Magnetism Questions 1
18 Questions

Name: __________________________
Class: _________________________
Date: _________________________

Time:

Marks:

Comments:
Q1.

A magnetic toy uses ring-shaped magnets.

Look at Figure 1.

The magnets can move up and down the rod. Ring magnet B appears to float.

![Figure 1](image)

(a) The magnetic poles are labelled on ring magnet A.

Label the magnetic poles on ring magnet B.

(b) What would happen if ring magnet B was turned upside down?

___________________________________________________________________
___________________________________________________________________

(c) Figure 2 shows four plotting compasses arranged around a wire.

The needle of a compass is a magnet.

![Figure 2](image)

In Figure 2 the switch is open and there is no current in the wire.

Explain why the compass needles all point in the same direction.

___________________________________________________________________
___________________________________________________________________
(d) Figure 3 shows the switch closed.

![Figure 3](image)

There is now a current in the wire.

The compass needles change direction.

On Figure 3 draw arrowheads on the three incomplete compass needles to show their direction.

(e) What would happen to the direction of the compass needles if the current was reversed?

(f) Figure 4 shows a coil of wire in a circuit.

![Figure 4](image)

On Figure 4 draw the magnetic field due to the current in the coil.
Q2.

A teacher used the equipment shown in the figure below to demonstrate the motor effect.

(a) Describe how Fleming's left-hand rule can be used to determine the direction in which the rod will move when the switch is closed, and state the direction.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
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___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(4)

(b) Increasing the current can increase the force acting on the copper rod.

Give one other way in which the size of the force acting on the copper rod could be increased.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(1)

(c) The copper rod in the figure above has a length of 7 cm and a mass of $4 \times 10^{-4}$ kg.

When there is a current of 1.12 A the resultant force on the copper rod is 0 N.

Calculate the magnetic flux density.

Gravitational field strength = 9.8 N / kg

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
Magnetic flux density = \[ \text{____________________ T} \] 

(Total 10 marks)

Q3.

The area around a magnet is called the magnetic field.

(a) The Earth has a magnetic field.

What causes the Earth’s magnetic field?

Tick one box.

- The movement of liquid iron in the Earth’s outer core
- The gravitational field of the Earth
- The permanent magnet in the Earth’s core

(b) Look at Figure 1.

Figure 1

Opposite poles brought together

\[ \begin{array}{c}
\text{N} & \text{S} \\
\Rightarrow & \Rightarrow
\end{array} \quad \begin{array}{c}
\text{N} & \text{S} \\
\Rightarrow & \Rightarrow
\end{array} \]

Same poles brought together

\[ \begin{array}{c}
\text{S} & \text{N} \\
\Rightarrow & \Rightarrow
\end{array} \quad \begin{array}{c}
\text{N} & \text{S} \\
\Rightarrow & \Rightarrow
\end{array} \]

What will happen in each case when the poles of two magnets are brought close together?

Opposite poles brought together

___________________________________________________________________

Same poles brought together

___________________________________________________________________
(c) Figure 2 shows an electromagnet being used to lift a car in a scrapyard.

An electromagnet is a solenoid.

Explain why it is better to use an electromagnet rather than a permanent magnet in a scrapyard.

You should include a comparison of the properties of electromagnets and permanent magnets in your answer.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Q4.

An electric current is a flow of electrical charge through a circuit.

(a) Complete the sentence.

Use a word from the box.

<table>
<thead>
<tr>
<th>atoms</th>
<th>electrons</th>
<th>ions</th>
<th>molecules</th>
</tr>
</thead>
</table>

(Total 7 marks)
Metals are good conductors of electricity because electrical charge is transferred by delocalised __________________________

(1)

(b) Draw one line from each symbol to the name of the component.

<table>
<thead>
<tr>
<th>Standard symbol</th>
<th>Name of component</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Symbol]</td>
<td>Battery</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Lamp</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>LED</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Resistor</td>
</tr>
<tr>
<td>![Symbol]</td>
<td>Switch</td>
</tr>
</tbody>
</table>

(3)

(c) The table below shows information about some electrical appliances.

<table>
<thead>
<tr>
<th>Electrical appliance</th>
<th>Power in watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hairdryer</td>
<td>1500</td>
</tr>
<tr>
<td>Kettle</td>
<td>2500</td>
</tr>
<tr>
<td>Electric hob</td>
<td>3000</td>
</tr>
<tr>
<td>Television</td>
<td>360</td>
</tr>
</tbody>
</table>

A student plugs all four of the appliances into one multi-way socket.
The mains electricity is 230 V.
The highest safe current in the socket is 30 A.
Explain why it is not safe to use all four appliances at the same time.
In your answer you should:
• calculate the total power needed
• use the equation
  \[
  \text{current} = \frac{\text{power}}{\text{potential difference}}
  \]
to calculate the total current needed.

(4)
(d) The figure below shows how electrical power is transferred from power stations to consumers using the National Grid.

Transformer 1 is a step-up transformer.
Explain why step-up transformers are used in the National Grid.
(e) What is the purpose of Transformer 2?

(f) In a power station 900 MJ of thermal energy were released by burning natural gas. Write down the equation that links efficiency, useful input energy transfer and useful output energy transfer.

(g) In a power station 900 MJ of thermal energy were released by burning natural gas. Only 405 MJ was generated. Calculate the efficiency of this energy transfer.

Efficiency = _________________

Q5.
Iron is a metal that has many uses.

(a) Iron is extracted from iron ore. Part of the process involves reduction of the ore with carbon monoxide.

Iron ore contains iron oxide (Fe₂O₃).

Write a balanced equation for the reaction of iron oxide with carbon monoxide.

(b) Explain why this reaction is a redox reaction.

Steel is an alloy of iron. Steel is used to make cars.
After its useful life a car is taken to a scrapyard for recycling.

(c) **Suggest four benefits of recycling a car body.**

(b) **Figure 1** shows an electromagnet being used to lift a car in a scrapyard.

![Figure 1](image1)

An electromagnet is made up of a solenoid.

**Figure 2** shows a solenoid.

![Figure 2](image2)

Draw the magnetic field of the solenoid on **Figure 2**.
In a scrapyard, an electromagnet is used to lift and release cars so they can be moved around.

Suggest two ways a solenoid could be made to lift and release cars in a scrapyard. Explain why each suggestion would be useful in the scrapyard.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

Q6.
This question is about magnetism.

(a) Which two materials are magnetic?

Tick two boxes.

Carbon

Cobalt

Copper

Nickel

Sodium

(2)

(b) Describe how you could find the magnetic field pattern of a permanent bar magnet.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
___________________________________________________________________
A student investigates how the number of turns of wire on a solenoid affects the strength of the solenoid.

To test the strength of the solenoid she looks at how many paper clips the solenoid could lift.

**Figure 1** shows how she sets up the equipment.

She keeps the current through the coil constant throughout the experiment.

The table below shows the student’s results.

<table>
<thead>
<tr>
<th>Number of turns of wire on solenoid</th>
<th>Number of paper clips picked up by solenoid</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Test 1</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>20</td>
<td>8</td>
</tr>
<tr>
<td>30</td>
<td>11</td>
</tr>
<tr>
<td>40</td>
<td>15</td>
</tr>
<tr>
<td>50</td>
<td>21</td>
</tr>
<tr>
<td>60</td>
<td>25</td>
</tr>
</tbody>
</table>

Use the data from the table above to complete the graph in **Figure 2**.

- The first two points have been plotted for you.
- Draw a line of best fit.

**Figure 2**
(d) Describe the pattern shown in the graph.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(e) Use your graph to predict how many paper clips the solenoid will pick up when 80 turns of wire are used.

Number of paper clips picked up = ________________

(Total 11 marks)

Q7.  
(a) **Diagram 1** shows a magnetic closure box when open and shut. It is a box that stays shut, when it is closed, due to the force between two small magnets.

These boxes are often used for jewellery.

**Diagram 1**
Diagram 2 shows the two magnets. The poles of the magnets are on the longer faces.

(i) Draw, on Diagram 2, the magnetic field pattern between the two facing poles.

(ii) The magnets in the magnetic closure box must not have two North poles facing each other.

   Explain why.
   
   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________
   _______________________________________________________________

(b) A student is investigating how the force of attraction between two bar magnets depends on their separation.

   She uses the apparatus shown in Diagram 3.
She uses the following procedure:

- ensures that the newtonmeter does not have a zero error
- holds one of the magnets
- puts sheets of paper on top of the magnet
- places the other magnet, with the newtonmeter magnetically attached, close to the first magnet
- pulls the magnets apart
- notes the reading on the newtonmeter as the magnets separate
- repeats with different numbers of sheets of paper between the magnets.

The results are shown in the table.

<table>
<thead>
<tr>
<th>Number of sheets of paper between the magnets</th>
<th>10</th>
<th>20</th>
<th>30</th>
<th>40</th>
<th>50</th>
<th>60</th>
<th>70</th>
<th>80</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newtonmeter reading as the magnets separate</td>
<td>3.1</td>
<td>2.6</td>
<td>2.1</td>
<td>1.5</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
<td>1.1</td>
</tr>
</tbody>
</table>

(i) Describe the pattern of her results.

(ii) No matter how many sheets of paper the student puts between the magnets,
the force shown on the newtonmeter never reaches zero. Why?

(iii) The student is unable to experiment with fewer than 10 sheets of paper without glueing the magnet to the newtonmeter. Suggest why.

(iv) Suggest three improvements to the procedure that would allow the student to gain more accurate results.

(v) The thickness of one sheet of paper is 0.1 mm. What is the separation of the magnets when the force required to separate them is 2.1 N?

Separation of magnets = ________________ mm

(Total 15 marks)
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](image)

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.

(ii) Which **two** pairs of electromagnets should be compared to make this conclusion?

**Pair 1:** Electromagnets _________ and _________

**Pair 2:** Electromagnets _________ and _________

(iii) Suggest **two** variables that the student should control in this investigation.

1. ____________________________________________________________
2. ____________________________________________________________

(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](image)
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.

___________________________________________________________________
___________________________________________________________________
___________________________________________________________________

(2)

(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)

Q9.

(a) Some people wear magnetic bracelets to relieve pain.

Figure 1 shows a magnetic bracelet.

There are magnetic poles at both A and B.

Part of the magnetic field pattern between A and B is shown.

What is the pole at A? _________________________

What is the pole at B? _________________________

(1)
(b) **Figure 2** shows two of the lines of the magnetic field pattern of a current-carrying wire.

![Figure 2](image)

The direction of the current is reversed.

What happens to the direction of the lines in the magnetic field pattern?

(1)

(c) Fleming’s left-hand rule can be used to identify the direction of a force acting on a current-carrying wire in a magnetic field.

(i) Complete the labels in **Figure 3**.

![Figure 3](image)

(ii) **Figure 4** shows:

- the direction of the magnetic field between a pair of magnets
- the direction of the current in a wire in the magnetic field.

![Figure 4](image)
In which direction does the force on the wire act?

(iii) Suggest three changes that would decrease the force acting on the wire.

1. ____________________________
2. ____________________________
3. ____________________________

(d) Figure 5 shows part of a moving-coil ammeter as drawn by a student.

The ammeter consists of a coil placed in a uniform magnetic field. When there is a current in the coil, the force acting on the coil causes the coil to rotate and the pointer moves across the scale.

(i) The equipment has not been set up correctly.

What change would make it work?

________________________________________________________________________

________________________________________________________________________

(ii) Figure 6 shows the pointer in an ammeter when there is no current.

Figure 6
Q10.

The diagram shows a ‘G-machine’. The G-machine is used in astronaut training.

The G-machine moves the astronaut in a horizontal circle.

(a) The force causing the astronaut to move in a circle is measured.

The graph shows how the speed of the astronaut affects the force causing the astronaut to move in a circle for two different G-machines.

The radius of rotation of the astronaut is different for each G-machine.

(i) State three conclusions that can be made from the graph.

1. ____________________________________________________________

2. ____________________________________________________________

3. ____________________________________________________________
(3) (ii) The speed of rotation of G-machine 1 is increased from 20 m/s to 40 m/s. Determine the change in force on the astronaut.

Change in force = ______________________________ N

(b) Each G-machine is rotated by an electric motor. The diagram shows a simple electric motor.

(i) A current flows through the coil of the motor. Explain why side A of the coil experiences a force.

(ii) Draw arrows on the diagram to show the direction of the forces acting on side A of the coil and side C of the coil.

(iii) When horizontal, side B experiences no force. Give the reason why.
(c) While a G-machine is rotating, the operators want to increase its speed. What can the operators do to make the G-machine rotate faster?

________________________________________________________________________
________________________________________________________________________

(1)

(d) The exploration of space has cost a lot of money. Do you think spending lots of money on space exploration has been a good thing? Draw a ring around your answer.

Yes        No

Give a reason for your answer.

________________________________________________________________________
________________________________________________________________________

(1)

(Total 10 marks)

Q11.

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 cell
the coil
and
a force
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. _________________________________________________________________
  ___________________________________________________________________

(Q12. (Total 5 marks)

(a) Complete the description of the device shown below by drawing a ring around the correct line in each box.

(i) The device is being used as
 an electric motor.
 a generator.
 a transformer.

(ii) The coil needs a flick to get started. Then one side of the coil is pushed by the
cell and the other side is pulled, so that the coil spins. (1)

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

1. _____________________________________________________________________
2. _____________________________________________________________________

(2)

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

1. _____________________________________________________________________
2. _____________________________________________________________________

(Total 6 marks)

Q13. (a) A science technician sets up the apparatus shown below to demonstrate the motor effect. He uses a powerful permanent magnet.

The copper roller is placed across the metal rails. When the switch is closed, the copper roller moves to the right.
(i) Complete the sentence by drawing a ring around the correct line in the box.

This happens because copper is

an electrical conductor.  
an electrical insulator.  
a magnetic material.

(ii) Suggest one change that the technician can make which will cause the copper roller to move faster.

________________________________________________________________________

________________________________________________________________________

(iii) Suggest two changes which the technician can make, each of which will separately cause the copper roller to move to the left.

1. _______________________________________________________________________

________________________________________________________________________

2. _______________________________________________________________________

________________________________________________________________________

(b) Many electrical appliances, such as vacuum cleaners, drills and CD players, contain electric motors. As more electrical appliances are developed, more electricity needs to be generated. Generating electricity often produces pollutant gases.

(i) Complete the sentence by drawing a ring around the correct line in the box.

Generating more electricity to power the increasing number of electrical

an ethical  
an environmental  
a political

appliances used raises  
issue.

(ii) The number of electrical appliances used in the world’s richest countries is increasing yet many people in the world’s poorest countries have no access to electricity.

What type of issue does this inequality between people in different countries raise?

________________________________________________________________________

_______________________________________________________________

(Total 6 marks)
(a) A laboratory technician sets up a demonstration.

Identify the effect which is being demonstrated.
__________________________________________________________________________________________ (1)

(b) A teacher makes some changes to the set-up of the demonstration.

What effect, if any, will each of the following changes have?

(i) more powerful horseshoe magnet is used.
__________________________________________________________________________________________
__________________________________________________________________________________________ (1)

(ii) The connections to the power supply are reversed.
__________________________________________________________________________________________
__________________________________________________________________________________________ (1)

(Total 3 marks)

Q15.
Many electrical appliances use the circular motion produced by their electric motor.

(a) Put ticks (✓) in the boxes next to all the appliances in the list which have an electric motor.
One simple design of an electric motor is shown in the diagram. It has a coil which spins between the ends of a magnet.

(i) Give two ways of reversing the direction of the forces on the coil in the electric motor.
1. ____________________________________________________________
2. ____________________________________________________________

(ii) Give two ways of increasing the forces on the coil in the electric motor.
1. ____________________________________________________________

Q16.
When a conductor carrying an electric current is placed in a magnetic field a force may act on it.

(a) State two ways in which this force can be increased.

1. __________________________________________________________
2. __________________________________________________________

(b) State two ways in which this force can be made to act in the opposite direction.

1. __________________________________________________________
2. __________________________________________________________

(c) In what circumstance will no force act on a conductor carrying an electric current and in a magnetic field?

__________________________________________________________________________

__________________________________________________________________________

(Total 5 marks)

Q17.
The diagram shows apparatus used to demonstrate the electric motor effect. When he switch is closed the wire moves.
Q18.
The diagram shows apparatus used to demonstrate the motor effect. X is a short length of bare copper wire resting on two other wires.

(a) (i) Describe what happens to wire X when the current is switched on.

(ii) What difference do you notice if the following changes are made?

A The magnetic field is reversed.
B The current is increased.

(b) The diagram shows a coil placed between the poles of a magnet. The arrows on the sides of the coil itself show the direction of the conventional current.

The arrows labelled F show the direction of the forces acting on the sides of the coil. Describe the motion of the coil until it comes to rest.

(c) Most electric motors use electromagnets instead of permanent magnets. State three of the features of an electromagnet which control the strength of the magnetic field obtained.

1. 

2. 

3. 

(Total 9 marks)
Q1.
(a) S – top, N – bottom  

(b) touch / attracted to magnet A  

(c) the magnetic needles point to the north pole  

because The Earth has a magnetic field  

\[ \text{accept the needles align to the Earth's magnetic field for 2 marks} \]

(d) 

![Diagram](image)

(e) point in the opposite direction  

\[ \text{change direction is insufficient} \]

(f) uniform field lines through the wire coil.  

field lines curving round the top and bottom of the wire coil.  

arrows indicating direction from N to S  

\[ \text{do not accept conflicting arrows} \]

Q2.
(a) thumb, index finger and third finger are held mutually at right angles  

index finger shows the direction of the magnetic field from North to South, third finger  

shows the direction of the current from positive to negative terminal  

the thumb then shows the direction of the force acting on the copper rod  

so the copper rod will move upwards
Q3.

(a) The movement of liquid iron in the Earth’s outer core

(b) will attract

will repel

(c) **Level 2 (3–4 marks):**
A detailed explanation is provided that includes a coherent comparison of the properties of the types of magnet and presents a clear argument to support the use of electromagnets. Logical links are made between relevant points and use in a scrapyard

**Level 1 (1–2 marks):**
Relevant points made about the properties of the magnets. An attempt at comparison may be made, but logic is unclear and unstructured and links to use in scrapyard may not be present

**0 marks:**
No relevant content.

Allow steel or iron for car body throughout

**Indicative content**
- an electromagnet can be switched on and off
• so it can be used to lift a car body
• and release a car body
• so it can easily be used to move car bodies from one place to another in the scrapyard
• a permanent magnet cannot be switched off to release a car body
• so would not be as useful in the scrapyard
• the strength of the magnetic field of an electromagnet can be varied
• so an electromagnet can lift different masses
• so can deal with different vehicles
• but the strength of the magnetic field of a permanent magnet cannot be varied or is fixed
• so a permanent magnet can only lift up to a certain mass

Q4.
(a) electrons

(b) [Image of a circuit diagram]

*extra lines from a symbol negate the mark*

(c) the total power = 7360 watts

\[
\text{current} = \frac{7360}{230} = 32 \text{ A}
\]

allow 32 with no working shown for 3 marks

so the current is greater than 30 A

(d) to increase the voltage (across the cables) or to decrease the current (through the cables)

reducing energy losses (in the cables)
do not allow electricity for energy
do not allow no energy loss

increasing the efficiency of transmission

(e) to decrease the potential difference for domestic use
(f) 
\[ \text{efficiency} = \frac{\text{useful output energy transfer}}{\text{total input energy transfer}} \]

(g) \[ \frac{405}{900} = 0.45 \]
accept 45%
allow 0.45 or 45% with no working shown for 2 marks

Q5.
(a) \[ \text{Fe}_2\text{O}_3 + 3 \text{CO} \rightarrow 2\text{Fe} + 3 \text{CO}_2 \]
correct formulae of reactants

   correct formulae of products

   correct balancing

(b) iron loses oxygen – reduction

   carbon gains oxygen – oxidation

(c) any four from:
   • resources for manufacture are limited
   • recycling reduces the use of resources
   • reduces energy consumption in extraction / manufacture
   • reduces waste from processing and extraction
   • reduces environmental impact of extraction

(d) field lines going through and around coil

   correct directional arrows

(e) any two from:
   1 mark for suggestion, 1 mark for correctly linked explanation
   • use many coils or tight coils or long wire (1)
   • to give a strong magnetic field for lifting heavy objects (1)
   explanation must be correctly linked to the suggestion to
gain the mark

or

• add an iron core
• to increase field circuit for lifting

or

• include a switch in circuit
• so can drop / pick up cars

max. 4

Q6.

(a) Cobalt

Nickel

(b) Either

• put iron filings
• on a piece of paper
• over the magnet

or

• use (plotting) compass(es) (1)
• around the magnet (1)
• with the needle showing the direction (1)

(c) all points plotted correctly

2 points plotted correctly for 1 mark

correctly drawn line of best fit

allow ecf from incorrectly drawn points

(d) as the number of turns increases so does the amount of paper clips picked up

linear / directly proportional

allow doubling the number of turns doubles the number of paper clips picked up

(e) 32

allow number correctly extrapolated from student’s graph

Q7.

(a) (i) field pattern shows:

some straight lines in the gap
direction N to S

(ii) north poles repel

(so) box will not close

(b) (i) as paper increases (rapid) decrease in force needed

force levels off (after 50 sheets)

(ii) the newtonmeter will show the weight of the top magnet

(iii) (top) magnet and newtonmeter separate before magnets separate

accept reverse argument

(because) force between magnets is greater than force between magnet and hook of newtonmeter

(iv) any three from:

• means of reading value of force at instant the magnets are pulled apart
• increase the pulling force gently
  or
  use a mechanical device to apply the pulling force
• clamp the bottom magnet
• use smaller sheets of paper
• fewer sheets of papers between readings (smaller intervals)
• ensure magnets remain vertical
• ensure ends of magnet completely overlap
• repeat the procedure several times for each number of sheets and take a mean
• make sure all sheets of paper are the same thickness

(v) 3 (mm)

\[
30 \times 0.1 \text{ ecf gains 2 marks}
\]

\[
2.1 \text{ N corresponds to 30 sheets gains 1 mark}
\]

Q8.

(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*

Q9.

(a) north (pole)

*accept N*

north (pole)

*both needed for mark*

(b) reverses

*accept changes direction*

(c) (i) first finger:

(direction of) (magnetic) field

second finger:
(direction of) (conventional) current

(ii) into (plane of the) paper

(iii) less current in wire

accept less current / voltage / more resistance / thinner wire

weaker field

allow weaker magnets / magnets further apart

do not accept smaller magnets

rotation of magnets (so) field is no longer perpendicular to wire

(d) (i) reverse one of the magnets

do not accept there are no numbers on the scale

(ii) systematic or zero error

accept all current values will be too big
accept it does not return to zero
accept it does not start at zero

Q10.

(a) (i) the greater the speed (of a centrifuge), the greater the force

answers must be comparative
accept velocity for speed
accept positive correlation between speed and force
speed and force are not proportional – treat as neutral

the smaller the radius, the greater the force (at a given speed)

allow (G machine) 1 has / produces a greater force (than G machine 2) at the same speed

must be comparative, eg a small radius produces a large force = 0 marks on own

as the speed increases the rate of change in force increases

accept force is proportional to the square of the speed
or
doubling speed, quadruples the force
accept any clearly correct conclusion

(ii) 12000 (N)

or

12 k(N)
(b) (i) the current (in the coil) creates a magnetic field (around the coil)

accept the coil is an electromagnet

so the magnetic field of the coil interacts with the (permanent) magnetic field of the magnets (producing a force)

accept the two magnetic fields interact (producing a force)

if no marks scored an answer in terms of current is perpendicular to the (permanent) magnetic field is worth max 1 mark

(ii) vertically downwards arrow on side A

one arrow insufficient

and

vertically upwards arrow on side C

(iii) the current is parallel to the magnetic field

allow the current and magnetic field are in the same direction

allow it / the wire is parallel to the magnetic field

(c) increase the current / p.d. (of the coil)

accept decrease resistance

accept voltage for p.d.

accept increase strength of magnetic field / electromagnet

(d) yes with suitable reason

or

no with suitable reason

eg

yes – it has increased our knowledge

yes – It has led to more (rapid) developments / discoveries (in technology / materials / transport) accept specific examples

no – the money would have been better spent elsewhere on such things as hospitals (must quote where, other things not enough)

no mark for just yes / no

reason must match yes / no

Q11.

(a) a force

[b] (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’

Q12.

(a) (i) an electric motor
  1

  (ii) 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’

(c) reverse the (polarity) of the cell
  allow ‘turn the cell the other way round’
  accept battery for cell
Q13.
(a) (i) an electrical conductor
(ii) increase current
    accept increase p.d. / voltage
    or
    use stronger magnets
    accept move magnets closer
    do not accept use larger magnets
(iii) reverse the poles / ends (of the magnet)
    either order
    reverse the connections (to the power supply)
(b) (i) environmental
(ii) ethical
    allow political (instability)
    allow economic (migration)
Q14.
(a) motor (effect)
(b) (i) wire kicks further (forward)
    accept moves for kicks
    accept moves more
    accept ‘force (on the wire) increased’
(ii) wire kicks back(wards) / into (the space in) the (horseshoe) magnet
    accept moves for kicks
    accept ‘direction of force reversed’
Q15.
(a) electric drill, electric fan, electric food mixer and electric screwdriver
    all four ticked and no others (2)
either all four of these ticked and only one other (1)
or any three of these ticked and none/one/two of the others (1)

(b) (i) reverse (the direction of the) current (1)
or reverse the connections (to the battery)
reverse (the direction of the) magnetic field (1)
or reverse the (magnetic) poles /ends
do not credit ‘swap the magnets (around)’

(ii) any two from:

- increase the strength of the magnet(s)/(magnetic) field
do not credit ‘use a bigger magnet’
- increase the current
allow ‘increase the voltage/p.d.’
allow add cells/batteries
allow increase the (electrical) energy
allow increase the power supply
allow ‘decrease the resistance’
allow ‘increase charge’
allow ‘increase the electricity’
do not credit ‘use a bigger battery’
- reduce the gap (between coil/armature and poles/magnets)
allow increase the (number of) coils
- increase the turns (on the coil/armature)
do not credit ‘use a bigger coil’

Q16.
(a) increase the current (1)
credit increase the p.d./voltage
credit reduce the resistance
credit have thicker wiring
credit add extra / more cells
increase the magnetic field (strength) (1)
credit ‘have stronger magnet(s)
do not credit ‘bigger magnets’ either order

(b) either reverse polarity
or connect the battery the other way round

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

(c) either

caputor parallel to the magnetic field

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

Q17.

(i) away from magnet

arrow should be perpendicular to field lines and current as judged by eye

(ii) current in wire creates magnetic field around wire

two fields interact or combine giving a resultant force (on the wire)

Q18.

(a) (i) it moves or experiences a force horizontally to the right

for 1 mark

(ii) A – moves in opposite direction or force reversed e.c.f.

B – faster movement or larger force

(not move further)

for 1 mark each

(b) turns clockwise

oscillates/reverses

comes to rest facing field/at 90° to field/vertically

for 1 mark each

(c) number of turns or linear number density of turns current core

for 1 mark each