4. Electricity and magnetism

4.1 Simple phenomena of magnetism

Paper 3 and 4

Question Paper

Paper 3

Questions are applicable for both core and extended candidates

1 **(a)** Different materials have differing magnetic properties.

(i) State the name of a material that is suitable for a **temporary** magnet.

..... [1]

(ii) State the name of a material that is suitable for a **permanent** magnet.

..... [1]

(iii) State how a magnet can show that a material is non-magnetic.

..... [1]

(b) A teacher uses the arrangement in Fig. 10.1 to demonstrate an electric bell. When the switch is closed, the hammer repeatedly hits the metal gong.

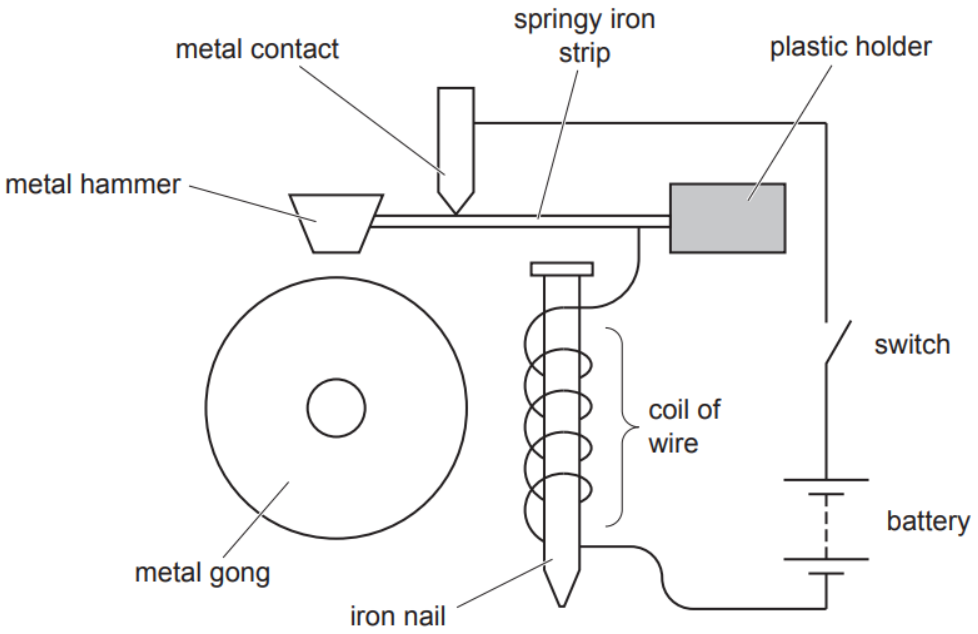

Fig. 10.1

Using the information in Fig. 10.1, explain why the hammer repeatedly hits the metal gong when the switch is closed.

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..... [4]

[Total: 7]

2 Fig. 8.1 shows the magnetic field pattern around two permanent magnets. The magnets are repelling each other.

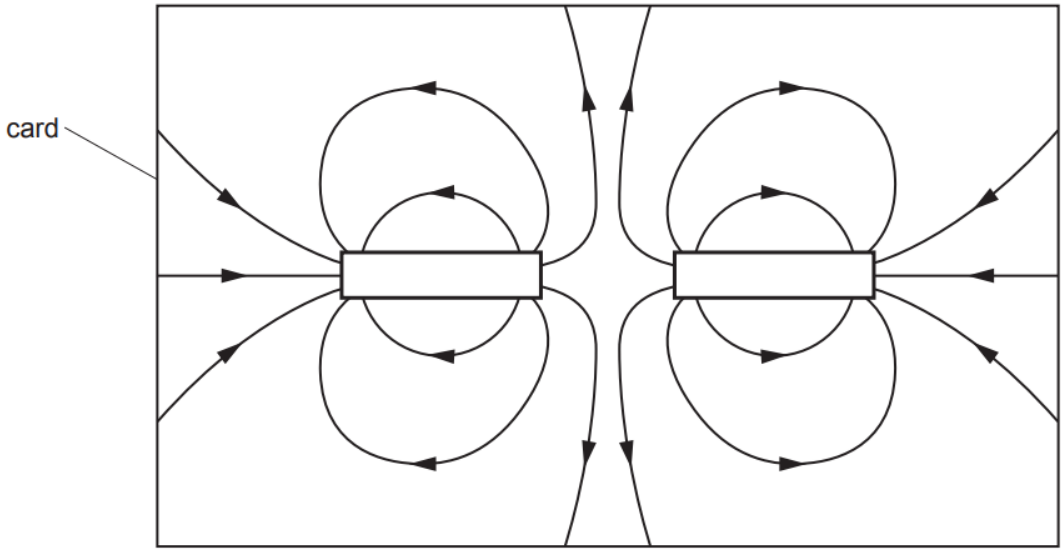

Fig. 8.1

(a) On Fig. 8.1, label both the poles on **each** magnet. [1]

(b) Describe how to plot the shape and direction of the magnetic field pattern shown in Fig. 8.1.

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..... [4]

[Total: 5]

3 A student uses a permanent magnet to lift some unmagnetised nails. Some of the nails are made of iron and some are made of steel. Fig. 7.1 shows the magnet lifting the nails.

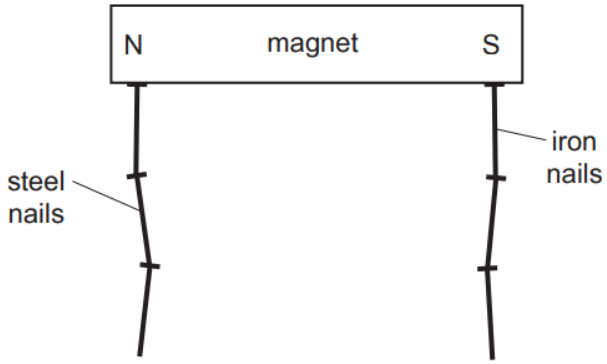

Fig. 7.1

(a) (i) Each nail lifts the nail below it by induced magnetism.

Describe what is meant by induced magnetism.

.....

..... [2]

(ii) The student leaves the nails attached to the magnet for several hours, then removes the magnet.

State a difference between a magnetic property of the iron nails and of the steel nails.

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..... [1]

(b) A metal wire XY is connected to a voltmeter. The wire is placed between the poles of a permanent magnet. Fig. 7.2 shows the arrangement.

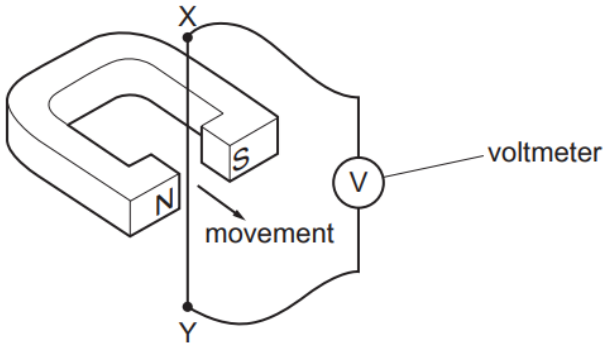

Fig. 7.2

(i) State the reading on the voltmeter when the wire is stationary between the poles.

..... [1]

(ii) Give a reason for the reading on the voltmeter when the wire is moving in the direction shown in Fig. 7.2.

.....

..... [1]

[Total: 5]

4 **(a)** A student has a bar magnet and a metal bar with ends X and Y. The student moves each pole of the bar magnet, in turn, to be close to end X of the metal bar.

Fig. 7.1 and Fig. 7.2 show the force between the magnet and the bar in each case.

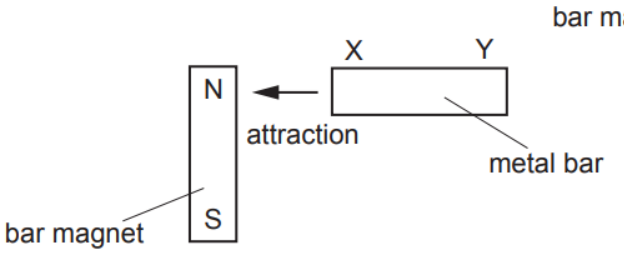

Fig. 7.1

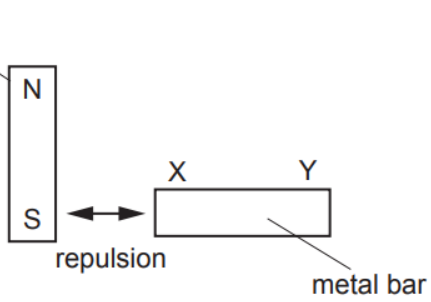

Fig. 7.2

State and explain what you can deduce about the metal bar.

Use the information shown in Fig. 7.1 and Fig. 7.2.

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..... [2]

(b) Fig. 7.3 shows two bar magnets on a piece of card.

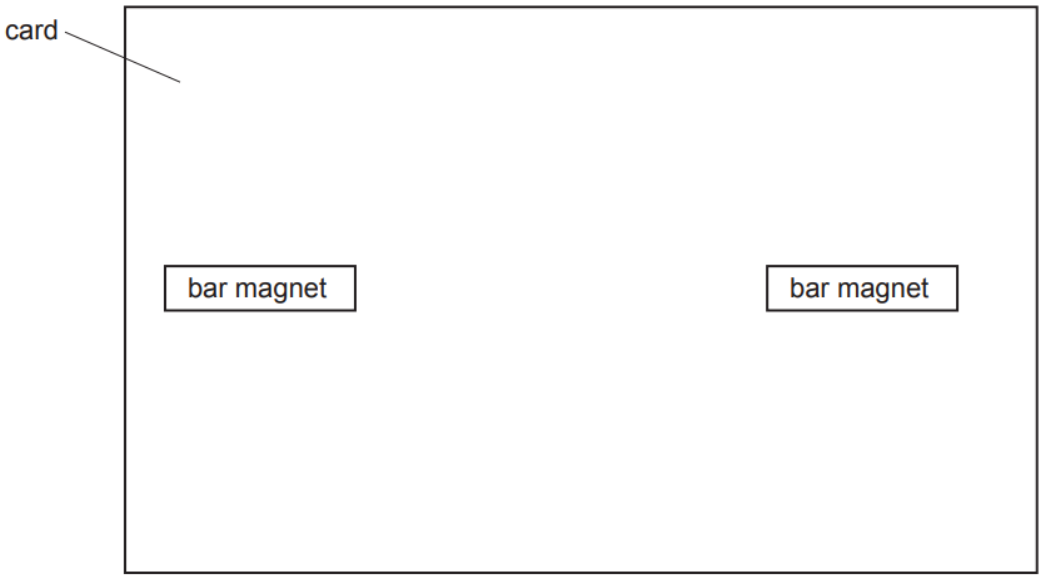

Fig. 7.3

Describe an experiment to show the pattern of the magnetic field between the bar magnets.

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..... [3]

[Total: 5]

5 Fig. 7.1 shows an arrangement that can produce a magnet.

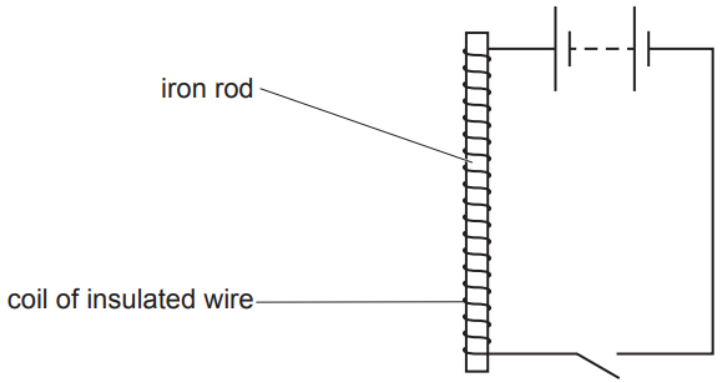

Fig. 7.1

(a) (i) State the name given to the type of magnet in Fig. 7.1.

..... [1]

(ii) Suggest an advantage of this type of magnet in comparison with other types of magnet.

.....

..... [1]

(iii) State **two** ways of increasing the strength of the magnet in Fig. 7.1.

1. ..... [1]

2. ..... [1]

(iv) Suggest **one** use for this type of magnet.

..... [1]

(b) (i) Compare the effect of using a steel rod instead of an iron rod in the arrangement in Fig. 7.1.
The steel rod is the same size as the iron rod.

.....

..... [1]

(ii) Compare the effect of using a copper rod instead of an iron rod in the arrangement in Fig. 7.1.
The copper rod is the same size as the iron rod.

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..... [1]

[Total: 7]

6 **(a)** Fig. 8.1 shows a bar magnet on a piece of card.

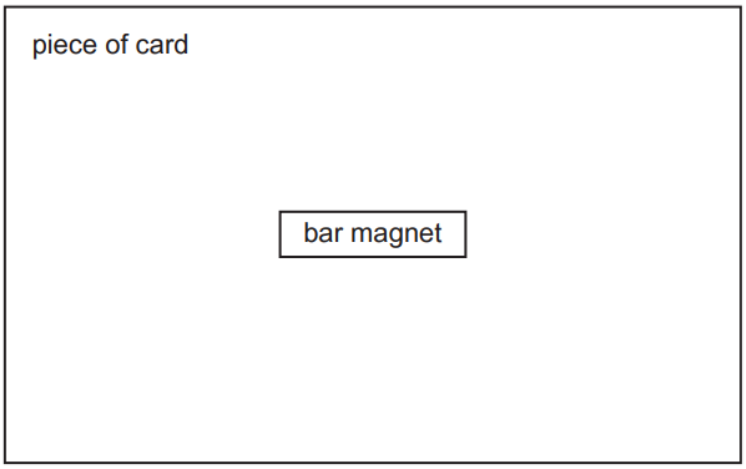

Fig. 8.1

Describe an experiment to determine the pattern of the magnetic field lines around the bar magnet.

You may draw on Fig. 8.1 if it helps to explain your answer.

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..... [3]

(b) A student has a bar magnet and a metal bar with ends labelled X and Y. The student moves the metal bar close to either pole of the bar magnet. Fig. 8.2 and Fig. 8.3 show the force on the metal bar in each case.

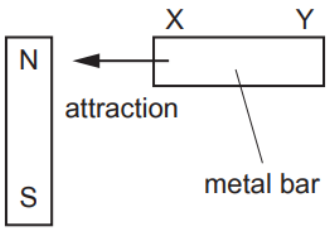

Fig. 8.2

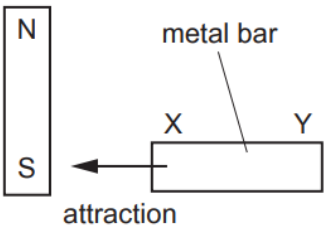

Fig. 8.3

State and explain what these results reveal about the metal bar XY.

.....

.....

..... [3]

[Total: 6]

7 **(a)** A student has a box containing objects made of different materials. The objects are:

aluminium foil **a silver ring** **an iron bar**

a plastic strip **a glass lens**

(i) State which objects are made of electrically insulating materials.

..... [1]

(ii) State which object is made of a magnetic material.

..... [1]

(b) Fig. 8.1 shows two magnets, X and Y. The magnets are attracting each other.

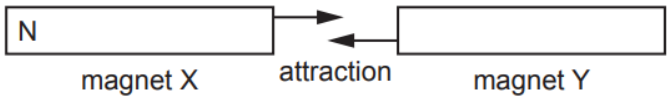

Fig. 8.1

On magnet X, the N pole is labelled N.

On Fig. 8.1, complete the labelling for the magnetic poles of each magnet. [1]

8 **(a)** Fig. 8.1 shows the magnetic field pattern around a bar magnet.

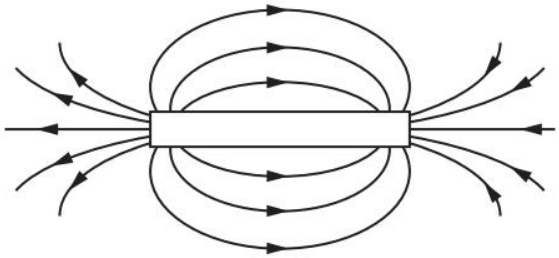

Fig. 8.1

(i) On Fig. 8.1, label the north and south poles of the magnet, using the letters N and S. [1]

(ii) A soft-iron bar is positioned as shown in Fig. 8.2.

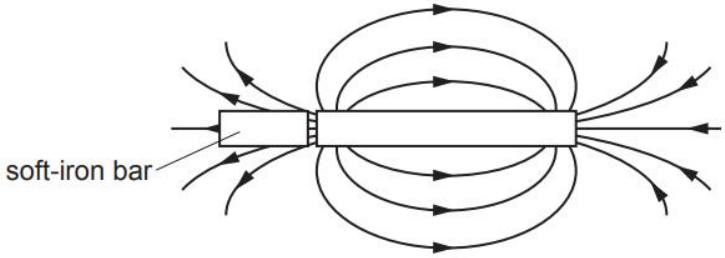

Fig. 8.2

State and explain what happens to the soft-iron bar.

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..... [3]

9 A student has a permanent bar magnet and two metal bars, as shown in Fig. 9.1.

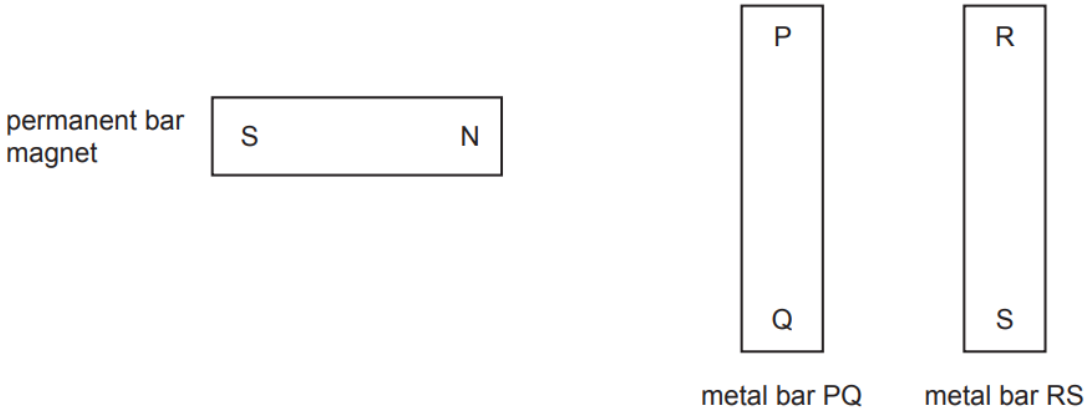

Fig. 9.1

The student tests bar PQ and bar RS separately. He holds the N pole of the permanent bar magnet close to each end of each metal bar. Table 9.1 shows the results of the tests.

Table 9.1

end of metal bar	result of test with N pole
P	attracted
Q	repelled
R	attracted
S	attracted

Deduce whether each metal bar is a magnet, an unmagnetised magnetic material or a non-magnetic material.

Give a reason for each of your answers.

1. metal bar PQ .....

.....

.....

2. metal bar RS .....

.....

.....

[4]

[Total: 4]

10 A student tests whether a bar magnet affects three different materials.

Fig. 9.1 shows the bar magnet and a sample of each material A, B and C.

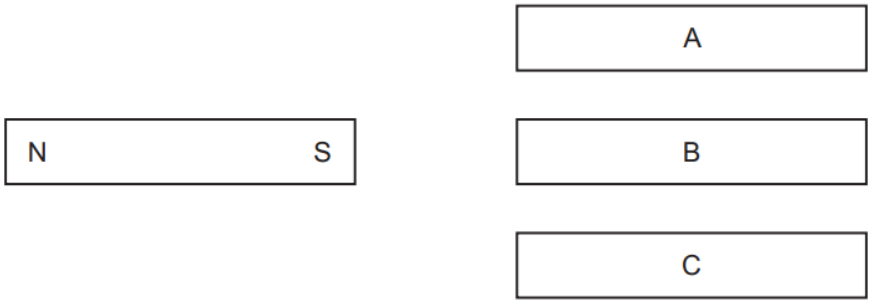

Fig. 9.1

The student tests each sample by holding each pole of the magnet close to one end of the sample. Table 9.1 shows his observations.

Table 9.1

sample	effect of N pole	effect of S pole
A	attraction	attraction
B	no effect	no effect
C	attraction	repulsion

(a) Using the information in Table 9.1, draw a straight line from each sample to its correct property. Draw **three** lines.

sample	**property**
A	magnetic and magnetised
B	magnetic but not magnetised
C	non-magnetic

[2]

(b) Describe **one** method of producing a magnet from a bar of unmagnetised steel.

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..... [2]

11 **(a)** Fig. 9.1 shows the magnetic field pattern around a bar magnet.

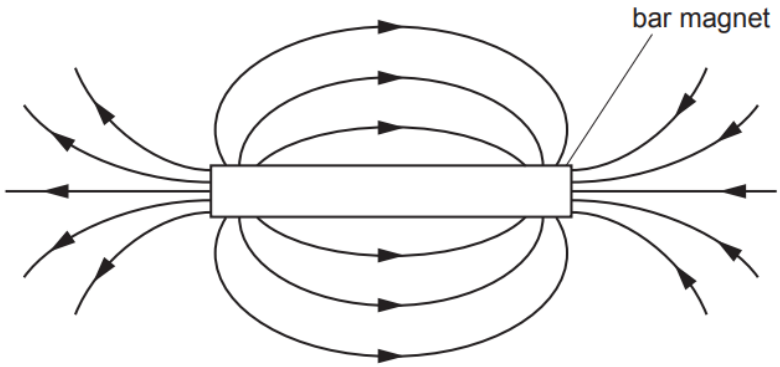

Fig. 9.1

(i) On Fig. 9.1, write the letters N and S to indicate the north and south poles of the magnet. [1]

(ii) Fig. 9.2 shows a soft-iron bar placed close to a permanent magnet.

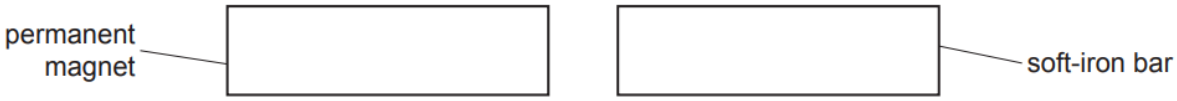

Fig. 9.2

State and explain what happens to the soft-iron bar. You may draw on Fig. 9.2.

.....

.....

..... [3]

12 **(a)** Identify which of the following metals can be permanently magnetised. Place a tick (✓) in the box next to any correct metal.

- ☐ aluminium
- ☐ copper
- ☐ steel
- ☐ tungsten

[1]

(b) Two metal rods are thought to be permanent magnets. Describe the test you would carry out to confirm that both rods are permanent magnets.

.....

.....

..... [2]

(c) **(i)** Describe how to make an electromagnet. You may draw a labelled diagram to help your answer.

.....

.....

.....

..... [3]

(ii) Suggest **two** factors that affect the strength of the magnetic field of an electromagnet.

1 .....

2 .....

[2]

[Total: 8]

13 **(a)** Fig. 8.1 shows the magnetic field pattern around a bar magnet.

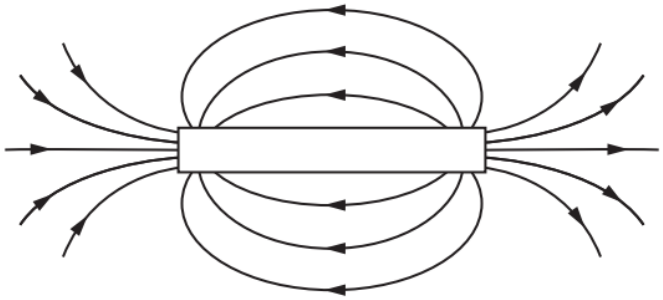

Fig. 8.1

(i) On Fig. 8.1, mark the North and South poles of the magnet. Use the letter N for the North pole and S for the South pole. [1]

(ii) A small bar of unmagnetised iron is placed next to a bar magnet, as shown in Fig. 8.2.

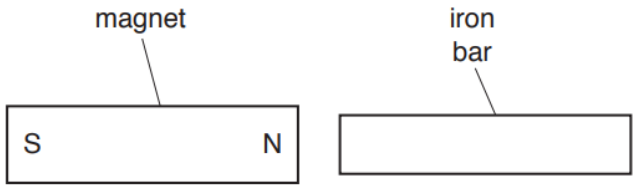

Fig. 8.2

The iron bar moves towards the magnet.

Explain why the iron bar moves.

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..... [2]

(b) Fig. 8.3 shows a coil of wire wrapped around an iron core. A student uses these to make an electromagnet.

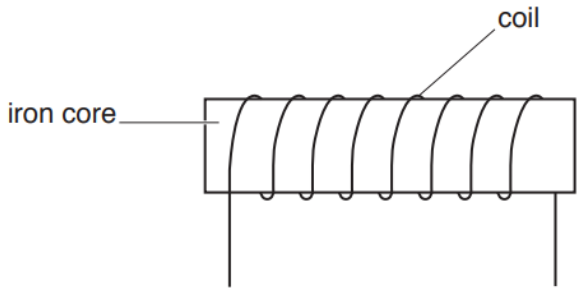

Fig. 8.3

(i) Complete the diagram in Fig. 8.3 to show how it could be used to make an electromagnet. [1]

(ii) State **one** advantage of an electromagnet compared to a permanent magnet.

..... [1]

[Total: 5]

Paper 4

Questions are applicable for both core and extended candidates unless indicated in the question

14 **(a)** Fig. 7.1 shows three bars of steel, A, B and C.

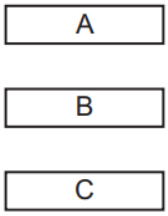

Fig. 7.1

A student is given the three pieces of steel. Two of the pieces are magnetised and one piece is unmagnetised.

Describe and explain how the student determines which piece is unmagnetised using only the three pieces of steel.

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..... [4]

15 This question is about the magnetic fields around bar magnets. Fig. 7.1 shows two positions used by a student doing an experiment.

Fig. 7.1

(a) Fig. 7.2 shows a magnet, labelled magnet 1, placed on position 1.

Fig. 7.2

On Fig. 7.2, draw lines to show the pattern of the magnetic field produced by magnet 1. Place arrows on the lines to show the direction of the field. [3]

(b) Magnet 1 is removed from position 1. Fig. 7.3 shows another magnet, labelled magnet 2, placed on position 2.

Fig. 7.3

On Fig. 7.3, draw, at the right-hand end of position 1, a line with an arrow to show the direction of the magnetic field produced by magnet 2. [1]

(c) Fig. 7.4 shows magnet 1 placed on position 1 and magnet 2 placed on position 2.

Fig. 7.4

(i) State the direction of the force that the N pole of magnet 2 exerts on the N pole of magnet 1.

..... [1]

(ii) Justify your answer to **(c)(i)**.

.....

..... [1]

[Total: 6]

16 **(a)** Fig. 7.1 shows two magnets and the gap between the N pole of one magnet and the S pole of the other magnet.

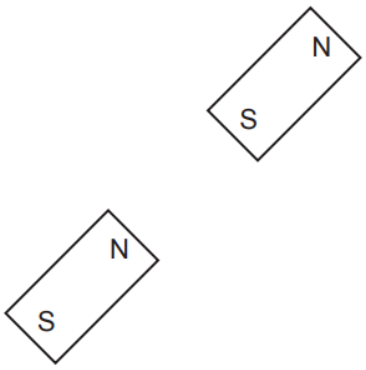

Fig. 7.1

On Fig. 7.1, draw **three** lines to show the pattern and direction of the magnetic field in the gap. [2]

(b) **(i)** Fig. 7.2 is a repeat of Fig. 7.1 showing the two magnets.

On Fig. 7.2, draw the position of a plotting compass needle when it comes to rest in the gap between the N pole and the S pole.

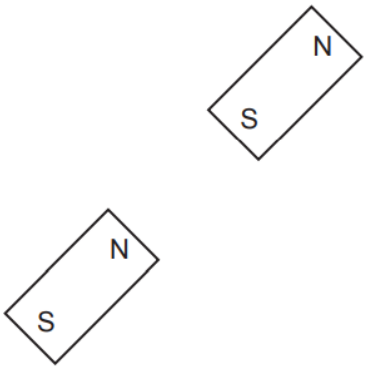

Fig. 7.2 [1]

(ii) Explain why the needle comes to rest in this position.

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..... [2]

(c) Describe a method of demagnetising a bar magnet.

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..... [2]

[Total: 7]

17 **(a)** Fig. 9.1 shows a bar magnet and four plotting compasses A, B, C and D.

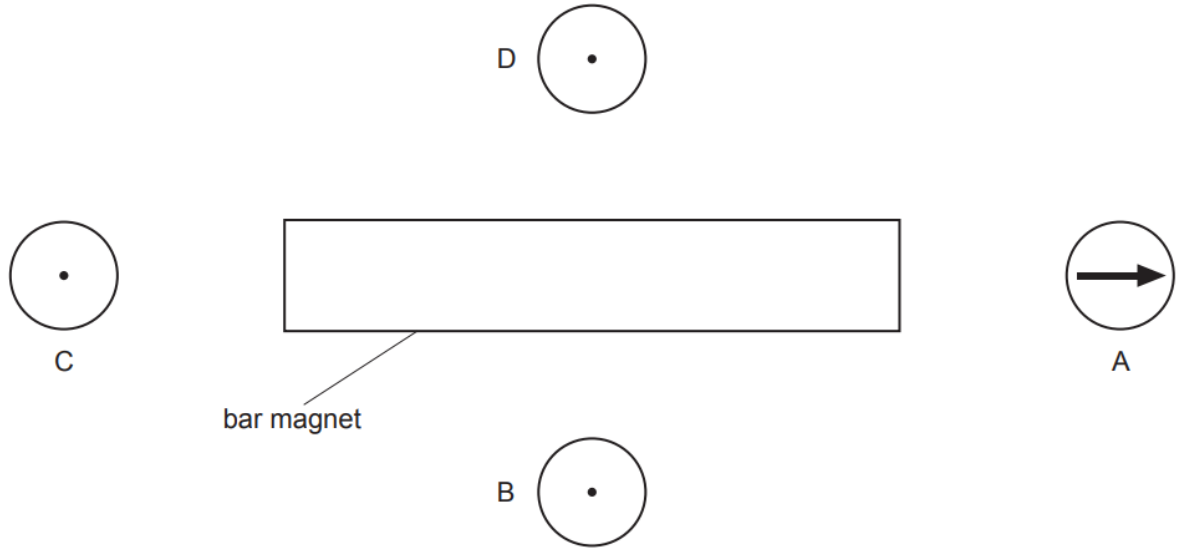

Fig. 9.1

On Fig. 9.1:

(i) draw an arrow on each of the three plotting compasses B, C and D to show the direction of the magnetic field [2]

(ii) label the magnetic poles of the bar magnet N and S. [1]

(b) Describe **one** method for demagnetising a bar magnet.

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..... [2]

(c) Fig. 9.2 represents a current in a wire. The current is into the plane of the paper.

(i) Draw the pattern of the magnetic field produced around the wire. Show clearly the direction of the magnetic field.

Fig. 9.2

[2]

(ii) The direction of the current in the wire is reversed. The magnitude of the current is unchanged. **(extended only)**

State the effect that reversing the current has on the magnetic field produced.

.....

..... [1]

[Total: 8]