

Mark schemes

- 1.** (a) at least three circles drawn 1
- clockwise arrows on circles
allow 1 mark for one or two circles with clockwise arrows 1
- (b) 4×10^{-6} 1
- (c) the sides of the coil (parallel to the magnet) experience a force (in opposite directions)
allow the current creates a magnetic field
ignore Fleming's Left Hand Rule 1
- the forces cause moments that act in the same (clockwise / anticlockwise) direction
or
the moments cause the coil to rotate (clockwise / anticlockwise)
allow the magnetic fields interact to create a pair of forces (acting in opposite directions)
or
allow the magnetic fields interact causing the coil to rotate 1
- (each half-revolution) the two halves of the (rotating) commutator swap from one (carbon) brush to the other 1
- (each half-revolution) the commutator reverses the current (in the coil)
or
keeping the forces in the same direction (keeping the coil rotating)
allow keeps the current in the same direction relative to the (permanent) magnetic field 1
- [7]**
- 2.** (a) motor effect 1
- (b) increase the strength of the magnet
or
increase the current 1
- (c) $4.8 \times 10^{-4} = F \times 8 \times 10^{-2}$ 1

$$F = 6 \times 10^{-3} \text{ (N)}$$

1

$$6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}$$

1

$$B = \frac{6 \times 10^{-3}}{7.5 \times 10^{-2}}$$

1

$$B = 8 \times 10^{-2} \text{ or } 0.08$$

1

*allow 8×10^{-2} or 0.08 with no working shown for 5 marks
a correct method with correct calculation using an incorrect value of F gains 3 marks*

Tesla

accept T

1

do not accept t

[8]

3.

- (a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

- (b) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content

Indicative content

- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

4.

(a) move a (magnetic / plotting) compass around the wire

1

the changing direction of the compass needle shows a magnetic field has been produced

OR

sprinkle iron filings onto the card (1)

tapping the card will move the filings to show the magnetic field (pattern) (1)

1

(b) **Level 2 (3–4 marks):**

A detailed and coherent explanation is provided. The response makes logical links between clearly identified, relevant points that explain how the ignition circuit works.

Level 1 (1–2 marks):

Simple statements are made. The response may fail to make logical links between the points raised.

0 marks:

No relevant content.

Indicative content

- closing the (ignition) switch causes a current to pass through the electromagnet
- the iron core (of the electromagnet) becomes magnetised
- the electromagnet / iron core attracts the (short side of the) iron arm
- the iron arm pushes the (starter motor) contacts (inside the electromagnetic switch) together
- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)

4

[6]

5.

(a) motor

1

(b) increase the strength of the magnetic field

accept use a stronger magnet

use a larger / bigger magnet is insufficient

*do **not** accept move magnets closer*

1

increase the (size of the) current

accept use a current greater than 2 (A)

accept increase the p.d. / voltage (of the power supply)

increase the power supply is insufficient

1

- (c) any **one** from:
- (reverse the) direction of the current
accept swap the wires at the power supply connections
swap the wires around is insufficient
 - (change the) direction of the magnetic field
accept turn the magnet around
*do **not** accept use an a.c. supply*

1

- (d) The wire is parallel to the direction of the magnetic field.

1

[5]

6.

- (a) (i) (closing the switch makes) a current (through the wire)

1

(the current flowing) creates a magnetic field (around the wire)

1

this field interacts with the permanent magnetic field

accept links / crosses attracts / repels is insufficient

1

- (ii) arrow drawn showing upwards force on XY

judge vertical by eye the arrow must be on or close to the wire XY

1

- (iii) motor

accept catapult

1

- (b) (i) the wire moves up and down
or
the wire vibrates

back and forth or side to side is insufficient for vibrate

1

- (ii) the force (continually) changes direction (from upwards to downwards, on the wire)

accept the direction of the magnetic field (of the wire) changes

1

[7]

7.

- (a) a force

1

(b) any **two** from:

- more powerful magnet
do not allow 'bigger magnet'
- reduce the gap (between magnet and coil)
- increase the area of the coil
- more powerful cell
do not allow 'bigger cell'
accept battery for cell
accept add a cell
accept increase current / potential difference
- more turns (on the coil)
allow 'more coils on the coil'
do not allow 'bigger coil'

2

- (c) reverse the (polarity) of the cell
allow 'turn the cell the other way round'
accept battery for cell

1

reverse the (polarity) of the magnet
allow 'turn the magnet the other way up'

1

[5]

8.

- (a) increase the current (1)
credit increase the p.d./voltage
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells

1

increase the magnetic field (strength) (1)
credit 'have stronger magnet(s)'
do not credit 'bigger magnets' either order

1

(b) **either** reverse polarity

or connect the battery the other way round

1

either reverse direction of the magnetic field

or put the magnet the other way round / reverse the magnet

*do **not** give any credit to a response in which both are done at the same time*

either order

1

(c) **either**

conductor parallel to the magnetic field

or lines of magnetic force and path of electricity do not cross

1

[5]