# Magnetism & Electromagnetism Revision Booklet



PREPARED BY PREETI MANOJ

# ELECTROMAGNETISM

1. What are the two ways to induce a current?

2. How can you increase the current induced?

3. What does Fleming's right hand grip rule tell us?

4. Draw a diagram showing how Fleming's right hand grip rule can be use in a single wire and a coil of wire.

5.Explain why the output for a simple generator is ac.

6. How could you make the output dc?

7. What is meant by the term mutual inductance?

8. Why must an ac current by used in for mutual inductance?

9. Is it possible to induce a current using a dc? Explain your reasoning .

Magnets can attract objects made from

| Magnetic | Non-magnetic |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

magnet materials.Classify the following as magnetic or non-magnetic materials:

Copper Iron
Plastic Steel
Carbon Glass
Wood Cobalt
Nickel Rubber

## Electromagnets

### Current Carrying Wires

A current carrying wire will generate a magnetic field around it. The direction of the field can be determined using the right-hand grip rule.

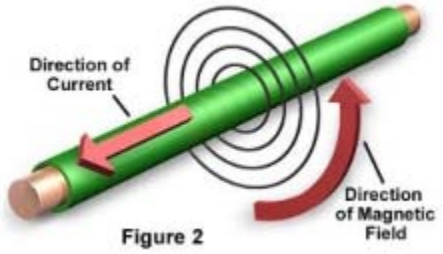
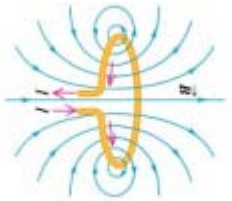


Figure 2

Figure 3

When using the right-hand grip rule we must use the direction of conventional current, i.e. From _____ to _____.

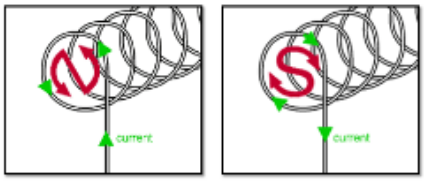
The strength of the magnetic field can be made stronger by:



1. Increasing the current.
2. Wrapping the wire into a coil or a solenoid.

**Solenoids**

The polarity of a solenoid can be found using .....rule.




The strength of a solenoid can be increased by:

1.

2.

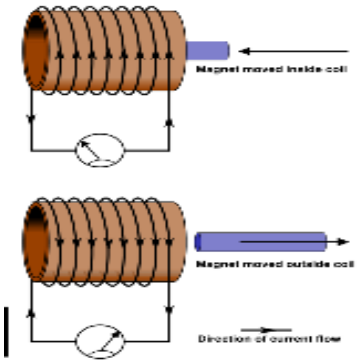
3.

**Electromagnetic Induction**

Generators are used to transform kinetic energy into electrical energy. They do this via a process called electromagnetic induction.

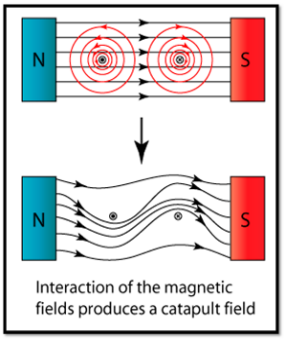
If a wire cuts through magnetic field lines a _____ is induced in the wire. If the wire is part of a circuit this causes a _____ to flow. The _____ of the current can be changed by changing the direction of the movement, or using the other ____ of the magnet.

| Words: | direction | voltage | pole | current |
|---|---|---|---|---|



The size of the induced voltage can be increased by:

1.
2.
3.
4.




## Motor Effect

When a current carrying wire is placed in an external magnetic field, thetwo magnetic fields interact with each other. When the two fields are in the same direction they reinforce each other. When they are in opposite directions they oppose each other, producing a weaker field. Indicate on the diagram where the field is strongest, and hence deduce the direction of movement of the wire.

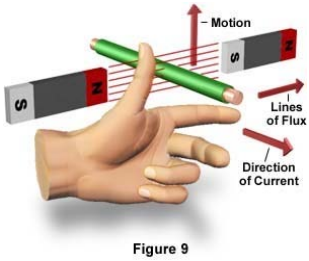



Figure 9

### Fleming"s Left-Hand Rule

The direction of force can be predicted using Fleming"s left-hand rule. Use the diagram to determine which finger relates to which variable.

Thumb: _____
First Finger: _____
Second Finger: _____

What would happen to the direction of the force if:

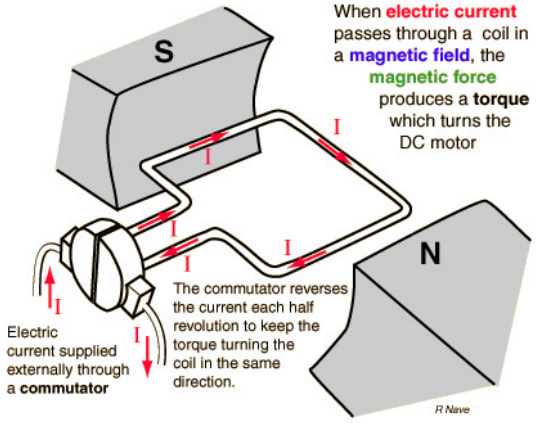
1. The current changes direction? _____
2. The field direction is reversed?

_____

3. Both current and field change direction?

_____

_____




## Electric Motors

The force acting on a current carrying wire in a magnetic field can be used to drive an electric motor. Why does the motor spin?

_____

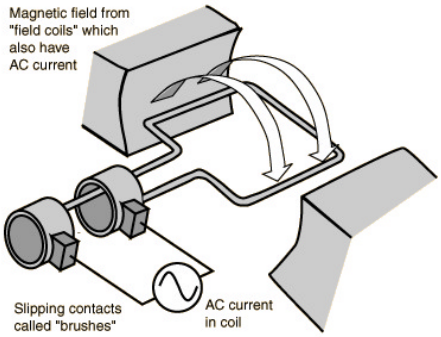
What is the function of the split-ring commutator?

_____

What would happen if the split-ring commutator was not there?

_____

On the diagram to the right:
Draw the direction of the magnetic field, label it B.
Draw the direction of the current, label it I.
Predict the direction of the force on the wire, label it F.
The rate at which the motor spins can be increased by:
1.
2.
3.




**<u>Generating Electricity</u>**

Explain why this generator will generate alternating current.

_____
_____
__
_____
___
_____

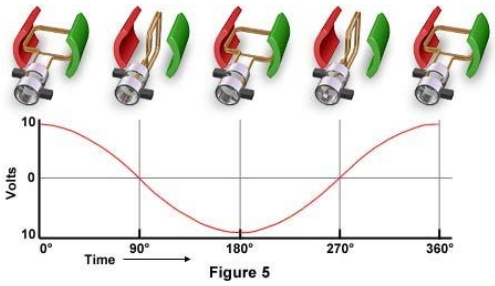


Figure 5

The diagram to the right shows the voltage induced at 90° intervals.
Explain the size and sign of the voltage at:
0° _____
_____
180°
_____
_____
270°
_____
_____

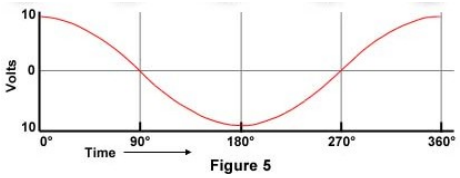
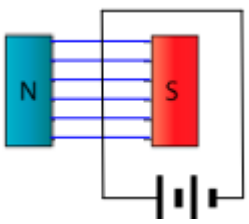


Figure 5

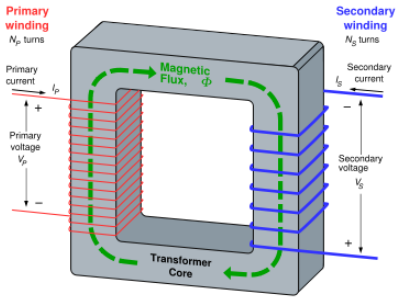
Frequency
The frequency of the UK mains supply is 50 Hz. This means that the coil inside the generator rotates __ times per second.

Direct Current
Draw onto the diagram how a 5 V direct current power supply would be displayed.



## Transformers

An alternating current will generate a changing magnetic field. This changing magnetic field can be used to induce a voltage in a secondary wire. This is an effect commonly used in transformers.
The relationship between the primary and secondary voltages is given by the equation:




$$\frac{\text{Input voltage}}{\text{Output voltage}} = \frac{V_p}{V_s} =$$

Since energy must be conserved, the input power must equal the output power.

$$P_{in} = P_{out}$$
$$V_p \times I_p = V_s \times I_s$$

Therefore, an increase (step-up) in voltage must be accompanied by a decrease in current.

Explain why a decrease in current is desirable when transmitting electricity through the national grid.

_____

_____

A transformer has 200 turns on its primary coil and 800 coils on its secondary coil. What will the voltage across the secondary coil be for a 3 V input voltage?

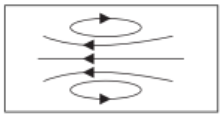
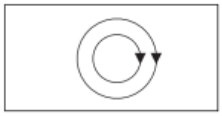
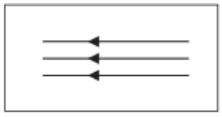
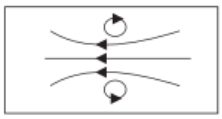
_____

Assuming the transformer is 100% efficient, what will the current in the second coil be if the current in the primary coil is 1 A?

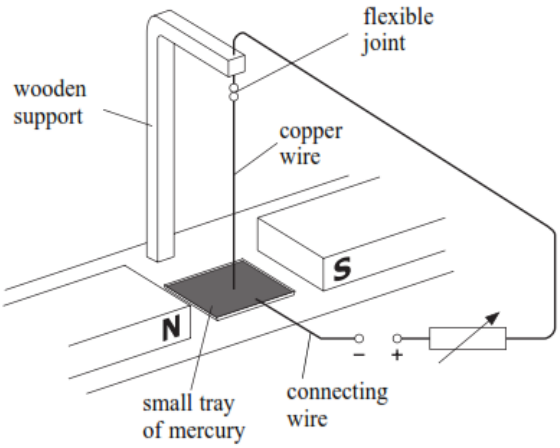
_____

## REINFORCEMENT

1. (a) An electric current produces a magnetic field. Draw a line from each box to its correct magnetic field pattern.

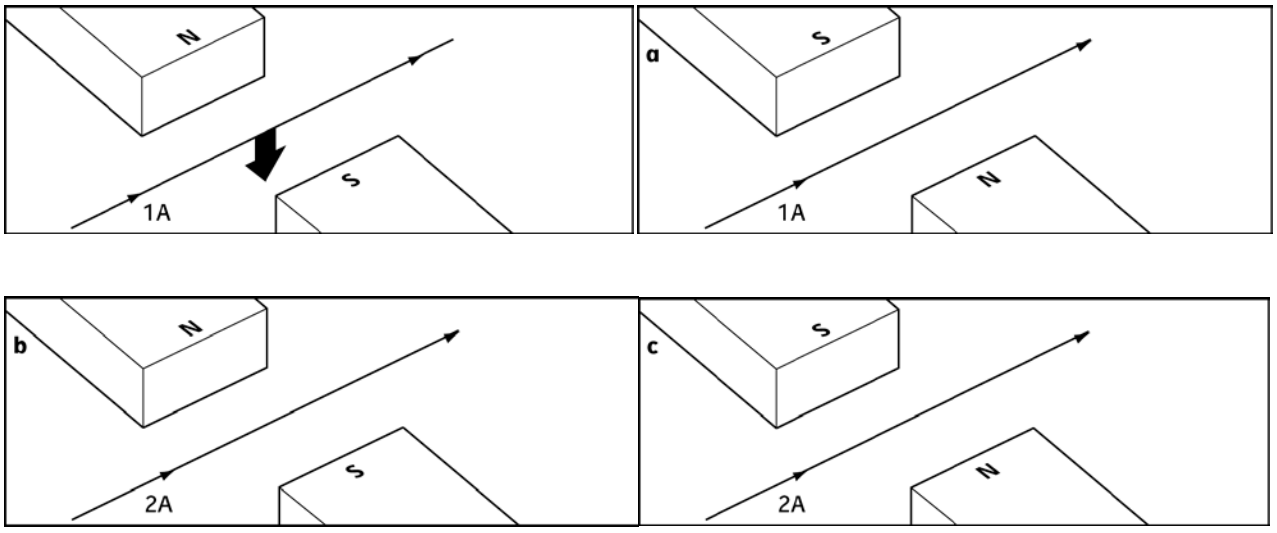
| | |
|---|---|
| current in a straight wire |  |
| current in a flat circular coil |  |
| |  |
| current in a solenoid |  |

2. (a) A teacher sets up the apparatus shown. A copper wire carrying a current is placed between the poles of two bar magnets. This wire dips into a small tray of mercury.




The teacher sets up the apparatus in a fume cupboard because mercury vapour is poisonous.
Draw arrows on the diagram to show the direction of
(i) the current in the copper wire and label it **I**
(ii) the magnetic field between the poles and label it **M**
(iii) the resulting force on the copper wire and label it **F**.
(b) At first the copper wire does not move.
State two changes that could be made to increase the force acting on the copper wire.
1 .....
2 .....

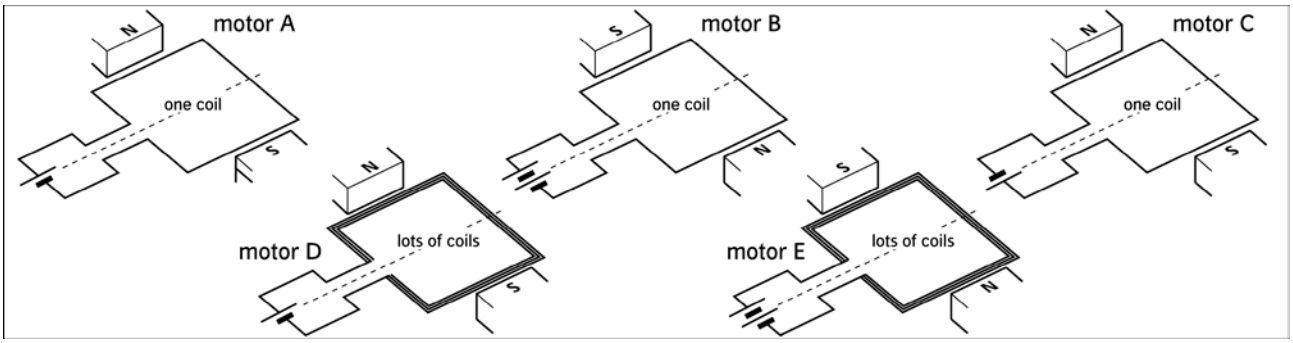
3. Add an arrow to each of the following diagrams to show both the size *and* direction of the force produced in each direction. Use a bigger arrow to mean a bigger force.




4. Motor A below rotates anticlockwise. Which motors will

**a)** rotate clockwise? Explain your answer.

**b)** rotate faster than motor A?




5. (a) A radio contains a small step-down transformer. It changes a 230 V a.c. input into a 5.75 V a.c. output.
(i) The letters a.c. stand for alternating current. What do the letters d.c. stand for?

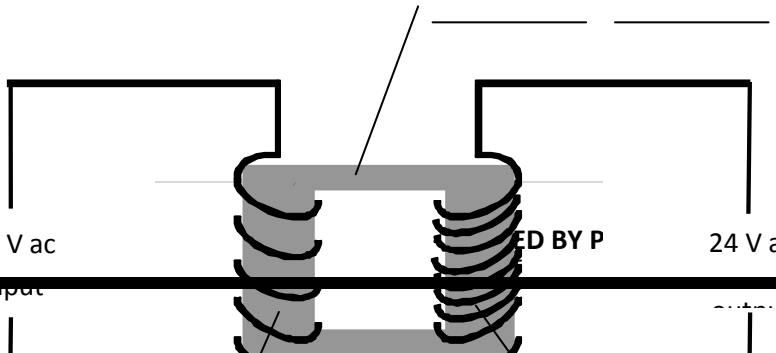
.....

(ii) Complete the sentence.
The number of turns on the output coil of this transformer is ..... than the number of turns on the input coil.

6. A small transformer for a radio has an input voltage of 230 V and an output voltage of 6.0 V.
Calculate the input current in mA when the output current is 575 mA.
Assume that the transformer is 100% efficient.

**7.(A)** The transformer shown below converts 12 volts to 24 volts. Label the diagram using the words from the box.

| | | | | |
|---|---|---|---|---|
| primary coil | secondary coil | iron core | primary voltage | secondary voltage |



A step down transformer has more coils on the primary coil than on the secondary coil and reduces the voltage. A step-up transformer has more coils on the secondary coil than on the primary coil and increases the voltage.

**B)** Is the transformer shown above a step-up or step-down transformer?

_____

**C)** How could the transformer above be changed to make it reduce the voltage?

_____

**D)** If the 25,000V output from a power station needs to be increased to 400,000V to join the National Grid, which kind of transformer should be used?

_____