegatiwiteit																	
29 Cu 63,5																	
Symbol Simbool																	
Approximate relative atomic mass Benaderde relatieve atoommassa																	
10 Ne																	
4																	

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## QUESTION PAPER: NOVEMBER 2019 PAPER 1



**basic education**  
Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA

**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 10**

**PHYSICAL SCIENCES: PHYSICS (P1)**  
**NOVEMBER 2019**

**MARKS: 150**  
**TIME: 2 hours**

This question paper consists of 13 pages and 2 data sheets.

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### INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of 11 questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

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Physical Sciences/P1

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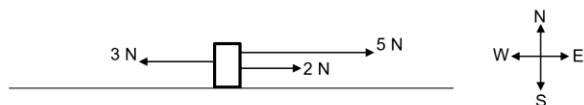
**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Which ONE of the following physical quantities is a scalar quantity?

- A A weight of 5 N
- B A velocity of  $10 \text{ m}\cdot\text{s}^{-1}$  east
- C A current of 2 A
- D A negative acceleration of  $0,4 \text{ m}\cdot\text{s}^{-2}$  (2)

1.2 Three forces act simultaneously on an object, as shown below.



The resultant (net) force acting on the object is ...

- A 10 N west.
  - B 4 N west.
  - C 10 N east.
  - D 4 N east. (2)
- 1.3 An object accelerates uniformly when the ... of the object changes with the same amount in equal time intervals.

- A velocity
- B displacement
- C speed
- D mechanical energy (2)

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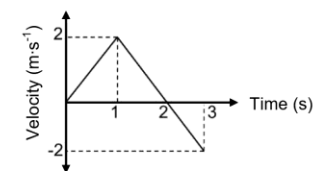
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1.4 The velocity-time graph for the motion of an object is shown below.



The object changes direction at ...

- A 0,5 s
- B 1 s
- C 2 s
- D 3 s (2)

1.5 An object moving at speed  $v$  has a kinetic energy  $E$ . The kinetic energy now changes to  $\frac{1}{4}E$ .

The speed of the object is now ...

- A  $\frac{1}{2}v$ .
- B  $2v$ .
- C  $\frac{1}{4}v$ .
- D  $4v$ . (2)

1.6 The frequency of a wave is defined as the ...

- A lowest point on a wave.
- B time taken for one complete wave.
- C number of complete waves per second.
- D number of points in phase in a wavelength. (2)

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- 1.7 When two wave crests overlap, the increase in amplitude is due to ...  
A cancellation.  
B two waves in phase.  
C destructive interference.  
D constructive interference. (2)
- 1.8 Which ONE of the following materials is a ferromagnetic material?  
A Chromium  
B Carbon  
C Cobalt  
D Calcium (2)
- 1.9 The SI unit for charge is the ...  
A ampere.  
B volt.  
C ohm.  
D coulomb. (2)
- 1.10 The maximum work done per unit charge by a battery is the ...  
A emf.  
B current.  
C resistance.  
D terminal potential difference. (2)  
[20]

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- QUESTION 2 (Start on a new page.)**
- A boy walks in an EASTERLY direction, as shown below. After he passes a tree, he continues in the same direction for another 20 m. He then stops, climbs on his skateboard and rides in a WESTERLY direction for 25 m before he finally stops.
- 
- The resultant displacement of the boy when he finally stops is 10 m EAST of his initial position.
- 2.1 Define the term *distance*. (2)
- 2.2 Determine the initial position of the boy relative to the tree. (2)
- 2.3 Calculate the total distance that the boy moved. (2)
- 2.4 When the boy is on the skateboard, he skates at an average speed of  $5 \text{ m} \cdot \text{s}^{-1}$ .  
Calculate how long, in seconds, the boy is on the skateboard during the motion. (3)
- 2.5 The total time for the motion of the boy from his initial position until he finally stops is 40 s. Calculate his average velocity. (3)  
[12]

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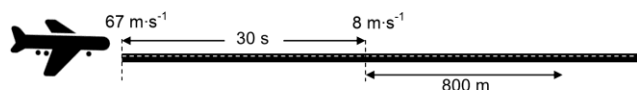
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**QUESTION 3 (Start on a new page.)**

An aeroplane touches down on a runway at a velocity of  $67 \text{ m}\cdot\text{s}^{-1}$ , as illustrated below. After 30 seconds the velocity of the aeroplane is  $8 \text{ m}\cdot\text{s}^{-1}$ .

The aeroplane then continues at a **CONSTANT VELOCITY** for a further 800 m before leaving the runway. The length of the runway is 2 000 m.



- 3.1 Define the term *vector*. (2)
- 3.2 Convert  $67 \text{ m}\cdot\text{s}^{-1}$  to  $\text{km}\cdot\text{h}^{-1}$ . (1)
- 3.3 Calculate the:
  - 3.3.1 Acceleration of the aeroplane during the first 30 seconds (4)
  - 3.3.2 Distance travelled by the aeroplane during the first 30 seconds (4)
  - 3.3.3 Time taken by the aeroplane to travel the 800 m (3)
  - 3.3.4 Length of the runway **NOT USED** when the aeroplane leaves the runway (2)
- 3.4 Pilots should take weather conditions, such as wind and rain, into account when they calculate landing speed.
  - 3.4.1 How should a pilot adapt the landing speed if the surface of the runway is wet? Choose from **INCREASES**, **DECREASES** or **REMAINS THE SAME**. (1)
  - 3.4.2 Explain the answer to QUESTION 3.4.1 by referring to the stopping distance in relation to the landing speed. (2)

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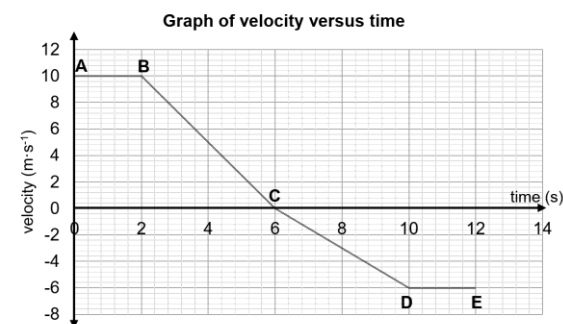
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**QUESTION 4 (Start on a new page.)**

The velocity-time graph below represents the motion of a car over a time period of 12 seconds. The car initially moves **NORTH**.



- 4.1 Define the term *velocity*. (2)
- 4.2 Describe the motion of the car from **C** to **E**. (3)
- 4.3 **WITHOUT USING EQUATIONS OF MOTION**, calculate the:
  - 4.3.1 Distance that the car travels from **A** to **C** (4)
  - 4.3.2 Acceleration of the car between **B** and **C** (4)
- 4.4 How does the magnitude of the acceleration of the car between **B** and **C** compare to the magnitude of its acceleration between **C** and **D**? Choose from **GREATER THAN**, **SMALLER THAN** or **EQUAL TO**. (1)
- 4.5 Refer to the graph and give a reason for the answer to QUESTION 4.4. (1)
- 4.6 Write down the direction of the resultant displacement of the car. (1)
- 4.7 Use an equation of motion to calculate the instantaneous velocity of the car at  $t = 5 \text{ s}$ . (4)

[20]

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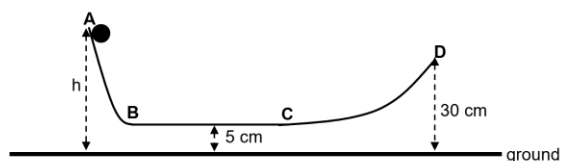
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**QUESTION 5 (Start on a new page.)**

A 2 kg ball rolls from rest from point **A** on a frictionless track **ABCD**, as shown below. The horizontal section, **BC**, of the track is 5 cm above the ground. The ball reaches point **D**, 30 cm above the ground, at a speed of  $1,71 \text{ m}\cdot\text{s}^{-1}$ .



- 5.1 Write down ONE term for the following statement:  
*The sum of gravitational potential energy and kinetic energy* (1)
- 5.2 Calculate the: (2)
- 5.2.1 Mechanical energy of the ball at point **D** (4)
- 5.2.2 Initial height **h** of the ball at point **A** (3)
- 5.2.3 Speed of the ball while it moves between point **B** and point **C** (3)
- 5.3 The 2 kg ball is now replaced with a 4 kg ball.  
How will the speed of the 4 kg ball compare to the speed of the 2 kg ball at point **D**? Choose from GREATER THAN, SMALLER THAN or EQUAL TO.  
Give a reason for the answer. (2)

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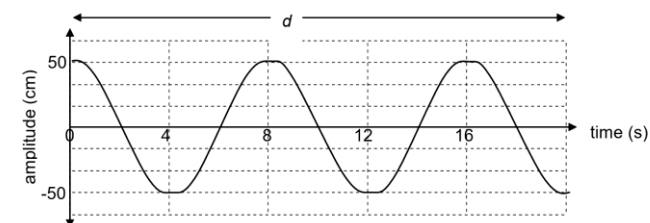
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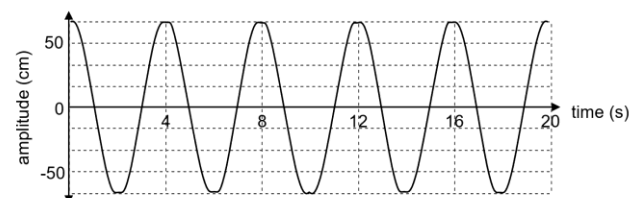
**QUESTION 6 (Start on a new page.)**

The diagram below represents a transverse wave produced by source **A**.



- 6.1 Define the term *amplitude of a wave*. (2)
- 6.2 Write down the amplitude, in metres, of this wave. (1)
- 6.3 Determine the period of this wave. (1)
- 6.4 Calculate the: (5)
- 6.4.1 Speed of the wave if the wavelength is 0,8 m (2)
- 6.4.2 Distance **d** on the diagram (3)

The diagram below represents the transverse wave produced by source **B**.



- 6.5 How does EACH of the following properties of the wave produced by source **B** compare to that of the wave produced by source **A**? Choose from GREATER THAN, SMALLER THAN or EQUAL TO. (1)
- 6.5.1 Amplitude (1)
- 6.5.2 Frequency (3)
- 6.6 Calculate the frequency of the wave produced by source **B**. (3)

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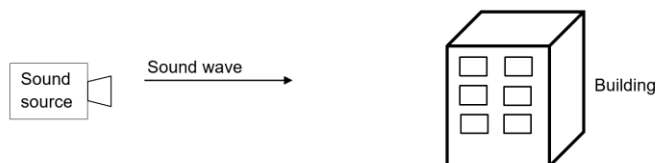
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**QUESTION 7 (Start on a new page.)**

A sound wave is produced by a source placed a certain distance from a building as shown below. The echo reaches the source after 8 seconds. The speed of sound in air is  $340 \text{ m s}^{-1}$ .



- 7.1 Define the term *longitudinal wave*. (2)
- 7.2 Calculate the distance between the sound source and the building. (4)
- 7.3 Name the property of a sound wave that influences its pitch. (1)
- 7.4 Above which frequency is a sound wave classified as ultrasound? (1)
- 7.5 Name ONE use of ultrasound in the medical treatment of patients. (1)

[9]

**QUESTION 8 (Start on a new page.)**

The frequency and corresponding energy of electromagnetic waves are given in the table below.

WAVE	FREQUENCY (Hz)	ENERGY (J)
A	$2 \times 10^9$	$1,33 \times 10^{-24}$
B	$4 \times 10^{12}$	$2,65 \times 10^{-21}$
C	$3,5 \times 10^{15}$	$2,32 \times 10^{-18}$
D	$1,8 \times 10^{18}$	$1,19 \times 10^{-15}$
E	f	$4,97 \times 10^{-14}$

- 8.1 Describe how an electromagnetic wave propagates. (2)
- 8.2 What is the relationship between frequency and energy of an electromagnetic wave, as shown in the table above? (2)
- 8.3 Calculate the:
  - 8.3.1 Frequency of wave E (3)
  - 8.3.2 Wavelength of wave D (3)
- 8.4 Which wave, A or B, has the HIGHER penetrating ability? Give a reason for the answer. (2)

[12]

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**QUESTION 9 (Start on a new page.)**

A compass is used to determine the poles of a magnet. The compass is placed in different positions around the magnet, as shown below. The dark arrow indicates the north pole of the compass.

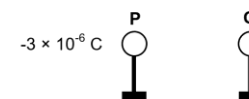


- 9.1 Explain the term *ferromagnetic materials*. (2)
- 9.2 Is X a NORTH pole or a SOUTH pole? (1)
- 9.3 At which position, 1 or 2, will the compass experience the strongest magnetic force? Give a reason for the answer. (2)
- 9.4 What is the direction of a magnetic field? Choose from NORTH TO SOUTH or from SOUTH TO NORTH. (1)
- 9.5 Give ONE term for each of the following descriptions:
  - 9.5.1 The point in the Northern Hemisphere where the rotation axis of the Earth meets the surface (1)
  - 9.5.2 The point where the magnetic field lines of the Earth enters the Earth (1)
- 9.6 State ONE advantage of the Earth's magnetosphere for life on Earth. (1)

[9]

**QUESTION 10 (Start on a new page.)**

The diagram below shows two small identical spheres, P and Q, on insulated stands. The charge on sphere P is  $-3 \times 10^{-6} \text{ C}$  and the charge on sphere Q is unknown.



- 10.1 Calculate the number of electrons in excess on sphere P. (3)
- The two spheres are brought into contact and are then returned to their original positions. Each sphere now carries a charge of  $-1 \times 10^{-6} \text{ C}$ .
- 10.2 Calculate the original charge on sphere Q before the spheres were brought into contact. (3)
- 10.3 Were electrons transferred from P TO Q or from Q TO P during contact? (1)

[7]

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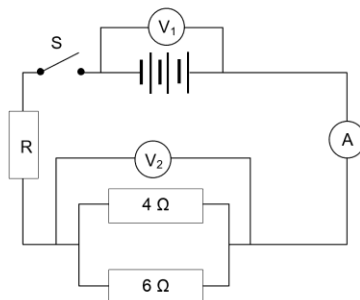
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**QUESTION 11 (Start on a new page.)**

In the circuit diagram below, the resistance of the battery, ammeter and connecting wires are negligible.



- 11.1 Explain the meaning of the following:  
*A current of 5 A* (2)
- 11.2 Calculate the effective resistance of the parallel resistors. (3)
- 11.3 Which one of the voltmeters,  $V_1$  or  $V_2$ , will show a reading if the switch is open? (1)
- Switch **S** is now CLOSED.
- 11.4 How does the reading on voltmeter  $V_2$  compare to that on voltmeter  $V_1$ ? Choose from HIGHER THAN, SMALLER THAN or EQUAL TO. (1)
- 11.5 Calculate the current in the circuit if 0,3 C passes through the ammeter in 2 s. (3)
- 11.6 The potential difference across resistor R is 5 V when a charge of 0,3 C flows through it. Calculate the energy transferred in resistor R. (3)

[13]

**TOTAL: 150**

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**DATA FOR PHYSICAL SCIENCES GRADE 10  
PAPER 1 (PHYSICS)  
GEGEWENS VIR FISIIESE WETENSKAPPE GRAAD 10  
VRAESTEL 1 (FISIKA)**

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIIESE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Acceleration due to gravity <i>Swaartekragversnelling</i>	g	9,8 m·s <sup>-2</sup>
Speed of light in a vacuum <i>Spoed van lig in 'n vakuum</i>	c	3,0 x 10 <sup>8</sup> m·s <sup>-1</sup>
Planck's constant <i>Planck se konstante</i>	h	6,63 x 10 <sup>-34</sup> J·s
Charge on electron <i>Lading op elektron</i>	e	-1,6 x 10 <sup>-19</sup> C
Electron mass <i>Elektronmassa</i>	m <sub>e</sub>	9,11 x 10 <sup>-31</sup> kg

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

**MOTION/BEWEGING**

$v_f = v_i + a\Delta t$	$\Delta x = v_i\Delta t + \frac{1}{2}a\Delta t^2$
$v_f^2 = v_i^2 + 2a\Delta x$	$\Delta x = \left(\frac{v_f + v_i}{2}\right)\Delta t$

**WORK, ENERGY AND POWER/ARBEID, ENERGIE EN DRYWING**

$U = mgh$ or/of $E_p = mgh$	$K = \frac{1}{2}mv^2$ or/of $E_k = \frac{1}{2}mv^2$
$E_M = E_k + E_p$ or/of $E_M = K + U$	

**WAVES, SOUND AND LIGHT/GOLWE, KLANK EN LIG**

$v = f\lambda$	$T = \frac{1}{f}$
$E = hf$ or/of $E = h\frac{c}{\lambda}$	

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**ELECTROSTATICS/ELEKTROSTATIKA**

$n = \frac{Q}{e}$ or/of $n = \frac{Q}{q_e}$	$Q = \frac{Q_1 + Q_2}{2}$
---	---------------------------

**ELECTRIC CIRCUITS/ELEKTRIESE STROOMBANE**


$Q = I \Delta t$	$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \dots$
$R_s = R_1 + R_2 + \dots$	$V = \frac{W}{Q}$

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## QUESTION PAPER: NOVEMBER 2019 PAPER 2



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Department:  
Basic Education  
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**NATIONAL  
SENIOR CERTIFICATE**

**GRADE 10**

**PHYSICAL SCIENCES: CHEMISTRY (P2)**  
**NOVEMBER 2019**

**MARKS: 150**  
**TIME: 2 hours**

This question paper consists of 13 pages and 2 data sheets.

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### INSTRUCTIONS AND INFORMATION

1. Write your name and class (e.g. 10A) in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between subquestions, e.g. between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your FINAL numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions, etc. where required.
12. Write neatly and legibly.

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**QUESTION 1: MULTIPLE-CHOICE QUESTIONS**

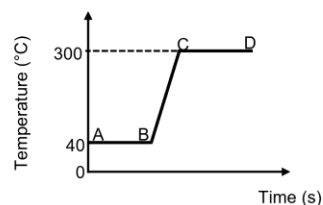
Various options are provided as possible answers to the following questions. Choose the answer and write only the letter (A–D) next to the question numbers (1.1 to 1.10) in the ANSWER BOOK, e.g. 1.11 E. Each question has only ONE correct answer.

1.1 Nitrogen gas is an example of a/an ...

- A element.
- B compound.
- C heterogeneous mixture.
- D homogeneous mixture.

(2)

1.2 The heating curve, not drawn to scale, of a compound is shown below.



During which section(s) on the curve will the potential energy of the compound INCREASE?

- A BC only
- B CD only
- C AB and CD
- D AB, BC and CD

(2)

1.3 Elements in the periodic table are arranged in order of increasing ...

- A mass number.
- B number of protons.
- C number of neutrons.
- D number of nucleons.

(2)

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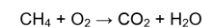
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1.4 Avogadro's number is equal to the number of ...

- A atoms in 1 mole CO.
- B atoms in 1 mole Br<sub>2</sub>.
- C molecules in 1 mole Au.
- D molecules in 1 mole N<sub>2</sub>.

(2)

1.5 The unbalanced equation for a chemical reaction is shown below.



Which ONE of the following represents the coefficients of reactants and products in the BALANCED equation?

	CH <sub>4</sub>	O <sub>2</sub>	CO <sub>2</sub>	H <sub>2</sub> O
A	2	1	2	1
B	1	1	2	2
C	1	2	1	2
D	2	2	1	1

(2)

1.6 A covalent bond forms ...

- A between metal and non-metal atoms.
- B through electron transfer.
- C through sharing of electrons.
- D between positive and negative ions.

(2)

1.7 The reaction between hydrogen chloride (HCl) and sodium hydroxide (NaOH) is an example of a/an ... reaction.

- A redox
- B acid-base
- C precipitation
- D gas forming

(2)

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1.8 Consider the Aufbau diagram of an element below.

3s	↑↓		
2p	↑↓	↑↓	↑↓
2s	↑↓		
1s	↑↓		

The element is a/an ...

- A halogen.
- B noble gas.
- C alkali metal.
- D alkaline-earth metal. (2)

1.9 Which ONE of the following equations represents a precipitation reaction?

- A  $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
- B  $\text{NaCl} + \text{HNO}_3 \rightarrow \text{NaNO}_3 + \text{HCl}$
- C  $\text{NaCl} + \text{AgNO}_3 \rightarrow \text{AgCl} + \text{NaNO}_3$
- D  $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{CO}_2 + \text{H}_2\text{O}$  (2)

1.10 The air surrounding the Earth is the ...

- A biosphere.
  - B lithosphere.
  - C atmosphere.
  - D hydrosphere. (2)
- [20]

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### QUESTION 2 (Start on a new page.)

Most elements found on Earth are metals. All metals have a metallic structure.

- 2.1 For a metallic structure, write down the:
  - 2.1.1 Type of particles present (2)
  - 2.1.2 Type of chemical bond formed between particles (1)
- 2.2 In which region on the periodic table are metals found? Choose from LEFT or RIGHT. (1)
- 2.3 Write down the SYMBOL of a metal which is a liquid at room temperature. (1)
- 2.4 To prevent iron from rusting it is often mixed with other metals, e.g. stainless steel is a mixture of iron, chromium and nickel.
  - 2.4.1 Is stainless steel a HOMOGENEOUS or HETEROGENEOUS mixture? Give a reason for the answer. (2)
  - 2.4.2 Rusting is the formation of iron(III) oxide. Write down the FORMULA of iron(III) oxide. (1)

2.5 The physical properties of two substances, **A** and **B**, are shown in the table below.

SUBSTANCES	DENSITY (g·cm <sup>-3</sup> )	ELECTRICAL CONDUCTIVITY	THERMAL CONDUCTIVITY
<b>A</b>	4,94	Poor	Poor
<b>B</b>	7,87	Good	Good

- 2.5.1 Which ONE of the substances, **A** or **B**, has the smaller mass to volume ratio? Give a reason for the answer. (2)
  - 2.5.2 Explain the difference between *electrical conductivity* and *thermal conductivity*. (2)
  - 2.5.3 Which ONE of the substances, **A** or **B**, is a metal? Give a reason for the answer. (2)
- [14]

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**QUESTION 3 (Start on a new page.)**

- 3.1 The three isotopes of magnesium are Mg-24, Mg-25 and Mg-26. The percentage abundance of the three isotopes is 80%, 10% and 10% respectively.

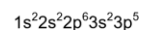
- 3.1.1 Define the term *isotope*. (2)
- 3.1.2 Calculate the relative atomic mass of magnesium. (4)
- 3.1.3 The number of protons and electrons, the mass number and the atomic number of Mg-24 and its ion are shown in the table below.

Some of these values in the table have been omitted. Write down the letters (a–e) in the ANSWER BOOK and next to each letter the number omitted.

	NUMBER OF PROTONS	NUMBER OF ELECTRONS	MASS NUMBER	ATOMIC NUMBER
Mg	12	(a)	24	(b)
Mg <sup>2+</sup>	(c)	(d)	(e)	12

(5)

- 3.2 The sp notation of an unknown element X is shown below.



For element X, write down the:

- 3.2.1 Number of valence electrons (1)
- 3.2.2 Period where this element is found on the periodic table (1)
- 3.2.3 Highest energy level in which electrons occur (1)
- 3.2.4 Symbol (1)

Magnesium combines with element X to form a compound.

- 3.2.5 Write down the type of bond that forms between magnesium and element X. (1)
- 3.2.6 Draw the Aufbau diagram for the MAGNESIUM ION. (2)
- 3.2.7 Draw Lewis dot diagrams to show the bond formation between magnesium and element X. (4)

[22]

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**QUESTION 4 (Start on a new page.)**

A section of the periodic table is shown below. Imaginary symbols are used to represent some of the elements.

	1	2		13	14	15	16	17	18
1									L
2		E					G	J	
3				D		M			
4	A				H				

- 4.1 Write down the IMAGINARY SYMBOL, as shown above, of the element that:

- 4.1.1 Is a halogen (1)
- 4.1.2 Will form a cation with a charge of +2 (1)
- 4.1.3 Has the largest atomic radius (1)
- 4.1.4 Has the highest electronegativity (1)
- 4.1.5 Is a metalloid (1)
- 4.1.6 Is a noble gas (1)
- 4.1.7 Will form a diatomic molecule (1)
- 4.1.8 Has three valence electrons (1)

- 4.2 The first ionisation energy of element A is 400 kJ·mol<sup>-1</sup>.

- 4.2.1 Define the term *first ionisation energy*. (2)
- 4.2.2 The first ionisation energy of element A can be represented by the following incomplete equation:  
A(g) + 400 kJ·mol<sup>-1</sup> → ... + ...  
Copy the equation above into the ANSWER BOOK and complete it. (2)

- 4.3 Atoms of element J release the most energy when gaining electrons to form negative ions.

Write down ONE word or term for the underlined phrase. (1)

- 4.4 Write down the formula of the compound formed when:

- 4.4.1 D combines with G (2)
- 4.4.2 A combines with J (2)

[17]

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**QUESTION 5 (Start on a new page.)**

Consider the compound  $\text{Al}_2(\text{SO}_4)_3$ .

- 5.1 Write down the NAME of the compound above. (1)
- 5.2 Define the term *molar mass*. (2)
- 5.3 Calculate the following for  $\text{Al}_2(\text{SO}_4)_3$ :
- 5.3.1 Its molar mass (2)
- 5.3.2 Its percentage composition (3)
- 5.3.3 The number of moles present in 85,5 g (3)
- 5.3.4 The number of aluminium atoms present in 85,5 g (3)
- 5.4 Particles of  $\text{Al}_2(\text{SO}_4)_3$  are bonded in a crystal lattice.  
Write down the following for this crystal lattice:
- 5.4.1 The name (1)
- 5.4.2 The particles of which it consists (2)
- 5.4.3 TWO physical properties (2)
- 5.5 500 g of  $\text{Al}_2(\text{SO}_4)_3$  is dissolved in 2 dm<sup>3</sup> water.
- 5.5.1 Define the term *concentration*. (2)
- 5.5.2 Calculate the concentration of the solution. (4)

[25]

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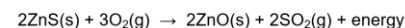
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**QUESTION 6 (Start on a new page.)**

- 6.1 The first step in the extraction of zinc from zinc sulphide (ZnS) is the combustion of ZnS in oxygen. The balanced equation for the reaction is:



- 6.1.1 Is the reaction above EXOTHERMIC or ENDOTHERMIC? Give a reason for the answer. (2)

Oxygen gas consists of oxygen molecules.

- 6.1.2 Define the term *molecule*. (2)

- 6.1.3 Draw the Lewis dot diagram of the oxygen molecule ( $\text{O}_2$ ). (2)

During the reaction above, 7 g ZnS reacts completely with oxygen gas.

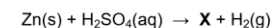
Calculate the:

- 6.1.4 Number of moles of ZnS that has reacted (3)

- 6.1.5 Mass  $\text{O}_2$  needed (3)

- 6.1.6 Volume of  $\text{SO}_2\text{(g)}$  produced at STP (4)

- 6.2 Consider the incomplete equation for the chemical reaction below.



- 6.2.1 Write down the NAME of the acid in the equation above. (1)

- 6.2.2 Write down the FORMULA of product X. (2)

- 6.2.3 Name the type of reaction illustrated above. Choose from ACID-BASE REACTION, PRECIPITATION REACTION or REDOX REACTION. Explain the answer. (3)

- 6.2.4 Briefly describe a test that can be used to verify the formation of hydrogen gas during the reaction above. (2)

[24]

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**QUESTION 7 (Start on a new page.)**

- 7.1 The relationship between conductivity and the concentration of ions in two electrolytes,  $\text{NaCl(aq)}$  and  $\text{CaCl}_2\text{(aq)}$ , of the SAME concentration are investigated.
- 7.1.1 Define the term *electrolyte*. (2)
- 7.1.2 Is the water molecule POLAR or NON-POLAR? Give a reason for the answer. (2)
- 7.1.3 For this investigation, write down the:
- (a) Independent variable (1)
- (b) Dependant variable (1)

The  $\text{NaCl(aq)}$  is added dropwise to distilled water in a beaker and the conductivity of the solution is measured after the addition of each drop. The experiment is repeated for the  $\text{CaCl}_2\text{(aq)}$ . The results obtained are shown in the table below.

NUMBER OF DROPS	0	1	2	3	4	5	6	7
Conductivity of $\text{NaCl(aq)}$ (mA)	0,18	0,34	0,55	0,74	0,92	1,10	1,29	1,47
Conductivity of $\text{CaCl}_2\text{(aq)}$ (mA)	0,18	0,55	0,91	1,29	1,47	1,84	2,21	2,21

- 7.1.4 Write down a balanced equation for the dissociation of  $\text{NaCl(s)}$  in water. (3)
- 7.1.5 Which electrolyte,  $\text{NaCl(aq)}$  or  $\text{CaCl}_2\text{(aq)}$ , has the higher conductivity? Give a reason for the answer. (2)

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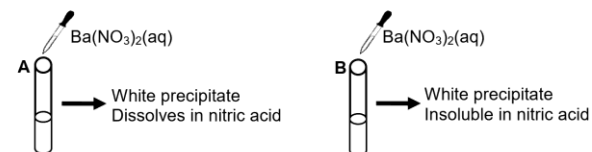
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- 7.2 A learner is supplied with two unlabelled bottles containing potassium salts. She knows that one bottle contains a SULPHATE and the other a CARBONATE.

To distinguish between the two salts she adds a few drops of barium nitrate,  $\text{Ba(NO}_3)_2\text{(aq)}$ , to a solution of each salt in two separate test tubes, **A** and **B**, as shown below.



The learner finds that a white precipitate forms in each test tube. After the addition of nitric acid, the precipitate in test tube **A** dissolves to release a gas, while the precipitate in test tube **B** remains.

Write down the:

- 7.2.1 FORMULA of the POTASSIUM SALT in test tube **A** (2)
- 7.2.2 FORMULA of the precipitate that forms in test tube **B** (2)
- 7.2.3 Balanced equation for the reaction that explains why the precipitate dissolves in test tube **A** after the addition of nitric acid (3)

**[18]**

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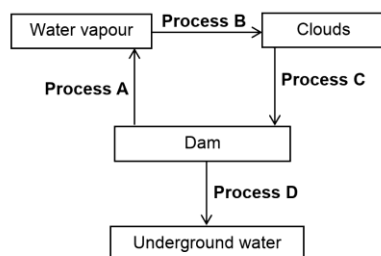
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**QUESTION 8 (Start on a new page.)**

The simplified diagram below represents the water cycle. Condensation and evaporation are two of the processes in the water cycle.



- 8.1 Define the term:
- 8.1.1 Condensation (2)
- 8.1.2 Evaporation (2)
- 8.2 Write down the name of:
- 8.2.1 Process A (1)
- 8.2.2 Process B (1)
- 8.2.3 Process C (1)
- 8.2.4 Process D (1)
- 8.3 Describe the term *hydrosphere* with reference to the different phases present. (2)

**[10]**

**TOTAL: 150**

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**DATA FOR PHYSICAL SCIENCES GRADE 10  
PAPER 2 (CHEMISTRY)**

**GEGEWENS VIR FISIESE WETENSAPPE GRAAD 10  
VRAESTEL 2 (CHEMIE)**

**TABLE 1: PHYSICAL CONSTANTS/TABEL 1: FISIESE KONSTANTES**

NAME/NAAM	SYMBOL/SIMBOOL	VALUE/WAARDE
Standard pressure <i>Standaarddruk</i>	$p^0$	$1,013 \times 10^5 \text{ Pa}$
Molar gas volume at STP <i>Molêre gasvolume by STD</i>	$V_m$	$22,4 \text{ dm}^3 \cdot \text{mol}^{-1}$
Standard temperature <i>Standaardtemperatuur</i>	$T^0$	273 K
Charge on electron <i>Lading op elektron</i>	$e$	$1,6 \times 10^{-19} \text{ C}$
Avogadro's constant <i>Avogadro-konstante</i>	$N_A$	$6,02 \times 10^{23} \text{ mol}^{-1}$

**TABLE 2: FORMULAE/TABEL 2: FORMULES**

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ OR/OF $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$

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TABLE 3: THE PERIODIC TABLE OF ELEMENTS/TABEL 3: DIE PERIODIEKE TABEL VAN ELEMENTE

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 H 1																	2 He 4
3 Li 7	4 Be 9											5 B 11	6 C 12	7 N 14	8 O 16	9 F 19	10 Ne 20
11 Na 23	12 Mg 24											13 Al 27	14 Si 28	15 P 31	16 S 32	17 Cl 35,5	18 Ar 40
19 K 39	20 Ca 40	21 Sc 45	22 Ti 48	23 V 51	24 Cr 52	25 Mn 55	26 Fe 56	27 Co 59	28 Ni 59	29 Cu 63,5	30 Zn 65	31 Ga 70	32 Ge 73	33 As 75	34 Se 79	35 Br 80	36 Kr 84
37 Rb 86	38 Sr 88	39 Y 89	40 Zr 91	41 Nb 92	42 Mo 96	43 Tc 98	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131
55 Cs 133	56 Ba 137	57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm 147	62 Sm 150	63 Eu 152	64 Gd 157	65 Tb 159	66 Dy 163	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175	72 Hf 178
87 Fr 226	88 Ra 226	89 Ac	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu 244	95 Am 243	96 Cm 247	97 Bk 247	98 Cf 251	99 Es 252	100 Fm 257	101 Md 258	102 No 259	103 Lr 262	104 Rf 261

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## MARKING GUIDELINE: JUNE 2018



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FREE STATE PROVINCE

**EXAMINATION / EKSAMEN**

**GRADE 10 / GRAAD 10**

**PHYSICAL SCIENCES  
FISIESE WETENSKAPPE**

**MEMORANDUM**

**JUNE 2018 / JUNIE 2018**

**MARKS: 150 / PUNTE: 150**

**TIME: 3 HOURS / TYD: 3 UUR**

**This memorandum consists of 9 pages.  
Hierdie memorandum bestaan uit 9 bladsye.**

PhySci Examination / FisWet Eksamen  
Grade 10 / Graad 10

2  
Memorandum

FS/June 2018 / VS Junie 2018

**QUESTION 1/VRAAG 1**

- 1.1 A ✓✓
- 1.2 D ✓✓
- 1.3 B ✓✓
- 1.4 D ✓✓
- 1.5 C ✓✓
- 1.6 C ✓✓
- 1.7 B ✓✓
- 1.8 D ✓✓
- 1.9 A ✓✓
- 1.10 C ✓✓

[20]

**QUESTION 2/VRAAG 2**

- 2.1.1 Heterogeneous ✓ Heterogeen ✓ (1)
- 2.1.2 Homogeneous ✓ Homogeen ✓ (1)
- 2.1.3 Heterogeneous ✓ Heterogeen ✓ (1)

- 2.2.1 From liquid ✓ to gas ✓ Van vloeistof ✓ na gas ✓ (2)

2.2.2

- ⊖ Ethanol. ✓  
→ Its boiling point is lower than that of water. ✓ (2)

- ⊖ Etanol ✓  
→ Sy kookpunt is laer as die van water. ✓

2.3

- ⊖ Magnetism / Magnetic ✓  
→ Iron is magnetic; salt is not (magnetic). ✓ (2)

- ⊖ Magnetisme / Magneties ✓  
→ Yster is magneties; sout is nie (magneties nie). ✓

2.4.1

- ⊖ Sunflower oil. ✓  
→ It is less dense than water. ✓ (2)

- ⊖ Sonneblomolie ✓  
→ Dit is minder dig as water. ✓

2.4.2 Water ✓

- ⊖  $V_{H_2O} = V_{oil/olie}$  ✓  
From/Van  $\rho = \frac{m}{v}$  ✓ OR/OF  $\rho \propto m$   
 $\rho_{H_2O} > \rho_{oil/olie}$  ✓

(4)  
[15]



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**QUESTION 3/VRAAG 3**

- 3.1 The process during which a solid ✓ changes directly into a gas (without passing through an intermediate liquid phase). ✓ (2)

*Die proses waardeur 'n vaste stof ✓ direk na 'n gas verander (sonder om deur die vloeistoffase te gaan). ✓*

- 3.2 Butter absorbs energy. ✓ The forces between particles weaken/ break. ✓ (2)  
*Botter neem energie op. ✓ Die kragte tussen deeltjies verswak/breek. ✓*

3.3.1

- ⊖ Cooling (curve) ✓  
→ The temperature decreases as time increases. ✓ (2)

⊖ Afkoeling(skurwe) ✓  
→ Die temperatuur neem af soos die tyd toeneem. ✓

- 3.3.2 80°C (✓✓) -40°C (✓✓) -40°C (✓✓) (6)

- 3.4.1 Gas (✓✓) (2)

- 3.4.2 Liquid/Vloeistof (✓✓) (2)

- 3.4.3 Solid/Vaste stof ✓ (1)

- 3.4.4 Liquid/Vloeistof ✓ (1)

- 3.5 Remain the same ✓

- ⊖ → Energy is given out (energy is absorbed) ✓ and particles move closer to one another (move further from one another). ✓ (3)

⊖ Bly dieselfde ✓  
→ Energie word uitgegee (energie word opgeneem) ✓ en deeltjies beweeg nader aan mekaar (verder vanmekaar). ✓

**[21]**

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**QUESTION 4/VRAAG 4**

- 4.1 Pure substance ✓ consisting of one type of atom. ✓ (2)  
*Suiwer stof ✓ bestaande uit een tipe atoom. ✓*
- 4.2.1 Ar/Argon ✓ (1)  
4.2.2 Si/Silicon/Silikon ✓ (1)  
4.2.3 Cl/Chlorine/Chloor ✓ (1)  
4.2.4  $1s^2 \quad 2s^2 2p^6 \quad 3s^2 3p^1$  (3)  
          ✓          ✓          ✓
- 4.2.5 Earth alkaline metals / Aard-alkalimetale ✓ (1)
- 4.3 Energy needed per mole ✓ to remove the first electron ✓ from an atom  
in the gaseous phase. ✓ (3)  
*Energie benodig per mol ✓ om die eerste elektron ✓ uit 'n atoom in die  
gasfase te verwyder. ✓*
- 4.4 Ionisation energy increases from left to right in a period. (✓✓) (2)  
*Ionisasie-energie vermeerder van links na regs in 'n periode.*
- 4.5  $1000 \text{ kJ} \cdot \text{mol}^{-1}$  ✓ (1)
- 4.6 Argon ✓ (not the symbol/nie die simbool nie) (1)
- 4.7.1 8 ✓ (1)  
4.7.2 3s ✓ (1)
- [18]**

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**QUESTION 5/VRAAG 5**

5.1 Atoms of the same element having the same number of protons ✓ but different number of neutrons. ✓ (2)  
*Atome van dieselfde element wat dieselfde aantal protone het ✓ maar verskillende hoeveelhede neutrone. ✓*

5.2 Same number of protons (atomic number) ✓; same number of electrons ✓ (2)  
*Dieselfde aantal protone (atoomgetal) ✓ ; dieselfde aantal elektrone. ✓*

5.3 Different number of neutrons ✓; different mass (mass number) ✓ (2)  
*Verskillende aantal neutrone ✓; verskillende massa (massagetal) ✓*

5.4 Same ✓



Their electron configuration is the same.  
OR They all have the same number of electrons.  
OR All three form one bond. ✓  
OR They share or transfer only one electron per atom. (2)

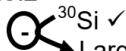
*Dieselfde ✓*



Hulle elektronkonfigurasie is dieselfde.  
OF Hulle het almal ewe veel elektrone.  
OF Al drie vorm een binding. ✓  
OF Hulle deel of dra slegs een elektron per atoom oor.

5.5.1 The number of protons ✓ in an atom ✓ (of an element). (2)  
*Die aantal protone ✓ in 'n atoom ✓ (van 'n element).*

5.5.2



Largest number of neutrons/Largest mass number ✓ (2)  
*Grootste aantal neutrone/Grootste massagetal*

5.5.3 Relative atomic mass =  $\frac{28 \times 92,23 + 29 \times 4,67 + 30 \times 3,10}{100}$  ✓  
*Relatiewe atoommassa = 28,11 ✓* (5)  
**[17]**

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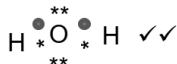
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**QUESTION 6/VRAAG 6**

6.1.1 All three/Al drie ✓

6.1.2



**Marking criteria**

- Two shared electron pairs between oxygen and hydrogen.
- Two (lone) pairs of electrons on oxygen.

**Nasienriglyne**

- Twee gedeelde elektronpare tussen suurstof en waterstof.
- Twee (alleen)pare elektrone by suurstof.

(1)

(2)

6.1.3  $2\text{C}_4\text{H}_{10} + 13\text{O}_2 \rightarrow 8\text{CO}_2 + 10\text{H}_2\text{O}$

**Marking criteria / Nasienriglyne**

Reagents correct / Reagense korrek ✓

Products correct / Produkte korrek ✓

Coefficients of reagents correct (whole numbers) / Koëffisiënte van reagense korrek (heelgetalle) ✓

Coefficients of products correct / Koëffisiënte van produkte korrek ✓

Both marks for balancing are forfeited if any reagent or products is incorrect. / Beide punte vir balansering word verbeur indien enige reagents of produk foutief is.

(4)

6.2.1  $\text{RAM} = 207 + 2(14 + 16 \times 3) + 2(1) + 32 \checkmark = 365 \checkmark$

(2)

6.2.2  $\text{RAM} = 207 + 32 + 2(1 + 14 + 16 \times 3) \checkmark = 365 \checkmark$

(2)

6.2.3 Law of conservation of mass/Wet van behoud van massa ✓

(1)

[12]

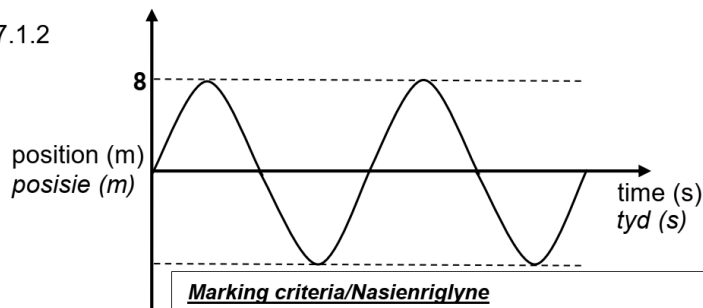
**QUESTION 7/VRAAG 7**

7.1.1 The maximum displacement of a particle ✓ from its position of rest (equilibrium position). ✓

(2)

Die maksimumverplasing van 'n deeltjie ✓ vanaf sy rusposisie (ewewigposisie). ✓

7.1.2



**Marking criteria/Nasienriglyne**

- Two complete waves; crest on far left above t-axis/Twee volledige golwe; kruin heel links bokant t-as ✓
- Amplitude correct/Amplitude korrek. ✓

(2)

7.1.3 Superposition/constructive interference (✓✓)

(2)

Superposisie/konstruktiewe interferensie

7.2.1 The distance between two successive points in phase. (✓✓)

(2)

Die afstand tussen twee opeenvolgende punte in fase.

7.2.2 Upward/Opwaarts ✓

(1)

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7.2.3

$$\begin{aligned} f &= \frac{1}{T} \checkmark \\ &= \frac{1}{5} \checkmark \\ &= 0,2 \text{ Hz} \checkmark \end{aligned}$$

OR/OF

$$\begin{aligned} f &= \frac{n}{\Delta t} \checkmark \\ &= \frac{1}{5} \checkmark \\ &= 0,2 \text{ Hz} \checkmark \end{aligned}$$

(3)

7.2.4 Positive marking from 7.2.3/Positiewe nasien vanaf 7.2.3.

**Option 1**

$$\begin{aligned} v &= f\lambda \\ &= 0,2(1,5) \\ &= 0,3 \text{ m.s}^{-1} \end{aligned}$$

**Option 2**

$$\begin{aligned} \Delta x &= v\Delta t \\ 1,5 &= v(5) \\ v &= 0,3 \text{ m.s}^{-1} \end{aligned}$$

$$\text{OR: Speed} = \frac{\text{distance}}{\text{time}}$$

$$\text{Spoed} = \frac{\text{afstand}}{\text{tyd}}$$

(3)

[15]

### QUESTION 8/VRAAG 8

8.1.1 Compression/Verdigting ✓

(1)

8.1.2 Wavelength (Accept rarefaction) ✓  
Golflengte (Aanvaar verdunning)

(1)

8.2.1 Y ✓

(2)

8.2.2 Greater amplitude ✓; same wavelength ✓  
Groter amplitude ✓; dieselfde golflengte

(2)

8.3

$$\begin{aligned} \text{Speed} &= \frac{\text{distance}}{\text{time}} \checkmark \\ &\checkmark \frac{2(225)}{\text{time}} \checkmark \\ 340 &= \frac{\text{time}}{\text{time}} \\ \text{Time} &= 1,32 \text{ m} \cdot \text{s}^{-1} \checkmark \end{aligned}$$

$$\text{Spoed} = \frac{\text{afstand}}{\text{tyd}}$$

$$\begin{aligned} \text{Speed} &= \frac{\text{distance}}{\text{time}} \checkmark \\ &\checkmark \frac{225}{\text{time}} \checkmark \\ 340 &= \frac{\text{time}}{\text{time}} \\ \text{Time} &= 0,662 \\ &\searrow \\ \text{Time} &= 2 \times 0,662 = 1,32 \text{ m} \cdot \text{s}^{-1} \checkmark \end{aligned}$$

$$\text{Spoed} = \frac{\text{afstand}}{\text{tyd}}$$

(4)

[9]

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**QUESTION 9/VRAAG 9**

- 9.1 Electrons ✓ are transferred from A to B ✓ until the spheres have the same charge ✓ and repel each other. ✓ (4)  
*Elektrone ✓ word oorgedra vanaf A na B ✓ totdat die sfere dieselfde lading het ✓ en mekaar afstoot. ✓*

9.2 
$$Q_A = \frac{-2,8 \times 10^{-6} + 4,5 \times 10^{-6}}{2} \checkmark$$
  
$$= 8,5 \times 10^{-7} \text{ C } \checkmark$$
 (3)

- 9.3 **Positive marking from 9.2/Positiewe nasien vanaf 9.2.**

**Option 1/Opsie 1**

$$\begin{aligned} \Delta Q_A &= Q_A(f) - Q_A(i) \\ &= 8,5 \times 10^{-7} - (-2,8 \times 10^{-6}) \checkmark \\ &= 3,65 \times 10^{-6} \end{aligned}$$

Number of electrons =  $\frac{3,65 \times 10^{-6}}{1,6 \times 10^{-19}} \checkmark$   
*Aantal elektrone*  
 $= 2,28 \times 10^{13} \text{ electrons/elektrone } \checkmark$

**Option 2/Opsie 2**

$$\begin{aligned} \Delta Q_B &= Q_B(f) - Q_B(i) \\ &= 8,5 \times 10^{-7} - (4,5 \times 10^{-6}) \checkmark \\ &= -3,65 \times 10^{-6} \end{aligned}$$

$$\frac{-3,65 \times 10^{-6}}{-1,6 \times 10^{-19}} \checkmark$$

(3)  
**[10]**

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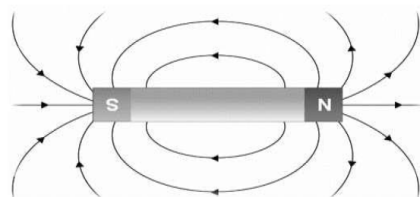
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**QUESTION 10/VRAAG 10**

10.1 A region in space where a magnet or ferromagnetic material ✓  
experiences a (non-contact) force. ✓ (2)  
'n Gebied in die ruimte waar 'n magneet of ferromagnetiese materiaal ✓  
'n (nie-kontak)krag ondervind. ✓

10.2 X: N ✓ Y: N ✓  
Every (piece of the) magnet must have two ✓ opposite poles. ✓ (4)  
Elke (deel van die) magneet moet twee ✓ teenoorgestelde pole hê. ✓

10.3

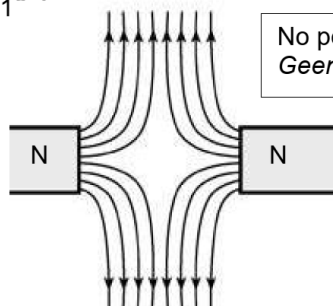


**Marking criteria/Nasienriglyne**

- Shape/Vorm ✓
- Direction/Rigting ✓
- Field lines do not touch one another./Veldlyne raak mekaar nie. ✓

(3)

10.4



No positive marking from 10.2 to 10.4.  
Geen positiewe nasien vanaf 10.2 na 10.4.

**Marking criteria/Nasienriglyne**

- Shape/Vorm ✓
- Direction/Rigting ✓
- Field lines do not touch one another./Veldlyne raak mekaar nie. ✓

(3)  
[12]

**GRAND TOTAL/GROOTTOTAAL: 150**

## MARKING GUIDELINE: JUNE 2019



**education**

Department of  
Education  
FREE STATE PROVINCE

**EXAMINATION / EKSAMEN**

**GRADE 10 / GRAAD 10**

**PHYSICAL SCIENCES  
FISIESE WETENSKAPPE**

**MEMORANDUM**

**JUNE 2019 / JUNIE 2019**

**MARKS: 150 / PUNTE: 150**

**TIME: 3 HOURS / TYD: 3 UUR**

This memorandum consists of SEVEN pages.  
*Hierdie memorandum bestaan uit SEWE bladsye.*



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### QUESTION 1 / VRAAG 1

- |     |      |      |      |     |      |     |      |
|-----|------|------|------|-----|------|-----|------|
| 1.1 | A ✓✓ | 1.2  | C ✓✓ | 1.3 | D ✓✓ | 1.4 | A ✓✓ |
| 1.5 | C ✓✓ | 1.6  | C ✓✓ | 1.7 | B ✓✓ | 1.8 | B ✓✓ |
| 1.9 | C ✓✓ | 1.10 | D ✓✓ |     |      |     |      |

[20]

### QUESTION 2 / VRAAG 2

- 2.1.1 An element is a pure substance consisting of one type of atom. ✓✓ /  
*'n Element is 'n suiwer stof wat bestaan uit een soort atoom.* (2)
- 2.1.2 A homogeneous mixture as a mixture of uniform composition ✓ and in  
which all components are in the same phase ✓ e.g. a solution of salt and  
water. / *Definieer 'n homogene mengsel as 'n mengsel van uniforme  
samestelling en waarin alle komponente in dieselfde fase is. bv. 'n  
oplossing van sout in water.* (2)
- 2.2  $H_2O$  and/ en  $NaCl$  ✓✓ ( Table salt and water)/ (*Tafelsout en water*) (2)
- 2.3 None of these substances can be separated into separate/simpler  
substances ✓ by physical methods. ✓ / *Geen van hierdie stowwe kan deur  
fisiese metodes in verskillende / eenvoudiger stowwe geskei word nie.* (2)
- 2.4 Sodium Chloride ✓ / *Natriumchloried* (1)
- 2.5.1 Si/Silicon/ *Silikon* ✓✓ (2)
- 2.5.2 Aluminium/Al ✓ and/ en Silicon/Si ✓ *Silikon/Si* (2)
- 2.5.3 Neon/Ne ✓✓ (2)
- 2.5.4 Water/ $H_2O$  ✓✓ (2)

[17]

### QUESTION 3 / VRAAG 3

- 3.1. The temperature at which a liquid changes to a solid ✓ by the removal  
of heat. ✓ / *Die temperatuur waarteen 'n vloeistof verander na 'n vaste stof  
deur die verwydering van hitte* (2)
- 3.2  $80,26\text{ }^{\circ}\text{C}$  ✓✓ (accept/aanvaar  $80\text{ }^{\circ}\text{C}$  -  $81\text{ }^{\circ}\text{C}$  ) (2)
- 3.3 The liquid remains at the same temperature for a long time while it  
changes phase. ✓✓ / *Die vloeistof bly vir 'n lang tyd by dieselfde  
temperatuur terwyl dit van fase verander.* (2)
- 3.4 Solid / *Vastestof* ✓ (2)

[8]

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**QUESTION 4 / VRAAG 4**

4.1.1  $H_2/H$  ✓ (1)

4.1.2  $H_2/H$  ✓ (1)

4.1.3 Ar ✓ (1)

4.1.4  $O_2 / O$  ✓ (1)

4.1.5 F ✓ (1)

4.1.6 Ar ✓ (1)

4.2.1 11 ✓ (1)

4.2.2  $(23-11) = 12$  ✓ ✓ (2)

4.2.3  $1s^2 2s^2 \checkmark 2p^6 3s^1 \checkmark$  (2)

4.2.4 Sodium. ✓ / *Natruim*  
Sodium has more energy levels than lithium ✓ making it to have  
larger radius / *Natrium het meer energie vlakke as litium en daarom het*  
*dit 'n groter radius.* (2)

4.2.5 Isotopes are atoms of the same element having the same number of  
protons/atomic number ✓, but different numbers of neutrons/mass  
numbers. ✓ / *Isotope is atome van dieselfde element met dieselfde*  
*aantal protone / atoomgetalle, maar verskillende getalle neutrone /*  
*massagetalle* (2)

4.2.6	11 Na 22	and	11 Na 23	Same atomic number / <i>Dieselfde atoomgetal</i>	✓
				Same symbol / <i>Dieselfde simbool</i>	✓
				Two correct different mass numbers / <i>Twee</i> <i>korrekte, verskillende massagetalle</i>	✓

(3)

4.3 Relative atomic mass of / *Relatiewe atoommassa van*  $Ag = \frac{107(51,8) \checkmark + 109(48,2) \checkmark}{100 \checkmark}$   
 $= 107,96 \checkmark$  (4)  
[22]

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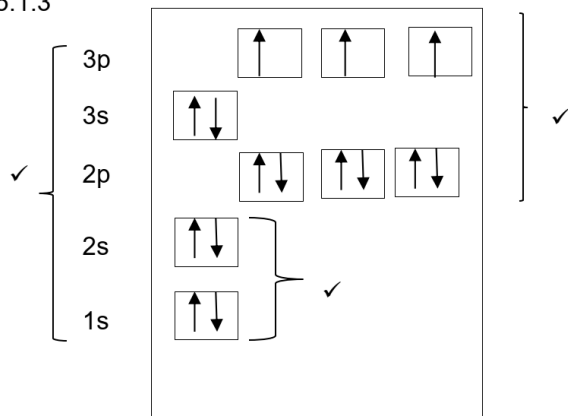
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**QUESTION 5 / VRAAG 5**

5.1.1 Energy needed (per mole) to remove electron(s) ✓ from an atom in the gaseous phase. ✓ / *Energie benodig (per mol) om elektron(e) van 'n atoom in die gasfase te verwyder.* (2)

5.1.2 Greater than/ Groter as ( $1012 \text{ kJ} \cdot \text{mol}^{-1}$ ) (2)

5.1.3



(3)

5.2.1 Ammonium ✓ Hydroxide ✓ / *Ammoniumhidroksied* (2)

5.2.2 Aluminium ✓ Oxide ✓ / *Aluminiumoksied* (2)

5.3.  $\text{Ca}^{2+}$  ✓ ✓ (2)

5.4.1.  $\text{Ca}(\text{NO}_3)_2$  ✓ ✓ (2)

5.4.2  $\text{N}_2$  ✓ ✓ (2)

5.5.1. (i) Metallic bonds ✓ / *Metaalbindings* (1)

(ii) Ionic bonds ✓ / *Ioniesebindings* (1)

5.5.2 Chemical change. ✓

A new substance, (namely magnesium oxide) will be formed during the reaction. ✓ / *Chemiese verandering.*

'n Nuwe stof (naamlik magnesiumoksied) sal tydens die reaksie gevorm word. (2)

5.5.3  $2\text{Mg(s)} + \text{O}_2\text{(g)} \rightarrow 2\text{MgO(s)}$  ✓  
another/ 'n ander ✓ for balancing/ 'n ander vir balansering (3)

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- 5.6  $M_r(\text{Mg}) = 24$   
 $M_r(\text{HNO}_3) = 1 + 14 + 3(16) = 63 \checkmark$   
 $M_r[\text{Mg}(\text{NO}_3)_2] = 24 + 2(14 + (3 \times 16)) = 148 \checkmark$   
 $M_r[\text{H}_2] = 2$   
 Mass of reactants / *Massa van reaktant*  $24 + 2(63) = 150$  }  $\checkmark$   
 Mass of products / *Massa van die produkte*  $= 148 + 2 = 150$  }  
 $\therefore$  Mass of reactant = Mass of the products  $\checkmark$  /  
 $\therefore$  *Massa van reaktant = Massa van die produkte* (4)  
**[28]**

**QUESTION 6 / VRAAG 6**

- 6.1.1 Transverse wave.  $\checkmark$  / *Transversale golf* (1)

- 6.1.2 The water particles move perpendicular  $\checkmark$  to the direction in which the wave propagates.  $\checkmark$  / *Die water deeltjies beweeg loodreg op die rigting waarin die golf voortplant.* (2)

- 6.1.3 10 cm  $\checkmark \checkmark$  (2)

- 6.1.4 12 s  $\checkmark \checkmark$  (2)

- 6.1.5 **POSITIVE MARKING FROM QUESTION 6.1.4 /  
POSITIEWE NASIEN VAN VRAAG 6.1.4**

$$f = \frac{1}{T} \checkmark$$

$$= \frac{1}{12} \checkmark$$

$$= 0,083 \text{ Hz } \checkmark$$

(3)

- 6.1.6 **POSITIVE MARKING FROM QUESTION 6.5 /  
POSITIEWE NASIEN VAN VRAAG 6.5**

OPTION 1 / OPSIE 1	OPTION 2 / OPSIE 2
$v = f\lambda \checkmark$ $2 = 0,083 \times \lambda \checkmark$ $\lambda = 24 \text{ m } \checkmark$	$v = \frac{\lambda}{T} \text{ or Speed/Spoed} = \frac{\text{distance, afstand} \checkmark}{\text{time, tyd}}$ $2 = \frac{\text{distance, afstand}}{12}$  Distance, <i>afstand</i> $= 2 \times 12 \checkmark$ $= 24 \text{ m } \checkmark$

(3)

- 6.2.1 A  $\checkmark \checkmark$  (2)

- 6.2.2 D  $\checkmark \checkmark$  (2)

- 6.2.3 A  $\checkmark$  (1)

- 6.2.4 B  $\checkmark$  (1)

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6.2.5 D ✓ (1)

6.3.1 They emit a sound wave that travels through to the medium and reflects back. ✓ They then measure the time it took for the sound wave to reflect. ✓ Since the speed of sound in the medium is known, the equation  $\text{Speed} \times \text{time} = 2(\text{distance})$  is used to calculate the distance to the object. ✓ /  
*Hulle gee 'n klankgolf uit wat deur die medium beweeg en terug reflekteer. Hulle meet dan die tyd wat dit nodig het vir die klankgolf om te reflekteer. Aangesien die spoed van klank in die medium bekend is, word die vergelyking  $\text{Spoed} \times \text{tyd} = 2(\text{afstand})$  gebruik om die afstand na die voorwerp te bereken.* (3)

6.3.2 The sound from the submarine ✓ / *Die geluid van die duikboot.* (1)

6.3.3 Sound travels faster through a liquid than through a gas. ✓✓ /  
*Klank beweeg vinniger deur 'n vloeistof as deur 'n gas.* (2)  
**[26]**

**QUESTION 7 / VRAAG 7**

7.1.1 Infrared ✓ / *infrarooi* accept: Radio waves/ *aanvaar Radiostrale* (1)

7.1.2 Gamma rays ✓ / *Gammastrale* (1)

7.1.3 Gamma rays ✓ / *Gammastrale* (1)

7.1.4 Radio waves. ✓ / *Radiostrale* (1)

7.2  $E = \frac{hc}{\lambda}$  ✓  
 $= \frac{6,63 \times 10^{-34} \times 3 \times 10^8}{2,1 \times 10^{-42}}$  ✓✓  
 $= 9,47 \times 10^{-17} \text{ J}$  ✓ (4)

7.3 Can move through a vacuum. ✓  
Speed of light is constant ( $3 \times 10^8 \text{ m} \cdot \text{s}^{-1}$ ) in a vacuum ✓  
Have properties of waves and particles  
Generated by accelerating charges. /  
*ENIGE TWEE VAN DIE VOLGENDE*  
*Kan deur 'n vakuum beweeg.*  
*Spoed van lig is konstant ( $3 \times 10^8 \text{ m} \cdot \text{s}^{-1}$ ) in 'n vakuum*  
*Het eienskappe van golwe en deeltjies*  
*Generereer deur die versnelling van ladings.* (2)  
**[10]**

PhySci Examination / FisWet Eksamen  
Grade 10 / Graad 10

7  
Memorandum

FS June 2019 / VS Junie 2019

### QUESTION 8 / VRAAG 8

- 8.1 Use a compass that consist of a small magnet ✓  
The N-pole of the compass will always point towards the S-pole of the Earth's magnetic field ✓ /  
*Gebruik 'n kompas wat uit 'n klein magneet bestaan. Die N-pool van die kompas sal altyd na die S-pool van die Aarde se magnetiese veld wys.* (2)
- 8.2 Geographic North Pole: Point in the northern hemisphere where the rotation axis of the Earth meets the surface. ✓  
Magnetic North Pole: The point where the magnetic field lines of the Earth enters the earth. It is the direction in which the north pole of a compass points. ✓ /  
*Geografiese Noordpool: Punt in die noordelike halfronde waar die rotasie-as van die Aarde aan die oppervlak ontmoet. Magnetiese Noordpool: Die punt waar die magnetiese veldlyne van die aarde die aarde binnedring. Dit is die rigting waarin die noordpool van 'n kompas wys.* (2)
- 8.3 The magnetosphere is able to deflect harmful radioactive particles that come from the sun towards earth. ✓✓ /  
*Die magnetosfeer is in staat om skadelike radioaktiewe deeltjies defekteer (af skerm) wat van die son af na die aarde kom.* (1)
- 8.4 Aurora Borealis/Northern lights. ✓ / Noordelike (1)  
[6]

### QUESTION 9 / VRAAG 9

- 9.1 Yes ✓  
Protons and electrons on the neutral ball which are equal. ✓  
*Ja, het dieselfde aantal protone en elektrone op die neutrale bal* (2)
- 9.2 Amount of particles/Aantal deeltjies 
$$= \frac{q}{1,6 \times 10^{-19}} \checkmark$$
$$= \frac{9 \times 10^{-9}}{1,6 \times 10^{-19}} \checkmark$$
$$= 5,625 \times 10^{10} \checkmark$$
 (3)
- 9.3 N is attracted to P. ✓ / N trek P aan. (1)
- 9.4.1 Electrons move ✓ from N to P ✓ / Elektrone beweeg van N na P (2)
- 9.4.2  $Q = \frac{Q_1 + Q_2}{2} \checkmark = \frac{+9 \times 10^{-9} + 0}{2} \checkmark = 4,5 \times 10^{-9} \text{ C} \checkmark$  (3)
- 9.5.1 Ball N is repelled by ball P. ✓ / Bal N word deur bal P afgestoot. (1)
- 9.5.2 Both balls has the exact same charge and like charges repel ✓ /  
*Albei balle het presies dieselfde lading en soortgelyke ladings stoot mekaar af.* (1)  
[13]

**GRAND TOTAL/GROOTTOTAAL: 150**

## MARKING GUIDELINE: NOVEMBER 2018 PAPER 1



**basic education**

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE/  
NASIONALE  
SENIOR SERTIFIKAAT**

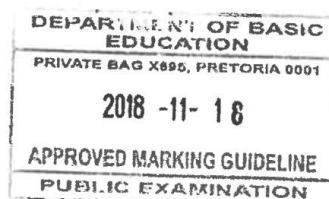
**GRADE/GRAAD 10**

**PHYSICAL SCIENCES: PHYSICS (P1)  
FISIESE WETENSKAPPE: FISIKA (V1)**

**NOVEMBER 2018**

**MARKING GUIDELINES/NASIENRIGLYNE**

**MARKS/PUNTE: 150**



**These marking guidelines consist of 12 pages.  
Hierdie nasienriglyne bestaan uit 12 bladsye.**

*Approved  
Fm Mub DBE  
18/11/2018*

*Approved  
CC DBE  
18/11/2018*

**QUESTION 1/VRAAG 1**

- 1.1 C✓✓  
1.2 C✓✓  
1.3 A✓✓  
1.4 A✓✓  
1.5 C✓✓  
1.6 A✓✓  
1.7 B✓✓  
1.8 B✓✓  
1.9 C✓✓  
1.10 C/B✓✓

[20]

**QUESTION 2/VRAAG 2**

- 2.1 The difference in position (in space). ✓✓/Die verskil in posisie in ruimte.

**OR/OF**

The change in position (of an object.)✓✓/Die verandering in posisie van 'n voorwerp. (2)

- 2.2 12 m ✓west/wes✓ or/of -12 m ✓✓

**IF/INDIEN**

- 12 m West/Wes (Award 1 mark only/Ken 1 punt toe)

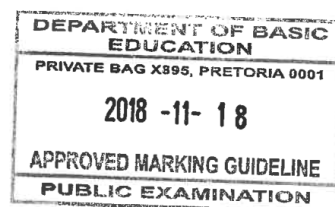
**Accept/Aanvaar**

12 m✓ left/links ✓ (2)

- 2.3 
$$v = \frac{\Delta x}{\Delta t}$$
$$= \frac{5}{30} \checkmark$$
$$= 0,17 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ west/wes } \checkmark$$

**Accept/Aanvaar**

0,17 m·s<sup>-1</sup>✓ left/links ✓ (4)





Physical Sciences P1/Fisiese Wetenskappe V1

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2.4 **POSITIVE MARKING FROM 2.2 and 2.3/POSITIEWE NASIEN VANAF 2.2.en2.3**

$$\text{Speed} = \frac{\text{distance}}{\text{time}} / \text{Spoed} = \frac{\text{afstand}}{\text{tyd}}$$

$$(0,17)(2) \checkmark = 0,34 \text{ m} \cdot \text{s}^{-1}$$

$$0,34 \checkmark = \frac{12}{\Delta t} \checkmark$$

$$\Delta t = 35,29 \text{ s} \checkmark$$

(4)  
[12]

**QUESTION 3/VRAAG 3**

- 3.1 **Motion with uniform velocity:** Motion at constant velocity. ✓✓/ Motion with zero or no acceleration.

**Beweging met uniforme snelheid:** Beweging teen konstante snelheid./ Beweging met nul of geen versnelling.

**Uniform accelerated motion:** Motion with constant acceleration. ✓✓/ Velocity changes with the same amount during each time interval. ✓✓/ Motion during which the velocity changes with a constant amount per unit time. ✓✓/

**Uniforme versnelde beweging:** Beweging met konstante versnelling/Snelheid verander met dieselfde hoeveelheid gedurende elke tydinterval/Beweging waartydens die snelheid met 'n konstante hoeveelheid per eenheid tyd verander.

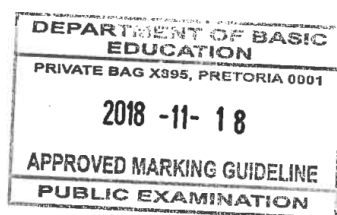
(4)

- 3.2.1 Motion with uniform velocity ✓/Beweging met uniforme snelheid

(1)

- 3.2.2 Uniform accelerated motion ✓/Uniforme versnelde beweging

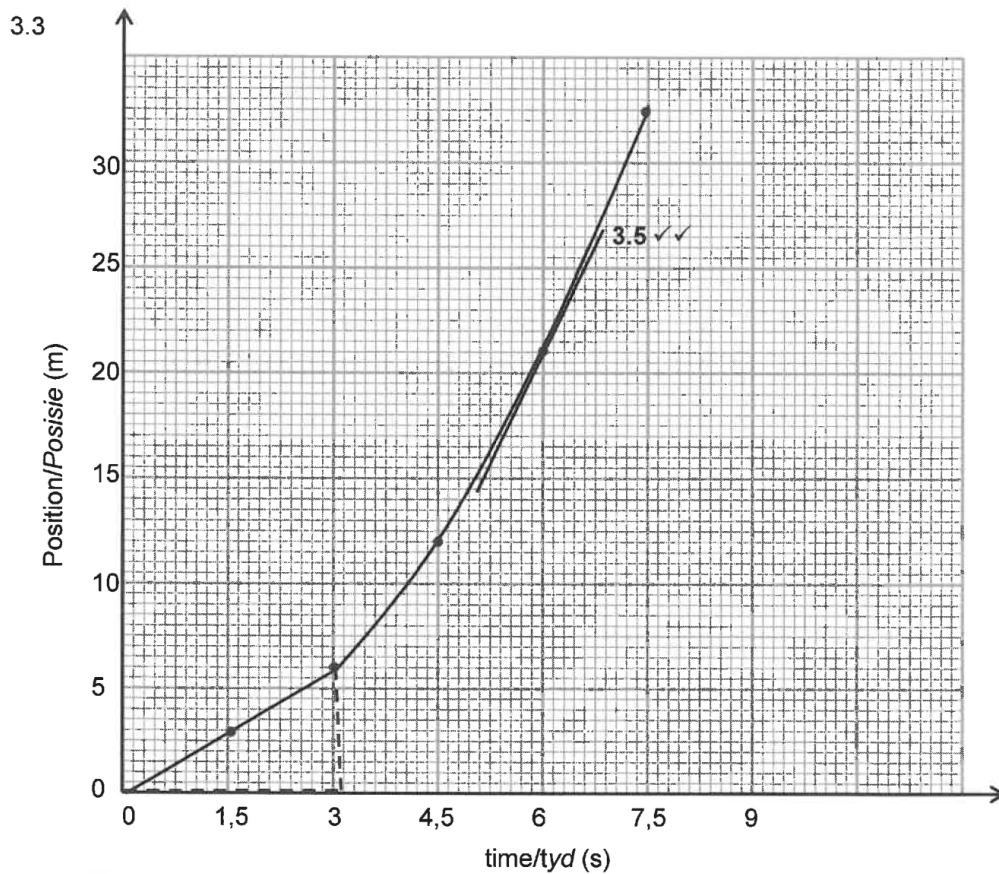
(1)



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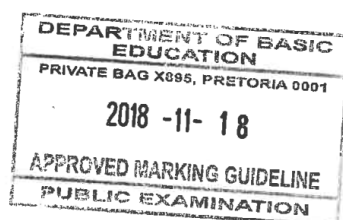
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**MARKING GUIDELINES/NASIENRIGLYNE**

- ✓ x-axis and units correctly labelled/x-as en eenhede korrek gemerk
- ✓ y-axis and units correctly labelled/y-as en eenhede korrek gemerk
- ✓ 2 points correctly plotted and joined/2 punte korrek gestip en verbind
- ✓ shape of the graph (0 – 3 s/vorm van die grafiek(0 – 3s) / straight line/reguitlyn
- ✓ shape of graph 3 – 7,5 s curved / vorm van grafiek 3 – 7,5 s kurwe / tangent / raaklyn

(5)



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- 3.4 Instantaneous velocity: rate of change in position. ✓✓/Oombliklike snelheid: tempo van verandering in posisie.

**OR/OF**

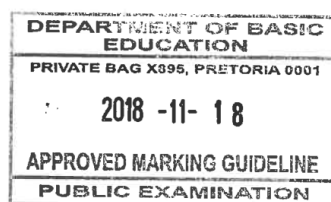
Displacement divided by a very small time interval. ✓✓/Verplasing gedeel deur 'n baie klein tydinterval.

**OR/OF**

Velocity at a particular time. ✓✓/Snelheid op 'n spesifieke tyd. (2)

- 3.5 Refer to the graph./Verwys na die grafiek.  
(Tangent to the curve/ Raaklyn aan kurwe) (2)

3.6 
$$v = \frac{\Delta x}{\Delta t}$$
$$= \frac{6-0}{3-0} \checkmark$$
$$= 2 \text{ m} \cdot \text{s}^{-1} \checkmark \quad \text{right/regs} \checkmark$$



(4)  
[19]

**QUESTION 4/VRAAG 4**

- 4.1 The rate of change of velocity. ✓✓/Die tempo van verandering van snelheid. (2)

4.2.1  $v_f = v_i + a\Delta t \checkmark$   
 $0 \checkmark = 15 + (-4,5)\Delta t \checkmark$   
 $\Delta t = 3,33 \text{ s} \checkmark$

**OR/OF**

$v_f = v_i + a\Delta t \checkmark$   
 $0 \checkmark = -15 + (4,5)\Delta t \checkmark$   
 $\Delta t = 3,33 \text{ s} \checkmark$  (4)

4.2.2 **OPTION 1/OPSIE 1**  
 $v_f^2 = v_i^2 + 2a\Delta x \checkmark$   
 $0^2 \checkmark = 15^2 + 2(-4,5)\Delta x \checkmark$   
 $\Delta x = 25 \text{ m} \checkmark$

**OPTION 2/OPSIE 2**

**POSITIVE MARKING FROM 4.2.1/POSITIEWE NASIEN VANAF 4.2.1**

$\Delta x = \left( \frac{v_f + v_i}{2} \right) \Delta t \checkmark$   
 $= \left( \frac{0 + 15}{2} \right) (3,33) \checkmark$   
 $= 24,98 \text{ m} \checkmark$

**OPTION 3/OPSIE 3**

**POSITIVE MARKING FROM 4.2.1/POSITIEWE NASIEN VANAF 4.2.1**

$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \checkmark$   
 $= (15)(3,33) \checkmark + \frac{1}{2} (-4,5)(3,33)^2 \checkmark$   
 $\Delta x = 25 \text{ m} \checkmark$

(4)

4.3 **OPTION 1/OPSIE 1**

$$v_f^2 = v_i^2 + 2a\Delta x \checkmark$$

$$0^2 \checkmark = 30^2 + 2(-4,5)\Delta x \checkmark$$

$$\Delta x = 100 \text{ m} \checkmark$$

Car B  $\checkmark$  has a larger stopping distance (100 m > 25 m)  $\checkmark$  / Kar B het 'n groter stopafstand (100 m > 25 m).

**OPTION 2/OPSIE 2**

$$v_f = v_i + a\Delta t \checkmark$$

$$0 \checkmark = 30 + (-4,5)\Delta t \checkmark$$

$$\Delta t = 6,67 \text{ s} \checkmark$$

Car B  $\checkmark$  it takes longer to stop hence larger stopping distance  $\checkmark$  / Kar B dit neem langer om tot stilstand te kom dus 'n groter stopafstand

**IF/INDIEN**

Car B  $\checkmark$  it has a higher velocity than car A and therefore have a larger stopping distance at the same acceleration  $\checkmark$  Max: (2/6)

Kar B dit het 'n hoër snelheid as kar A en het dus 'n groter stopafstand met dieselfde versnelling Maks: (2/6)

(6)

- 4.4 The greater/larger the speed, the larger the stopping distance  $\checkmark$  if acceleration is constant.  $\checkmark$  / Hoe groter die spoed, hoe groter die stopafstand indien versnelling konstant is.

(2)  
[18]

**QUESTION 5/VRAAG 5**

- 5.1 The energy an object has because of its position in the gravitational field  $\checkmark$  relative to some reference point.  $\checkmark$  / Die energie wat 'n voorwerp het as gevolg van die posisie daarvan in die gravitasieveld relatief tot 'n sekere verwysingspunt.

(2)

- 5.2  $E_p = mgh \checkmark$   
 $= (65)(9,8)(4,5) \checkmark$   
 $= 2\,866,5 \text{ J} \checkmark$

(3)

- 5.3 The net/total mechanical energy (sum of kinetic and gravitational potential energy) in an isolated/closed system  $\checkmark$  remains constant/ is conserved.  $\checkmark$  / Die netto/totale meganiese energie in 'n geïsoleerde/geslote sisteem bly konstant/bly konstant.

(2)

- 5.4  $(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}} \checkmark$   
 $mgh + 0 = mgh + \frac{1}{2}mv^2$   
 $(65)(9,8)(4,5) \checkmark = 0 + \frac{1}{2}(65)v^2 \checkmark$   
 $v = 9,39 \text{ m}\cdot\text{s}^{-1} \checkmark$

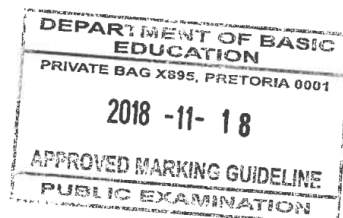
**OR/OF**

$$(E_p + E_k)_{\text{top/bo}} = (E_p + E_k)_{\text{bottom/onder}} \checkmark$$

$$mgh + 0 = mgh + \frac{1}{2}mv^2 \checkmark$$

$$2\,866,5 \checkmark = 0 + \frac{1}{2}(65)v^2 \checkmark$$

$$v = 9,39 \text{ m}\cdot\text{s}^{-1} \checkmark$$



(4)

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5.5

**OPTION 1/OPSIE 1**

$$\begin{aligned} (E_p + E_k)_{\text{top/bo}} &= (E_p + E_k)_{\text{bottom/onder}} \quad \checkmark \\ mgh + 0 &= mgh + \frac{1}{2}mv^2 \quad \checkmark \\ (65)(9,8)h \quad \checkmark + 0 &= 0 + \frac{1}{2} \times 65 \times (9,39)^2 \quad \checkmark \\ 637 h &= 2\,865,6 \\ h &= 4,49 \text{ m} \end{aligned}$$

No✓/Nee.  $h = 4,49 \text{ m} < 6 \text{ m}$ ✓

**OPTION 2/OPSIE 2**

$$\begin{aligned} E_p \text{ at Y} &= mgh \quad \checkmark \\ &= (65)(9,8)(6) \quad \checkmark \\ &= 3\,822 \text{ J} \quad \checkmark \end{aligned}$$

$E_{\text{mech}} < E_p \text{ at Y}$  ✓ therefore he will not reach point Y ✓ /  $E_{\text{meg}} < E_p \text{ by Y}$  daarom sal hy nie punt Y bereik nie

(5)  
[16]

**QUESTION 6/VRAAG 6**

6.1

Difference/Verskil	Similarity/Ooreenkoms
Amplitudes✓	Wavelength✓/Golflengte Period/Tydperk Frequency/Frekwensie Transverse/Transversaal (Any one)/(Enige een)

(2)

6.2.1 A and/en B✓

OR/OF

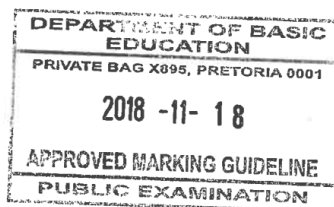
C and/en D✓

OR/OF

B and/en C

OR/OF

A and/en D



(1)

6.2.2 15 (mm) ✓

(1)

6.3 The number of waves/wave pulses✓ passing a point per second.✓ / Die getal golwe/golfpulse wat per sekonde by 'n punt verby beweeg.

(2)

6.4.1

$$\begin{aligned} f &= \frac{1}{T} \quad \checkmark \\ &= \frac{1}{1,5} \quad \checkmark \\ &= 0,67 \text{ Hz} \quad \checkmark \end{aligned}$$

(3)

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6.4.2	<b>POSITIVE MARKING FROM 6.4.1</b> <b>POSITIEWE NASIEN VANAF 6.1</b> <b>OPTION 1/OPSIE 1</b> $v = f\lambda$ ✓ $= (0,67)(0,1)$ ✓ $= 0,067 \text{ m} \cdot \text{s}^{-1}$ ✓	<b>OPTION 2/OPSIE 2</b> $v = \frac{\Delta x}{\Delta t}$ or/of speed = $\frac{\text{distance}}{\text{time}}$ ✓ $= \frac{0,1}{1,5}$ ✓ $= 0,067 \text{ m} \cdot \text{s}^{-1}$	(3) [12]
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### QUESTION 7/VRAAG 7

- 7.1.1 What is the relationship between the speed of sound and temperature? ✓✓/  
Wat is die verband tussen die spoed van klank en temperatuur?

#### OR/OF

How will the temperature affect the speed of sound? ✓✓/Hoe sal die temperatuur die spoed van klank beïnvloed?

#### OR/OF

What is the relationship between the time taken for the sound to travel and temperature? ✓✓/ Wat is die verband tussen die spoed van klank en temperatuur?

#### Marking criteria/Nasienriglyne:

Dependent and independent variables correctly identified. ✓

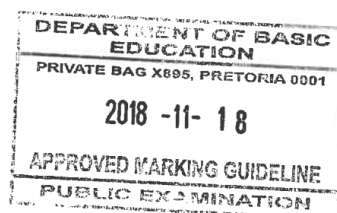
Afhanklike en onafhanklike veranderlikes korrek geïdentifiseer.

Ask a question about the relationship between the independent and dependent variables./Vra 'n vraag oor die verwantskap tussen die afhanklike en onafhanklike veranderlikes. ✓

- 7.1.2 Temperature ✓/Temperatuur (1)

- 7.1.3 Speed of sound ✓/Time taken for the sound to travel./Spoed van klank/Tyd geneem vir die klank om te beweeg. (1)

- 7.2  $v = \frac{\Delta x}{\Delta t}$  or/of speed =  $\frac{\text{distance}}{\text{time}}$  ✓  
 $= \frac{50}{0,146}$  ✓  
 $= 342,47 \text{ m} \cdot \text{s}^{-1}$  ✓



- 7.3 The speed of sound increases / time taken for the sound to travel decreases / as the temperature increases. ✓✓/Die spoed van klank neem toe / tyd geneem vir die klank om te beweeg neem af soos die temperatuur toeneem. (2)

- 7.4 Echo ✓/Eggo (1)  
[10]

### QUESTION 8/VRAAG 8

- 8.1 Accelerating charges ✓/Versnelde ladings (1)

- 8.2 Gamma rays ✓/Gammastrale (1)

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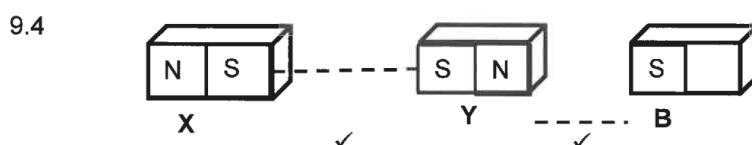
- 8.3 It has the highest frequency ✓ Energy is directly proportional to frequency ✓ /  
 $E \propto f$  /  
*Dit het die hoogste frekwensie. Energie is direk eweredig aan die frekwensie/*  
 $E \propto f$  (2)

- 8.4.1
- | OPTION 1/OPSIE 1   | OPTION 2/OPSIE 2  |
|--|---|
| $c = f\lambda$ ✓<br>$3 \times 10^8 = f(600 \times 10^{-10})$ ✓<br>$f = 5 \times 10^{15} \text{ Hz}$ ✓<br>Ultraviolet ✓/Ultraviolet | $E = \frac{hc}{\lambda}$<br>$= \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{600 \times 10^{-10}}$ ✓<br>$= 3,315 \times 10^{-18} \text{ J}$<br><br>$E = hf$<br>$3,315 \times 10^{-18} = (6,63 \times 10^{-34})f$<br>$f = 5 \times 10^{15} \text{ Hz}$ ✓<br>Ultraviolet ✓/Ultraviolet |
- ✓ Any one  
Enige een
- (4)

- 8.4.2 **POSITIVE MARKING FROM 8.4.1/POSITIEWE NASIEN VANAF 8.4.1**  
 Sterilisation of medical equipment. ✓/ Sterilisasie van mediese toerusting  
 Suntan beds /Sonbeddens  
 Security in currency/Veiligheid in valuta  
 Astronomy/ Astronomie  
**(Any one/Any relevant use/Enige een/Enige relevante gebruik)** (1)  
**[9]**

**QUESTION 9/VRAAG 9**

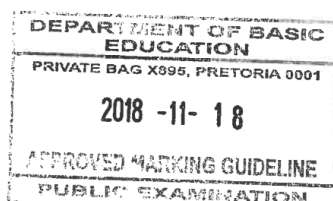
- 9.1 Ferromagnetic (material) ✓/Ferromagneties (materiaal) (1)
- 9.2 B ✓ (1)
- 9.3 South ✓/Suid (1)



**OR/OF**

Magnets X repels Y/ South pole ✓/Magneet X stoot Y af / Suidpool

Magnet Y attracts B/ South pole at B ✓/Magneet Y trek B aan / Suidpool by B (2)



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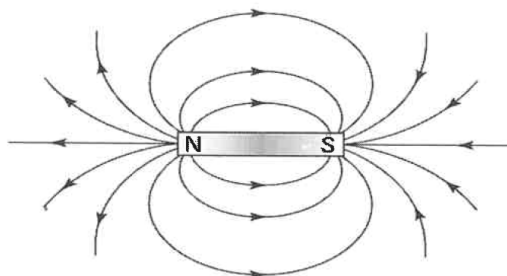
Physical Sciences P1/Fisiese Wetenskappe V1

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9.5



Marking criteria/Nasienkriteria	
Correct direction of field lines/Korrekte rigting van veldlyne	✓
Shape of the magnetic field/Vorm van die magneetveld	✓
No field lines crossing each other/Geen veldlyne kruis mekaar nie.	✓

(3)

9.6.1 Less than 5 cm ✓ / Minder as 5 cm

(1)

9.6.2 Magnitude of magnetic force is inversely proportional to the distance. ✓ B, is no longer attracting Y to the right ✓  
Grootte van magnetiese krag is omgekeerd eweredig aan die afstand. B, trek nie meer Y na regs aan nie

**OR/OF**

A decrease in distance increases the magnetic force. ✓ B, is no longer attracting Y to the right ✓

'n Afname in afstand laat die magnetiese krag toeneem, B, trek nie meer Y na regs aan nie

(2)  
[11]

### QUESTION 10/VRAAG 10

10.1  $n = \frac{Q}{e} \checkmark \text{ or/of } \frac{Q}{q_e}$   
 $30 = \frac{Q}{-1,6 \times 10^{-19}} \checkmark$   
 $Q = -4,8 \times 10^{-18} \text{ C } \checkmark$

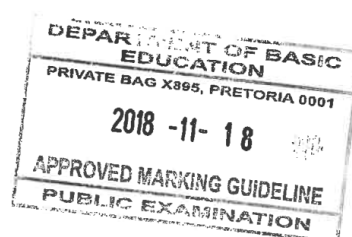
**Accept/Aanvaar**

$n = \frac{Q}{e} \checkmark \text{ or/of } \frac{Q}{q_e}$   
 $30 = \frac{Q}{1,6 \times 10^{-19}} \checkmark$   
 $Q = 4,8 \times 10^{-18} \text{ C } \checkmark$

(3)

10.2 Unlike/opposite charges ✓ attract ✓ / Ongelyksoortige/teenoorgestelde ladings trek mekaar aan.

(2)





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- 10.3 The net/total charge in an isolated/closed system remains constant/is conserved ✓✓ Die netto/totale lading in 'n geïsoleerde/geslote sisteem bly konstant. (2)

**NOTE/LET WEL:**

If any of the underlined words/phrases are omitted in the correct context: minus 1 mark.)

Indien enige van die onderstreepte woorde/frases in die korrekte konteks weggelaat is: minus een punt.)

- 10.4 **POSITIVE MARKING FROM 10.1/POSITIEWE NASIEN VANAF 10.1**

$$Q_{\text{net/netto}} = \frac{Q_1 + Q_2}{2} \checkmark$$

$$= \frac{4 \times 10^{-18} + (-4,8 \times 10^{-18})}{2} \checkmark$$

$$= -4 \times 10^{-19} \text{ C} \checkmark$$

(4)  
[11]

**QUESTION 11/VRAAG 11**

- 11.1.1 (a)  $V_1 = 24 \text{ (V)}$  ✓ (1)

- (b)  $A_1 = 0 \text{ (A)}$  ✓ (1)

- 11.1.2 **OPTION 1/OPSIE 1**

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} \checkmark$$

$$= \frac{1}{8} + \frac{1}{8} \checkmark$$

$$R_p = 4 \Omega$$

$$R_T = R_s + R_p$$

$$= 8 + 4 \checkmark$$

$$= 12 \Omega \checkmark$$

**OPTION 2/OPSIE 2**

$$R_p = \frac{\text{product / produk}}{\text{sum / som}} \checkmark$$

$$= \frac{(8)(8)}{8 + 8} \checkmark$$

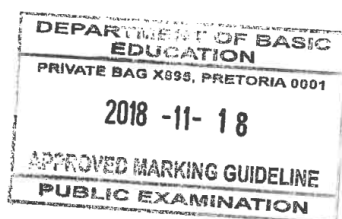
$$= 4 \Omega$$

$$R_T = R_s + R_p$$

$$= 8 + 4 \checkmark$$

$$= 12 \Omega \checkmark$$

(4)



Physical Sciences P1/Fisiese Wetenskappe V1

12

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CAPS/KABV – Grade10/Graad 10 – Marking Guidelines/Nasienriglyne

11.1.3

**OPTION 1/OPSIE 1**

V divides in a ratio 8 : 4 ✓ (series)/V verdeel in 'n verhouding 8 : 4 (serie)

$$V_2 = \frac{8}{12} \times 24 \checkmark \text{ or/of } V_2 = \frac{2}{3} \times 24 \\ = 16 \text{ V } \checkmark$$

**OPTION2 / OPSIE 2**

**POSITIVE MARKING FROM 11.1.2/POSITIEWE NASIEN VANAF 11.2.1**

$$V = IR$$

$$24 = I(12)$$

$$I = 2 \text{ A}$$

$$V = IR \checkmark \\ = (2)(8) \checkmark \\ = 16 \text{ V } \checkmark$$

(3)

11.1.4  $A_2 = A_3$  . ✓

(1)

11.2.1 Resistance is directly proportional to the length of the conducting wire. ✓/  
Weerstand is direk eweredig aan die lengte van die geleidingsdraad.

**OR/OF**

As the length of the wire increases, the resistance increases./Soos die lengte  
van die geleidingsdraad toeneem, neem die weerstand toe

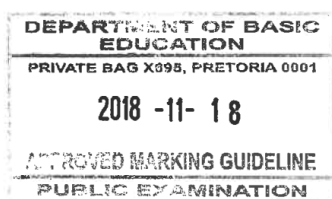
(1)

11.2.2  $1,35 \Omega$  ✓ (Range/Variasiewydte:  $1,3 \Omega$  to/tot  $1,4 \Omega$ )

(1)

**[12]**

**TOTAL/TOTAAL: 150**



## MARKING GUIDELINE: NOVEMBER 2018 PAPER 2



### basic education

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**GRADE/GRAAD 10**

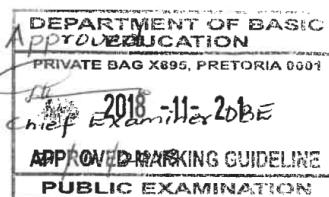
**PHYSICAL SCIENCES: CHEMISTRY (P2)  
FISIESE WETENSKAPPE: CHEMIE (V2)**

**NOVEMBER 2018**

**MARKING GUIDELINES/NASIENRIGLYNE**

**MARKS/PUNTE: 150**

Approved  
Beyers  
DBE: INT. MOD  
2018: 11: 21



**These marking guidelines consist of 10 pages.  
Hierdie nasienriglyne bestaan uit 10 bladsye.**

**NOTE/NOTA:** Ignore 1.4/ Ignoreer 1.4 and  
Question 8.4 molecular formula not in CAPS /Vraag 8.4 molekulere  
formule nie in KABV  
**MARKS/PUNTE: 141**

Physical Sciences P1/Fisiese Wetenskappe V1 2  
CAPS/KABV – Grade10/Graad 10 – Marking Guidelines/Nasienriglyne

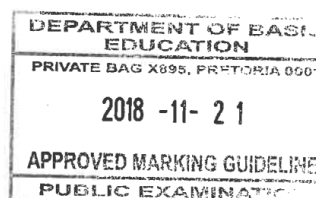
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**QUESTION 1/VRAAG 1**

- 1.1 C ✓✓ (2)  
1.2 C ✓✓ (2)  
1.3 B ✓✓ (2)  
1.4 (Ignore this question/Ignoreer hierdie vraag)  
1.5 A ✓✓ (2)  
1.6 D ✓✓ (2)  
1.7 C ✓✓ (2)  
1.8 C ✓✓ (2)  
1.9 D ✓✓ (2)  
1.10 C ✓✓ (2)  
**[18]**

**QUESTION 2/VRAAG 2**

- 2.1 A pure substance consisting of one type of atom. ✓✓/In Suiwer stof wat uit een tipe atoom bestaan. (2)  
2.2.1 P ✓ (1)  
2.2.2 Q ✓ (1)  
2.2.3 R ✓ (1)  
2.3 Element ✓ (1)  
2.4 Evaporation ✓/Verdamping (1)  
2.5.1 Q: Boiling point ✓/Kookpunt (1)  
2.5.2 R: Magnetism ✓/Magnetisme (1)  
**[9]**



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**QUESTION 3/VRAAG 3**

3.1 The temperature of the liquid at which the vapour pressure equals the external (atmospheric) pressure. ✓✓/Die temperatuur van die vloeistof waarteen die dampdruk aan die eksterne (atmosferiese) druk gelyk is. (2)

3.2.1 80 °C ✓ (1)

3.2.2 D ✓ (1)

3.2.3 C ✓ (1)

3.3 Liquid changes to gas ✓/Vloeistof verander na gas (1)

3.4 Remains the same. ✓/Bly dieselfde (1)

3.5 Energy is used to overcome the intermolecular forces. ✓/Energie word gebruik om die intermolekulêre kragte te oorkom.  
No energy available to increase the kinetic energy of the particles. ✓/Geen energie beskikbaar om die kinetiese energie van die partikels te verhoog nie. (2)

3.6 A ✓  
Lowest boiling point. ✓✓/Laagste kookpunt

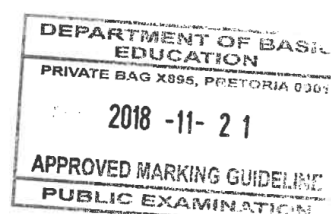
**OR/OF**

Highest vapour pressure at a specific temperature./Hoogste dampdruk by 'n spesifieke temperatuur (3)

3.7 Vapour pressure increases with an increase in temperature. ✓✓/Dampdruk verhoog wanneer temperatuur verhoog.

**OR/OF**

Vapour pressure is proportional to temperature. ✓✓/Dampdruk is direk eweredig aan temperatuur. (2)  
**[14]**



### QUESTION 4/VRAAG 4

4.1 The number of protons in an atom of an element ✓✓ / Die aantal protone in 'n atoom van 'n element (2)

4.2.1  $^{30}_{14}\text{Si}$  ✓✓  $^{28}_{14}\text{Si}$  ✓

- Identification of element (Si) / Identifiseer element (Si) ✓
- Correct mass number and atomic number (A and Z) / Korrekte massagetal en atoomgetal (A en Z) ✓
- No mark for swopping of A and Z / Geen punt indien A en Z omgeruil word

4.2.2 P ✓ / Sodium / Na / Natrium (1)

4.2.3  $\text{S}^{2-}$  ✓✓

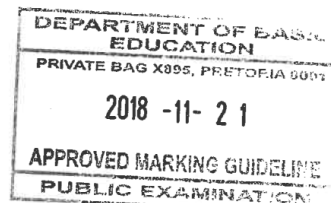
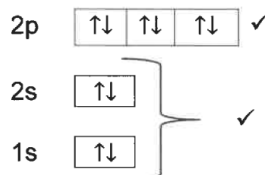
- Identification of correct element (S) / Identifiseer korrekte element (S) ✓
- Correct charge (2-) / Korrekte lading (2-) ✓
- Incorrect identification of element / Verkeerde element (0/2)

4.3.1  $\text{Rb}_2\text{O}$  ✓✓ (2)

4.3.2 Rb is in the same group as P / Na ✓ / Rb is in dieselfde groep as P / Na  
**OR/OF** Rb is in group 1 / Rb is in groep 1  
∴ has the same valency as P / Na. ✓ / ∴ het dieselfde valensie as P / Na. (2)

4.4 Increases. ✓ / Neem toe  
From P to R, the atomic radius gets smaller. ✓ **OR/OF** The outer electrons get closer to the nucleus.  
Van P na R raak die atomiese radius kleiner. / Die buite-elektrone kom nader aan die kern.  
The attraction between the nucleus and the outer electron gets stronger ✓ ∴ more energy is needed to remove the electrons. ✓ / Die aantrekkingskrag tussen die kern en die buite-elektrone raak sterker ∴ meer energie is nodig om die elektrone te verwyder. (4)

4.5 10 (electrons) ✓



4.6 Hund's rule ✓ / Hund se reël (1)

KE  
B

4.7 Relative atomic mass/*Relatiewe atoommassa*:

$$A_r = \frac{(28 \times 92,23 + 29 \times 4,68 + 30 \times 3,09)}{100} \checkmark$$

$$= 28,11 \text{ (u)} \checkmark$$

(3)  
[22]

**QUESTION 5/VRAAG 5**

- 5.1 A change in which no new substances are formed. ✓✓*I'n Verandering waarin geen nuwe stowwe gevorm word nie.*

**OR/OF**

A change in which energy changes are small in relation to chemical changes. ✓✓*I'n Verandering waarin energieveranderinge klein is in vergelyking met chemiese veranderinge.*

**OR/OF**

A change in which mass, number of atoms and molecules are being conserved. ✓✓*I'n Verandering waarin massa, getal atome en molekule behoue bly.* (2)

- 5.2.1 X ✓ (1)

- 5.2.2 Y ✓ (1)

- 5.3 Sublimation. ✓*I/Sublimasie* (1)

- 5.4 Colour change. ✓*I/Kleurverandering* (1)

Formation of gas ✓*I/Vorming van gas*

Formation of a precipitate ✓*I/Vorming van 'n neerslag*

Change in temperature ✓*I/Verandering in temperatuur* (Any two/*Enige twee*) (2)

- 5.5.1 Heat. ✓*I/Hitte* (1)

- 5.5.2  $4\text{Fe(s)} + 3\text{O}_2\text{(g)} \rightarrow 2\text{Fe}_2\text{O}_3\text{(s)}$  (4)

**Notes/Aantekeninge**

- Reactants✓; products✓; phases✓; balancing✓  
*Reaktanse/produkte/fases/balansering*

Marking rule 6.3.10./*Nasienreël 6.3.10.*

- 5.6.1 States that, no matter how a chemical compound is prepared, it always contains the same elements in the same proportion by mass. ✓✓*I/Stel dit dat dit nie saak maak hoe 'n chemiese binding berei word nie; dit bevat altyd dieselfde elemente in dieselfde verhouding by massa.* (2)

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5.6.2 **OPTION 1/ OPSIE 1:**

Mass of CO<sub>2</sub> in the 1<sup>st</sup> sample/Massa van CO<sub>2</sub> in die 1<sup>ste</sup> monster

$$= 20 - 11,2 \checkmark$$

$$= 8,8 \text{ g}$$

Proportion of CO<sub>2</sub> in the 1<sup>st</sup> sample/Verhouding van CO<sub>2</sub> in die 1<sup>ste</sup> monster

$$= \frac{8,8}{20} \checkmark$$

∴ Mass of CO<sub>2</sub> in the 2<sup>nd</sup> sample/Massa van CO<sub>2</sub> in die 2<sup>de</sup> monster

$$= \frac{8,8}{20} \times 30 \checkmark$$

$$= 13,2 \text{ g} \checkmark$$

(4)

OPTION 2/ OPSIE 2:	OPTION 3/ OPSIE 3:
100 g CaCO <sub>3</sub> → 44 g CO <sub>2</sub> ✓ 30 g CaCO <sub>3</sub> → x g CO <sub>2</sub> ✓	20 g CaCO <sub>3</sub> → 11,2 g CaO ✓ 30 g CaCO <sub>3</sub> → x g CaO ✓
$x = \frac{30 \times 44}{100} \checkmark$	$x = 16,83 \text{ g CaO}$
$x = 13,2 \text{ g} \checkmark$	∴ Mass of CO <sub>2</sub> in the 2 <sup>nd</sup> sample/ Massa van CO <sub>2</sub> in die 2 <sup>de</sup> monster = 30 – 16,83 ✓ = 13,2 g ✓

[18]

**QUESTION 6/VRAAG 6**

6.1.1 A ✓

6.1.2 B ✓

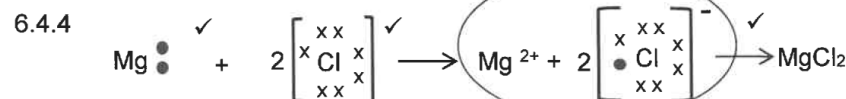
6.2 It is formed when a pool of delocalised electrons ✓ surround the positive metal ion core. ✓ / Rooster metaal ione met wolk/poel gedelokaliseerde elektrone wat positiewe ionkerne omring (2)

6.3 Ionic (bond) ✓ / Ioniese (binding) (1)

6.4.1 A pure substance consisting of two or more different elements. ✓ ✓ / 'n Suiwer stof wat uit twee of meer verskillende elemente bestaan. (2)

6.4.2 Alkali earth ✓ (metals) / Aardalkali (metale) (1)

6.4.3 1 (one/een) ✓ (1)



(3)  
[12]

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### QUESTION 7/VRAAG 7

7.1 Hydrated: surrounded by water molecules ✓ / Gehidrateer: omring deur water molekules (1)

7.2  $\text{Na}_2\text{CO}_3(\text{s}) \rightarrow 2\text{Na}^+(\text{aq}) + \text{CO}_3^{2-}(\text{aq})$   
Products: ✓ Balancing: ✓ / Produkte: / Balansering: (2)

7.3.1 The amount of a substance having the same number of particles as there are atoms in 12 g carbon-12. ✓ ✓ / Die hoeveelheid van 'n stof met dieselfde getal partikels as wat daar atome in 12 g koolstof-12 is. (2)

7.3.2 Acid-base ✓ / gas forming (reaction) / Suur-basis / gasvormend (reaksie) (1)

7.3.3  $c(\text{HCl}) = \frac{n(\text{HCl})}{V(\text{HCl})}$  ✓  
 $1 = \frac{n(\text{HCl})}{0,005}$  ✓  
 $n = 0,005 \text{ mol}$  ✓ (3)

### 7.4 POSITIVE MARKING FROM 7.3.3/ POSITIEWE NASIEN VANAF 7.3.3

$$n(\text{NaCl}) : n(\text{HCl}) = 1 : 1$$

$$n(\text{NaCl}) = \frac{1}{1} \times 0,005 \text{ ✓}$$

$$n(\text{NaCl}) = 0,005 \text{ mol}$$

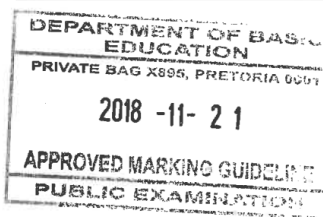
$$n(\text{NaCl}) = \frac{m}{M} \text{ ✓}$$

$$0,005 \text{ ✓} = \frac{m}{58,5 \text{ ✓}} \text{ ✓}$$

$$m = 0,29 \text{ g ✓}$$

Marking criteria/Nasienriglyne:

- Using ratio / **Gebruik** verhouding ✓
- Formula / **Formule**  $n = \frac{m}{M}$  ✓
- Substituting of / **Inervanging** van 0,005 mol ✓ &  $58,5 \text{ g} \cdot \text{mol}^{-1}$  ✓ in  $n = \frac{m}{M}$
- Final answer / **Finale antwoord**: 0,29 g ✓



(5)  
[14]

### QUESTION 8/VRAAG 8

8.1 A solution that conducts electricity ✓ ✓ (through the movement of ions). / 'n Oplossing wat elektrisiteit deur die beweging van ione gelei. (2)  
**NOTE/LET WEL:** If learners refer to movement of electrons, a mark is forfeited / **Indien leerder verwys na beweging van elektrone, penaliseer met 1 punt.**

8.2.1 What is the relationship between a type of substance and its (electrical) conductivity? ✓ ✓ / Wat is die verwantskap tussen 'n tipe stof en sy (elektriese) geleidingsvermoë?

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S

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**OR/OF**

How does a type of substance affect the (electrical) conductivity of a substance? ✓✓/Hoe beïnvloed 'n tipe stof die (elektriese) geleidingsvermoë van 'n stof?

(2)

**Marking Criteria/Nasienriglyne:**

Dependent and independent variable correctly stated.

✓

Afhanklike en onafhanklike veranderlikes korrek genoem.

Ask a question about the relationship between the independent and dependent variables.

✓

Vra 'n vraag oor die verwantskap tussen die onafhanklike en afhanklike veranderlikes.

8.2.2 Conductivity ✓/Geleidingsvermoë

(1)

8.2.3 Type of a substance ✓/Tipe stof

(1)

8.2.4 Mass OR Temperature ✓/Massa OF Temperatuur

(1)

8.3.1 A solution of  $\text{CaCl}_2$  ✓/In Oplossing  $\text{CaCl}_2$

It is the strongest electrolyte ✓/Dit is die sterkste elektroliet.

**OR/OF**

It has the highest concentration of (chloride) ions ✓/Dit het die grootste getal (chloried) ione.

(2)

8.3.2 A solution of sugar ✓/In Oplossing van suiker

It contains no free ions. ✓/Dit bevat geen vrye ione nie.

(2)

8.4  $n(\text{C}) : \text{C}(\text{H}) : n(\text{O})$

$$\frac{m(\text{C})}{M[\text{C}]} : \frac{m(\text{H})}{M[\text{H}]} : \frac{m(\text{O})}{M[\text{O}]}$$

Assume mass of 100 g of a sample/Aanvaar massa van 100 g van 'n monster

$$\frac{40}{12} \checkmark : \frac{6,67}{1} \checkmark : \frac{53,33}{16} \checkmark$$

$$3,33 : 6,67 : 3,33$$

$$\frac{3,33}{3,33} : \frac{6,67}{3,33} : \frac{3,33}{3,33}$$

$$1 : 2 : 1 \checkmark$$

Empirical formula/Empiriese formule:  $\text{CH}_2\text{O}$

$$M(\text{CH}_2\text{O}) = 12 + 2 + 16 = 30 \text{ g} \cdot \text{mol}^{-1} \checkmark$$

$$\text{Factor/Faktor} = \frac{180}{30} = 6 \checkmark$$

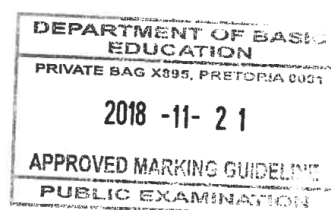
∴ Molecular formula/Molekulêre formule is:  $\text{C}_6\text{H}_{12}\text{O}_6 \checkmark$

(7)  
[11]

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9

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**QUESTION 9/VRAAG 9**

9.1 Precipitation reaction ✓ / *Presipitasiereaksie* (1)

9.2.1 Sulphate ✓ / *Sulfaat* (1)

9.2.2  $\text{BaCO}_3 + 2\text{HNO}_3 \checkmark \rightarrow \text{Ba}(\text{NO}_3)_2 + \text{CO}_2 + \text{H}_2\text{O} \checkmark$

Reactants ✓; products ✓; balancing ✓  
*Reaktanse/produkte/ balansering* (3)

$$\begin{aligned} 9.3.1 \quad n(\text{Na}_2\text{CO}_3) &= \frac{m}{M} \checkmark \\ &= \frac{5}{106} \checkmark \\ &= 0,047 \text{ mol} \end{aligned}$$

$$n(\text{BaCO}_3) : n(\text{Na}_2\text{CO}_3)$$

$$1 : 1 \checkmark$$

$$m(\text{BaCO}_3) = n \times M$$

$$= 0,047 \times 197 \checkmark$$

$$= 9,26 \text{ g} \checkmark \quad (\text{Range/Gebied: } 9,25 - 9,87) \quad (5)$$

Marking criteria/Nasienriglyne:

- Formula/Formule  $n = \frac{m}{M} \checkmark$
- Substitution/Inervanging ✓
- Using ratio/Gebruik verhouding ✓
- Multiply by/Vermenigvuldiging met  $197 \text{ g} \cdot \text{mol}^{-1} \checkmark$  in  $n = \frac{m}{M}$
- Final answer/Finale antwoord: 9,26 g ✓

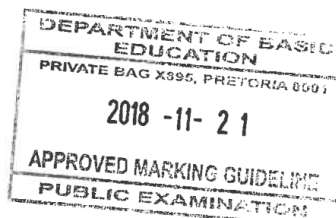
**9.3.2 POSITIVE MARKING FROM 9.3.1/ POSITIEWE NASIEN VANAF 9.3.1**

$$\% \text{ yield/opbrengs} = \frac{\text{actual yield/werklike opbrengs}}{\text{theoretical yield/teoretiese opbrengs}} \times 100$$

$$= \frac{8,3}{9,26} \times 100 \checkmark$$

$$= 89,63\% \checkmark \quad (\text{Range/Gebied: } 84,26 - 89,64) \quad (2)$$

**[12]**



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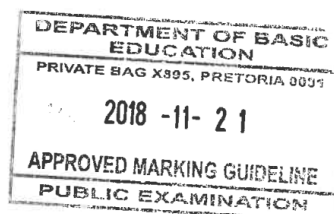
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CAPS/KABV – Grade10/Graad 10 – Marking Guidelines/Nasienriglyne

**QUESTION 10/VRAAG 10**

- 10.1 Hydrosphere: includes all water of the earth found as liquid water ✓  
*Hidrosfeer: sluit alle water van die aarde in wat as vloeibare water gevind word*  
Biosphere: includes all the living organisms. ✓*Biosfeer: sluit alle lewende organismes in* (2)
- 10.2.1 (A) Transpiration ✓*Transpirasie*
- 10.2.2 (B) Condensation ✓*Kondensasie*
- 10.2.3 (C) Precipitation ✓*Presipitasie* (3)
- 10.3 (A) Energy gained ✓*Energie gewen*
- (B) Energy lost. ✓*Energie verloor* (2)
- 10.4 Roots of plants absorb water from the ground. ✓*Plantwortels absorbeer water uit die grond.*  
Plants release the water to the atmosphere by transpiration. ✓*Plante stel water deur transpirasie aan die atmosfeer vry.*  
The water condenses to form clouds. ✓*Die water kondenseer om wolke te vorm.*  
Then water falls back to the ground by precipitation. ✓*Water val dan terug grond toe deur presipitasie.* (4)  
**[11]**

**TOTAL/TOTAAL: 150**  
**141**



## MARKING GUIDELINE: NOVEMBER 2019 PAPER 1



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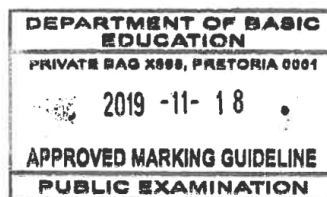
**GRADE/GRAAD 10**

**PHYSICAL SCIENCES: PHYSICS (P1)  
FISIESE WETENSKAPPE: FISIKA (V1)**

**NOVEMBER 2019**

**MARKING GUIDELINES/NASIENRIGLYNE**

**MARKS/PUNTE: 150**



**These marking guidelines consist of 12 pages.  
Hierdie nasienriglyne bestaan uit 12 bladsye.**

*Approved  
JDBE-IM  
2019/11/18*

*Approved  
Examiner  
15/11/19*

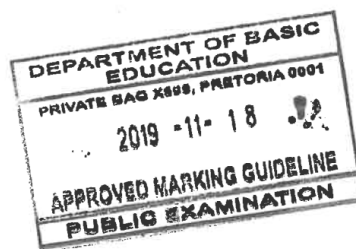
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CAPS/KABV – Grade/Graad 10 – Marking Guidelines/Nasienriglyne

**QUESTION 1/VRAAG 1**

- |      |      |             |
|------|------|-------------|
| 1.1  | C ✓✓ | (2)         |
| 1.2  | D ✓✓ | (2)         |
| 1.3  | A ✓✓ | (2)         |
| 1.4  | C ✓✓ | (2)         |
| 1.5  | A ✓✓ | (2)         |
| 1.6  | C ✓✓ | (2)         |
| 1.7  | D ✓✓ | (2)         |
| 1.8  | C ✓✓ | (2)         |
| 1.9  | D ✓✓ | (2)         |
| 1.10 | A ✓✓ | (2)         |
|      |      | <b>[20]</b> |



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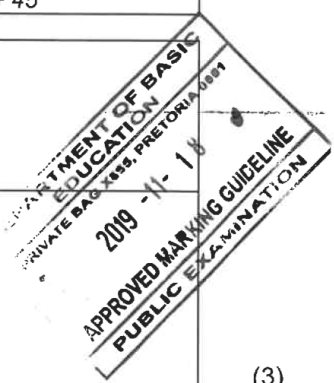
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### QUESTION 2/VRAAG 2

- 2.1 Total path length travelled. ✓✓ (2 or 0)  
Totale padlengte afgelê. (2 of 0) (2)

- 2.2 Original pos./Oorspronklike pos. = 10 + 5  
= 15 m ✓ west (of tree)/wes (van boom) ✓  
**ACCEPT/AANVAAR:** 15 m left (of the tree)/links (van die boom) (2)

- 2.3 **POSITIVE MARKING FROM QUESTION 2.2.**  
**POSITIEWE NASIEN VANAF VRAAG 2.2.** (2)  
Distance/Afstand = 15 + 20 + 25  
= 60 m ✓✓  
**ACCEPT/AANVAAR:**  
Any answer in Q2.2. + 45  
Enige antwoord in Q2.2. + 45

- 2.4 **Marking guidelines/Nasienriglyne**  
• Formule/Formule:  $v = \frac{\Delta x}{\Delta t}$  /  $v = \frac{D}{\Delta t}$  ✓  
• Substitute 25 m and 5 m·s<sup>-1</sup>/Vervang 25 m en 5 m·s<sup>-1</sup> ✓  
• Final answer/Finale antwoord: 5 s ✓  
**OPTION 1/OPSIE 1**  
 $v = \frac{\Delta x}{\Delta t}$  ✓  
 $5 = \frac{25}{\Delta t}$  ✓  
 $\Delta t = 5 \text{ s}$  ✓  
**OPTION 2/OPSIE 2**  
 $\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$  ✓  
 $25 = \left( \frac{5 + 5}{2} \right) \Delta t$  ✓  
 $\Delta t = 5 \text{ s}$  ✓  
 (3)

- 2.5  $v = \frac{\Delta x}{\Delta t}$   
 $= \frac{10}{40}$  ✓  
 $= 0,25 \text{ m} \cdot \text{s}^{-1}$  ✓ east/oos ✓  
**Marking guidelines/Nasienriglyne**  
• Substitute/Vervang 10 m & 40 s ✓  
• Final answer/Finale antwoord: 0,25 m·s<sup>-1</sup> ✓  
• Direction/Rigting: East/Oos/Right/Regs ✓ (3)  
**[12]**

### QUESTION 3/VRAAG 3

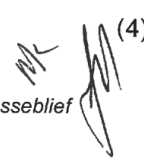
- 3.1 A physical quantity with magnitude and direction. ✓✓ (2 or 0)  
'n Fisiese hoeveelheid met grootte en rigting. (2 of 0) (2)

- 3.2  $67 \times 3,6 = 241,2 \text{ (km} \cdot \text{h}^{-1}\text{)}$  ✓ (1)

3.3

- 3.3.1  $v_f = v_i + a\Delta t$  ✓  
 $8 = 67 + a(30)$  ✓  
 $\therefore a = -1,97 \text{ m} \cdot \text{s}^{-2}$   
 $\therefore a = 1,97 \text{ m} \cdot \text{s}^{-2}$  in the opposite direction/in die teenoorgestelde rigting ✓

**ACCEPT/AANVAAR:** west/wes/to the left/na links

 (4)

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3.3.2

**Marking guidelines/Nasienriglyne**

- Formule/Formule:  $\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t$  /  $\Delta x = v_i t + \frac{1}{2} a \Delta t^2$  /  $v_f^2 = v_i^2 + 2a\Delta x$  ✓
- Substitute velocity in relevant formula./Vervang snelheid in geskikte formule. ✓
- Substitute time/acceleration in relevant formula/Vervang tyd/versnelling in geskikte formule. ✓
- Final answer/Finale antwoord: 1 125 m ✓

**Range/Gebied:** 1 123,1 to/tot 1 125 m

**POSITIVE MARKING FROM QUESTION 3.3.1.**

**POSITIEWE NASIEN VANAF VRAAG 3.3.1.**

**OPTION 1/OPSIE 1**

$$\Delta x = \left( \frac{v_f + v_i}{2} \right) \Delta t \quad \checkmark$$

$$= \left( \frac{8 + 67}{2} \right) 30 \quad \checkmark$$

$$= 1125 \text{ m} \quad \checkmark$$

**OPTION 2/OPSIE 2**

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$= (67)(30) \quad \checkmark + \frac{1}{2}(-1,97)(30)^2 \quad \checkmark$$

$$= 1123,5 \text{ m} \quad \checkmark$$

**OPTION 3/OPSIE 3**

$$v_f^2 = v_i^2 + 2a\Delta x \quad \checkmark$$

$$(8)^2 = (67)^2 + 2(-1,97)\Delta x \quad \checkmark$$

$$\Delta x = 1123,1 \text{ m} \quad \checkmark$$

(4)

3.3.3

**OPTION 1/OPSIE 1**

$$\Delta x = v_i \Delta t + \frac{1}{2} a \Delta t^2 \quad \checkmark$$

$$800 = 8\Delta t + \frac{1}{2}(0)\Delta t^2 \quad \checkmark$$

$$\Delta t = 100 \text{ s} \quad \checkmark$$

**OPTION 2/OPSIE 2**

$$\Delta x = \left( \frac{v_i + v_f}{2} \right) \Delta t \quad \checkmark$$

$$800 = \left( \frac{8 + 8}{2} \right) \Delta t \quad \checkmark$$

$$\Delta t = 100 \text{ s} \quad \checkmark$$

**OPTION 3/OPSIE 3**

$$v = \frac{D}{\Delta t} \quad \checkmark$$

$$8 = \frac{800}{\Delta t} \quad \checkmark$$

$$\Delta t = 100 \text{ s} \quad \checkmark$$

(3)

3.3.4

**POSITIVE MARKING FROM QUESTION 3.3.2.**

**POSITIEWE NASIEN VANAF VRAAG 3.3.2.**

$$\text{Length/Lengte} = 2000 - 800 - 1125$$

$$= 75 \text{ m} \quad \checkmark \checkmark$$

**ACCEPT/AANVAAR:**

2 000 – 800 – any answer in Q3.3.2  
2 000 – 800 – enige antwoord in Q3.3.2

(2)

3.4

3.4.1 Decreases/Verlaag ✓

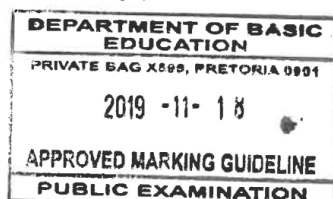
(1)

3.4.2

On a wet runway, the tyres have less grip, ✓ and to stop within the same distance, ✓ the landing speed should be less.  
*Op 'n nat landingstrook het die bande minder greep en om in dieselfde afstand tot stilstand te kom, moet die landingspoed kleiner wees.*

(2)

[19]



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#### QUESTION 4/VRAAG 4

4.1

##### Marking guidelines/Nasienriglyne

If any of the underlined key words/phrases in the correct context are omitted: minus 1 mark

*Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is: minus 1 punt*

Rate of change of position./Change of position per (unit) time. ✓✓ (2 or 0)

Tempo waarteen posisie verander./Verandering in posisie per (eenheid)tyd. (2 or 0)

(2)

4.2

##### **From C to D:**

- The car turns around / moves south / moves in opposite direction. ✓
- Increased velocity / Constant acceleration / Velocity increases from  $0 \text{ m} \cdot \text{s}^{-1}$  to  $6 \text{ m} \cdot \text{s}^{-1}$  ✓

##### **From point D to E:**

- The car travels at a constant velocity south/in the opposite direction. ✓

##### **Van C na D:**

- *Die motor draai om / beweeg suid / beweeg in teenoorgestelde rigting.* ✓
- *Toenemende snelheid / Konstante versnelling / Snelheid neem toe van  $0 \text{ m} \cdot \text{s}^{-1}$  na  $6 \text{ m} \cdot \text{s}^{-1}$*  ✓

##### **Van D tot E:**

- *Die motor beweeg teen 'n konstante snelheid suid/in die teenoorgestelde rigting.*

(3)

4.3.1

##### Marking criteria/Nasienriglyne

- Any area formula/*Enige oppervlak-formule:*  
Area =  $L \times B$ /Area =  $\frac{1}{2} b \perp h$ /Area  $\frac{1}{2}(\text{sum/som} \parallel \text{sides/sye}) \perp h$  ✓
- Substitution of values from graph./*Vervanging van waardes vanaf grafiek.* ✓✓
- Final answer/*Finale antwoord:* 40 m ✓

##### **OPTION 1/OPSIE 1**

Area A-B/*Oppervlak A-B:*

$$\begin{aligned} A &= L \times B \checkmark \\ &= 10 \times 2 \checkmark \\ &= 20 \text{ m} \end{aligned}$$

Area B-C/*Oppervlak B-C:*

$$\begin{aligned} A &= \frac{1}{2} b \perp h \\ &= \frac{1}{2}(4)(10) \checkmark \\ &= 20 \text{ m} \end{aligned}$$

Total distance/*Totale afstand* = 40 m ✓

##### **OPTION 2/OPSIE 2**

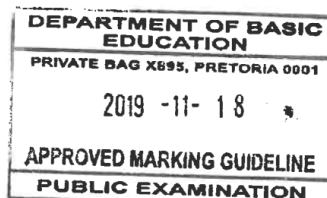
Area of trapezium/*Oppervlak van trapesium:*

$$\begin{aligned} A &= \frac{1}{2}(\text{sum/som} \parallel \text{sides/sye}) \perp h \checkmark \\ &= \frac{1}{2}(2 + 6) \checkmark (10) \checkmark \\ &= 40 \text{ m} \checkmark \end{aligned}$$

(4)

4.3.2

$$\begin{aligned} m &= \frac{\Delta v}{\Delta t} / \frac{\Delta y}{\Delta x} \\ &= \frac{0 - 10}{6 - 2} \checkmark \\ &= -2,5 \checkmark \\ a &= 2,5 \text{ m} \cdot \text{s}^{-2} \text{ south/suid} \checkmark \end{aligned}$$



(4)

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4.4 Greater than/Groter as ✓ (1)

4.5 Slope of the graph at B-C is steeper than C-D. ✓  
Die helling van die grafiek is steiler by B-C as by C-D.

**OR/OF**

$$\text{Gradient of CD/Gradiënt van CD} = \frac{-6 - 0}{10 - 6} = -1,5 \text{ (m} \cdot \text{s}^{-2}) \checkmark \quad (1)$$

4.6 North/Noord ✓ (1)

4.7 **POSITIVE MARKING FROM QUESTION 4.3.2.**  
**POSITIEWE NASIEN VANAF VRAAG 4.3.2.**

$$v_f = v_i + a\Delta t \checkmark$$

$$= 10 + (-2,5)(3) \checkmark \quad \text{OR/OF} \quad 5 + (-2,5)(1) \quad \text{OR/OF} \quad 7,5 + (-2,5)(2) \quad (4)$$

$$v_f = 2,5 \text{ m} \cdot \text{s}^{-1} \checkmark \text{ north/noord} \checkmark \quad [20]$$

**QUESTION 5/VRAAG 5**

**Penalise ONLY ONCE for incorrect conversion of units in this question.**  
**Penaliseer SLEG EEN MAAL vir verkeerde omskakeling van eenhede in hierdie vraag.**

5.1 Mechanical energy / Meganiese energie ✓ (1)

5.2.1  $E_m = E_k + E_p$  } ✓ Any one/Enige een  
 $= \frac{1}{2}mv^2 + mgh$   
 $= \frac{1}{2}(2)(1,71)^2 + (2)(9,8)(0,3) \checkmark$   
 $= 8,8 \text{ J} \checkmark \quad (4)$

5.2.2 **POSITIVE MARKING FROM QUESTION 5.2.**  
**POSITIEWE NASIEN VAN VRAAG 5.2.**

**OPTION 1/OPSIE 1**

$$E_{m_A} = E_{m_D} \quad \checkmark \text{ Any one/Enige een}$$

$$\frac{1}{2}m_A v_A^2 + m_A gh = \frac{1}{2}m_D v_D^2 + m_D gh$$

$$0 + (2)(9,8)h = 8,8 \checkmark$$

$$h = 0,45 \text{ m} \checkmark \quad (3)$$

**OPTION 2/OPSIE 2**

$$[E_p = mgh \text{ and/en } E_k = 0] \checkmark$$

$$8,8 = (2)(9,8)h \checkmark$$

$$h = 0,45 \text{ m} \checkmark$$

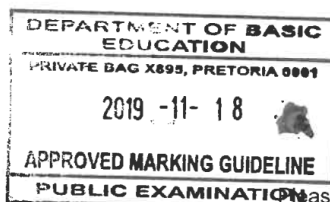
**IF/INDIEN:**

$$E_p = mgh$$

$$8,8 = (2)(9,8)h \checkmark$$

$$h = 0,45 \text{ m} \checkmark$$

Max/Maks.  $\frac{2}{3}$



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5.2.3 **POSITIVE MARKING FROM QUESTION 5.2.2.**  
**POSITIEWE NASIEN VAN VRAAG 5.2.2.**

$$E_{mA} = E_{mB}$$

$$0 + \frac{1}{2}(2)(9,8)(0,45) \checkmark = \frac{1}{2}(2)v^2 + (2)(9,8)(0,05) \checkmark$$

$$\therefore v = 2,8 \text{ m}\cdot\text{s}^{-1} \checkmark$$

**OR/OF**  
**POSITIVE MARKING FROM QUESTION 5.2.1.**  
**POSITIEWE NASIEN VAN VRAAG 5.2.1.**

$$E_{mD} = E_{mC}$$

$$8,8 \checkmark = \frac{1}{2}(2)v^2 + (2)(9,8)(0,05) \checkmark$$

$$\therefore v = 2,8 \text{ m}\cdot\text{s}^{-1} \checkmark$$

(3)

5.3 **Equal to/Gelyk aan** ✓

The speed is independent of the mass of the object. ✓  
Die speed is onafhanklik van die massa van die voorwerp.

**OR/OF**  
Speed only depends on the initial height.  
Spoed hang slegs van die aanvanklike hoogte af.

(2)  
[13]

**QUESTION 6/VRAAG 6**

6.1 **Marking guidelines/Nasienriglyne**

If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark  
Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks  
uitgelaat is: minus 1 punt

The maximum disturbance of a particle from its rest/equilibrium position. ✓✓  
Maksimum versteuring van 'n deeltjie vanaf sy rusposisie/ewewigposisie.

(2)

6.2 0,5 (m) ✓

(1)

6.3 T = 8 s ✓ (8 seconds/sekondes)

(1)



*MA*

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6.4.1 **POSITIVE MARKING FROM QUESTION 6.3.**

**POSITIEWE NASIEN VAN VRAAG 6.3.**

**Marking guidelines/Nasienriglyne**

- Formula/Formule:  $f = \frac{1}{T}$  ✓
- Substitute period or time./Vervang periode of tyd. ✓
- Formula/Formule:  $v = f\lambda$  ✓
- Substitute f and  $\lambda$ ./Vervang f en  $\lambda$ . ✓
- Final answer/Finale antwoord:  $0,1 \text{ m} \cdot \text{s}^{-1}$  ✓

**OPTION 1/OPSIE 1**

$$f = \frac{1}{T} \checkmark$$

$$= \frac{1}{8} \checkmark$$

$$= 0,125 \text{ Hz}$$

$$v = f\lambda \checkmark$$

$$= (0,125)(0,8) \checkmark$$

$$= 0,1 \text{ m} \cdot \text{s}^{-1} \checkmark$$

**OPTION 2/OPSIE 2**

$$\text{Frequency} = \frac{\text{number of waves}}{\text{time}} \checkmark$$

$$= \frac{2}{16} \checkmark$$

$$= 0,125 \text{ Hz}$$

$$v = f\lambda \checkmark$$

$$= (0,125)(0,8) \checkmark$$

$$= 0,1 \text{ m} \cdot \text{s}^{-1} \checkmark$$

**OPTION 3/OPSIE 3**

$$v = \frac{\lambda}{T} \checkmark \checkmark = \frac{0,8}{8} \checkmark = 0,1 \text{ m} \cdot \text{s}^{-1} \checkmark$$

(5)

6.4.2 **POSITIVE MARKING FROM QUESTION 6.4.1.**

**POSITIEWE NASIEN VAN VRAAG 6.4.1.**

**OPTION 1/OPSIE 1**

$$\text{Distance/Afstand} = (2\frac{1}{2})(0,8) \checkmark$$

$$= 2 \text{ m} \checkmark$$

**OPTION 2/OPSIE 2**

$$v = \frac{D}{\Delta t} / \text{speed} = \frac{\text{distance}}{\text{time}} / \text{spoed} = \frac{\text{afstand}}{\text{tyd}}$$

$$0,1 = \frac{D}{20} \checkmark$$

$$D = 2 \text{ m} \checkmark$$

(2)

6.5

6.5.1 Greater than/Groter as ✓

(1)

6.5.2 Greater than/Groter as ✓

(1)



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6.6

**OPTION 1/OPSIE 1**

$$\text{Frequency} = \frac{\text{vibrations}}{\text{time}} \quad / \quad \text{Frekwensie} = \frac{\text{vibrasies}}{\text{tyd}} \quad \checkmark$$

$$= \frac{5}{20} \quad \checkmark$$

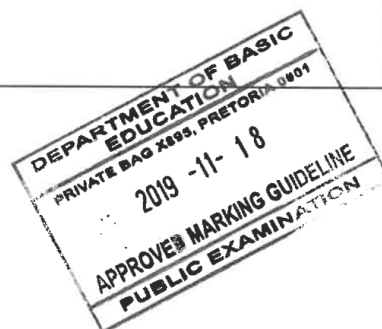
$$= 0,25 \text{ Hz} \quad \checkmark$$

**OPTION 2/OPSIE 2**

$$f = \frac{1}{T} \quad \checkmark$$

$$= \frac{1}{4} \quad \checkmark$$

$$= 0,25 \text{ Hz} \quad \checkmark$$



(3)  
[16]

**QUESTION 7/VRAAG 7**

7.1

**Marking guidelines/Nasienriglyne**

If any of the underlined key words/phrases in the correct context are omitted: minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases in die korrekte konteks uitgelaat is: minus 1 punt

IF the word "perpendicular" is used: // **INDIEN** die woord "loodreg" gebruik word: 0/2

A wave in which the particles of the medium vibrate parallel to the direction of motion of the wave. ✓✓

'n Golf waarin die deeltjies van die medium parallel vibreer met die rigting van beweging van die golf.

(2)

7.2

**OPTION 1/OPSIE 1**

$$v = \frac{\Delta x}{\Delta t} \quad \checkmark$$

$$340 = \frac{\Delta x}{4} \quad \checkmark$$

$$\Delta x = 1360 \text{ m} \quad \checkmark$$

**OPTION 2/OPSIE 2**

$$v = \frac{\Delta x}{\Delta t} \quad \checkmark$$

$$340 = \frac{\Delta x}{8} \quad \checkmark$$

$$\Delta x = 2720 \text{ m}$$

$$D = 2720 \div 2 \quad \checkmark$$

$$= 1360 \text{ m} \quad \checkmark$$

**Marking guidelines/Nasienriglyne**

- Formula/Formule:  $v = \frac{\Delta x}{\Delta t}$  ✓
- Substitute/Vervang 340 m·s<sup>-1</sup>. ✓
- Divide time or final distance by 2/Deel tyd of finale afstand deur 2. ✓
- Final answer/Finale antwoord: 1 360 m ✓

(4)

7.3 Frequency/Frekwensie ✓

(1)

7.4 20 kHz / 20 000 Hz ✓

(1)

7.5 Diagnosis of medical condition/pregnancy/Sonar/Measure blood flow. ✓  
Diagnose van medies toestand/swangerskap/Sonar/Meet van bloedvloeï.

(1)  
[9]

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### QUESTION 8/VRAAG 8

- 8.1 An oscillating electric field (in one plane) produces an (oscillating) magnetic field ✓ at right angles/perpendicular to it. ✓  
*'n Ossilerende elektriese veld (in een vlak) produseer 'n (ossilerende) magneetveld wat loodreg daarop is.* (2)

- 8.2 The higher the frequency, the higher the energy of the wave. ✓✓ (2 or 0)  
*Hoe hoër die frekwensie, hoe hoër is die energie van die golf.* (2 of 0)

#### OR/OF


Frequency is directly proportional to energy.  
*Frekwensie is direk eweredig aan energie.* (2)

- 8.3  
8.3.1  $E = hf$  ✓  
 $4,97 \times 10^{-14} = 6,63 \times 10^{-34} f$  ✓  
 $f = 7,5 \times 10^{19} \text{ Hz}$  ✓ (7,4962  $\times 10^{19} \text{ Hz}$ ) (3)

- 8.3.2
- | OPTION 1/OPSIE 1  | OPTION 2/OPSIE 2   |
|---|--|
| $c = f\lambda$ ✓  | $E = \frac{hc}{\lambda}$ ✓   |
| $3 \times 10^8 = (1,8 \times 10^{18})\lambda$ ✓           | $1,19 \times 10^{-15} = \frac{(6,63 \times 10^{-34})(3 \times 10^8)}{\lambda}$ ✓ |
| $\lambda = 1,67 \times 10^{-10} \text{ m}$ ✓              | $\lambda = 1,67 \times 10^{-10} \text{ m}$ ✓                                     |
| <b>ACCEPT/AANVAAR:</b><br>Formula/Formule: $v = f\lambda$ |  |
- (3)

- 8.4  B ✓  
Highest frequency/energy ✓  
*Hoogste frekwensie/energie.* (2)  
**[12]**

### QUESTION 9/VRAAG 9

- 9.1 Materials that are (strongly) attracted by magnets ✓ and can be (easily) magnetised. ✓  
*Materiale wat baie (sterk) aangetrek word deur magnete en wat (maklik) gemagnetiseer kan word.* (2)
- 9.2 South/Suid ✓ (1)
- 9.3  (Position) 1/Posisie 1 ✓  
Magnetic field is strongest at the poles of a magnet. ✓  
*Magneetveld is die sterkste by die pole van magneet.* (2)
- 9.4 North to South ✓  
*Noord na Suid* (1)

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- 9.5  
9.5.1 Geographic north pole ✓ **ACCEPT:** True north  
Geografiese noordpool **AANVAAR:** Ware noord (1)
- 9.5.2 Magnetic north pole ✓  
Magnetiese noordpool (1)
- 9.6 Protection from solar winds. ✓  
Beskerming teen sonwinde. (1)
- [9]**

**QUESTION 10/VRAAG 10**

- 10.1  $Q = nq_e$  ✓  
 $-3 \times 10^{-6} = n(-1,6 \times 10^{-19})$  ✓  
 $n = 1,88 \times 10^{13}$  ✓ (3)
- 10.2  $Q = \frac{Q_1 + Q_2}{2}$  ✓  
 $-1 \times 10^{-6} = \frac{(-3 \times 10^{-6}) + Q_{2/Q}}{2}$  ✓  
 $Q_{2/Q} = 1 \times 10^{-6} \text{ C}$  ✓ (3)
- 10.3 **P to/na Q** ✓ (1)
- [7]**



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**QUESTION 11/VRAAG 11**

- 11.1 A charge of 5 C ✓ flows (past a point) in one second/per second. ✓  
'n Lading van 5 C vloei verby 'n punt in een sekonde/per sekonde. (2)

- | OPTION 1/OPSIE 1                                  | OPTION 2/OPSIE 2                    |
|---|-------------------------------------|
| $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$ ✓ | $R_p = \frac{R_1 R_2}{R_1 + R_2}$ ✓ |
| $\frac{1}{R_p} = \frac{1}{4} + \frac{1}{6}$ ✓     | $= \frac{(4)(6)}{4+6}$ ✓            |
| $R_p = 2,4 \Omega$ ✓                              | $= 2,4 \Omega$ ✓                    |
- (3)

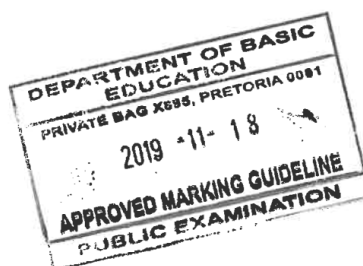
- 11.3  $V_1$  ✓ (1)

- 11.4 Smaller than/Kleiner as ✓ (1)

- 11.5  $Q = I\Delta t$  ✓  
 $0,3 = I(2)$  ✓  
 $I = 0,15 \text{ A}$  ✓ (3)

- 11.6  $V = \frac{W}{Q}$  ✓  
 $5 = \frac{W}{0,3}$  ✓  
 $W = 1,5 \text{ J}$  ✓ (3)  
[13]

**TOTAL/TOTAAL: 150**



*nk*



## MARKING GUIDELINE: NOVEMBER 2019 PAPER 2



**basic education**

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**NATIONAL  
SENIOR CERTIFICATE/  
NATIONALE  
SENIOR SERTIFIKAAT**

**GRADE/GRAAD 10**

**PHYSICAL SCIENCES: CHEMISTRY (P2)  
FISIESE WETENSKAPPE: CHEMIE (V2)**

**NOVEMBER 2019**

**MARKING GUIDELINES/NASIENRIGLYNE**

**MARKS/PUNTE: 150**

DEPARTMENT OF BASIC EDUCATION
PRIVATE BAG X695, PRETORIA 0001
2019 -11- 19
APPROVED MARKING GUIDELINE PUBLIC EXAMINATION

**These marking guidelines consist of 10 pages.  
Hierdie nasienriglyne bestaan uit 10 bladsye.**

*Approved  
K. M. M. M.  
19/11/19*  
*Approved  
Ant. M. M. M.  
19/11/2019*

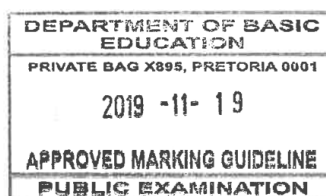
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Physical Sciences P2/Fisiese Wetenskappe/V2 2 DBE/November 2019  
CAPS/KABV – Grade/Graad 10 – Marking Guidelines/Nasienriglyne

**QUESTION 1/VRAAG 1**

- |      |      |             |
|------|------|-------------|
| 1.1  | A ✓✓ | (2)         |
| 1.2  | C ✓✓ | (2)         |
| 1.3  | B ✓✓ | (2)         |
| 1.4  | D ✓✓ | (2)         |
| 1.5  | C ✓✓ | (2)         |
| 1.6  | C ✓✓ | (2)         |
| 1.7  | B ✓✓ | (2)         |
| 1.8  | D ✓✓ | (2)         |
| 1.9  | C ✓✓ | (2)         |
| 1.10 | C ✓✓ | (2)         |
|      |      | <b>[20]</b> |



*MA* *R*

Physical Sciences P2/Fisiese Wetenskappe/V2

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DBE/November 2019

CAPS/KABV – Grade/Graad 10 – Marking Guidelines/Nasienriglyne

## QUESTION 2/VRAAG 2

2.1

2.1.1 Positive ions/cations/positiewe ione /katione ✓

Delocalised valence electrons/gedelokaliseerde valenselektrone ✓ (2)

2.1.2 Metallic bond/metaalbinding ✓

(1)

2.2 Left/Links ✓

(1)

2.3 Hg ✓

(1)

2.4

2.4.1 Homogeneous/Homogeen ✓

Uniform composition/Separate particles cannot be distinguished. /All components are in the same phase. ✓  
Uniforme samestelling/Afsonderlike deeltjies kan nie onderskei word nie./Alle komponente is in dieselfde fase.

(2)

2.4.2 Fe<sub>2</sub>O<sub>3</sub> ✓

(1)

2.5

2.5.1 A ✓

Lowest density/Laagste digtheid ✓

(2)

2.5.2 Electrical conductivity is the conduction of electric current/charge ✓ and thermal conductivity is the conduction of heat. ✓

Elektriese geleiding is die geleiding van elektriese stroom/ladings en termiese geleiding is die geleiding van hitte.

(2)

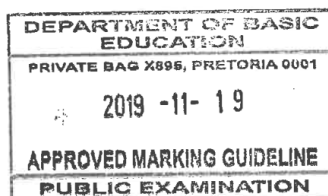
2.5.3 B ✓

B has a high density. /B is a good conductor of electricity. /B is a good conductor of heat. ✓

B het 'n hoë digtheid./B is 'n goeie geleier van elektrisiteit./B is 'n goeie geleier van hitte.

(2)

[14]



### QUESTION 3/VRAAG 3

3.1.1

#### Marking guidelines/Nasienriglyne

If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases in korrekte konteks uitgelaat is: minus 1 punt

Atoms of the same element having the same number of protons, but different number of neutrons. ✓✓

Atome van dieselfde element wat dieselfde getal protone het, maar verskillende getalle neutrone.

OR/OF

Same atomic number, but different mass numbers.

Dieselfde atoomgetalle, maar verskillende massagetalle.

(2)

3.1.2

$$\text{Average/gemiddelde } A_R = \frac{(80)(24) + (10)(25) + (10)(26)}{100}$$

$$= 24,3 \checkmark$$

(4)

3.1.3

(a) 12 ✓

(1)

(b) 12 ✓

(1)

(c) 12 ✓

(1)

(d) 10 ✓

(1)

(e) 24 ✓

(1)

3.2.1

7 ✓

(1)

3.2.2

3 ✓

(1)

3.2.3

3 ✓

(1)

3.2.4

Cl ✓

(1)

3.2.5

Ionic bond/Ioniese binding ✓

(1)

3.2.6

Mg<sup>2+</sup>:

2p	↑↓	↑↓	↑↓
2s	↑↓		
1s	↑↓		

#### Marking criteria/Nasienriglyne

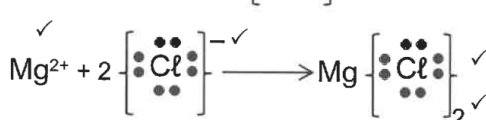
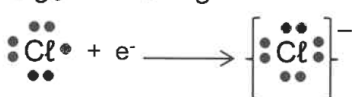
- 2 electrons in 1s and 2s orbitals each ✓  
2 elektrone in elk van 1s- en 2s-orbitale
- 6 electrons in 2p orbitals / 6 elektrone in 2p-orbitale ✓

IF/INDIEN:

Any extra electrons/Enige ekstra elektrone: minus 1

(2)

3.2.7



#### Marking Criteria / Nasienriglyne

- Mg<sup>2+</sup> ✓
- Ratio/verhouding 1 Mg : 2 Cl ✓
- Final(e) answer/antwoord: MgCl<sub>2</sub> ✓

(4)

[22]

Physical Sciences P2/Fisiese Wetenskappe/V2

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#### QUESTION 4/VRAAG 4

- 4.1
- 4.1.1 J ✓ (accept/aanvaar F) (1)
- 4.1.2 E ✓ (accept/aanvaar Be) (1)
- 4.1.3 A ✓ (accept/aanvaar K) (1)
- 4.1.4 J ✓ (accept/aanvaar F) (1)
- 4.1.5 H ✓ (accept/aanvaar Ge) (1)
- 4.1.6 L ✓ (accept/aanvaar He) (1)
- 4.1.7 **Any ONE/Enige EEN**
- G ✓ (accept/aanvaar O) (1)
  - J (accept/aanvaar F) (1)
- 4.1.8 D ✓ (accept/aanvaar Al) (1)

4.2

4.2.1

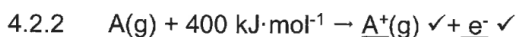
#### Marking guidelines/Nasienriglyne

If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases in korrekte konteks uitgelaat is: minus 1 punt

First ionisation energy is the energy needed (per mole) ✓ to remove the first electron from an atom (in the gaseous phase). ✓

Eerste ionisasie energie is die energie benodig (per mol) om die eerste elektron te verwyder vanaf 'n atoom (in die gasfase). (2)



#### ACCEPT/AANVAAR

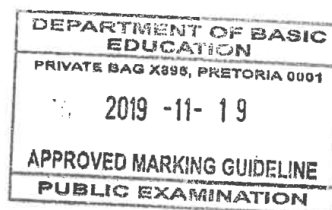


4.3 Electron affinity/Elektronaffiniteit ✓ (1)

4.4



[17]



*Handwritten initials/signature*

Physical Sciences P2/Fisiese Wetenskappe/V2

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CAPS/KABV – Grade/Graad 10 – Marking Guidelines/Nasienriglyne

**QUESTION 5/VRAAG 5**

5.1 Aluminium sulphate/Aluminiumsulfaat ✓ (1)

5.2 The mass of one mole of a substance (measured in  $\text{g} \cdot \text{mol}^{-1}$ ). ✓✓ (2 or 0)  
Die massa van een mol van 'n stof (gemeet in  $\text{g} \cdot \text{mol}^{-1}$ ). (2 of 0) (2)

5.3

5.3.1  $M(\text{Al}_2(\text{SO}_4)_3) = 2(27) + 3(32) + 12(16)$   
 $= 342 \text{ g} \cdot \text{mol}^{-1}$  ✓✓

**Note/Let wel:**

If unit omitted/Indien eenheid uitgelaat

is: Max./Maks.  $\frac{1}{2}$

(2)

5.3.2 **POSITIVE MARKING FROM QUESTION 5.3.1.**  
**POSITIEWE NASIEN VANAF VRAAG 5.3.1.**

$$\% \text{Al} = \frac{2(27)}{342} \times 100$$

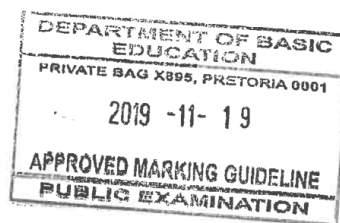
$$= 15,79\% \quad \checkmark$$

$$\% \text{S} = \frac{3(32)}{342} \times 100$$

$$= 28,07\% \quad \checkmark$$

$$\% \text{O} = \frac{12(16)}{342} \times 100$$

$$= 56,14\% \quad \checkmark$$



(3)

5.3.3 **POSITIVE MARKING FROM QUESTION 5.3.1.**  
**POSITIEWE NASIEN VANAF VRAAG 5.3.1.**

$$n(\text{Al}_2(\text{SO}_4)_3) = \frac{m}{M} \quad \checkmark$$

$$= \frac{85,5}{342} \quad \checkmark$$

$$= 0,25 \text{ mol} \quad \checkmark$$

(3)

5.3.4 **POSITIVE MARKING FROM QUESTION 5.3.3.**  
**POSITIEWE NASIEN VANAF VRAAG 5.3.3.**

$$\text{Number of Al atoms} = n \times N_A \times \text{number of atoms}$$

$$= (0,25)(6,02 \times 10^{23}) \quad \checkmark (2) \quad \checkmark$$

$$= 3,01 \times 10^{23} \text{ atoms} \quad \checkmark$$

(3)

5.4

5.4.1 Ionic structure/Ioniese struktuur ✓ (1)

*Handwritten initials/signature*

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- 5.4.2  $\text{Al}^{3+}$  / aluminium ions / positive ions / cations / *aluminiumione/positiewe ione/katione* ✓  
 $\text{SO}_4^{2-}$  / sulphate ions / negative ions / anions / *sulfaatione / negatiewe ione / anione* ✓  
**IF/INDIEN**  
 Ions/ione Max./Maks.  $\frac{1}{2}$  (2)


- 5.4.3 **ANY TWO/ENIGE TWEE:**  
 • Brittle/bros ✓  
 • Hard ✓  
 • Non-conductor of electricity/ *Nie-geleier van elektrisiteit*  
 • Non-conductor of heat/ *Nie-geleier van hitte*  
 • High melting point/ *Hoë smeltpunt* (2)

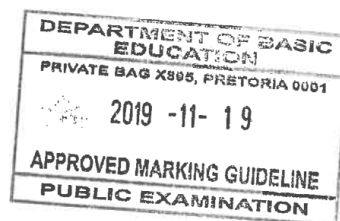
- 5.5  
 5.5.1 The amount/number of moles (of solute) per cubic decimetre/litre (of solution). (2 or 0)  
*Die hoeveelheid/aantal mol (opgeloste stof) per kubieke desimeter/liter (van die oplossing).* (2 of 0) (2)

POSITIVE MARKING FROM QUESTION 5.3.1. POSITIEWE NASIEN VANAF VRAAG 5.3.1.							
5.5.2	<table border="1"> <thead> <tr> <th>OPTION 1/OPSIE 1</th> <th>OPTION 2/OPSIE 2</th> </tr> </thead> <tbody> <tr> <td> <math>n = \frac{m}{M}</math>  <math>= \frac{500}{342}</math> ✓  <math>= 1,46 \text{ mol}</math>  <math>c = \frac{n}{V}</math> ✓  <math>= \frac{1,46}{2}</math> ✓  <math>= 0,73 \text{ mol} \cdot \text{dm}^{-3}</math> ✓ </td> <td> <math>c = \frac{m}{MV}</math> ✓  <math>= \frac{500}{\sqrt{(342)(2)}}</math> ✓  <math>= 0,73 \text{ mol} \cdot \text{dm}^{-3}</math> ✓ </td> </tr> <tr> <td colspan="2"> <b>Marking criteria/Nasienriglyne</b> <ul style="list-style-type: none"> <li>Appropriate formula for concentration ✓  <i>Toepaslike formule vir konsentrasie</i></li> <li>Dividing/ <i>Deel</i> 500 g by/deur 342 g·mol<sup>-1</sup> ✓</li> <li>Dividing by / <i>Deel</i> deur 2 dm<sup>3</sup> ✓</li> <li>Final(e) answer/antwoord: 0,73 mol·dm<sup>-3</sup> ✓</li> </ul> </td> </tr> </tbody> </table>	OPTION 1/OPSIE 1	OPTION 2/OPSIE 2	$n = \frac{m}{M}$ $= \frac{500}{342}$ ✓ $= 1,46 \text{ mol}$ $c = \frac{n}{V}$ ✓ $= \frac{1,46}{2}$ ✓ $= 0,73 \text{ mol} \cdot \text{dm}^{-3}$ ✓	$c = \frac{m}{MV}$ ✓ $= \frac{500}{\sqrt{(342)(2)}}$ ✓ $= 0,73 \text{ mol} \cdot \text{dm}^{-3}$ ✓	<b>Marking criteria/Nasienriglyne</b> <ul style="list-style-type: none"> <li>Appropriate formula for concentration ✓  <i>Toepaslike formule vir konsentrasie</i></li> <li>Dividing/ <i>Deel</i> 500 g by/deur 342 g·mol<sup>-1</sup> ✓</li> <li>Dividing by / <i>Deel</i> deur 2 dm<sup>3</sup> ✓</li> <li>Final(e) answer/antwoord: 0,73 mol·dm<sup>-3</sup> ✓</li> </ul>	
OPTION 1/OPSIE 1	OPTION 2/OPSIE 2						
$n = \frac{m}{M}$ $= \frac{500}{342}$ ✓ $= 1,46 \text{ mol}$ $c = \frac{n}{V}$ ✓ $= \frac{1,46}{2}$ ✓ $= 0,73 \text{ mol} \cdot \text{dm}^{-3}$ ✓	$c = \frac{m}{MV}$ ✓ $= \frac{500}{\sqrt{(342)(2)}}$ ✓ $= 0,73 \text{ mol} \cdot \text{dm}^{-3}$ ✓						
<b>Marking criteria/Nasienriglyne</b> <ul style="list-style-type: none"> <li>Appropriate formula for concentration ✓  <i>Toepaslike formule vir konsentrasie</i></li> <li>Dividing/ <i>Deel</i> 500 g by/deur 342 g·mol<sup>-1</sup> ✓</li> <li>Dividing by / <i>Deel</i> deur 2 dm<sup>3</sup> ✓</li> <li>Final(e) answer/antwoord: 0,73 mol·dm<sup>-3</sup> ✓</li> </ul>							

(4)  
[25]

**QUESTION 6/VRAAG 6**

- 6.1  
 6.1.1  Exothermic ✓  
Energy is released. ✓  
*Eksotermies.*  
*Energie word vrygestel.*



(2)

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6.1.2

**Marking guidelines/Nasienriglyne**

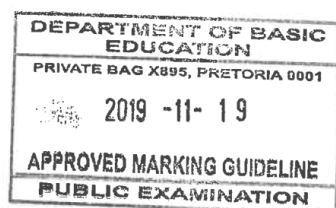
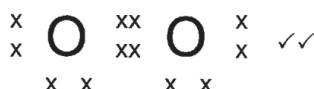
If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases in korrekte konteks uitgelaat is: minus 1 punt

A group of two or more atoms that are covalently bonded (and that functions as a unit). ✓✓

'n Groep van twee of meer atome wat kovalent gebind is (en as 'n eenheid funksioneer). (2)

6.1.3



6.1.4

$$n(\text{ZnS}) = \frac{m}{M} \checkmark$$

$$= \frac{7}{97} \checkmark$$

$$= 0,072 \text{ mol} \checkmark$$

6.1.5

**Marking guidelines/Nasienriglyne**

- Use ratio/Gebruik verhouding:  $n(\text{O}_2) = 1\frac{1}{2}n(\text{ZnS}) \checkmark$
- Substitute/Vervang  $32 \text{ g} \cdot \text{mol}^{-1} \checkmark$
- Final answer/Finale antwoord:  $3,46 \text{ g} \checkmark$

**POSITIVE MARKING FROM QUESTION 6.1.4.**

**POSITIEWE NASIEN VANAF VRAAG 6.1.4.**

**OPTION 1/OPSIE 1**

$$n(\text{O}_2) = \frac{3}{2} n(\text{ZnS})$$

$$= \frac{3}{2} (0,072) \checkmark$$

$$= 0,108 \text{ mol}$$

$$n(\text{O}_2) = \frac{m}{M}$$

$$0,108 = \frac{m}{32} \checkmark$$

$$\therefore m = 3,46 \text{ g} \checkmark$$

**OPTION 2/OPSIE 2**

$$2 \text{ mol ZnS} + 3 \text{ mol O}_2 \checkmark$$

$$2(97) \text{ g} + 3(32) \text{ g} \checkmark$$

$$7 \text{ g} + 3,46 \text{ g O}_2 \checkmark$$

6.1.6

**POSITIVE MARKING FROM QUESTION 6.1.4.**

**POSITIEWE NASIEN VANAF VRAAG 6.1.4.**

**OPTION 1/OPSIE 1**

$$n(\text{SO}_2) = n(\text{ZnS})$$

$$= 0,072 \text{ mol}$$

$$n = \frac{V}{V_M} \checkmark$$

$$0,072 \checkmark = \frac{V}{22,4}$$

$$V = 1,62 \text{ dm}^3 \checkmark$$

$$\text{Range/Gebied } (1,568 - 1,62 \text{ g})$$

**OPTION 2/OPSIE 2**

$$2 \text{ mol ZnS} \rightarrow 2 \text{ mol SO}_2 \checkmark$$

$$2(97) \text{ g} \checkmark \rightarrow 2(22,4) \text{ dm}^3 \checkmark$$

$$7 \text{ g} \rightarrow 1,62 \text{ dm}^3 \checkmark$$



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6.2

6.2.1 Sulphuric acid/ swawelsuur ✓

**ACCEPT/AANVAAR:**

Hydrogen sulphate/Waterstofsulfaat ✓

(1)

6.2.2  $\text{ZnSO}_4$  ✓✓

(2)

6.2.3 Redox (reaction)/Redoks(reaksie) ✓

- The charge (of Zn/H) changes. / Transfer of electrons. / Change in oxidation number. ✓

*Die lading (van Zn/H) verander. / Oordrag van elektrone. / Verandering in oksidasie getal.*

- (Zn) 0 to/na +2 ✓ in  $\text{ZnSO}_4$ . / (H) +1 (in  $\text{H}_2\text{SO}_4$ ) to/na 0 (in  $\text{H}_2$ ).

(3)

6.2.4 When a burning wood splinter ✓ is brought close to the gas it makes a popping sound. ✓

*'n Brandende houtsplinter wat naby die gas gebring word, maak 'n plofgeluid.*

(2)

[24]

### QUESTION 7/VRAAG 7

7.1.1

**Marking guidelines/Nasienriglyne**

If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark

*Indien enige van die onderstreepte sleutelwoorde/frases in korrekte konteks uitgelaat is: minus 1 punt*

An electrolyte is a solution that conducts electricity ✓ through the movement of ions. ✓

*'n Elektroliet is 'n oplossing wat elektrisiteit gelei deur die beweging van ione.*

(2)

7.1.2 Polar/Polêr ✓

It has (two) oppositely charged poles/Dit het (twee) teenoorgesteld gelaaide pole. ✓

(2)

7.1.3

a) Concentration of ions/Konsentrasie van ione ✓

(1)

b) Conductivity/Geleidingsvermoë ✓

(1)

7.1.4  $\text{NaCl(s)} \xrightarrow{\text{H}_2\text{O(l)}} \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$  ✓ Bal. ✓

**NOTE/LET WEL:**

Ignore phases./Ignoreer fases.

(3)

7.1.5  $\text{CaCl}_2$  ✓



A higher concentration of ions forms in solution. ✓

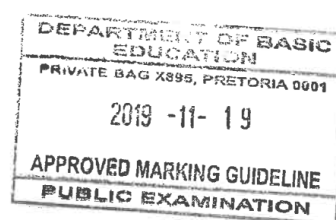
*'n Hoër konsentrasie van ione vorm in oplossing.*

**ACCEPT/AANVAAR**

For the same number of drops the conductivity is higher.

*Vir dieselfde aantal druppels is die geleidingsvermoë hoër.*

(2)



*Handwritten signature/initials.*

Physical Sciences P2/Fisiese Wetenskappe/V2 10 DBE/November 2019  
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- 7.2.1  $K_2CO_3$  ✓✓ (2)
- 7.2.2  $BaSO_4$  ✓✓ (2)
- 7.2.3  $BaCO_3(s) + 2HNO_3(aq) \rightarrow Ba(NO_3)_2(aq) + CO_2(g) + H_2O(l)$  ✓ Bal. ✓
- NOTE/LET WEL:**  
Ignore phases./Ignoreer fases. (3)
- [18]**

### QUESTION 8/VRAAG 8

8.1

8.1.1

**Marking guidelines/Nasienriglyne**

If any of the underlined key words/phrases in correct context are omitted:  
minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases in korrekte konteks uitgelaat is: minus 1 punt

Condensation is the process during which a gas or vapour changes to a liquid. ✓✓

Kondensasie is die proses waardeur 'n gas of damp in 'n vloeistof verander. (2)

8.1.2

**Marking guidelines/Nasienriglyne**

If any of the underlined key words/phrases are omitted: minus 1 mark

Indien enige van die onderstreepte sleutelwoorde/frases uitgelaat is: minus 1 punt

Evaporation is the change of a liquid into a vapour at any temperature (below the boiling point). ✓✓

Verdamping is die verandering van 'n vloeistof in 'n damp by enige temperatuur (onder die kookpunt). (2)

8.2

8.2.1 Evaporation/Verdamping ✓

8.2.2 Condensation/Kondensasie ✓

8.2.3 Precipitation/Presipitasie ✓

8.2.4 Infiltration/Percolation/Infiltrasie/insypeling/Perkolasië ✓ (1)

8.3

The hydrosphere is the water of the Earth. ✓ It is found as liquid water, ice and water vapour (in the atmosphere). ✓

Die hidrosfeer is die water van die Aarde en dit word gevind as vloeibare water, ys en waterdamp (in die atmosfeer). (2)

**[10]**

**TOTAL/TOTAAL: 150**