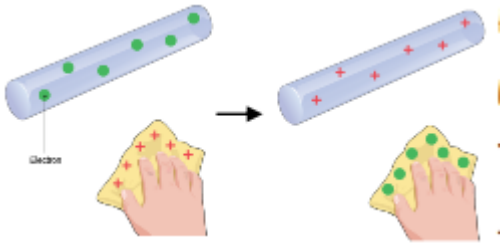
Electricity Revision Booklet

PREPARED BY PREETI MANOJ

Electric Charge

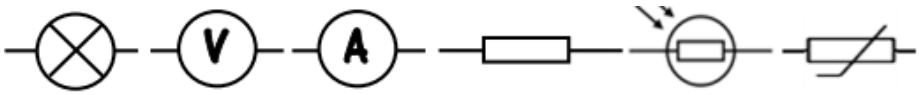
Explain how you can use a cloth to charge a plastic rod, making specific reference to the transfer of electrons.



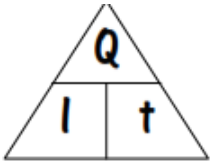
Which combinations of positive and negative charge attract and repel each other?
Positive & Positive: Positive & Negative Negative & Negative:

Electrical Circuits

Circuit Symbols
Label the following circuit symbols:



Current
Current is defined as the rate of flow of _____.

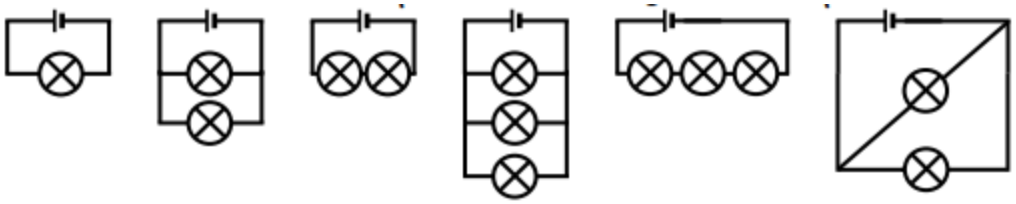


Current =

The charge flowing in an electrical circuit is provided by free _____.

Series & Parallel

A series circuit is one continuous loop.
A parallel circuit has one or more branches" connected to the loop.
Label the following as series or parallel.

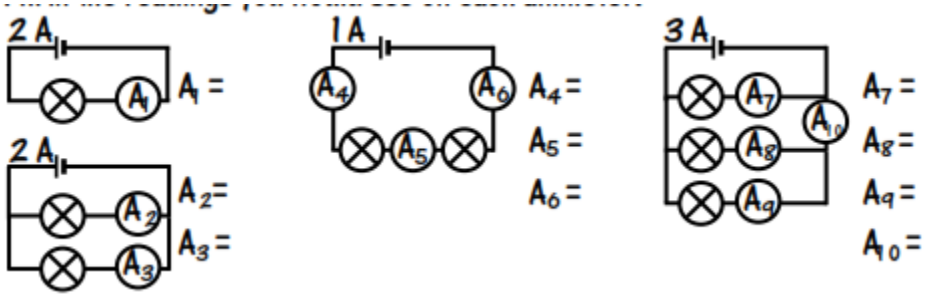


Current in Series and Parallel

Current in a series circuit (is the same at all points/splits down each branch).

Current in a parallel circuit (is the same at all points/splits down each branch).

Fill in the readings you would see on each ammeter.



Potential Difference

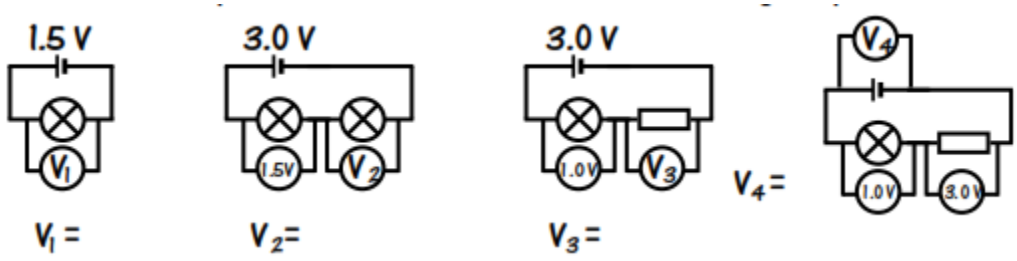
Potential difference is a measure of how much _____ is transferred from a component. It is measured in _____ (_____ per _____).The _____ or battery provides the potential difference needed for a _____ to flow. An _____ in the potential difference of the power supply will make the current _____.

Words: cell volts increase joules higher energy coulomb current

Potential Difference in Series Circuits

The sum of potential differences across each component in a series circuit must equal the potential difference across the cell; i.e. if a cell has a potentidifference of 1.5 V, the potential differences across the other components must add up to 1.5 V. Any more and we would be violating the laws of physics

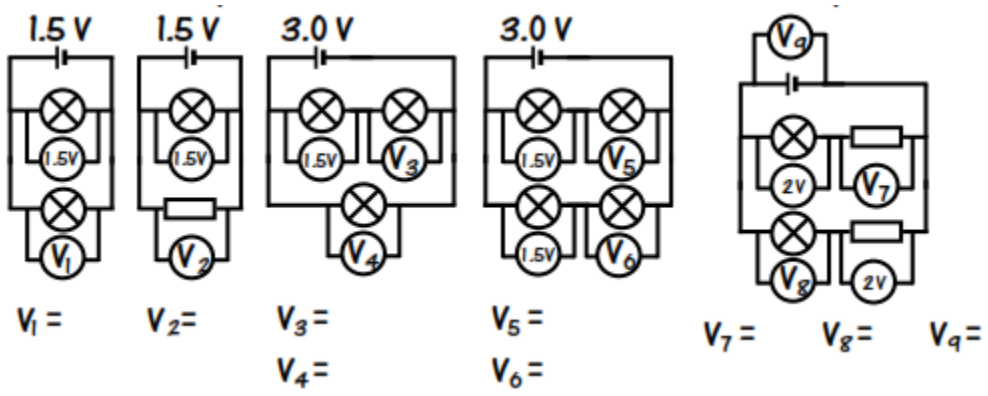
What would the potential differences be across the following components?



Potential Difference in Parallel Circuits

The sum of potential differences across each component in each branch must equal the potential difference across the cell. Why aren"t we violating the laws of physics? Each branch will have a lower current, so each branch only gets a fraction of the energy, thus energy is conserved.

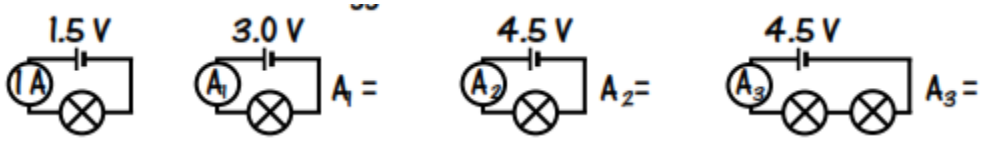
What would the potential differences be across the following components?



V_1 = V_2= V_3 = V_4= V_5 = V_6= V_7 = V_8= V_9=

Current & Potential Difference

Use the first circuit to suggest what the current would be in the other circuits.



Suggest why the values may not exactly match the values above.

_____

_____

_____

Summary

In a series circuit:

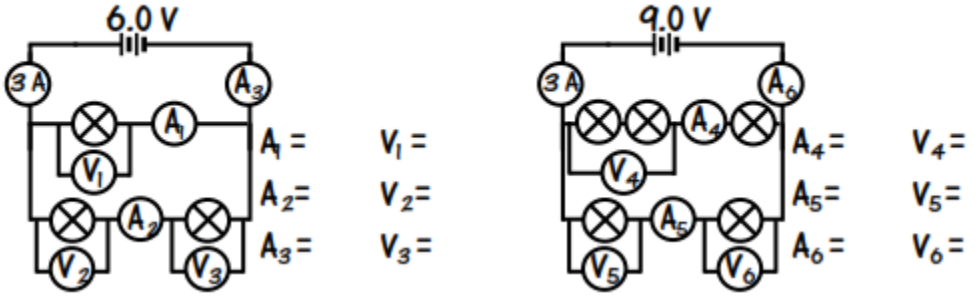
Current is the same/splits up at any point

Voltage is the same/splits up over each component

In a parallel circuit:

Current is the same/splits up down each "branch"
Voltage is the same/splits up across each "branch"

Example Questions



Explain the readings on the ammeters in each of the circuits.

_____

_____

_____

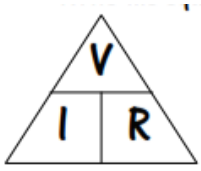
Resistance

Resistance in an electrical circuit is provided by anything that _____ a current; i.e. it makes it _____ for current to flow. Connecting wires have relatively ___ resistance compared to filament bulbs. Resistance is measured in _____, and can be calculated from the _____ _____ across a component and the _____ flowing through it. Longer wires have _____ resistance than shorter wires, and thick wires have _____ resistance than thin wires.

Words:	higher	harder	ohms	resists	low
potential difference		current		lower	

Calculating Resistance

Write the equation for calculating resistance below.



Resistance =

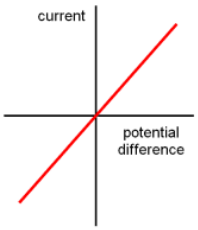
Example Questions

What is the resistance of the following?

1. A bulb with a potential difference of 1.5 V and a current of 0.5 A.

_____

2. A resistor with a potential difference of 1 V and a current of 0.1 A.



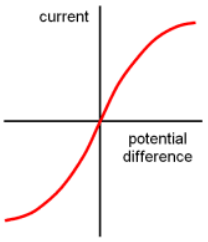
_____

3. A motor with a potential difference of 6 V and a current of 12 A.

_____

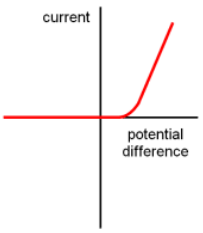
4. Calculate the following:

a) The potential difference across the resistor
b) The resistance of the bulb.



Ohm"s Law

For a component that obeys Ohm"s law the _____ _____ across a component is directly _____ to the _____ flowing through it; i.e. if you _____ the potential difference, you double the _____. Components such as resistors and connecting wires will obey Ohm"s law, assuming temperature stays constant.



Ohm's law, assuming temperature stays constant.

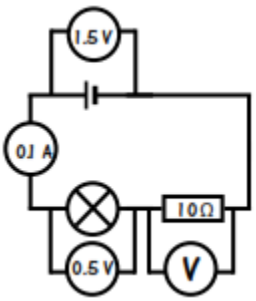
Words:	current	potential difference	double	proportional	current

Filament Bulbs

Filament bulbs do/do not obey Ohm"s law. As a current flows it causes the filament to heat up, emitting heat and light. The resistance of the filament increases/decreases as the temperature increases. As the temperature increases the resistance increases/decreases. As potential difference increases the resistance increases/decreases, so potential difference is/is not proportional to current.

Diodes

Diodes have a very high resistance in one direction, so an electrical current can only flow in the opposite direction. It takes a potential difference of around 0.6 V for a current to flow through a diode. Light emitting diodes (LEDs) are often used as indicator lights in electrical equipment, e.g. computers.



Light Dependent Resistors (LDRs)

Explain how the resistance of LDRs changes with light intensity.

_____

_____

Thermistors

Explain why the resistance of thermistors made from semiconductors decreases with temperature, while the resistance of metals increases.

_____

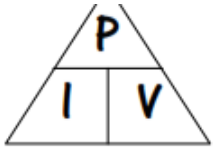
_____

_____

_____

Power

Power is a measure of how much energy is transferred every second.



Power =

Calculating Power

Calculate the power of the following:

1. A light bulb with a potential difference of 12 V and a current of 5 A.

_____

2. An electric fire with a potential difference of 230 V and a current of 4 A.

_____

Energy Transferred

1 watt of power is equal to 1 J of energy being transferred every second.

Calculate the energy transferred in the following examples:

1. A 60 W light bulb switched on for 2 minutes.

_____

2. An 800 W microwave running for 4 minutes.

_____

Fuse ratings

Calculate the current each of the following appliances needs, and suggest which fuse would be the most suitable. Fuses are either 3 A, 5 A, or 13 A.

Assume they are all connected to the mains at 230 V.

1. A 1.8 kW kettle.

_____

2. An 800 W microwave

_____

3. A 1.15 kW electric heater.

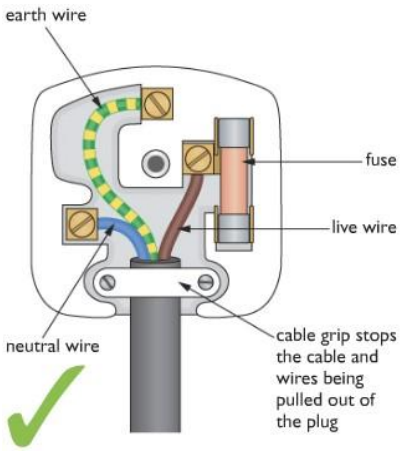
_____

Heating Effect of a Current

A current carrying wire will heat up. Give one problem of this effect:

Problem: _____

Label the plug:



How do the earth wire and the fuse protect people from electric shocks?

_____

_____

What are the advantages of using circuit breakers instead of fuses?

_____

Why do double insulated appliances not need an earth wire?

_____

IGCSE PHYSICS TEST ON ELECTRICITY (MCQ)

1.

When a plastic rod is rubbed with a dry cloth, the rod gains electrons from the cloth.

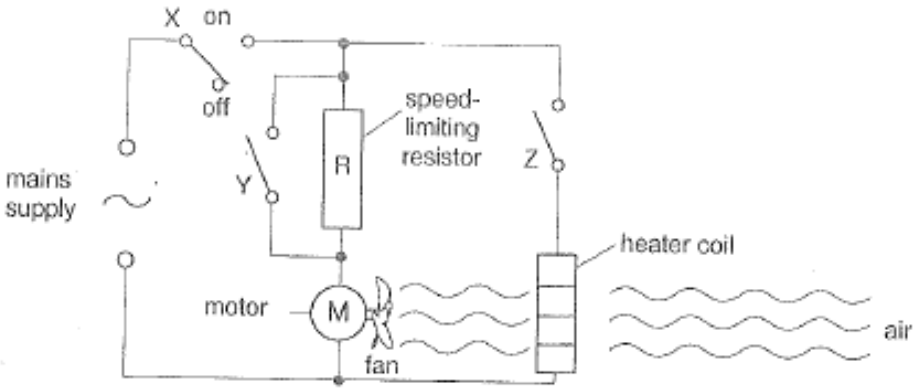
What is the sign of the charge on the rod and on the cloth, and the nature of the force between them?

	sign of charge on the rod	*sign of charge on the cloth*	*nature of force exerted between them*
A	positive	positive	repulsive
B	negative	positive	attractive
C	positive	negative	repulsive
D	negative	negative	attractive

2.

The circuit diagram for a fan heater is shown. The motor can run at high or low speed, and the fan heater can blow hot or cold air.

The motor driving the fan runs at low speed when resistor R is connected in series with the motor.



Which switches should be closed so that the motor runs at high speed and the heater blows hot air?

A X only

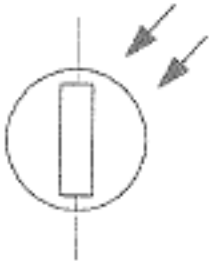
B X and Y

C X and Z

D X, Y and Z

3.

A circuit contains the component shown by the following symbol.



Which change would the component detect?

A change in

A light level.

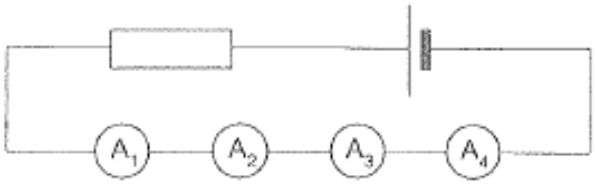
B potential difference.

C radioactivity.

D temperature.

4.

Two faulty ammeters and two perfect ammeters are connected in series in the circuit shown.



The readings on the ammeters are:

A_1 2.9 A

A_2 3.1 A

A_3 3.1 A

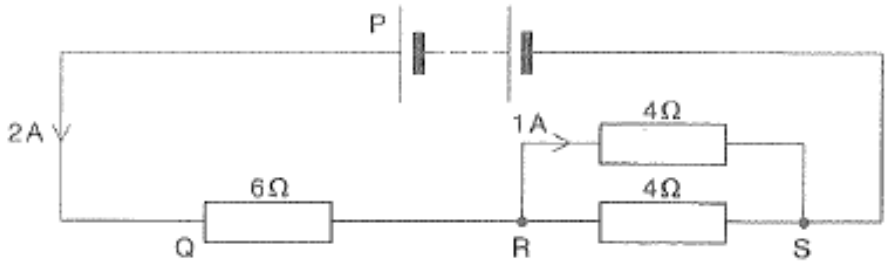
A_4 3.3 A

Which two ammeters are faulty?

A A_1 and A_2 B A_1 and A_4 C A_3 and A_2 D A_3 and A_4

5.

The circuit shows three resistors connected to a battery.

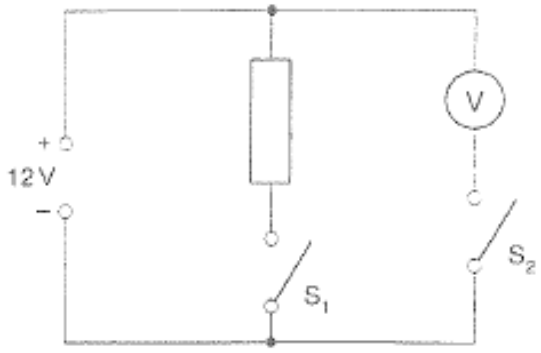


Given that p.d. = current x resistance, across which part of the circuit is there a p.d. of 4 V?

A PR **B** PS **C** QR **D** RS

6.

In the circuit, the switches S_1 and S_2 may be open (off) or closed (on).



switches shown open (off)

Which line in the table correctly shows the voltmeter reading for the switch positions given?

	S_1	S_2	*voltmeter reading* / V
A	open	open	12
B	closed	closed	12
C	open	closed	0
D	closed	open	12

7.

A mains circuit can safely supply a current of 40 A.

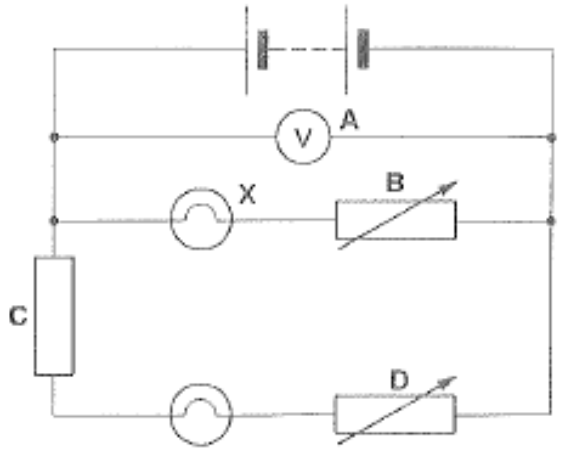
A hairdryer takes 2 A. It is connected to the circuit by a lead which can carry up to 5 A.

What is the current rating of the fuse which should be put in the plug fitted to the hairdryer lead?

A 1 A B 3 A C 10 A D 50 A

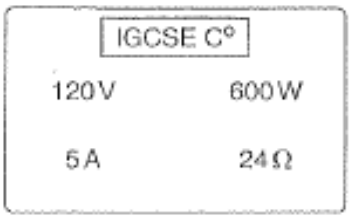
8.

Which labelled component in the circuit controls the brightness of the lamp X?



9.

The diagram shows a label on a heater.

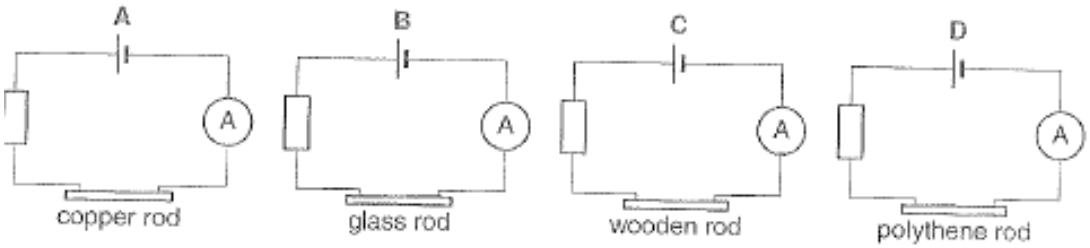


What is the power of the heater?

A 5 A B 24 Ω C 120 V D 600 W

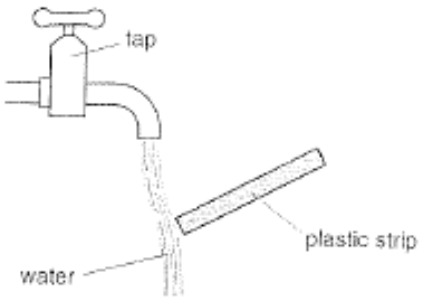
10.

In which circuit is there a reading on the ammeter?



11.

A plastic strip is rubbed on a piece of cloth and held near water running slowly from a tap. The water moves towards the plastic strip.



Why does this happen?

A The plastic strip cools the water.

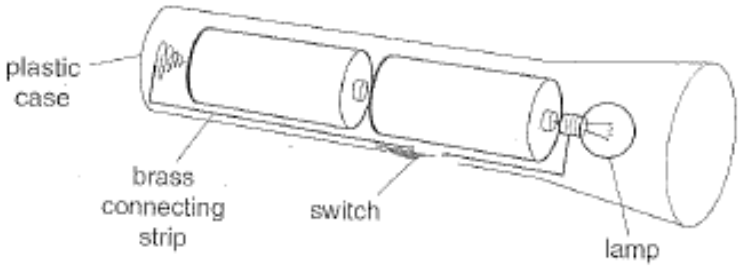
B The plastic strip warms the water.

C There is a magnetic force on the water.

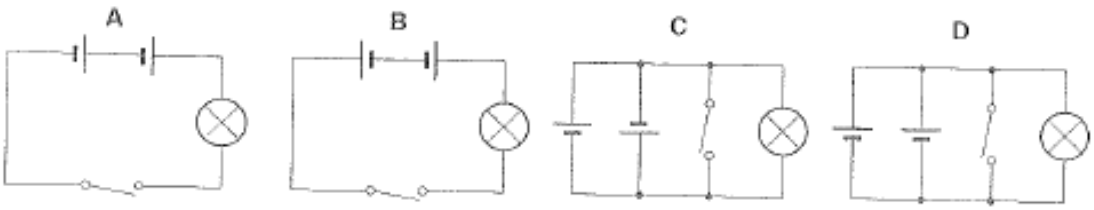
D There is an electrostatic force on the water.

12.

) The diagram shows a torch containing two 2 V cells, a switch and a lamp.

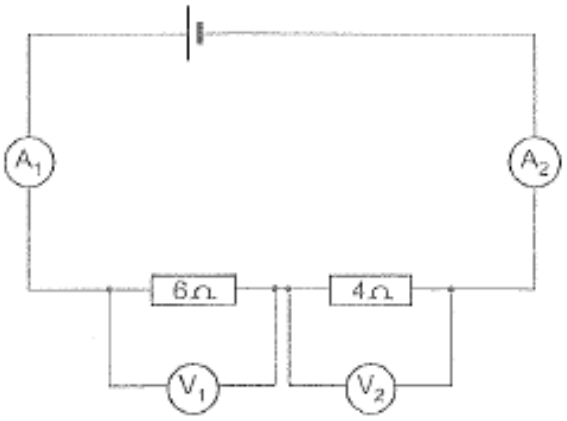


What is the circuit diagram for the torch?



13.

The diagram shows a series circuit that includes two ammeters and two voltmeters.

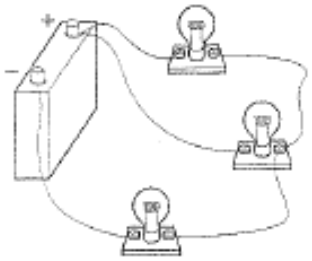


How do the readings on the meters in the circuit compare?

	reading on A_1	*reading on* V_1
A	equal to reading on A_2	less than reading on V_2
B	equal to reading on A_2	greater than reading on V_2
C	greater than reading on A_2	greater than reading on V_2
D	greater than reading on A_2	less than reading on V_2

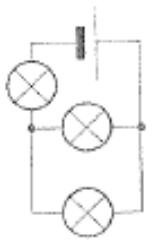
14.

The diagram shows a circuit with three lamps and a cell.

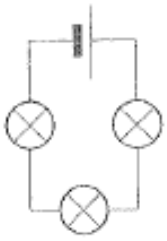


What is the circuit diagram for the above arrangement?

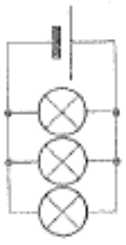
A



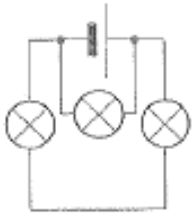
B



C

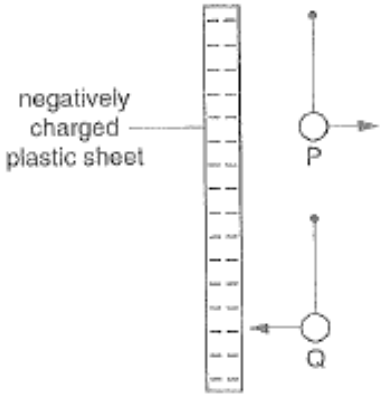


D



15.

Two very light, charged balls P and Q are hung, one above the other, from nylon threads. When a negatively charged plastic sheet is placed alongside them, P is repelled and Q is attracted.

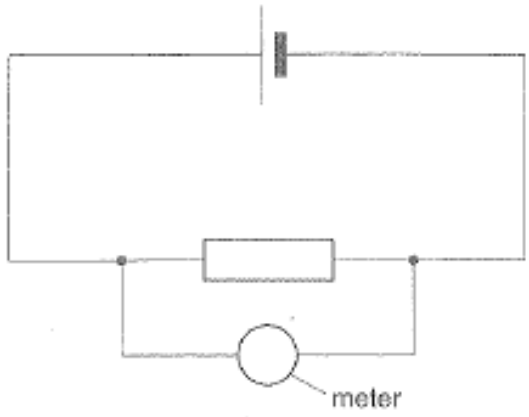


What are the original charges on P and on Q?

	charge on P	charge on Q
A	negative	negative
B	negative	positive
C	positive	negative
D	positive	positive

16.

The meter in the circuit measures the potential difference across the resistor.



Which unit is marked on the scale of the meter?

A amp

B ohm

C volt

D watt

REVISION QUESTIONS

1.) What does electrical insulation do?

It prevents electrocution by shielding current-carrying cables

2.) How does a fuse work?

A fuse breaks a circuit when too much current flows through it,causing it to heat up and melt

3.) What two things does electrical resistance do?

Resistance opposes the flow of current and causes heating

4.)What equation links power, current and potential difference?

Power = current × potential difference

5.) What equation links energy transferred, current, potential difference and time?

Energy transferred = current × potential difference × time

6.) What is the difference between AC and DC current?

AC current oscillates between positive and negative voltage. DC current does not.

7.) Is the UK mains supply AC or DC?

AC

8.) Is the current from a battery of cells AC or DC?

DC

9.) In a parallel circuit is potential difference or current the same across all components?

Potential difference

10.) What equation links resistance, potential difference and current?

Resistance = potential difference / current

11.) What is current?

Current is a flow of charge

12.) What equation links charge, current and time?

Charge = current × time

13.) What is one volt equivalent to?

One volt is one joule per coulomb of charge

14.)How does the resistance of a thermistor vary with temperature?

As temperature rises resistance falls

15.) How does the resistance of a light-dependent resistor vary with luminance?

As luminance increases resistance decreases

16.)What is the difference between and insulator and a conductor?

An insulator does not allow current to flow; a conductor does

17.) What causes an object to become positively charged?

A loss of electrons

18.) Do unlike charges attract or repel each other?

Unlike charges attract each other

19.) How can electrostatic charges be dangerous?

A build-up of electrostatic charge can cause sparks

20.) What are electrostatic charges used for?

Inkjet printers, photocopiers, crop and paint spraying, smoke filtration etc.

STRUCTURED QUESTIONS

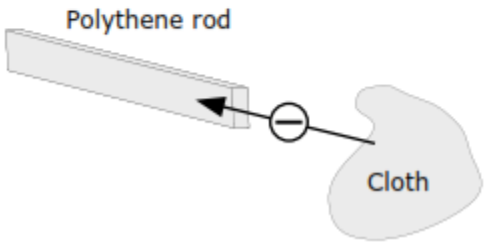
1.

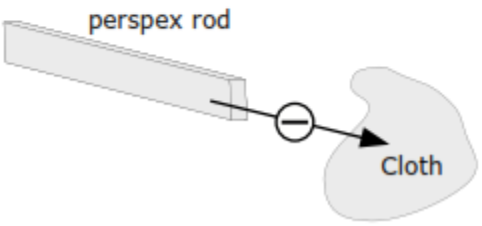
Read the passage and answer the questions below

Everything is made of atoms. Under normal circumstances every atom in an object has equal numbers of electrons and protons. Each electron carries a negative charge and each proton carries a positive charge. However, sometimes when objects are rubbed together a few electrons jump from one object to the other. This leaves one object with too few electrons and the other object with too many electrons.

Polythene and Perspex are both types of plastic. All plastics are electrical insulators.

Any object that is made from plastic can be electrically charged by rubbing it with a woollen cloth. If the plastic is polythene, electrons will jump from the cloth to the polythene as they rub together. If the plastic is perspex electrons will jump from the perspex to the cloth as they rub together.





(i) When perspex rod is rubbed with a woollen cloth, which becomes negatively charge and which becomes positively charged?

_____

_____ [2]

(ii) When a rod of polythene is rubbed with a woollen cloth which becomes negatively charge and which becomes positively charged?

_____

_____ [2]

(b) Having charged the perspex and polythene rods the following experiment is carried out. The charged perspex rods is hung by a thin string so that it is free to move around as shown in diagram 1. The charge polythene rod is held close to the perspex rod.

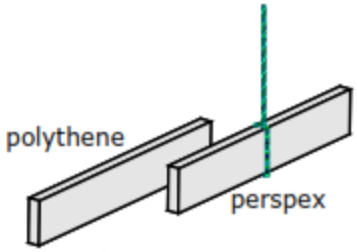


diagram 1

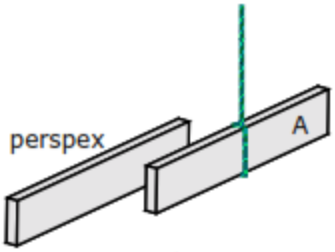


diagram 2

(i) Describe what you would see when this is done.

_____

_____ [2]

In a second experiment a charged Perspex rod is held close to a charged rod A. Rod A moves away from the Perspex rod.

(ii) What is the charge on rod A? _____ [1]

(c) (i) When long dry hair is brushed the strands often move away from one another. Explain why this happens.

_____

_____

_____ [2]

(ii) As you brush strands of hair are also attracted to the bristles of the brush. Explains this.

_____

_____

_____ [2]

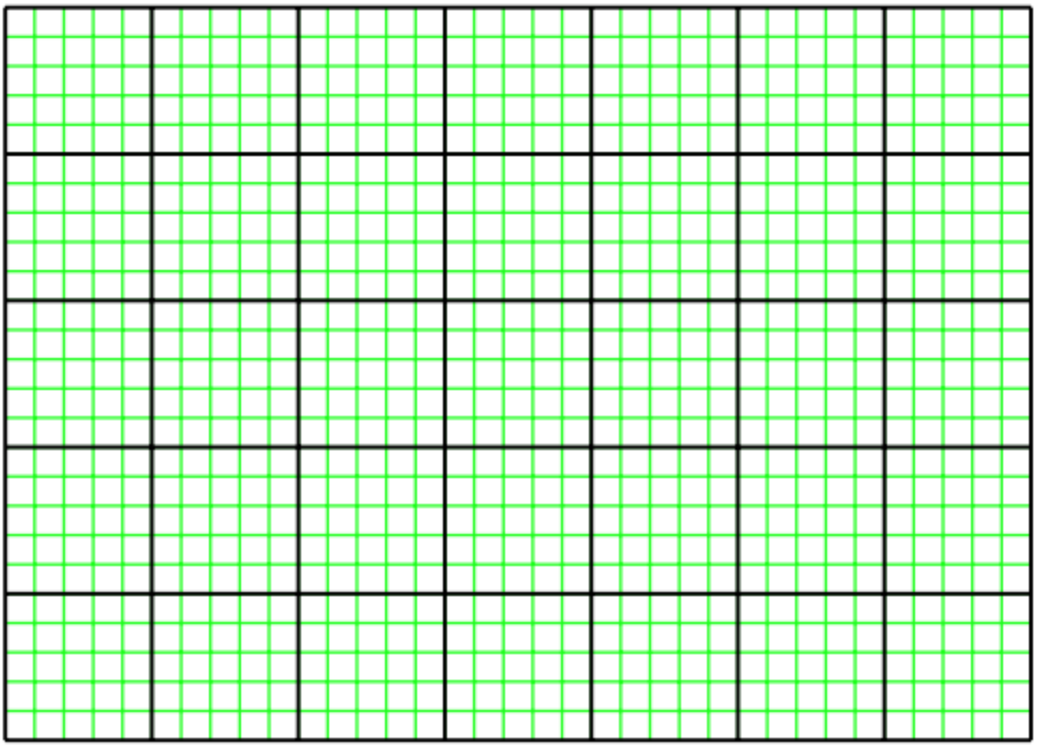
2.

In an experiment with a filament lamp, the following readings of p.d. and current were obtained.

p.d./ V	0	1.0	2.0	3.0	4.0	5.0	6.0
Current/ A	0	0.1	0.19	0.27	0.34	0.40	0.45

(a) Draw a diagram of the circuit you would use in order to obtain these readings.

(b) Plot a graph of p.d. (x-axis) against current (y-axis)



1

(c) For each pair of readings calculate the resistance of the lamp.

p.d. / V	0	1.0	2.0	3.0	4.0	5.0	6.0
Current / A	0	0.1	0.19	0.27	0.34	0.40	0.45
Resistance / Ohms							

(e) What conclusion can you draw from the graph about the effect of current on the resistance of the filament of the lamp?

_____ [1]

3.

(a) Bulb A is rated at 1.5 V. Draw a circuit diagram for the arrangement shown in figure 1 [1]

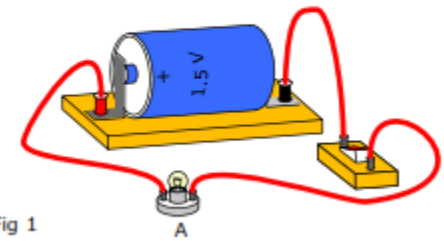


Fig 1

(b) (i) What type of circuit is shown in figure 2a? _____ [1]
(ii) Complete figure 2b by joining the components to make the circuit shown in figure 2a. [3]

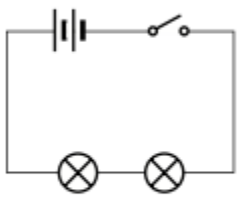


Fig 2a

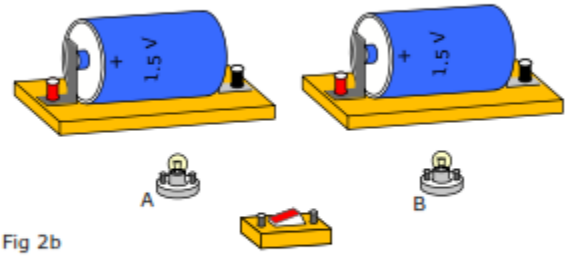
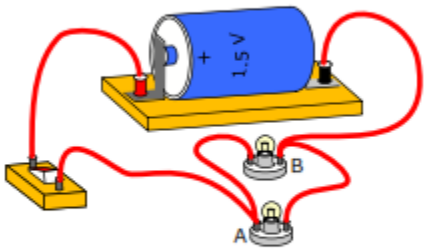


Fig 2b

(iii) How does the brightness of bulb A and B in figure 2b compare to the brightness of bulb A in figure 1 given that they are all identical bulbs.

_____ [1]

(c) (i) What type of circuit is shown in figure 3? _____ [1]
(ii) Draw the circuit diagram for figure 3. [3]



(iii) How does the brightness of bulb A and B in figure 3 compare to the brightness of bulb A in figure 1 given that they are all identical bulbs.

_____ [1]

(d) (i) Complete figure 4 so that the three lamps are in parallel with one another. [2]
(ii) Draw the circuit diagram for this arrangement in the space on the right. [2]

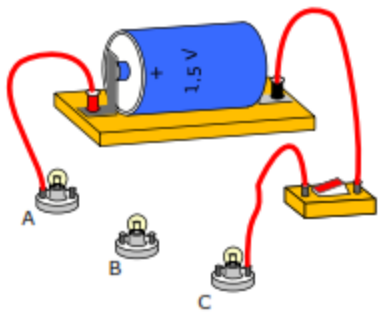


Fig 4

(ii) How does the brightness of bulbs A , B and C in figure 4 compare to the brightness of bulb A in figure 1 given that they are all identical bulbs.

_____ [1]

(e) (i) Draw the circuit diagram for the arrangement in figure 5 in the space on the right. [2]

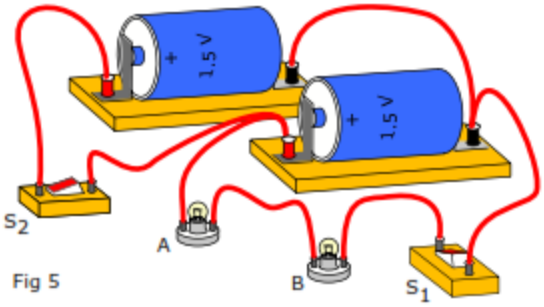


Fig 5

(ii) How does the brightness of A & B in figure 5 compare with the brightness of A in figure 1 when both switches S_1 and S_2 are closed?

_____ [1]

(ii) How does the brightness of A & B compare with the brightness of A in figure 1 when switche S_1 is closed and S_2 is open?

_____ [1]

(f) (i) Draw the circuit diagram for the arrangement in figure 6 in the space on the right. [2]

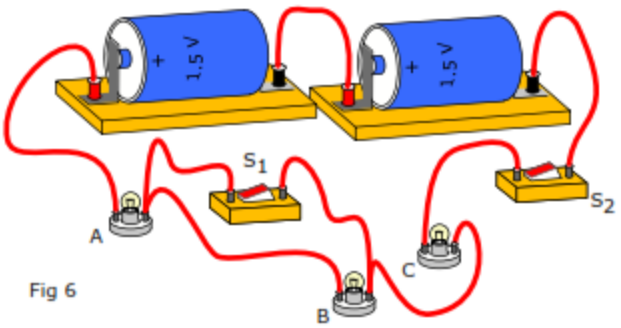


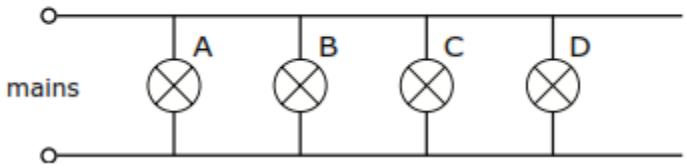
Fig 6

(ii) How does the brightness of A, B & C compare with the brightness of A in figure 1 when both switches S_1 and S_2 are closed?

_____ [1]

4.

Ceiling lights in the home are always wired in parallel as shown in the diagram.



(a) What is the advantage, if any, of wiring lamps in parallel?

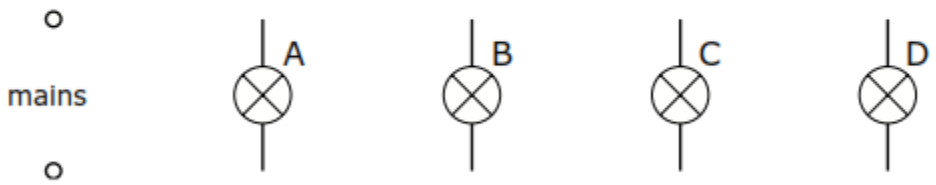
_____

_____

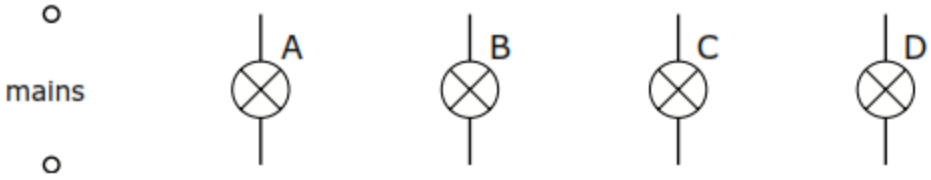
_____ [3]

(b) Complete the diagram below to show where would you place a switch to turn all the lamps on or off at the same time.

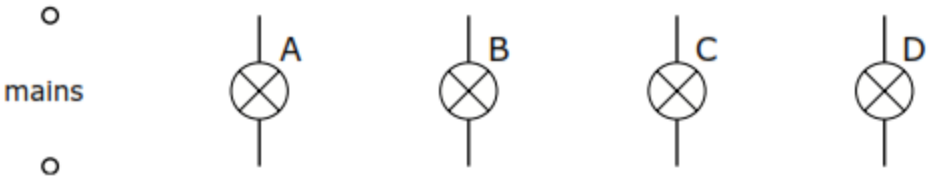
[2]



(c) Complete the diagram below to show where would you place switches to turn each lamp on and off independently of all the others?
[2]



(d) Complete the diagram below to show how you could turn off lamps C & D from the same switch? [2]



5.

Two identical lamps are connected in **series** with a battery of **three** cells each of 1.5 V and a switch.

(a) Complete the circuit diagram in figure 1.

Fig. 1

(b) What is the total p.d. of the battery? _____ [1]

(c) What is the p.d. across each lamp? _____ [2]

(d) The current through one of the lamps is 0.25A. What is the current though the other lamp?

_____ [1]

(e) What is the total current drawn from the battery? _____ [1]

(f) What is the resistance of one of these lamps?

_____ [2]

(g) What is the total resistance of this circuit?

_____ [1]

6.

3 Two identical lamps are connected in **parallel** with one another. They are both connected to the same battery of two cells each of 1.5 V.

(a) One of the lamps has been drawn for you. Draw the rest of the circuit. [3]

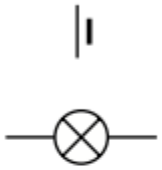


Fig. 2

(b) The current through one of the lamps is 0.8A. What is the current though the other lamp?

_____ [1]

(c) What is the total current drawn from the battery? _____ [1]

(d) What is the p.d. across each lamp? _____ [1]

(e) What is the resistance of one of these lamps?

_____ [2]

7.

(a) Figure 1 shows a simple electrical circuit consisting a resistor R_1 and a battery *B*.

(i) Add an arrow to show which way around the circuit the current flows [1]

(ii) Add a circle to show where you would connect an ammeter to measure the current through the resistor. Label this *A*. [1]

(iii) Add a circle to show where you would connect a voltmeter to measure the current through the resistor. Label this *V*. [1]

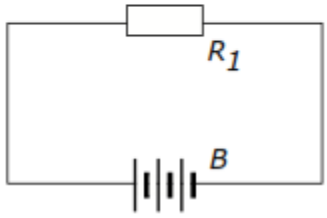


fig. 1

(b) (i) Write down in words the formula that links electrical resistance, potential difference and electric current [3]

(ii) What are the units for each of these quantities? Complete the table below.

Quantity	*Resistance*	*Potential difference*	*Current*
Unit			

(c) The resistance of the resistor is 3 Ohms and the p.d. of the battery is 12 volts. Calculate the current flowing through the 3 Ohm resistor in figure 1.

_____

_____ [2]

(d) A second resistor, R_2, of resistance 12 Ohms is connected in series with the first one.

(i) Complete figure 2 to show the complete circuit.

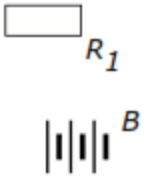


fig. 2

(ii) Write down *in symbols* the formula links the total resistance R_T , R_1 and R_2. [1]

(iii) What is the total electrical resistance in this new circuit?

_____ [1]

(iv) How does the current through the through the 12 Ohm resistor compare with the current through the 3 Ohm resistor in figure 2?

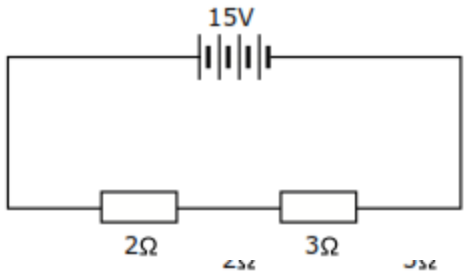
_____ [1]

(v) Calculate the current flowing through the 12 Ohm

_____ [2]

8.

A resistor of 2Ω is joined in series to one of 3Ω. The p.d. across the combination is 15V.



Calculate

(a) the total resistance of the circuit.

_____

_____ [2]

(b) the current though each resistor.

(i) Current through 2Ω resistor _____

_____ [2]

(ii) Current through 3Ω resistor _____ [1]

(c) the p.d. across each resistor.

(i) p.d. across 2Ω resistor _____

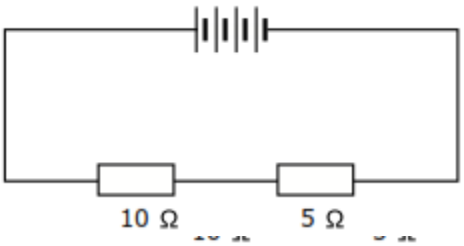
_____ [2]

(ii) p.d. across 3Ω resistor _____

_____ [1]

9.

A resistor of 10Ω is joined in series with one of 5Ω.



(i) What is the total resistance of the circuit?

_____ [2]

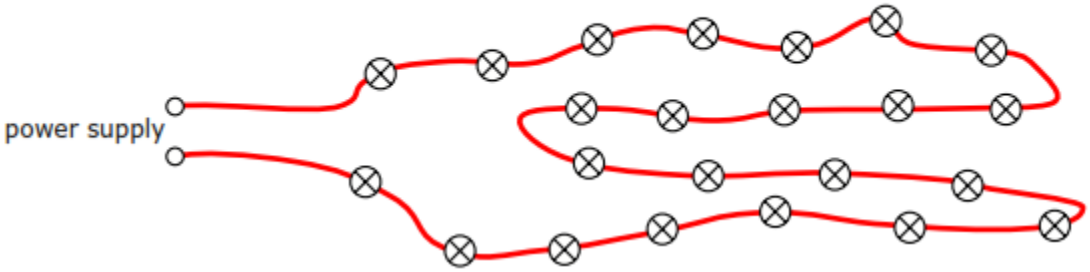
(ii) What is the p.d. of the battery that will drive a current of 0.1A through the combination?

_____

_____ [2]

10.

(a) Christmas tree lights are connected in series as shown in the diagram. A typical arrangement consists of twenty lamps connected to the mains supply. Mains voltage is 230 V.



(i) If the filament in one of the lamps breaks, all the other lamps go out. Why is this?

_____

_____ [2]

(ii) How does the brightness of the lamps change if another five similar lamps are connected in series?

_____ [1]

(iii) Explain why the brightness changes in the way you have described in part (ii).

_____

_____ [2]

(b) The current through the string of lights is 0.25 amps

(i) How many lamps does the diagram show? _____ [1]

(ii) Calculate the current through each lamp.

_____

_____ [2]

(v) Calculate the resistance of one of these lamps.

_____

_____ [2]

11.

Copy and complete the table.

	Device	from	to
1	An electric fire	electrical energy	radiant energy
2	A filament lamp		
3	A heating element in a kettle		
4	An electric motor		
5	A loudspeaker		

12.

What important information do the quantities A and B in figure 1 tell you about the light bulb?

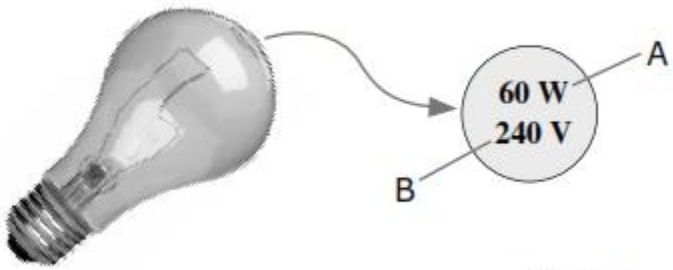


Figure 1

A means _____ [1]

B means _____ [1]

13.

An electrical drill is rated at 500W, 240 V.

(a) What current does the drill draw from the mains supply?

_____

_____ [2]

(b) How much energy does the drill transfer if it is used for 3 minutes?

_____

_____ [2]

(c) Into what form of energy does a drill convert electrical energy?

_____ [1]

14.

(a) How much electrical power can be transferred by a current of 5 amps at 240 V?

_____

_____ [2]

(b) How many 60W light bulbs could be operated from this supply?

_____

_____ [2]

15.

Fill in the missing values for the appliances in the table below. Available fuses are rated as follows: 3A, 5A and 13 A.

	Appliance	power	p.d.	current	correct fuse
A	car headlamp	48W	12V		
B	T.V.	200W	240V		
C	hairdryer		240V	2A	
D	iron	960W	240V		
E	kettle		240V	10A	
F	immersion heater	3000W	240V		

16.

The power of a lamp is 60W.

(a) How much electrical energy is transferred by the filament of the lamp in 1 hour?

_____

_____ [2]

(b) Into what form does the filament transfer electrical energy?

_____ [1]

The average filament lamp transfers 5% of the electrical energy into light.

(c) What becomes of the remaining 95% of electrical energy?

_____ [1]

(d) Given that the purpose of a lamp is to provide illumination, how efficient is it?

_____

_____ [3]

17.

An electric kettle has a heating element rated at 2200W, 240V. It takes 3 minutes to boil some water.

(a) Into what form of energy does the element transfer electrical energy?

_____ [1]

(b) How much energy does the element transfer in one second?

_____

_____ [2]

(c) How much energy is transferred by the heating element in 3 minutes?

_____

_____ [2]

18.

The element of an electric fire is rated at 1200W, 240 V. It is switched on for 8 hours.

(a) How many Units of electrical energy are used?

_____

_____ [2]

(b) How much does it cost to use the fire if 1 Unit of electrical energy costs 6p?

_____

_____ [2]

(c) How much does it cost to use this heater for 8 hours a day for a week?

_____

_____ [2]

19.

A kettle takes 2 minutes 30 seconds to boil 1 litre of water. The heating element in the kettle is rated at 2400 W.

(a) How much thermal energy is developed by the heating element in boiling the water?

_____

_____ [2]

(b) How much does it cost to boil 1 litre of water if the cost of electrical energy is 6 p per Unit.

(i) Number of units used to boil water = _____

_____ [2]

(ii) cost of boiling water = _____

_____ [1]

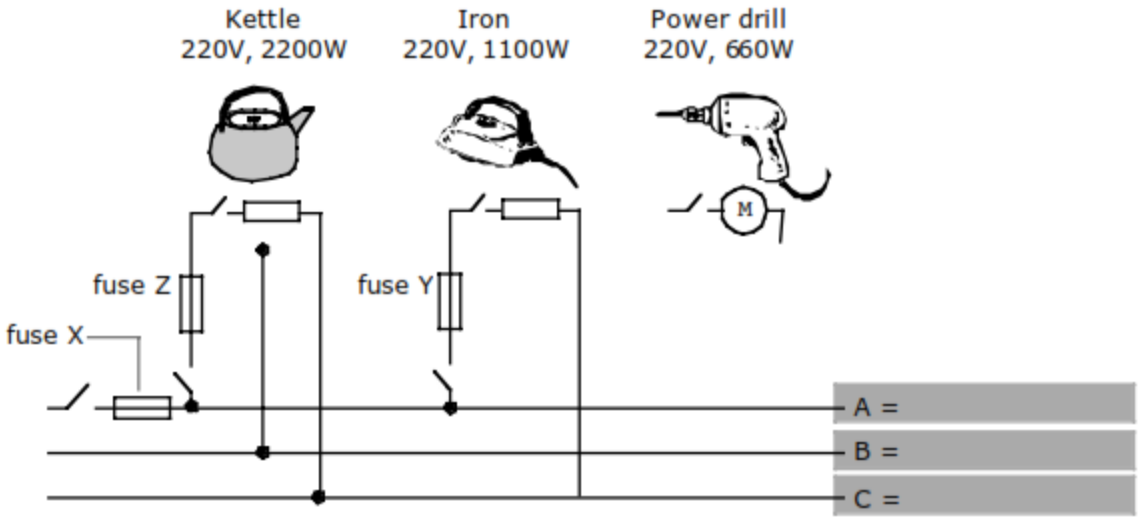
(c) Utility bill are paid quarterly. How much does it cost to boil 1 litre of water 2 times a day, 7 days a week for 12 weeks?

_____

_____ [2]

20.

The diagram shows part of a ring main in a house. Three appliances, with their operating voltages and powers, are also represented.



(a) On the diagram,

(i) label the live wire with a letter L, the neutral wire with a letter N and the earth wire with a letter E. [3]

(ii) complete the circuit from the main to the power drill. The power drill is double insulated (i.e. it has a plastic casing). [2]

(b) (i) Write down in words the equation that links electrical power, voltage and current.

_____ [1]

(ii) Calculate the current to the kettle.

_____

[2]