



7.9.8 Elctromagnetism

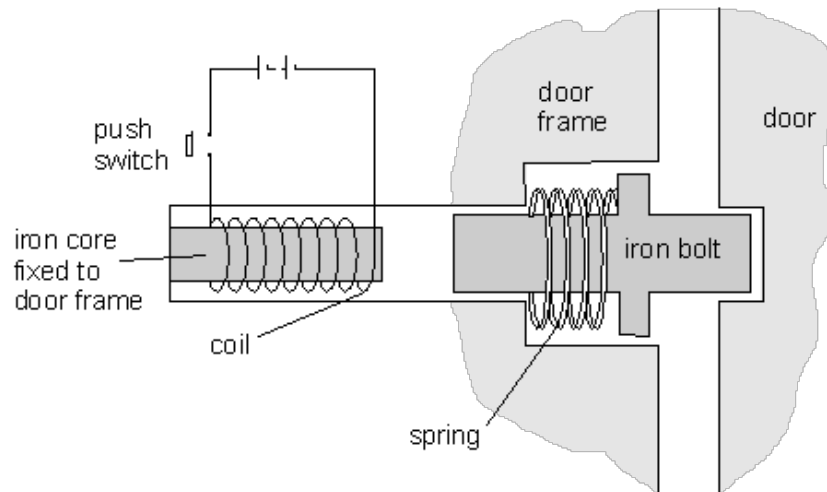


71 minutes



86 marks

Q1. 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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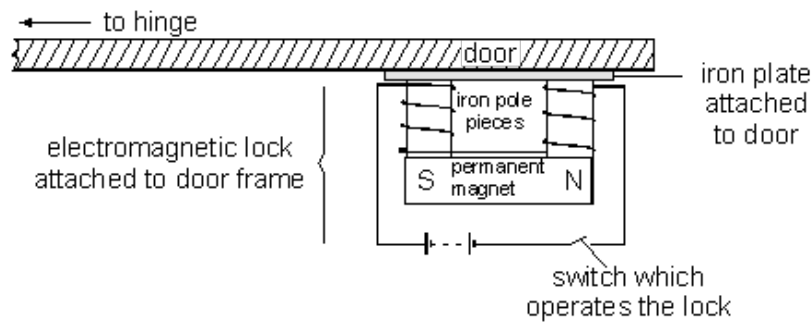
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2 marks
Maximum 5 marks

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The diagram shows a magnetic lock for a door. It consists of both a strong permanent magnet and an electromagnet. It is fitted into the door frame. An iron plate is attached to the door.



- (a) In the diagram the switch is open. Explain why the door cannot be opened.

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1 mark

- (b) When the switch is closed the door may be opened. Explain why the door may now be opened.

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1 mark

- (c) A burglar tries to get in by cutting the wires to the battery. Explain why the door still cannot be opened.

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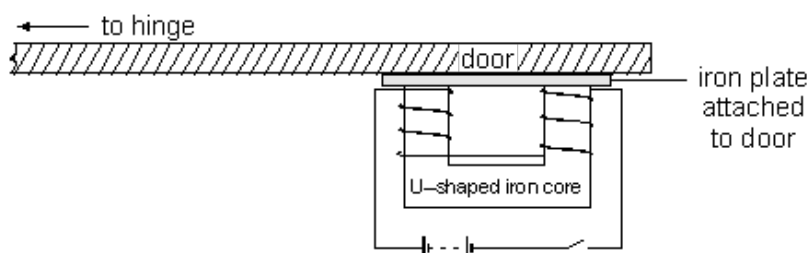
1 mark

- (d) When the wires are repaired, the battery is accidentally connected the other way round. Explain why the door cannot now be opened.

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1 mark

- (e) Another magnetic lock is shown below. It does **not** have a permanent magnet in it.



Explain how this kind of lock works and why it is not as secure as the one shown at the beginning of the question.

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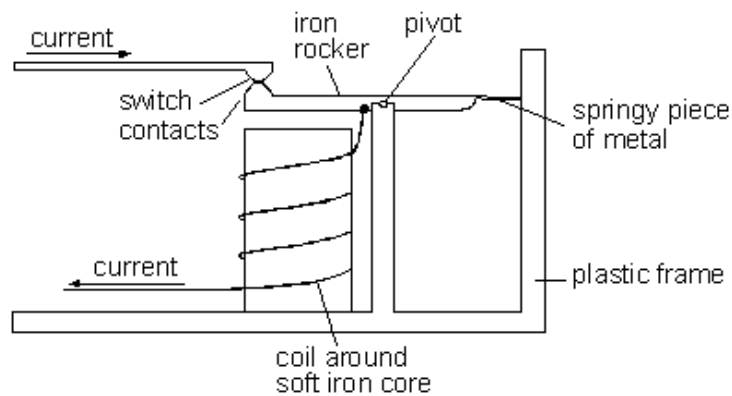
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2 marks
Maximum 6 marks

- Q3.** Circuit breakers are switches which open when the current becomes too large. The diagram shows a simple circuit breaker. The springy piece of metal pushes down on the iron rocker, and this holds the switch contacts together.



- (a) (i) There is a current in the coil in the circuit breaker. What is the purpose of the coil?

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1 mark

- (ii) What is the purpose of the soft iron core in the coil?

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1 mark

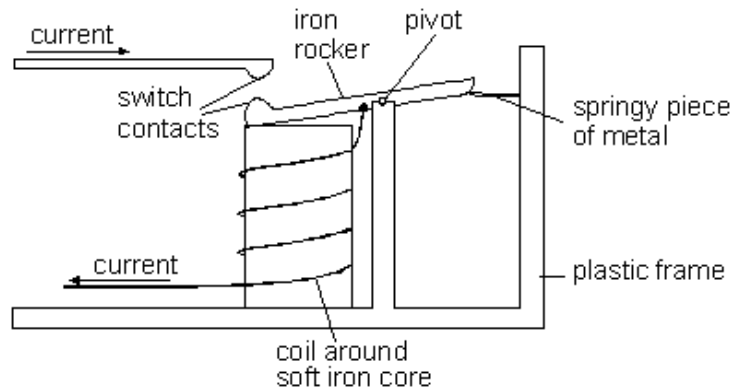
- (b) Give **two** properties of iron which make it a good choice of material for the **rocker**.

1.

2.

2 marks

- (c) The diagram below shows the circuit breaker with the switch contacts open.



Why do the switch contacts separate when the current becomes too large?

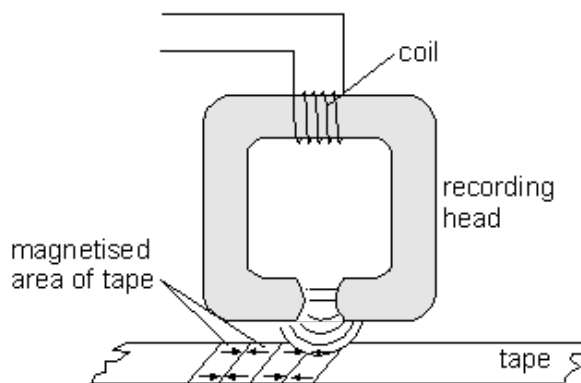
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1 mark
Maximum 5 marks

##

Digital information can be stored on magnetic recording tape in several different ways. One way is shown in the diagram below.



The recording head produces a magnetic field. The magnetic particles in the section of tape under the recording head line up with the field.

- (a) As the tape moves past the recording head, different sections of the tape become magnetised. The direction of the current is changed at regular intervals.

How would the pattern on the tape be different if the tape were moved past the recording head more quickly?

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1 mark

- (b) The direction of the current is changed at regular intervals. The tape is moved past the recording head at a steady speed.

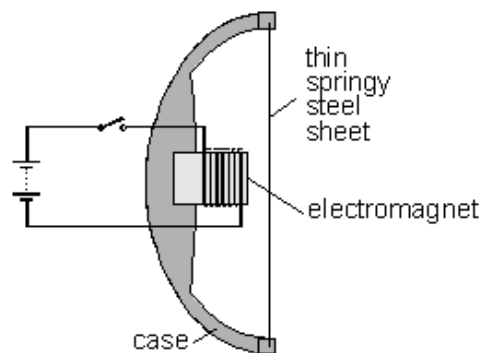
The gap between the poles of the recording head is made much bigger. Suggest **two** effects this might have on the pattern on the tape.

- 1
-
- 2
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2 marks
Maximum 3 marks

##

A pupil fixes a small electromagnet close to a thin springy steel sheet. The device acts like a small speaker. She connects a battery and switch to the electromagnet as shown.



- (a) (i) When the pupil closes the switch, what will happen to the steel sheet?

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1 mark

- (ii) The pupil opens the switch again. What will happen to the steel sheet now?

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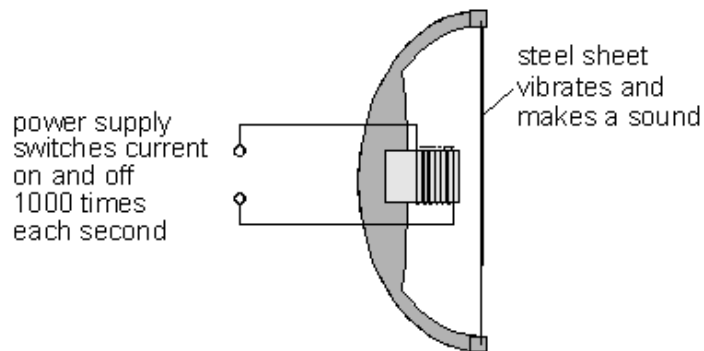
1 mark

- (iii) If the pupil had connected the battery the other way round, what difference would this have made to your answer to part (i)?

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1 mark

- (b) The pupil removes the battery and switch. She connects the electromagnet to a power supply which switches the current on and off 1000 times each second. The steel sheet vibrates and makes a sound.



- (i) She then adjusts the power supply so that the current is switched on and off 3000 times each second.

What difference does this make to the pitch of the sound?

Give a reason for your answer.

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2 marks

- (ii) The pupil now adjusts the power supply so that the current is larger. Explain why this makes the sound louder.

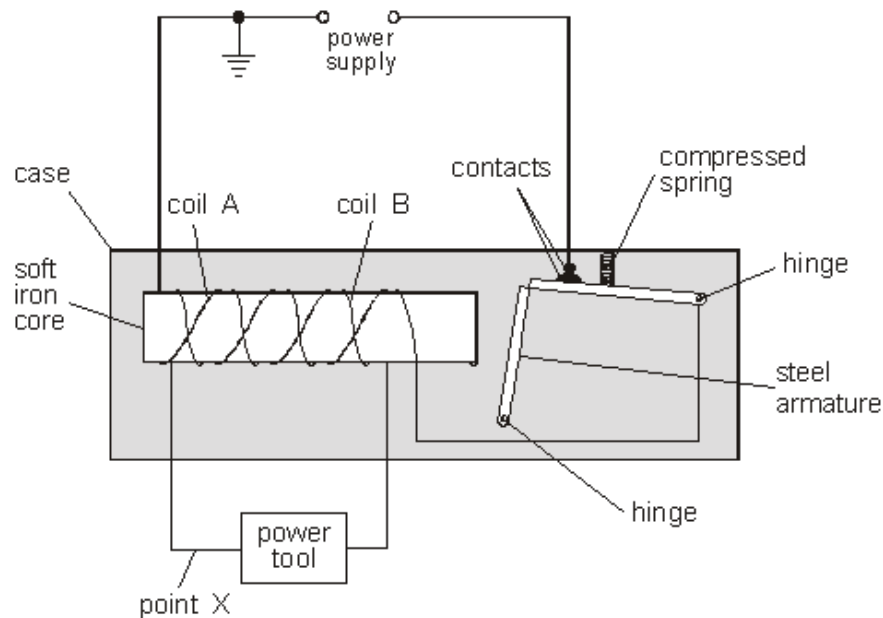
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1 mark
Maximum 6 marks

- Q6.** 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

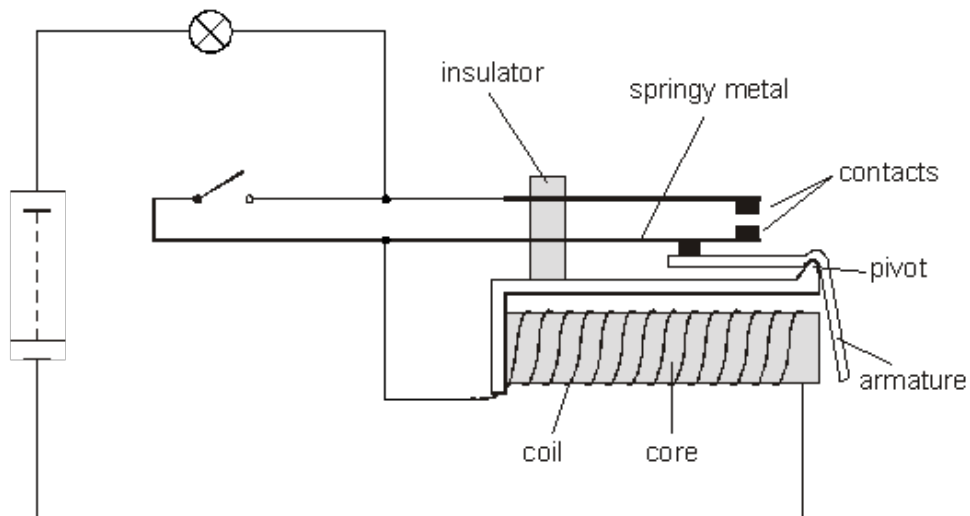
- (b) A gardener accidentally cuts the wire at point X. Current from the power supply starts to flow through the gardener to earth.

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

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3 marks
 Maximum 4 marks

- Q7.** The diagram shows an electromagnetic relay. The relay is connected in a circuit with a battery, a lamp and a switch.



- (a) (i) Give the name of a suitable material to use for the core of the electromagnet.

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1 mark

- (ii) Give the name of a suitable material to use for the armature.

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1 mark

- (b) (i) Explain why the contacts come together when the switch is closed.

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3 marks

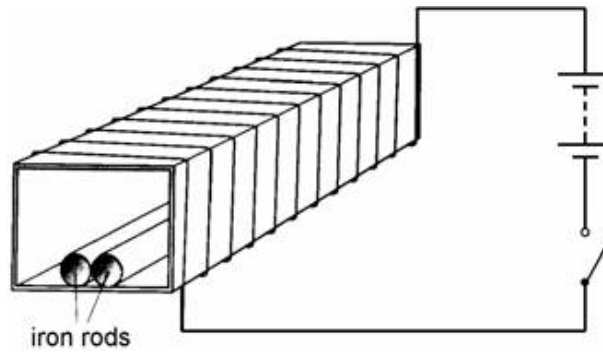
- (ii) When the switch is now opened, the bulb stays on. Explain why.

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1 mark

Maximum 6 marks

- Q8.** The diagram shows a rectangular coil and circuit. It has two iron rods in it. The rods are parallel and touching. They are free to move.



- (a) When the switch is closed, the two rods move apart.

- (i) Explain why this happens.

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2 marks

- (ii) The switch is then opened to break the circuit. What, if anything, happens to the two iron rods?

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1 mark

- (b) One of the two iron rods is taken out and replaced with a brass rod. The rods are parallel and touching. What, if anything, will happen to the rods when the switch is closed? Explain your answer.

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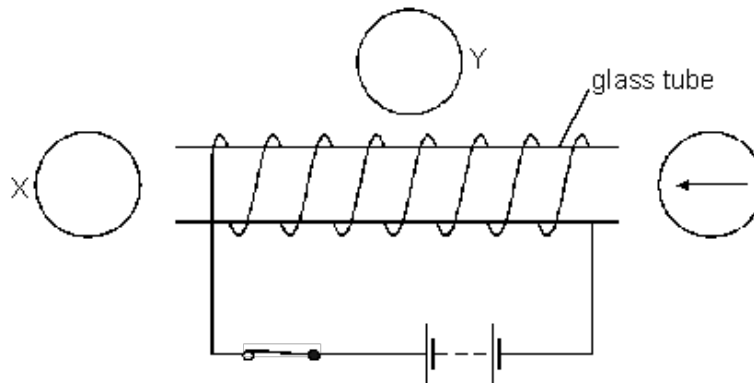
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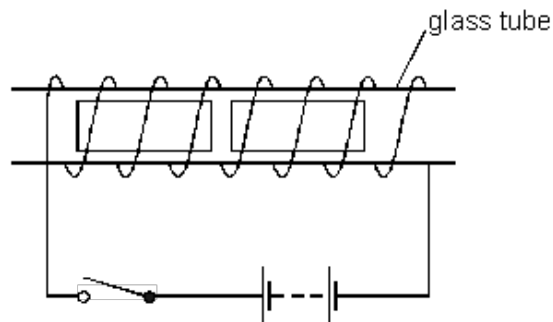
2 marks
Maximum 5 marks

- Q9.** A pupil wound a coil of copper wire around a glass tube and connected the wire to a battery. She placed a compass at each end of the tube and one compass beside the tube as shown.



- (a) (i) Complete the diagram by drawing arrows in compasses X and Y to show the direction of the magnetic field. 2 marks
- (ii) Draw an arrow in the middle of the glass tube to show the direction of the magnetic field in the glass tube. 1 mark
- (iii) When the switch is opened, in which direction will the three compass needles point?
 1 mark
- (b) Give **one** way to reverse the magnetic field around the glass tube

 1 mark
- (c) Two pieces of iron are placed inside the glass tube.
- (i) When the switch is closed, the magnetic field is the same as in the diagram opposite. The pieces of iron become magnetised. Label the **four** poles on the pieces of iron.



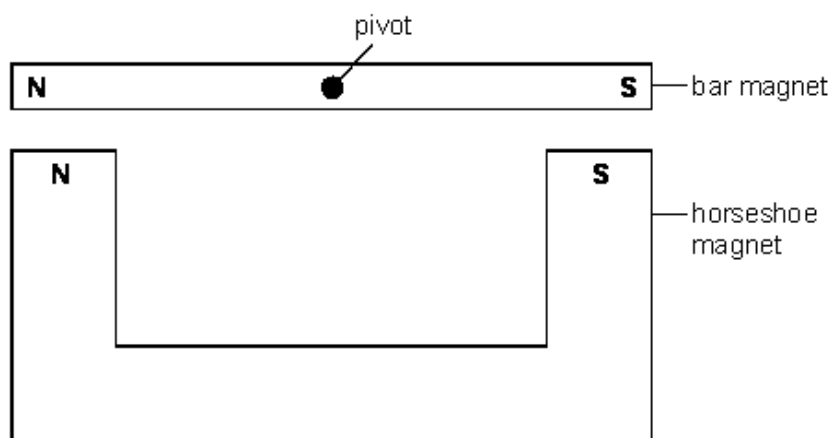
1 mark

- (ii) When the switch was closed, the pieces of iron moved.
Explain why they moved.

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1 mark
Maximum 7 marks

- Q10.** Anita has arranged a horseshoe magnet with a long bar magnet pivoted above it.

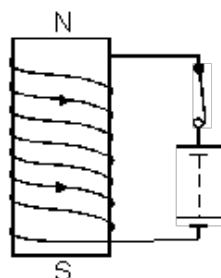


- (a) Whenever Anita tips the bar magnet, it always moves back to the position shown in the diagram. Explain why this happens.

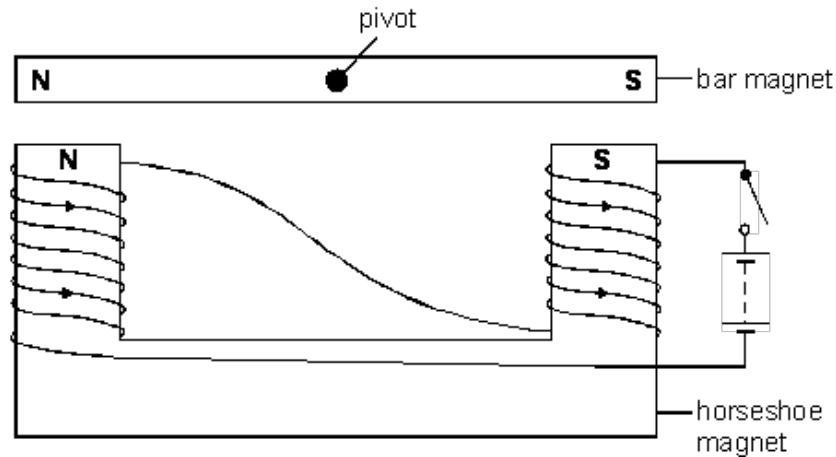
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2 marks

- (b) When a current is passed through a coil, it produces magnetic poles as shown in the diagram below.



Anita winds a coil around each end of the horseshoe magnet as shown below.



- (i) Describe what will happen to the bar magnet when she closes the switch. Explain your answer.

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3 marks

- (ii) Anita reverses the battery. Suggest what happens to the bar magnet.

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1 mark

- (iii) Anita replaces the battery with a power supply which changes the direction of the current every second. Suggest what happens to the bar magnet.

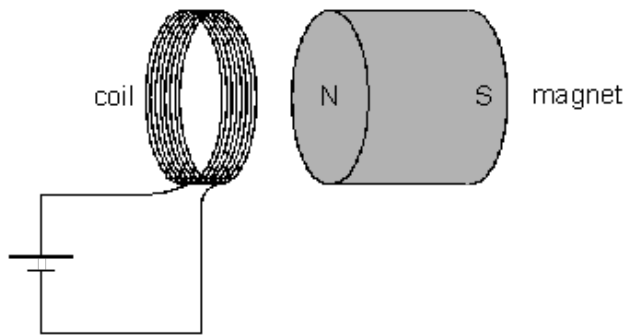
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1 mark

Maximum 7 marks

- Q11.** (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.

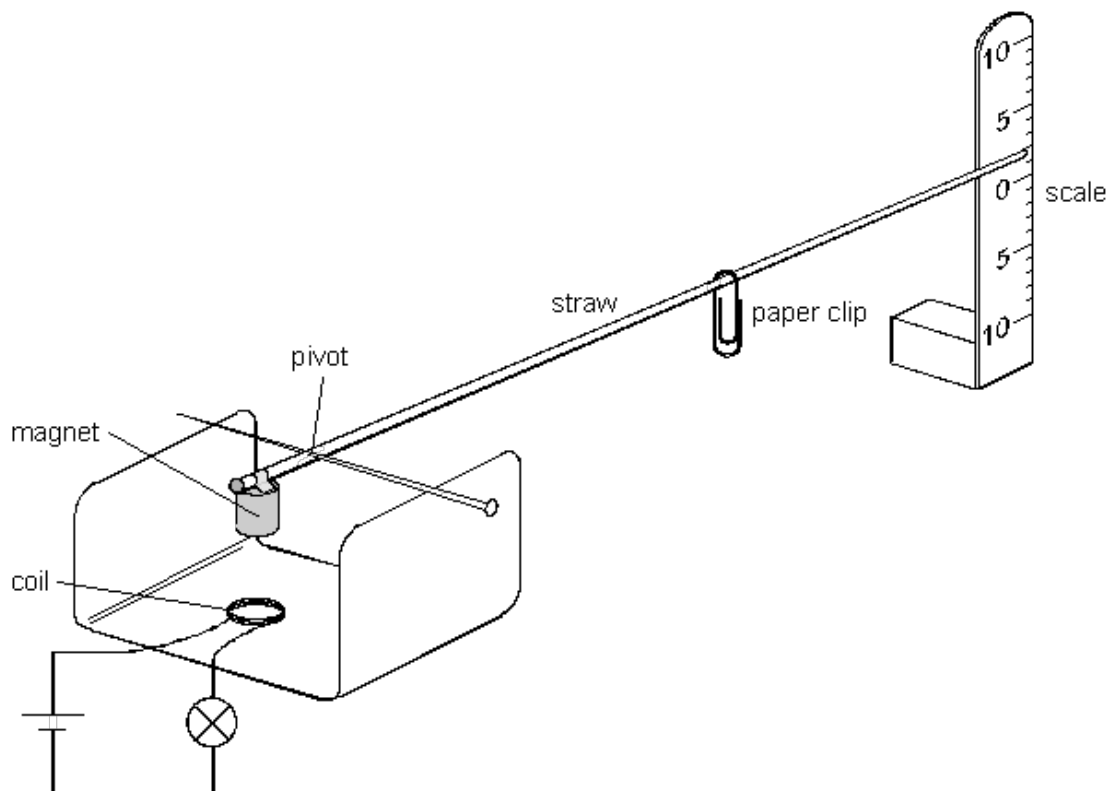


The magnet is attracted towards the coil. The pupil turns the magnet around so that the South pole is nearest the coil.
What effect, if any, will this have?

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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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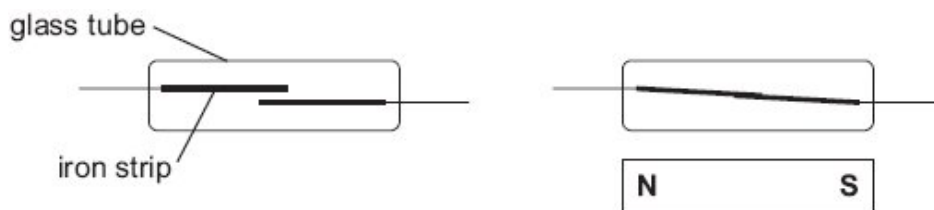
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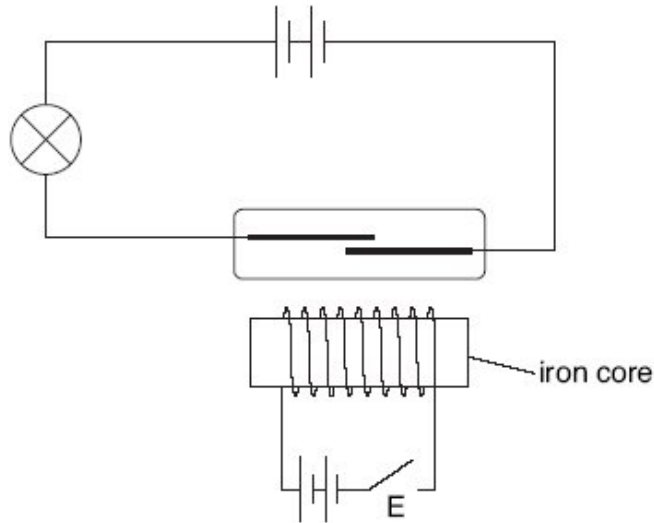
2 marks

Maximum 6 marks

- Q12.** 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.



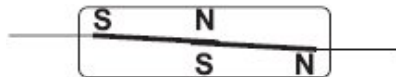
She closed switch E but the electromagnet was **not** strong enough to close the reed switch.

- (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

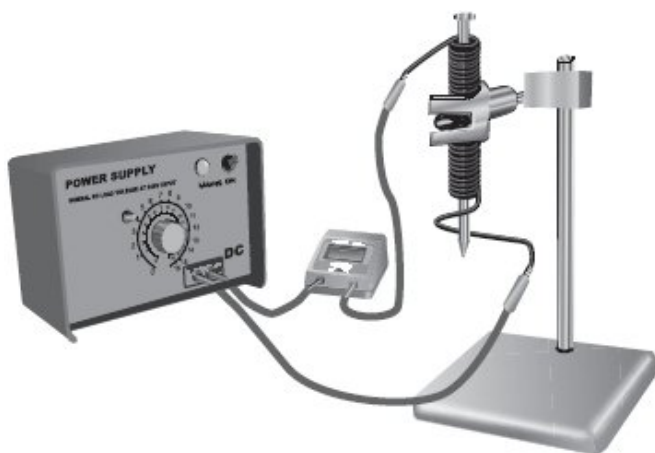
- (ii) She replaced the reed switch with a piece of copper wire.
The current through the bulb increased.

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

- Q13.** Alex makes an electromagnet.
She winds insulated wire around an iron nail.
She connects the wire to a power supply.
She uses the electromagnet to pick up some steel paper-clips.



This is her prediction.

The more turns of wire around the iron nail the stronger the electromagnet becomes.

- (a) (i) Give the **one** factor she should change as she investigates her prediction.

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1 mark

- (ii) Give **one** factor she should keep the same.

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1 mark

- (iii) Describe how she could use the paper-clips to measure the strength of the electromagnet.

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1 mark

- (b) Alex wrote a report of her investigation.

My report.

My results are accurate because I can't see any odd results.





What would an odd result suggest?

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1 mark

- (c) (i) Which size paper-clips would Alex use to make her results more accurate?
Tick the correct box.

			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

1 mark

- (ii) Give a reason for your choice.

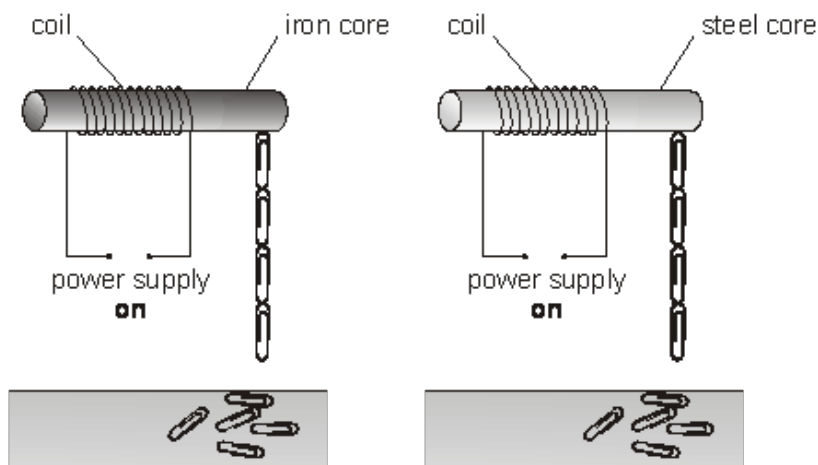
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1 mark
maximum 6 marks

- Q14.** 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.

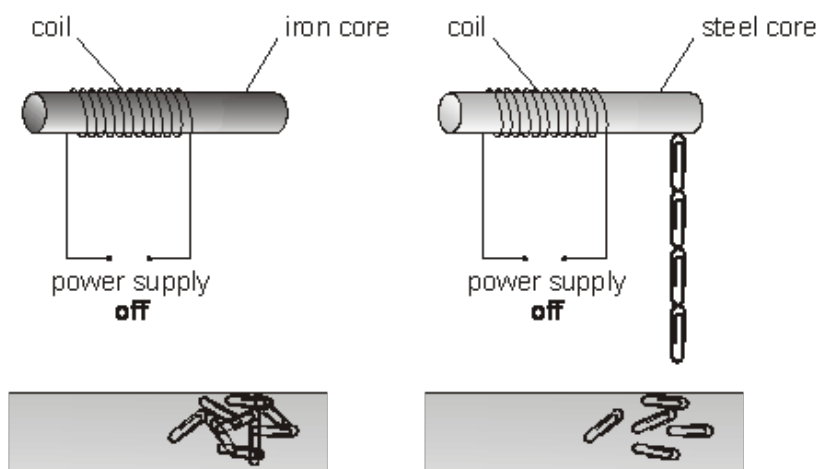


- (a) How can you tell that the strength of both electromagnets is the same?

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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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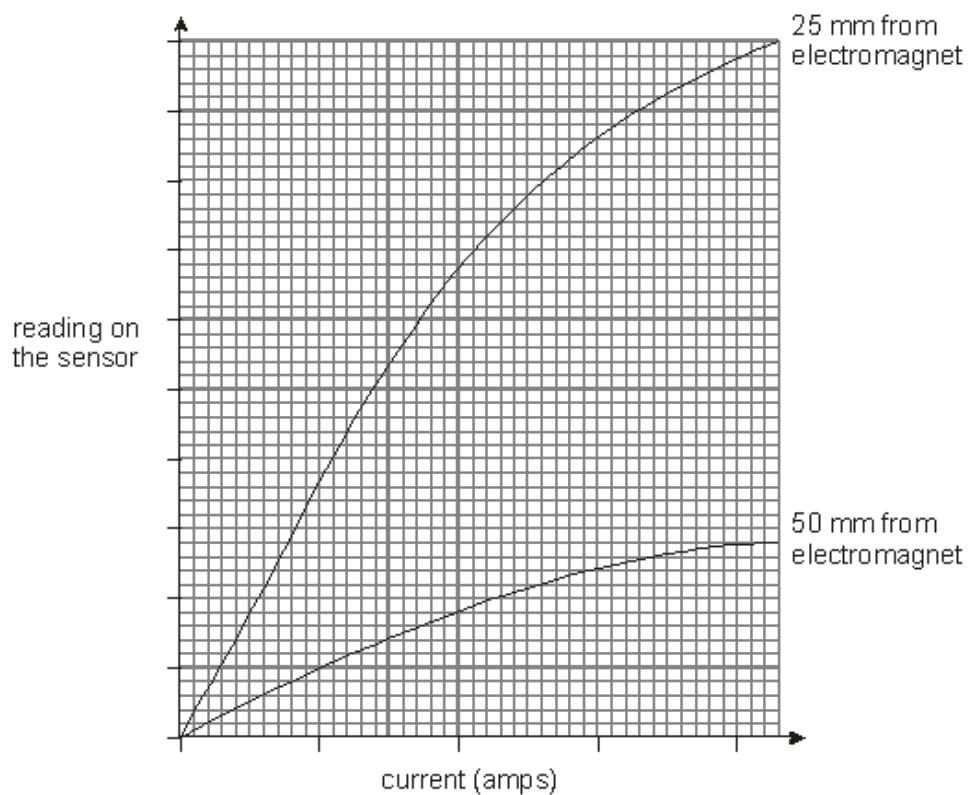
1 mark

(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

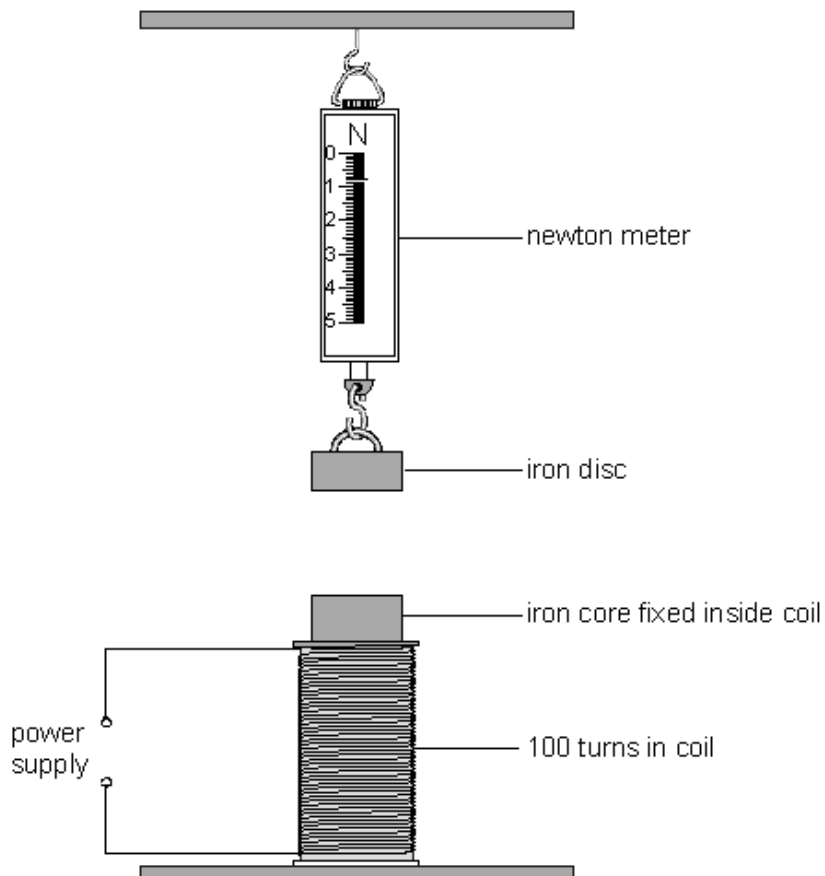
- (iii) What else could David do to an electromagnet to change its strength?

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1 mark
maximum 5 marks

- Q15.** 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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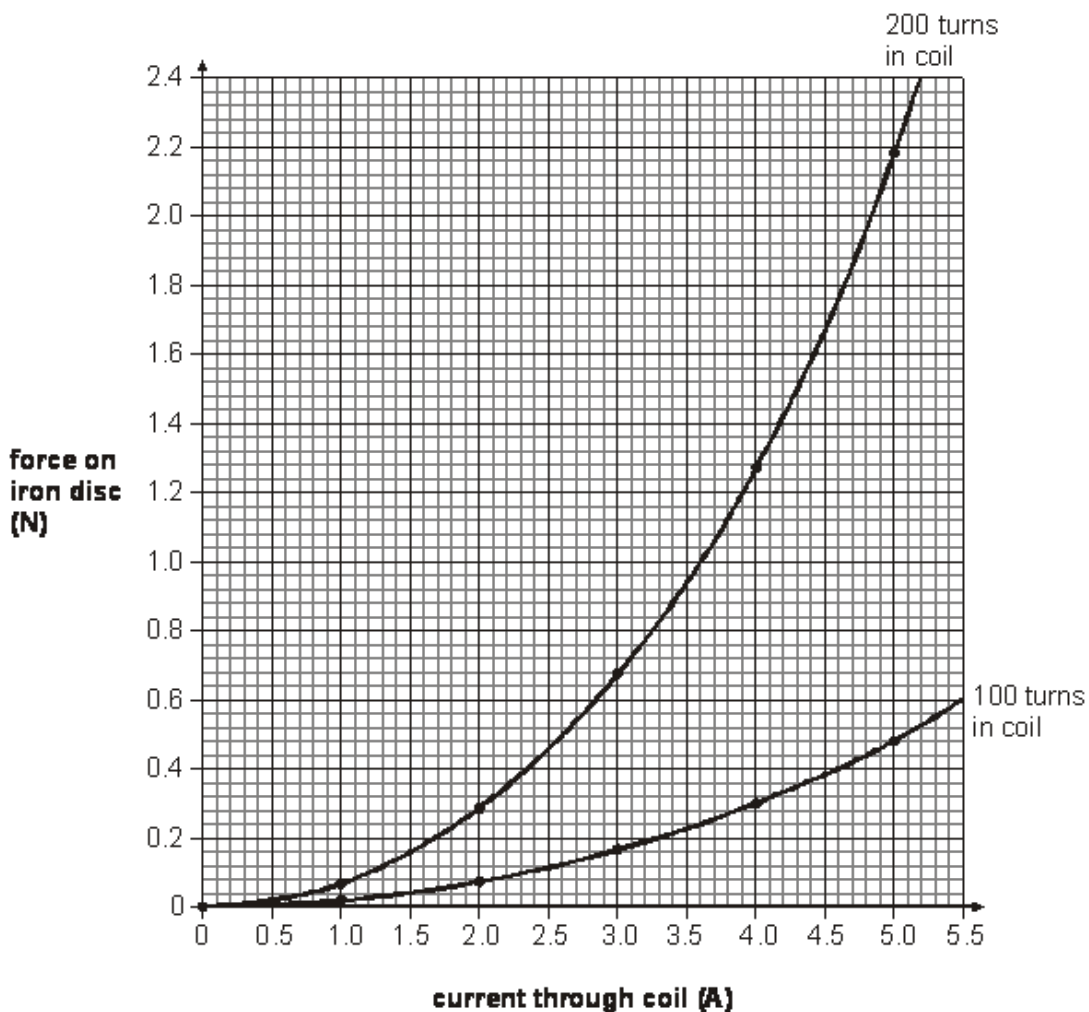
1 mark

- (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.
.....

2 marks
maximum 5 marks

Q16. 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.

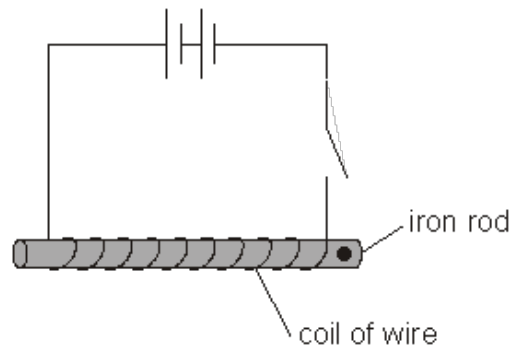
- (a) Hannah uses **only** a bar magnet to identify each rod. She puts each pole of the bar magnet next to the dotted end of each rod.

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

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

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

