Mark schemes

(a) induced 1

(b) bar 2 1

(the same end) of bar 1 attracts both ends of bar 2

or

only two magnets can repel so cannot be bar 1 or bar 3 1

(c) so the results for each magnet can be compared

or

so there is only one independent variable

fair test is insufficient

allow different thickness of paper would affect number of sheets

each magnet could hold

accept it is a control variable

(d) because the magnet with the biggest area was not the strongest

accept any correct reason that confirms the hypothesis is wrong eg

smallest magnet holds more sheets than the largest 1

2

(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)

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- the starter motor circuit is complete
- a current flows through the starter motor (which then turns)
(a) It is easily magnetised.

(b) p.d. across the secondary coil is smaller (than p.d. across the primary coil)

(c) ratio \( \frac{V_p}{V_s} = 6 \)

\[ \frac{V_p}{V_s} = 12 \]

*accept any other correct ratio taken from the graph*

\[ \frac{6}{12} = \frac{50}{N_p} \]

*use of the correct turns ratio and substitution or correct transformation and substitution*

\( N_p = 100 \)

*allow 100 with no working shown for 3 marks*

(a) in a longitudinal wave the oscillations / vibrations are parallel to the direction of energy transfer.

*accept wave travel for energy transfer throughout*

in a transverse wave the oscillations / vibrations are perpendicular to the direction of energy transfer.

(b) accept any sensible suggestion eg a vibrating drum skin does not move the air away to create a vacuum (around the drum)
Level 3 (5–6 marks):
A detailed explanation linking variations in current to the pressure variations of a sound wave, with a logical sequence.

Level 2 (3–4 marks):
A number of relevant points made, but not precisely. A link between the loudspeaker and a sound wave is made.

Level 1 (1–2 marks):
Some relevant points but fragmented with no logical structure.

0 marks:
No relevant content.

Indicative content
the current in the electrical circuit is varying
the current passes through the coil
the coil experiences a force (inwards or outwards)
reversing the current reverses the force
the size of the current affects the size of the force
the varying current causes the coil to vibrate
the (vibrating) coil causes the cone to vibrate
the vibrating cone causes the air molecules to move
the movement of the air molecules produces the pressure variations in the air needed for a sound wave
the air molecules bunch together forming compressions and spread apart forming rarefactions

(a) motor effect

(b) increase the strength of the magnet
   or
   increase the current

(c) \(4.8 \times 10^{-4} = F \times 8 \times 10^{-2}\)

\[ F = 6 \times 10^{-3} \text{ (N)} \]
\[6 \times 10^{-3} = B \times 1.5 \times 5 \times 10^{-2}\]

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

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

allow \(8 \times 10^{-2}\) \textbf{or} 0.08 with no working shown for 5 marks

\textit{a correct method with correct calculation using an incorrect value of F gains 3 marks}

\textit{Tesla}

\textit{accept T}

\textit{do not accept t}

\[\textbf{[8]}\]

\[\text{7} \]

(a) \textit{an electromagnet can be switched off}

\textit{accept a permanent magnet cannot be switched off}

\textit{or}

\textit{an electromagnet is stronger}

\textit{accept control the strength}

\[1\]
Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should apply a ‘best-fit’ approach to the marking.

**Level 3 (5 – 6 marks):**
there is a description of how the electromagnet is made  
and  
there is a description of how the strength of the electromagnet can be varied  
and  
there is a description of how the strength of the electromagnet can be tested

**Level 2 (3 – 4 marks):**
there is a description of how the electromagnet is made  
and either  
there is a description of how the strength of the electromagnet can be varied  
or  
there is a description of how the electromagnet can be tested

**Level 1 (1 – 2 marks):**
there is a basic description of how to make an electromagnet  
or  
there is a basic description of how the strength of the electromagnet can be varied  
or  
there is a basic description of how the electromagnet can be tested

**Level 0 (0 marks):**
No relevant / correct content
examples of the points made in the response

Details of how to make an electromagnet
• wrap the wire around the nail
• connect the wire to the power supply (with connecting leads and croc clips)
• switch on the power supply
  accept a current should be sent along the wire

Details of how to vary the strength of the electromagnet
• change the number of turns (on the coil)
• change the current (through the coil)
• change the separation of the turns
  allow change the potential difference (across the coil)
  accept wrap the coil more tightly

Details of how to test the electromagnet
• suspend paperclips from the electromagnet
• the more paperclips suspended, the stronger the electromagnet is
• clamp the electromagnet at different distances from the paperclip(s)
• the further the distance from which paperclips can be attracted the stronger the electromagnet is
• test before and after making alterations to change the strength
• compare the results from before and after making alterations
• use de-magnetised paper clips
  accept count the number of paperclips
  with different current or p.d. or no. of turns
  or core and see if the number changes/increases

(a) a magnetic field
  accept electromagnetic field
  heat is insufficient

that is alternating / changing

(b) 20
  allow 1 mark for correct
  substitution, ie
  230
  \[
  11.5
  \]
  provided no subsequent step

(c) (most) transformers are not 100% efficient
  allow energy / power is lost to the surroundings
  allow energy / power is lost as heat / sound
  power is lost is insufficient
(d) (i) 0.01 (V)

because there is a change in p.d. each time (the number of turns changes)
allow because all the results (to 2 decimal places) are different
accept if results were to 1 decimal place, there might not be a difference

(ii) student 2 moved the coil more slowly (than student 1)
accept student 2 moved the coil at a different speed to student 1
do not accept student 2 moved the coil faster (than student 1)

(iii) both sets of results show the same pattern
accept trend for pattern
results are similar is insufficient
results follow a pattern is insufficient

(iv) (electromagnetic) induction
accept it is induced
do not accept electric / magnetic induction

(e) any one from:

• more economical / cheaper for the consumer
  allow more convenient

• easier/cheaper to replace if broken/lost
  allow in case one gets lost

• since fewer transformers need to be made less resources are used
  allow fewer plug sockets are needed
  allow fewer transformers are needed
  environmentally friendly is insufficient

[11]
(a) (i) 16 000

allow 1 mark for correct substitution

\[ 400 \div 25 = n \div 1000 \]

(ii) p.d. increased (by transformer at power station)

\textit{do not accept energy increased}

so current decreases

this reduces energy / power loss (in cables)

\textit{allow heat for energy}

\textit{allow increases the efficiency}

\textit{do not accept no energy losses}

(b) smaller / lighter

uses little power / energy

when left switched on with no load applied

\textit{dependent on second marking point}
(a) field
   
   correct order only

   current

   force
   accept motion
   accept thrust

(b) (i) arrow pointing vertically downwards

   (ii) increase current / p.d.
   accept voltage for p.d.

   increase strength of magnetic field
   accept move poles closer together

   (iii) reverse (poles of) magnets

   reverse battery / current

(c) (i) 1.5 or 150%

   efficiency = 120 / 80 (× 100)
   gains 1 mark

   an answer of 1.5 % or 150
   gains 1 mark

   (ii) efficiency greater than 100%
   or
   output is greater than input
   or
   output should be 40 (W)

   (iii) recorded time much shorter than actual time
   accept timer started too late
   accept timer stopped too soon

   [12]
(a) (i) Iron

(ii) 50

ignore references to current
reason only scores if 50 chosen

there are more turns on the secondary coil (than the primary coil)
accept it is a step-up transformer
not more coils

(b) (i) 200

(ii) any one from:
• Lighter
• smaller
• use very little power / current (when switched on with no load / phone attached).
accept more efficient
do not accept uses no power / current

a disadvantage of a traditional transformer is insufficient on its own

(a) motor

(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

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

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

(a) induced

(b) any two from:
- use the same (strength) magnet
  
  * same size magnet is insufficient
- the speed that the magnet is moved
  
  * accept movement of the magnet
- the area of the turns
  
  * same type / length of wire is insufficient
- the magnetic pole being moved towards the coil (of wire).
  
  * use the same voltmeter is insufficient

(c) (i) voltmeter misread
  
  or

  number of turns miscounted

  * result misread is insufficient
  
  * human error is insufficient

  * allow the magnet was moved at a (slightly) different speed (into the coil) than for the other readings
  
  * allow spacing between the turns had changed

(ii) line of best fit passing through all points except (100, 0.034)

  * line does not need to go back to origin

(d) any one from:
- can re-check data / readings.
  
  * accept can go back to data
- can take more readings (in a given time)
  
  * can store data is insufficient
- easier to identify maximum value.
  
  * automatically records data is insufficient
  
  * accept is more accurate
  
  * accept eliminates human error
(a)  
(i)  (closing the switch makes) a current (through the wire)  
the current flowing creates a magnetic field (around the wire)  
this field interacts with the permanent magnetic field  
accept links / crosses attracts / repels is insufficient  

(ii) arrow drawn showing upwards force on XY  
judge vertical by eye the arrow must be on or close to the wire XY  

(iii) motor  
accept catapult  

(b)  
(i) the wire moves up and down  
or the wire vibrates  
back and forth or side to side is insufficient for vibrate  

(ii) the force (continually) changes direction (from upwards to downwards, on the wire)  
accept the direction of the magnetic field (of the wire) changes