7-Magnetism and Electromagnetism

Total mark – 20

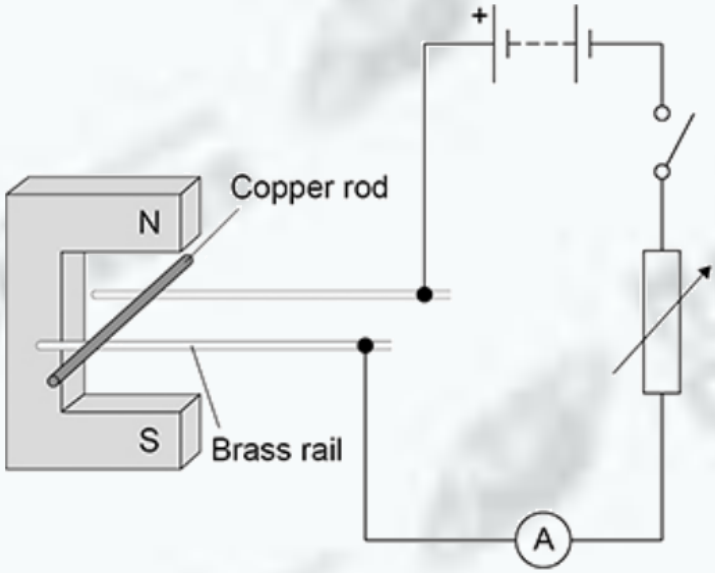
Question: 1

A teacher demonstrated how a magnetic field can cause a copper rod to accelerate.

The teacher placed the copper rod on two brass rails in a magnetic field.

The copper rod was able to move.

The figure below shows the equipment used.



(a) The teacher closes the switch and the copper rod accelerates.

Explain how Fleming's left hand rule can be used to predict the direction in which the copper rod will move.

(5)

(b) Suggest **two** changes to the equipment that would increase the force on the copper rod.

1 _____

_____

2 _____

_____

(2)

(c) The teacher closed the switch and the copper rod accelerated uniformly from rest for 0.15 s.

The current in the copper rod was 1.7 A.

mass of copper rod = 4.0 g

length of copper rod in the magnetic field = 0.050 m

magnetic flux density = 0.30 T

Calculate the maximum possible velocity of the copper rod when it left the magnetic field.

Maximum velocity = _____ m/s

(6)

Mark Scheme

(a) hold thumb first finger and second finger (of left hand) at right angles to each other

allow first two fingers/index and middle for first and second finger throughout

1

second finger represents the current pointing out of the paper

1

first finger represents the field pointing downwards

1

thumb points in the direction of the force / thrust / acceleration

1

(therefore) the rod moves left to right

allow correct description (eg away from the magnet)
dependent on scoring marking point 3 or 4

1

(b) decrease the resistance of the variable resistor

allow increase the current/pd

1

use a stronger magnet

allow use a magnet with a greater flux density

1

(c) $F = 0.30 \times 1.7 \times 0.050$

1

$F = 0.0255$ (N)

1

m = 0.004(0 kg)

1

$0.0255 = 0.0040 \times a$

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

1

$a = 0.0255 / 0.0040$

or

$a = 6.375$

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

1

$\Delta v = 6.375 \times 0.15 = 0.95625$ (m/s)

allow a correct calculation using an incorrectly / not converted m and / or an incorrectly calculated F

allow 0.96 ***or*** *0.956 (m/s)*

1

alternative method

$F = 0.30 \times 1.7 \times 0.050$ (1)

$F = 0.0255$ (N) (1)

m = 0.004(0 kg) (1)

$0.0255 = \frac{0.0040 \times \Delta v}{0.15}$ (1)

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

$\Delta v = \frac{0.0255 \times 0.15}{0.0040}$ (1)

this mark may be awarded if m is incorrectly / not converted and / or F is incorrectly calculated

$\Delta v = 0.95625$ (m/s) (1)

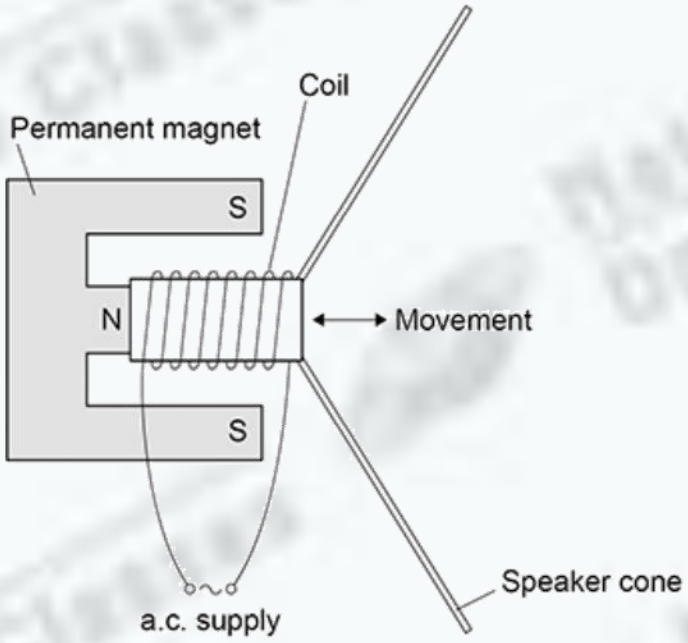
allow a correct calculation using an incorrectly / not converted m and / or an incorrectly calculated F

allow 0.96 ***or*** *0.956 (m/s)*

Question: 2

A student made a moving-coil loudspeaker.

The figure below shows a diagram of the loudspeaker.



(a) What is the name of the effect used by the moving-coil loudspeaker to produce sound waves?

_____

(1)

(b) Explain how a moving-coil loudspeaker produces a sound wave.

(4)

(c) A student investigated how the loudness of sound from the loudspeaker depends on:

- the number of turns on the coil
- the frequency of the supply.

The table below shows the results.

Number of turns	Frequency of supply in Hz	Loudness of sound in arbitrary units
100	200	32
200	400	47
300	600	63

Explain why the results **cannot** be used to make a valid conclusion.

(2)

Mark Scheme

(a) motor (effect)

1

(b) current creates a magnetic field (around the coil)

1

(which) interacts with the permanent magnet field

1

producing a (resultant) force causing the coil/cone to move

1

(when the) direction of the current reverses, the direction of the (resultant) force reverses (producing a sound wave)

allow coil/cone for force allow backwards for reverses

1

(c) the student changed two variables at the same time

allow only one variable should be changed at a time

1

(so) it is not possible to know the effect of each variable

1