A student is required to find the shape of the magnetic field around a bar magnet. She is given a plotting compass and a sheet of plain paper. She places the magnet on the paper and the compass close to the magnet, as shown in Fig. 1

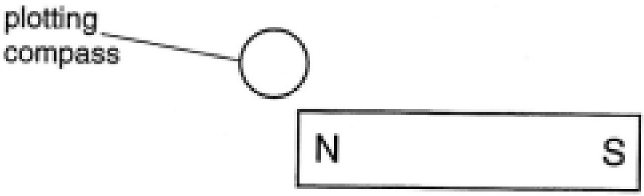


Fig. 1

The circle represents the plotting compass.

(a) Draw an arrow in the circle to show the direction of its pointer. [1]

(b) Describe how the student should proceed to plot the magnetic field.

....

....

....

....

....[3]

(c) On Fig. 2, sketch the magnetic field shape of the magnet.

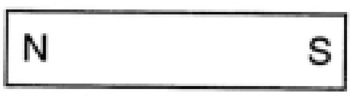
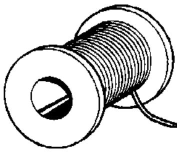


Fig. 2

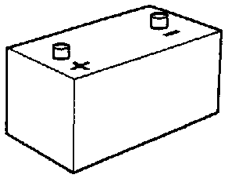
Core 2

You are given an iron bar, a reel of insulated wire, a battery and some wire cutters.

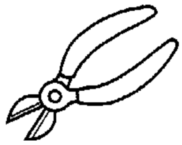
iron bar



reel of copper wire



battery



pliers

(a) In the space below, describe how you would make an electromagnet. You may use a labelled diagram if it helps you to answer the question.

[3]

(b) How would you check if your electromagnet works?

....

....

.... [2]

Core 3

A child suspends a magnet from a piece of string as in Fig. 3

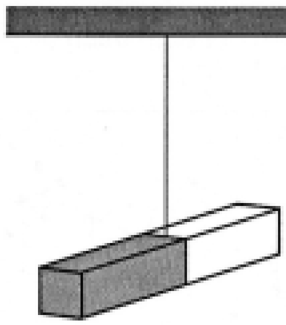


Fig. 3

(a) (i) Explain why the magnet comes to rest in a north-south direction.

....

....

(ii) What name is given to the end that points north?

....

(iii) Name an instrument that is based on this behaviour of a magnet.

.... [3]

Fig. 4 shows the results of placing different metal bars near the magnet.

metal	result of placing different metal bars near magnet
P	there is no force between metal **P** and the magnet
Q	each end of metal **Q** attracts the magnet
R	one end of metal **R** repels the shaded end of the magnet

Fig. 4

(b) (i) Name a possible metal for each of **P**, **Q** and **R**.

P ....

Q ....

R .... [3]

(ii) State what you would expect to happen if the other end of metal **R** was brought up to the shaded end of the magnet.

....[1]

Core 4

Fig. 5 shows a long straight wire between the poles of a permanent magnet.
It is connected through a switch to a battery so that, when the switch is closed, there is a steady current in the wire.

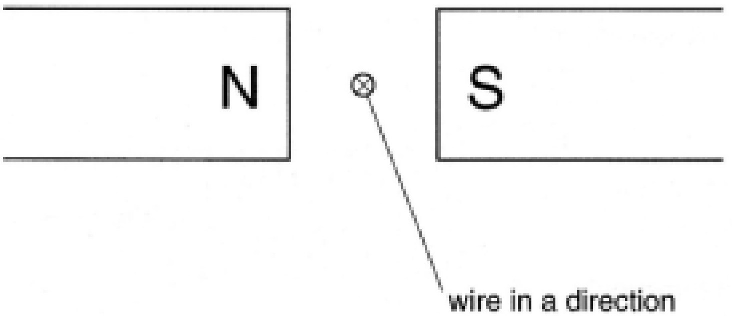


Fig. 5

(a) State the direction of the magnetic field between the poles of the magnet.

....[1]

(b) The wire is free to move. The current is switched on so that its direction is into the page.

(i) State the direction of movement of the wire.

....

....

(ii) Explain how you reached your answer to **(b)(i)**.

....

....

....

[4]

(c) This experiment is the basis of an electric motor.
Describe two changes to the arrangement shown in Fig. 5 that would enable continuous rotation to take place.

change 1 ....

....

change 2 ....

....[2]

Core 5

Fig. 6 shows the structure of a simple electric motor.

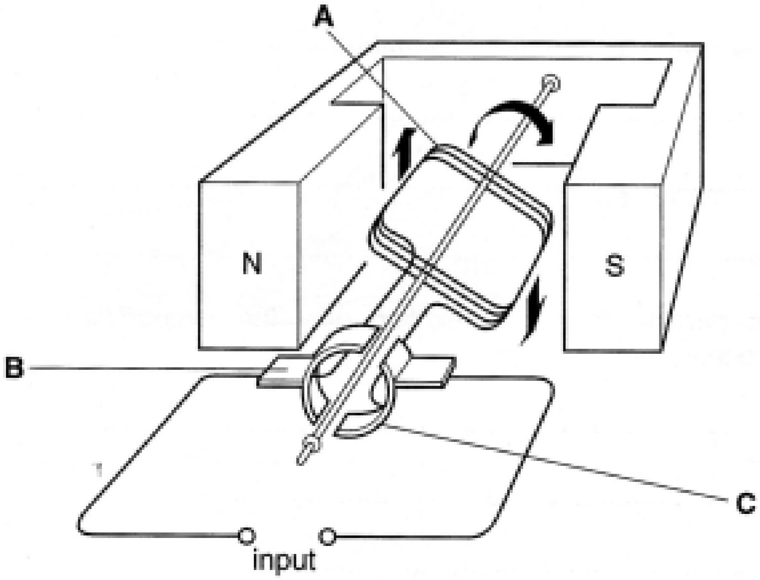


Fig. 6

(a) Name the parts labelled **A**, **B** and **C**.

A ....

B ....

C ....[3]

(b) State two design changes that would allow the motor to lift larger loads.

1. ....

....

2. ....

....[2]

(c) Explain what would happen if too large a potential difference were put across the input.

....

....[2]

Alternative to practical

When investigating the magnetic field due to a bar magnet, a student places the magnet on a sheet of paper as shown in Fig. 7, on page 7. The edge of the paper is placed so that it is parallel to the direction of the Earth's magnetic field. The bar magnet is then placed as shown so that it is at right angles to the direction of the Earth's magnetic field. (In Fig. 3, the lines OX and OY are perpendicular to each other.) A small plotting compass is used to investigate the magnetic field.

(a) It is found that there are positions where the small magnet in the **plotting compass** points so that it is parallel to the line OX.
Some of these positions are located and are labelled A, B, C, D, E, F, G and H, as shown on Fig. 3.
The positions shown in Fig. 3 also lie on straight lines that come from the centre of the bar magnet.

Describe how you would locate the position labelled A. Your answer should explain

(i) what you would do to help you judge when the small magnet in the plotting compass is parallel to OX,

(ii) how you would ensure that the small magnet of the plotting compass is not sticking,

(iii) what you would do so as to mark the point A on the radial line,

(iv) how you would avoid making a parallax error when locating the point A.

,

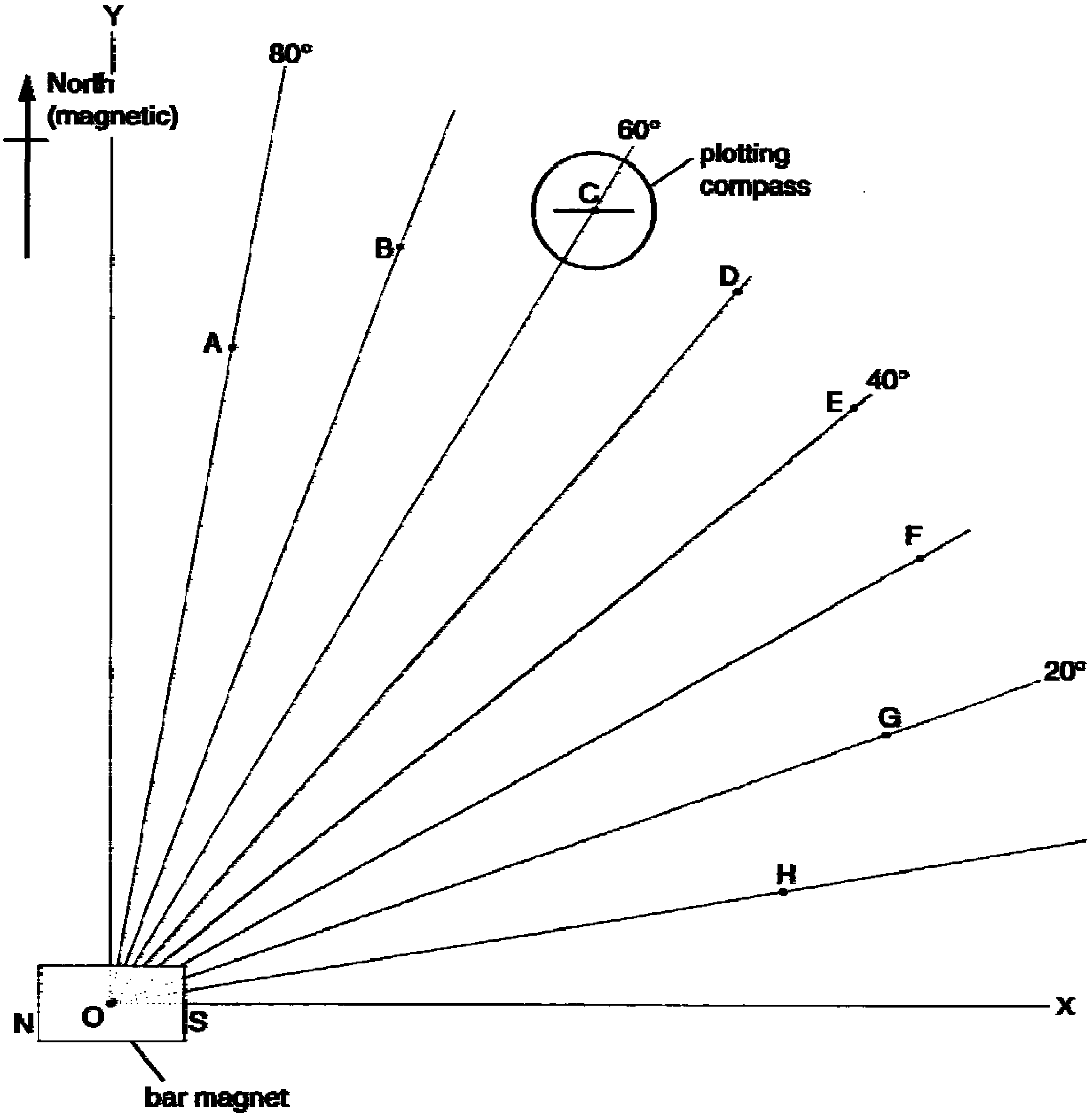


Fig 7

(b) The plotting compass is at point C as shown in Fig

(i) Mark the plotting compass in such a way as to show which end of the small magnet of the plotting compass is a North pole.

(ii) The compass is at point C. It is then moved along the radial line so that it is closer to the bar magnet. Describe and explain what happens to the small magnet of the plotting compass.

....

....

....

....[3]

Fig. 8 shows a transformer.

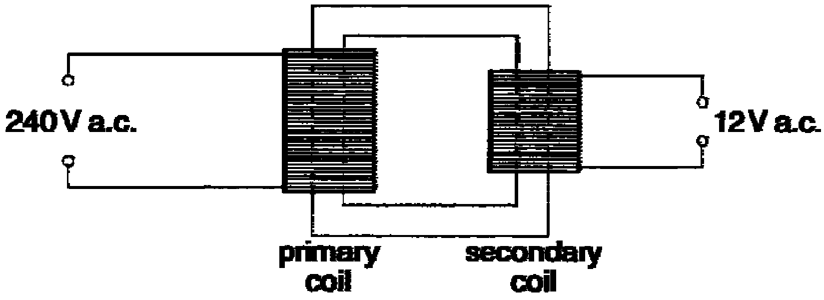


Fig. 8

(a) Explain why there is an e.m.f. across the secondary coil even though there is no electrical connection between the primary and secondary coils.

....

....

....

....

....[3]

(b) When the transformer is in use, the current in the secondary circuit is 3.2 A. The transformer may be considered 100% efficient.

Calculate the current in the primary coil.

current = ... [3]

Extension 2

Fig. 9 shows the outline of an a.c. generator. The peak output voltage of the generator is 6.0 V and the output has a frequency of 10 Hz.

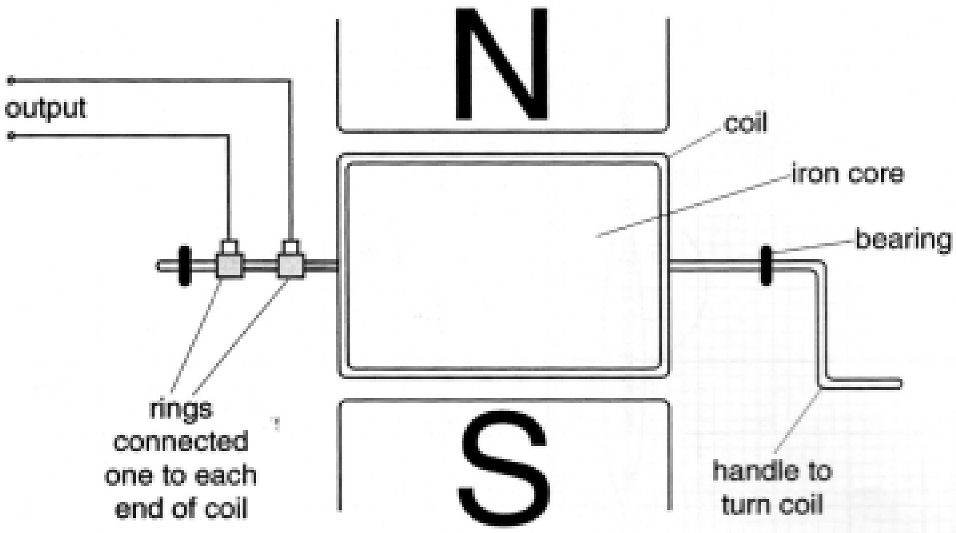


Fig. 9

(a) Fig. 10 shows the axes of a voltage-time graph for the generator output.

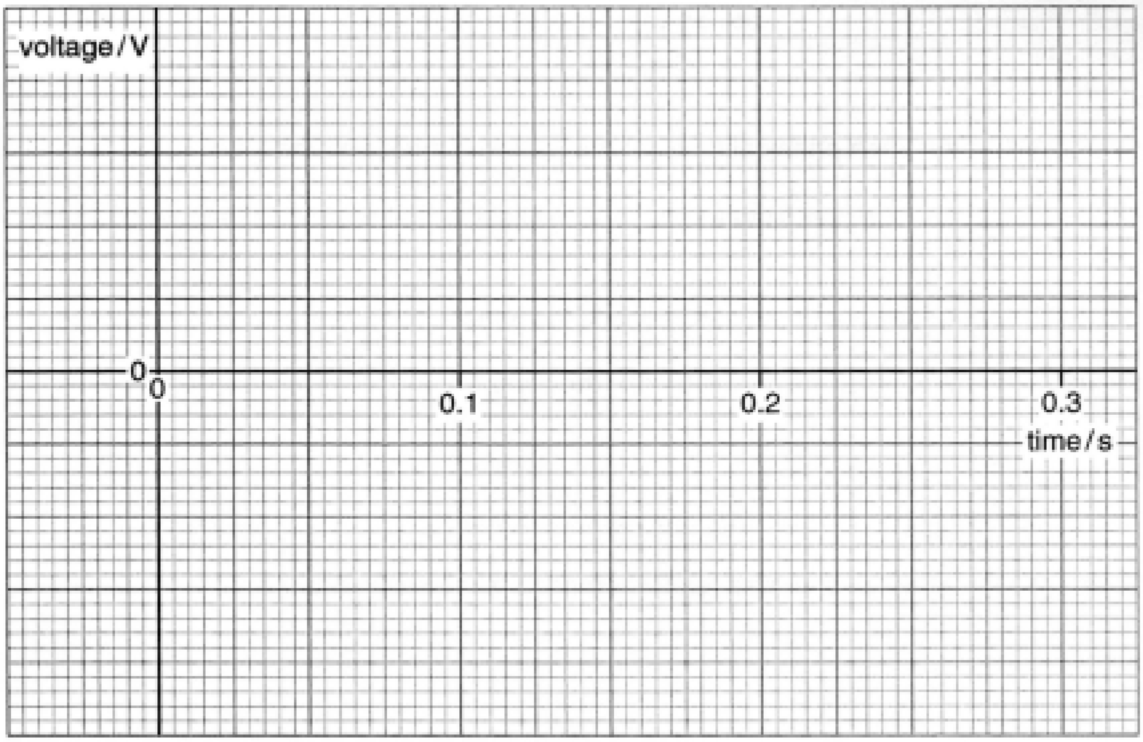


Fig. 10

On Fig. 10

(i) mark suitable voltage values on the voltage axis,

(ii) draw a graph of the generator output.

[3]

(b) The generator shown in Fig. 9 works by electromagnetic induction.

Explain how this effect produces the output voltage.

....

....

....

.... [3]

(c) State the energy changes that occur in the generator when it is producing output.

.... [2]

Extra Core

(a) Fig. 11 illustrates a cathode-ray tube.

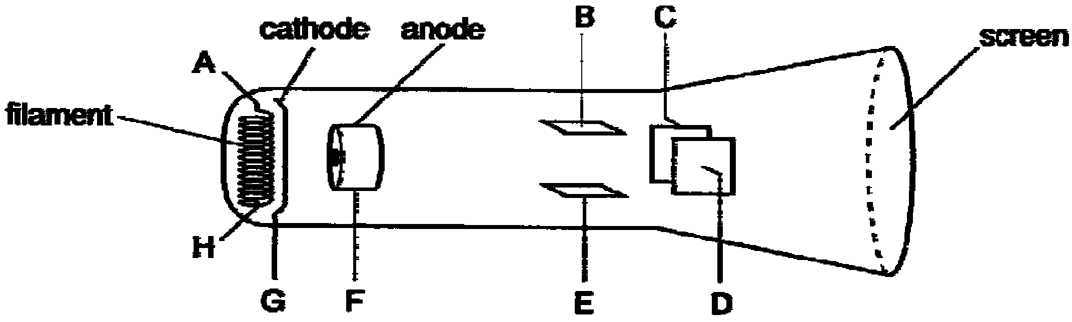


Fig. 11

(i) Between which two points would you connect a low potential difference in order to heat the cathode?

Between .... and ....

(ii) Between which two points would you connect a high potential difference in order to produce cathode rays?

Between .... and ....

(iii) Between which two points would you connect a potential difference in order to deflect the cathode rays upwards?

Between .... and ....

[3]

(b) When the time base of a cathode-ray oscilloscope is turned on, there is a horizontal trace across the screen, as shown in Fig. 12

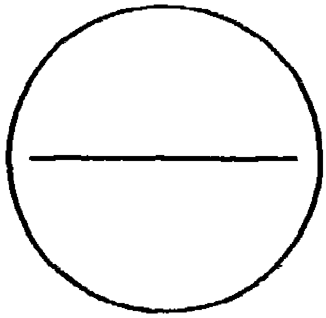


Fig. 12

(i) An alternating potential difference of constant frequency and constant amplitude is connected to the Y-input of the oscilloscope.

On Fig. 12 , sketch the trace which might be obtained.

(ii) The time base is switched off but the alternating potential difference is left connected. Describe what would be seen on the screen.

....

.... [4]

(c) A microphone is connected to another cathode-ray oscilloscope, with the time base switched to a suitable setting. First, a lady with a high-pitched voice sings into the microphone. Then a man with a low-pitched voice sings into the microphone. Describe how the traces seen on the screen would differ.

....

.... [2]

Answers

Core 1

(a)(i) Arrow poitning diagonally (ignore arrow head)

(b) mark tip of arrow

move compass so tail at this point and repeat

repeat with new starting point

(c) Correct magnetic field shape

no lines touching nor crossing

Core 2

(a) wind the wire round the iron bar
connect both ends of the coil to the battery
strip the ends of the wire

or these points shown in a diagram

(b) attracts / picks up iron filings, steel paper clips etc
deflects a compass needle
repels another magnet
induces an emf if moves into a wire coil

Core 3

(a)(i) aligns with Earth's field

(ii) north (seeking) pole

(iii) compass

(b)(i) Any non frrous metal

(ii) iron / steel/ cobalt/ nickel

(iii) attracts

Core 4

(a) north to south

(b) current, field and force mutually perpendicular

(c) make wire into a coil

use of split ring / brushes

Core 5

(a) **A** coil

B brush

C split ring

(b) stronger magnets

larger current

more turns in coil ANY TWO

(c) coil gets hot
insulation melts/ burns out

Alternative to practical

(a) move the centre of the compass along the line from the magnet

(i) judge that the small magnet is parallel using .g. lined paper, ruler and set square etc
(ii) tap the compass to prevent sticking
(iii) mark either end of the needle as near as possible to the compass then mark A between
(iv) look directly down on to the compass so the centre is on the line

(b)(i) N pole should be marked at the right hand end

(ii) the needle moves gradually to a direction of approximately

Extension 1

(a) any three from
primary current creates magnetic field
field is constantly changing
the field in the core links into the secondary coil
there is a changing field in or through the secondary coil a
current is induced in the secondary coil

(b) $V_P I_P = V_S I_S$

$240 \times I_P = 12 \times 3.2$

$I_P = 0.16$ A

Extension 2

(a)(i) Suitable marking of 6 v, ignore effect of rms factor

(ii) 2 complete waves with amplitude between 6 and 9 V

one wave every 0.1 s

(b) conductor / cil moves in magnetic field
cutting field lines / flux
inducing an emf across the coil

(c) work done in turning coil to electrical energy

Extra Core

(a)(i) A and H

(ii) G and F

(iii) B and E

(b)(i) a waveform of approximately constant period and amplitude

(ii) a vertical line

(c) different spacing

higher voice with closer waves than lower voice