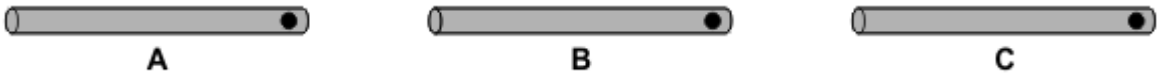
KS3 Science

Electromagnetism

Question Paper

Time available: 33 minutes
Marks available: 40 marks

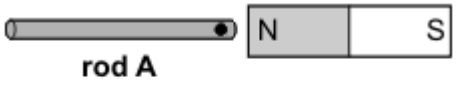
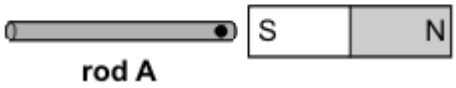
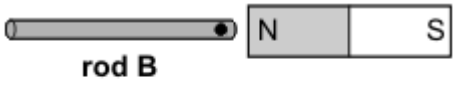
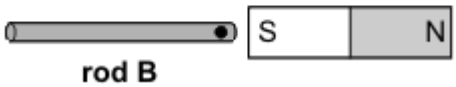
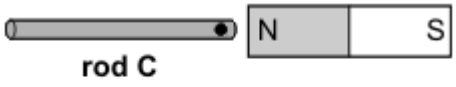
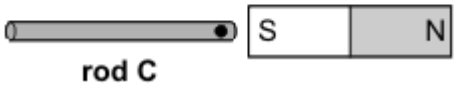
1. Hannah has three rods (A, B and C) made from different metals.
One rod is a **magnet**; one is made of **copper**; and one is made of **iron**.
She does not know which rod is which.



Each rod has a dot at one end.

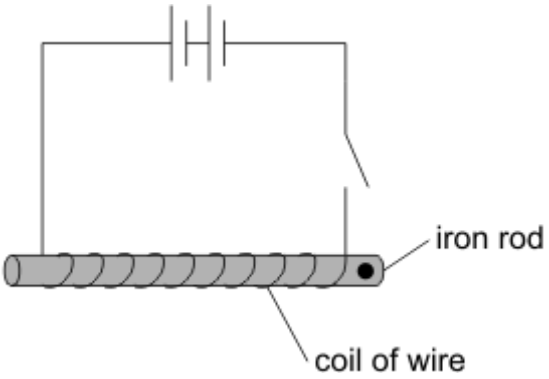
(a) Hannah uses **only** a bar magnet to identify each rod.
She puts each pole of the bar magnet next to the dotted end of each rod.

Complete Hannah's observations in the table below.
Write if each rod is **copper**, **iron** or a **magnet**.

test	observations	type of rod
 	attract attract	Rod A is ..... .
 	nothing happens	Rod B is ..... .
 	attract	Rod C is ..... .

3 marks

(b) Hannah uses the iron rod to make an electromagnet.



When the switch is closed the iron rod becomes an electromagnet.
Give **two** ways Hannah could make the electromagnet stronger.

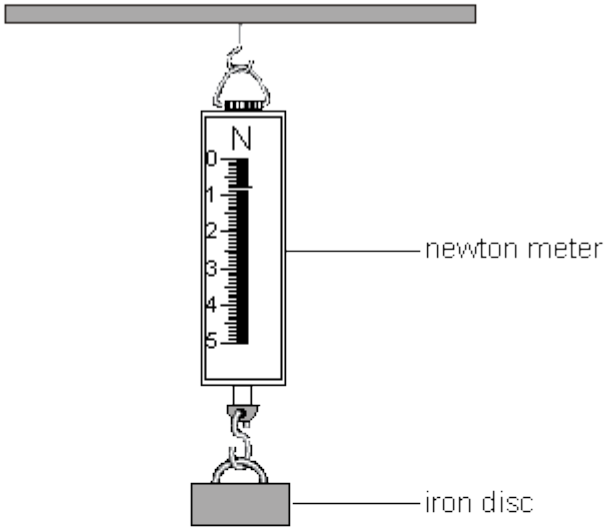
1. .....

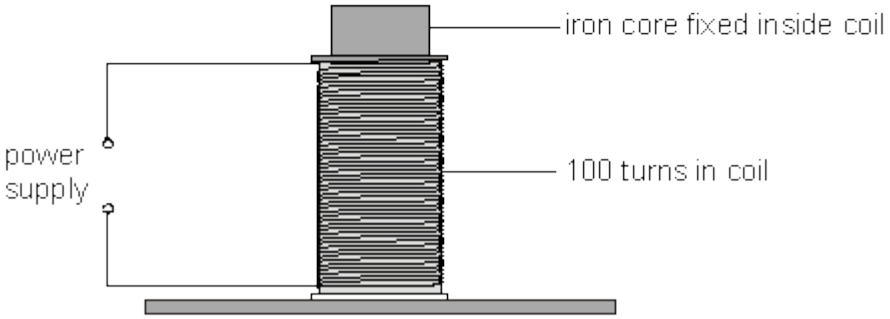
1 mark

2. .....

1 mark
maximum 5 marks

2. Mary used the apparatus below to test the strength of an electromagnet.
She used the reading on the newton meter to measure the force of the magnet on the iron disc.





(a) Explain why the reading on the newton meter increases when a current passes through the coil.

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2 marks

(b) When a current passes through the coil, some of the electrical energy is changed to thermal energy.
What would happen to the coil if the current passing through it was too large?

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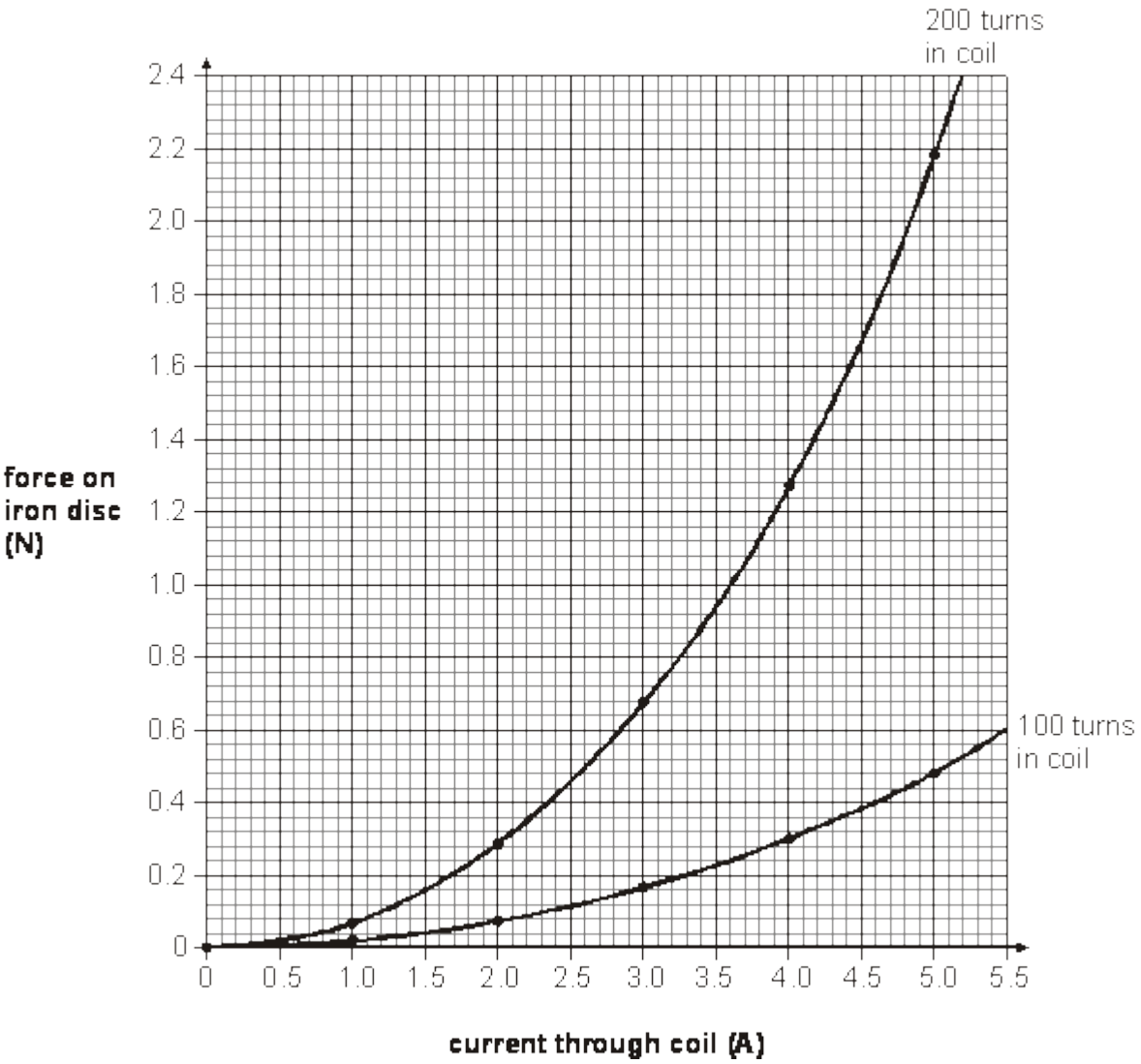
1 mark

(c) Mary made two electromagnets, one with 100 turns of wire in the coil and one with 200 turns.
She varied the current through the coil of each electromagnet.
She measured the force of each electromagnet on the iron disc.
The graph shows her results.



Write **two** conclusions that Mary could make from these results.

1. .....

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2. .....

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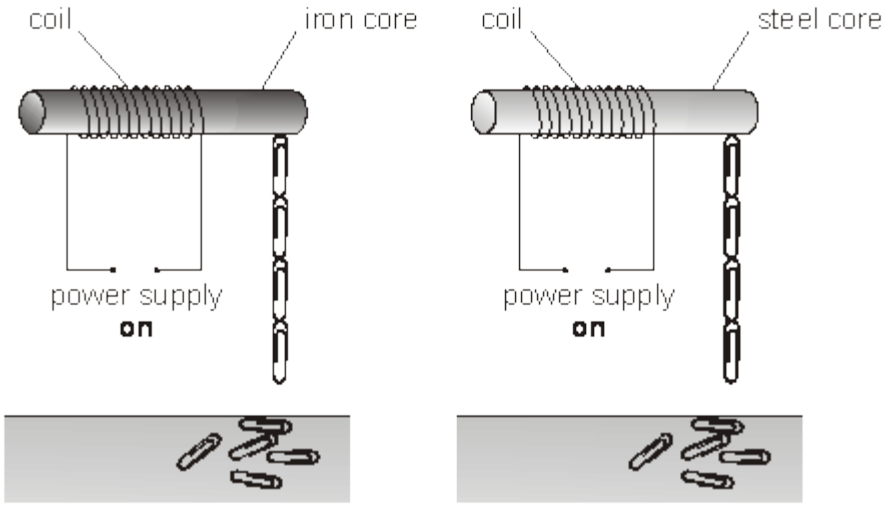
2 marks
maximum 5 marks

3. David made two electromagnets as shown below.
He used paper-clips to test the strength of each electromagnet.
He switched on the power supply in both circuits.



(a) How can you tell that the strength of both electromagnets is the same?

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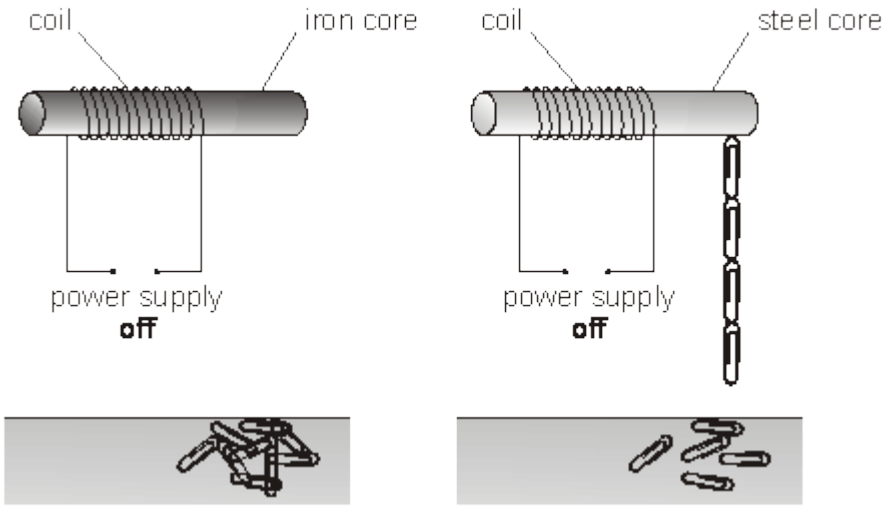
1 mark

(b) David switched off the power supply in both circuits.
The paper-clips fell off the iron core, but **not** off the steel core.



Why is iron used, rather than steel, for the core of an electromagnet?
Use the diagrams above to help you.

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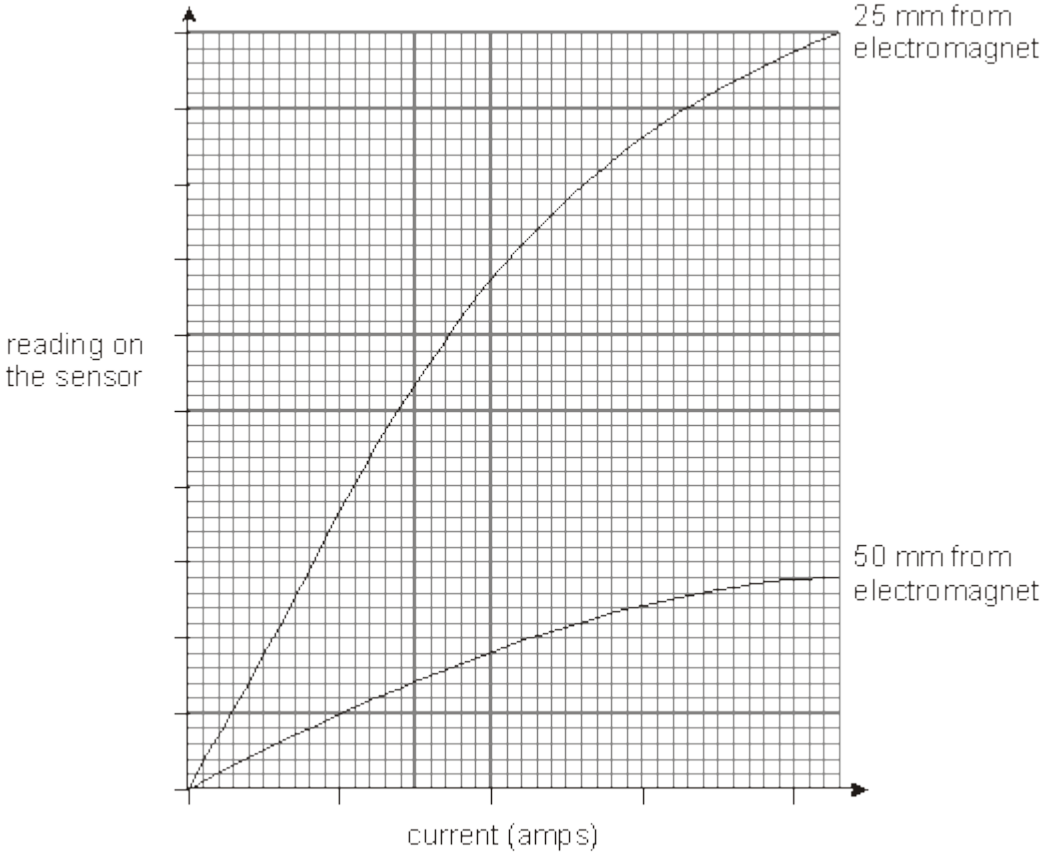
1 mark

(c) David used a sensor to measure the strength of an electromagnet.

He placed the sensor 25 mm from the electromagnet and increased the current in the coil.

He repeated the experiment with the sensor 50 mm from the electromagnet.

The graph below shows his results.



(i) How did the distance of the sensor from the electromagnet affect the reading on the sensor?

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1 mark

(ii) How did the size of the current in the coil affect the strength of the electromagnet?

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1 mark

(iii) What else could David do to an electromagnet to change its strength?

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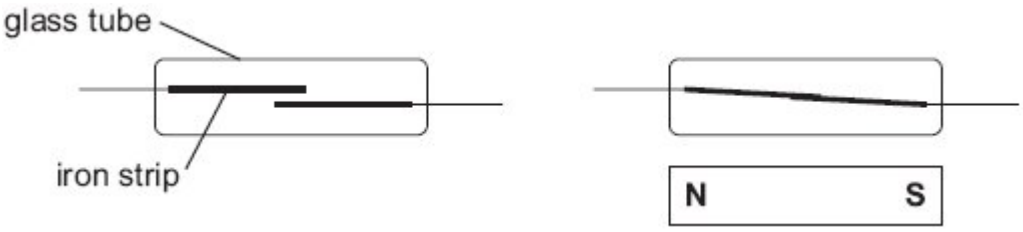
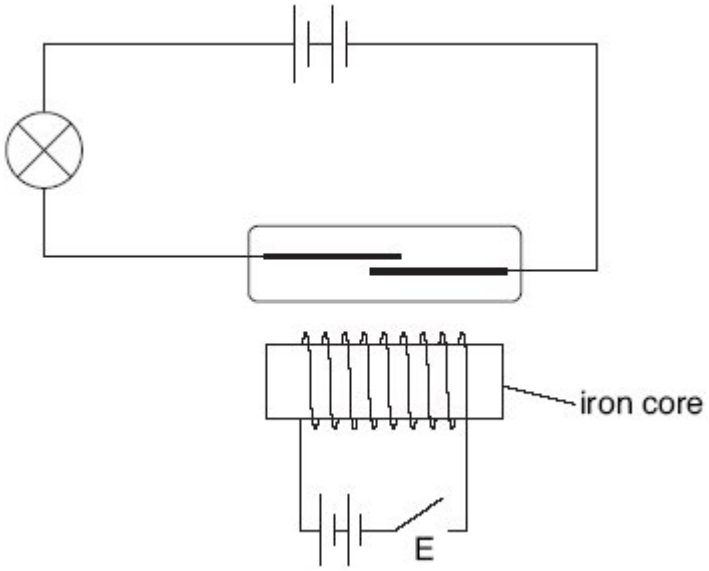
1 mark

maximum 5 marks

4. A reed switch is made of two iron strips inside a glass tube.
The iron strips close together when a magnet is brought near.
They spring apart again when the magnet is removed.



(a) Hilary set up the circuit shown below.
She tried to close the reed switch using an electromagnet.



She closed switch E but the electromagnet was **not** strong enough to close the reed switch.

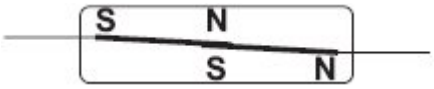
(i) Give **two** ways Hilary could increase the strength of the electromagnet.

1. .....

2. .....

2 marks

(ii) Hilary increased the strength of the electromagnet.
The reed switch closed.
The iron strips were magnetised as shown below.



She reversed the current in the coil of the electromagnet.
On the diagram below, label the poles of the iron strips when the current was reversed.

1 mark

(b) (i) Iron and steel are both magnetic materials.
Explain why the strips must be made of iron and **not** steel.

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1 mark

(ii) She replaced the reed switch with a piece of copper wire.
The current through the bulb increased.

Explain why more current flowed through the bulb when the reed switch was replaced with copper wire.

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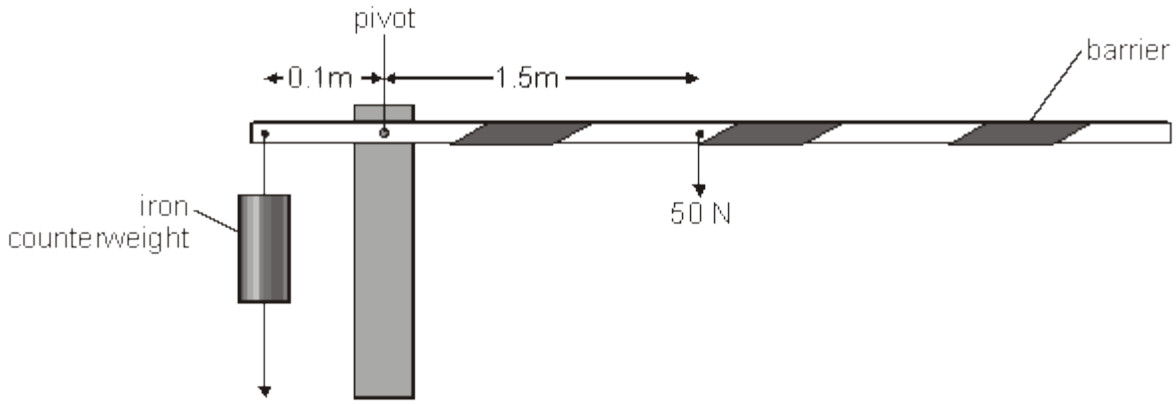
1 mark
maximum 5 marks

5. (a) The diagram below shows a car park barrier.



(i) Calculate the turning moment produced by the barrier about the pivot.
Give the unit.

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2 marks

(ii) The barrier is horizontal. The weight of the barrier is balanced by an iron counterweight. Calculate the downward force produced by the counterweight.

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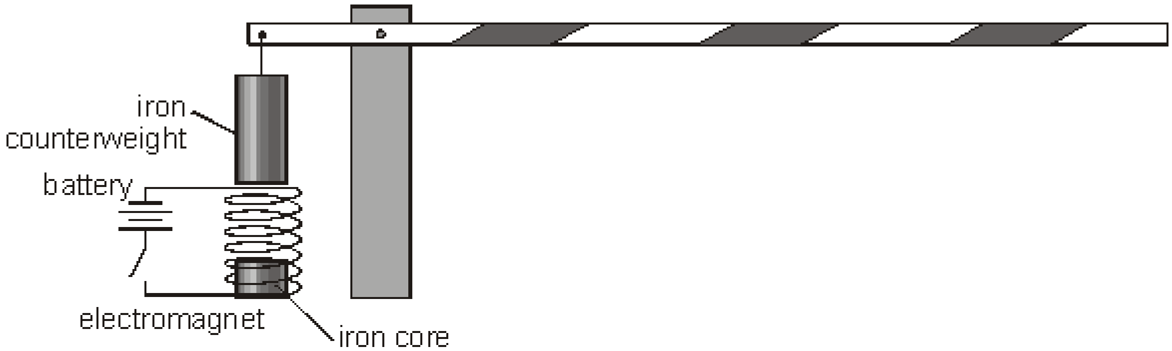
1 mark

(b) An electromagnet is placed beneath the iron counterweight as shown below.



When the switch is closed the barrier rises.
Explain how the electromagnet can be used to raise the barrier.

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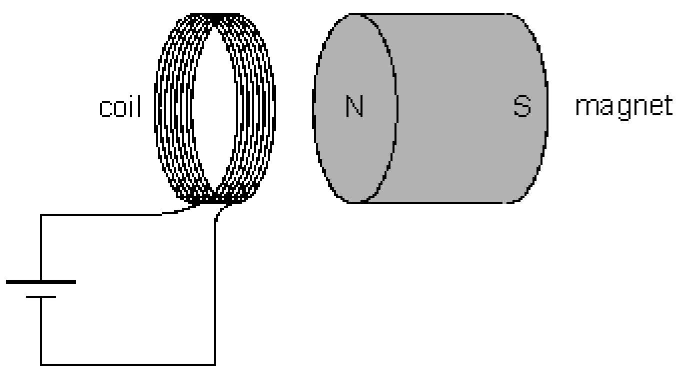
2 marks
maximum 5 marks

6. (a) A pupil makes a small coil of copper wire and passes an electric current through it.
The pupil places a small magnet near the coil.



The magnet is attracted towards the coil. The pupil turns the magnet around so that the South pole is nearest the coil.
What effect, if any, will this have?

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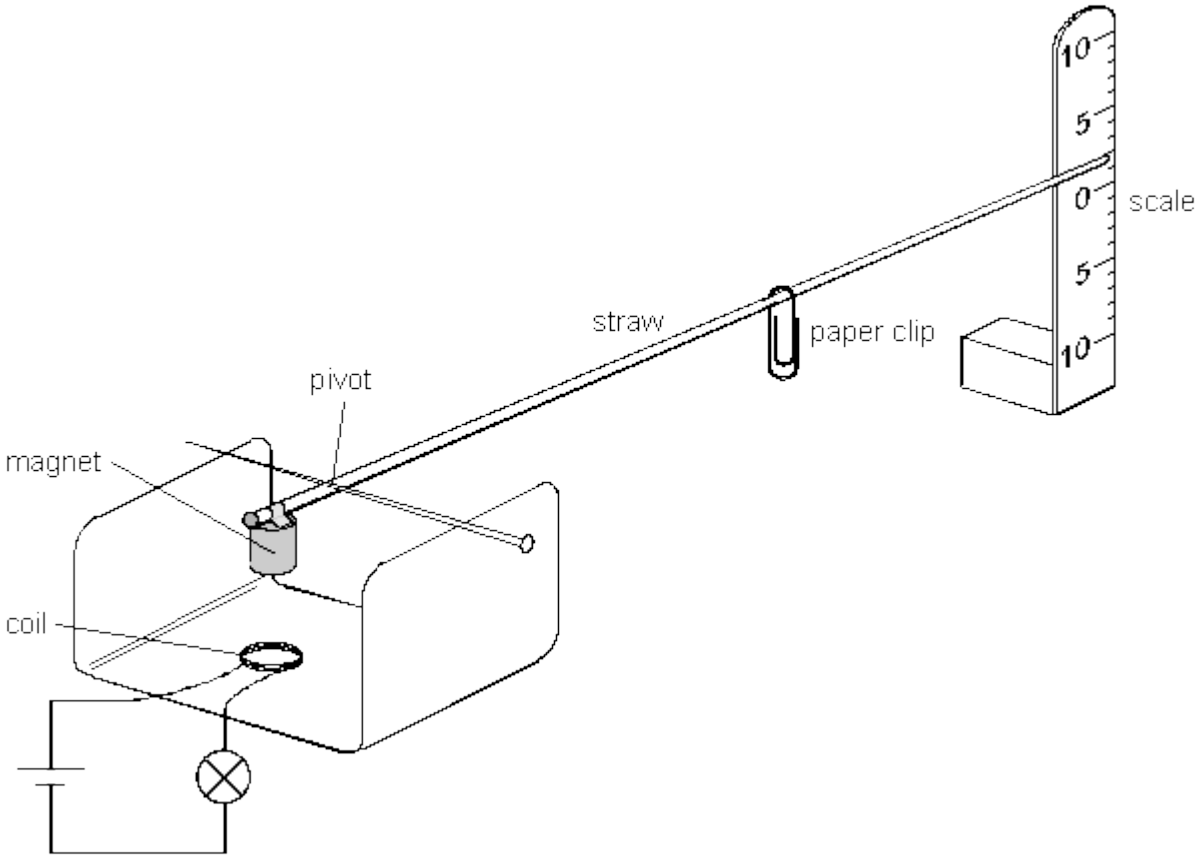
… … … . …

1 mark

(b) The pupil uses the coil and the magnet to make a simple ammeter to measure the current through a bulb.



not to scale

(i) The paper clip is used to balance the weight of the magnet.
Why is the paper clip further away from the pivot than the magnet is?

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… …

1 mark

(ii) Explain how a current in the coil makes the straw pointer move.

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2 marks

(iii) The pupil places a piece of soft iron in the middle of the coil.
Describe and explain how this will affect the reading on the scale when the same current flows through the coil.

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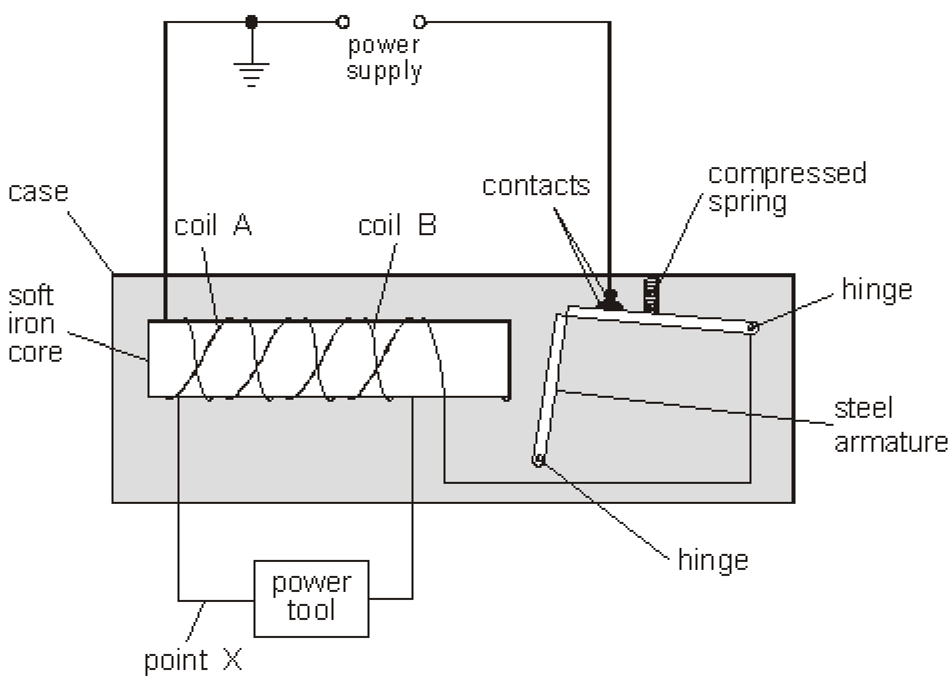
2 marks
Maximum 6 marks

7. The simplified diagram shows a device which protects people from being electrocuted when using power tools such as hedge cutters. The wire in one part of the circuit is shown darker to make the circuit clearer.

When the armature is attracted towards the soft iron core, the contacts are pushed apart and break the circuit.



(a) The power tool, coil A and coil B are all in the same series circuit. Coils A and B are wound in opposite directions.

The current in the coils has no magnetic effect on the armature. Explain why.

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1 mark

(b) A gardener accidentally cuts the wire at point X. Current from the power supply starts to flow through the gardener to earth.

What effect will this have on the armature? Explain your answer.

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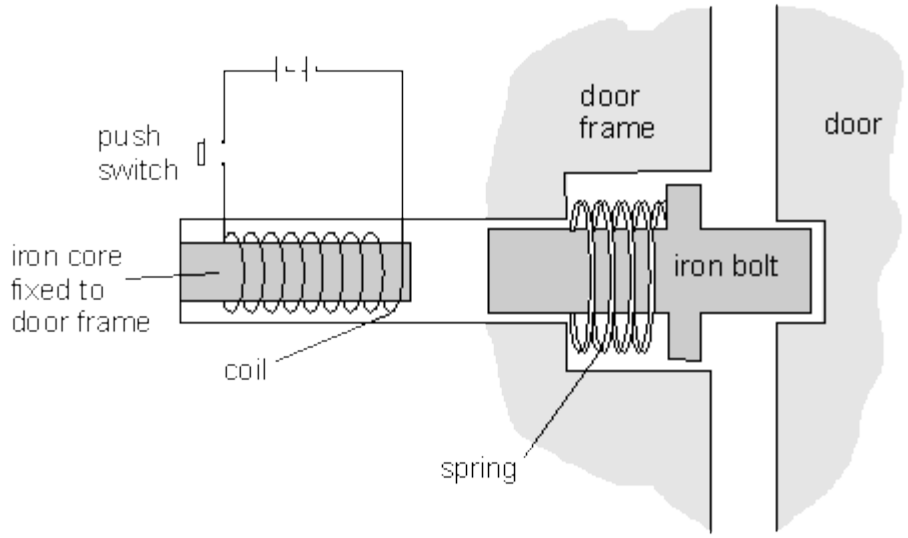
3 marks
Maximum 4 marks

8. The diagram shows an electromagnet used in a door lock.



(a) The push switch is closed and the door unlocks. Explain in detail how this happens.

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3 marks

(b) The switch is released and the door locks. Explain in detail how this happens.

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2 marks
Maximum 5 marks