Q1. Figure 1 shows two iron nails hanging from a bar magnet.

The iron nails which were unmagnetised are now magnetised.

**Figure 1**

(a) Complete the sentence.

Use a word from the box.

| forced | induced | permanent |

The iron nails have become .......................................... magnets.

(1)

(b) Each of the three metal bars in Figure 2 is either a bar magnet or a piece of unmagnetised iron.

The forces that act between the bars when different ends are placed close together are shown by the arrows.

**Figure 2**

Which one of the metal bars is a piece of unmagnetised iron?
(c) A student investigated the strength of different fridge magnets by putting small sheets of paper between each magnet and the fridge door.

The student measured the maximum number of sheets of paper that each magnet was able to hold in place.

Why was it important that each small sheet of paper had the same thickness?

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(d) Before starting the investigation the student wrote the following hypothesis:

‘The bigger the area of a fridge magnet the stronger the magnet will be.’

The student’s results are given in the table below.

<table>
<thead>
<tr>
<th>Fridge magnet</th>
<th>Area of magnet in mm²</th>
<th>Number of sheets of paper held</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>B</td>
<td>110</td>
<td>16</td>
</tr>
<tr>
<td>C</td>
<td>250</td>
<td>6</td>
</tr>
</tbody>
</table>
Give one reason why the results from the investigation do not support the student’s hypothesis.

.............................................................................................................................
.............................................................................................................................
.............................................................................................................................

(1)
(Total 5 marks)

Q2. Figure 1 shows a traditional transformer.

(a) (i) Which metal should the core of the transformer be made from?

Tick (✓) one box.

- aluminium
- copper
- iron

(1)
(ii) What would the reading be on the voltmeter shown in Figure 1?

Draw a ring around the correct answer.

\[ \begin{array}{ccc}
2 \text{ V} & 10 \text{ V} & 50 \text{ V} \\
\end{array} \]

Give the reason for your answer.

........................................................................................................................................................................
........................................................................................................................................................................

(2)

(b) Figure 2 shows a tablet computer and its charger.

The charger contains a switch mode transformer.

(i) Use the correct answer from the box to complete the sentence.

\[ \begin{array}{ccc}
200 & 1000 & 20000 \\
\end{array} \]

Switch mode transformers operate at frequencies from 50 kHz to ............... kHz.

(1)

(ii) Give one advantage of a switch mode transformer over a traditional transformer.

........................................................................................................................................................................
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(1)

(Total 5 marks)
Q3. The diagram shows a demonstration carried out by a teacher.

When the switch is closed, there is a current of 2 A through the wire. The wire experiences a force and moves.

(a) Use the correct word from the box to complete the sentence.

| generator | motor | transformer |

The demonstration shows the .................................................. effect.

(1)

(b) State two changes that the teacher could make to the demonstration, each of which would increase the force on the wire. The teacher does not touch the wire.

1...........................................................................................................

........................................................................................................................

2......................................................................................................................

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(2)

(c) State one change that the teacher could make to the demonstration to change the
With the switch closed, the teacher changes the position of the wire so that the force on the wire is zero.

What is the position of the wire?

Tick (✓) one box.

The wire is at 90° to the direction of the magnetic field.

The wire is at 45° to the direction of the magnetic field.

The wire is parallel to the direction of the magnetic field.

Q4. A student has made a simple electric motor. The diagram shows the electric motor.

(a) Complete the following sentence by drawing a ring around the correct line in the box.
Once the coil is spinning, one side of the coil is pushed by the coil and the other side is pulled, so the coil continues to spin.  

(b) Suggest two changes to the electric motor, each one of which would make the coil spin faster.

1 ..................................................................................................................................  
..................................................................................................................................  
2 ..................................................................................................................................  
..................................................................................................................................  

(c) Suggest two changes to the electric motor, each one of which would make the coil spin in the opposite direction.

1 ..................................................................................................................................  
..................................................................................................................................  
2 ..................................................................................................................................  
..................................................................................................................................  

(Total 5 marks)

Q5. A student is investigating the strength of electromagnets.

Figure 1 shows three electromagnets.

The student hung a line of paper clips from each electromagnet.

Figure 1
Electromagnet A  Electromagnet B  Electromagnet C

No more paper clips can be hung from the bottom of each line of paper clips.

(a)  (i) Complete the conclusion that the student should make from this investigation.

Increasing the number of turns of wire wrapped around the nail will .........................
the strength of the electromagnet.

(b)  The cell in electromagnet A is swapped around to make the current flow in the opposite direction. This is shown in Figure 2.

Figure 2
What is the maximum number of paper clips that can now be hung in a line from this electromagnet?

Draw a ring around the correct answer.

- fewer than 4
- 4
- more than 4

Give one reason for your answer.

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(c) Electromagnet A is changed to have only 10 turns of wire wrapped around the nail.

Suggest the maximum number of paper clips that could be hung in a line from the end of this electromagnet.

Maximum number of paper clips = ..................................................

(Total 7 marks)

Q6. The diagram shows a transformer with a 50 Hz (a.c.) supply connected to 10 turns of insulated wire wrapped around one side of the iron core. A voltmeter is connected to 5 turns wrapped around the other side of the iron core.

(a) What type of transformer is shown in the diagram?
Draw a ring around the correct answer.

<table>
<thead>
<tr>
<th>step-down</th>
<th>step-up</th>
<th>switch mode</th>
</tr>
</thead>
</table>

(b) The table shows values for the potential difference (p.d.) of the supply and the voltmeter reading.

<table>
<thead>
<tr>
<th>p.d. of the supply in volts</th>
<th>Voltmeter reading in volts</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.4</td>
<td>3.2</td>
</tr>
<tr>
<td>3.2</td>
<td>6.4</td>
</tr>
</tbody>
</table>

(i) Complete the table.

(ii) Transformers are used as part of the National Grid.

How are the values of p.d. in the table different to the values produced by the National Grid?

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(c) Transformers will work with an alternating current (a.c.) supply but will not work with a direct current (d.c.) supply.

(i) Describe the difference between a.c. and d.c.

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(ii) Explain how a transformer works.

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(4) (Total 10 marks)
M1. (a) induced

(b) bar 2

(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

(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

M2. (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

M3. (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.

M4.(a) a force

(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'

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

   reverse the (polarity) of the magnet
   *allow* 'turn the magnet the other way up'
M5. (a) (i) increase

(ii) A and B
and
B and C
both required for the mark
either order

(iii) any two from:

• size of nail
  or
  nail material
  allow (same) nail

• current
  allow (same) cell
  allow p.d.
  same amount of electricity is insufficient

• (size of) paper clip

• length of wire
  accept type / thickness of wire

(b) 4

B picks up the same number as C, so this electromagnet would pick up the same number as A
or
direction of current does not affect the strength of the electromagnet
  allow it has got the same number of turns as A

(c) 2

allow 1 or 3

M6. (a) step-down

(b) (i) 1.6

correct order only
12.8

(ii) values of p.d. are smaller than 230 V

(c) (i) a.c. is constantly changing direction
   accept a.c. flows in two / both directions
   accept a.c. changes direction(s)
   a.c. travels in different directions is insufficient

   d.c. flows in one direction only

(ii) an alternating current / p.d. in the primary creates a changing /
   alternating magnetic field

   (magnetic field) in the (iron) core
   current in the core negates this mark
   accept voltage for p.d.

   (and so) an alternating p.d.

   (p.d.) is induced across secondary coil