1 Photograph **E** shows a rechargeable torch.

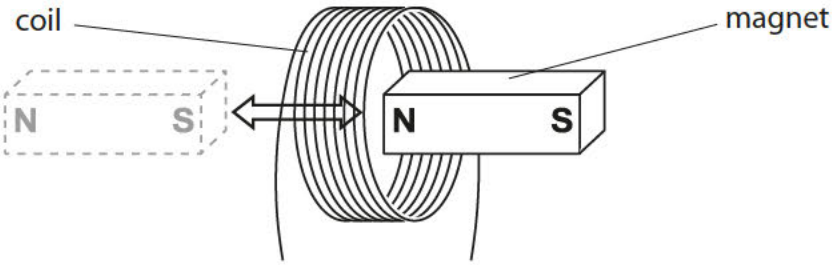


Photograph **E**

(a) When a student shakes the torch, the magnet moves through the coil and back again.

This induces a voltage across the ends of the coil.

The voltage is used to provide current to recharge the battery.



(i) Explain why a voltage is induced.

(2)

.....

.....

.....

.....

.....

(ii) State **one** way to increase this voltage.

(1)

.....

.....

.....

.....

(b) Photograph **F** shows the components inside the torch.



Photograph **F**

The torch uses a light-emitting diode (LED) to provide light.

(i) When the LED is on, it shows that

(1)

☒ **A** the current is alternating

☒ **B** the torch is switched off

☒ **C** there is a current in the circuit

☒ **D** there is a fault in the circuit

(ii) The manufacturer of the torch states, "An LED is a more efficient source of light than a filament lamp."

Explain this statement in terms of energy transfer.

(2)

.....

.....

.....

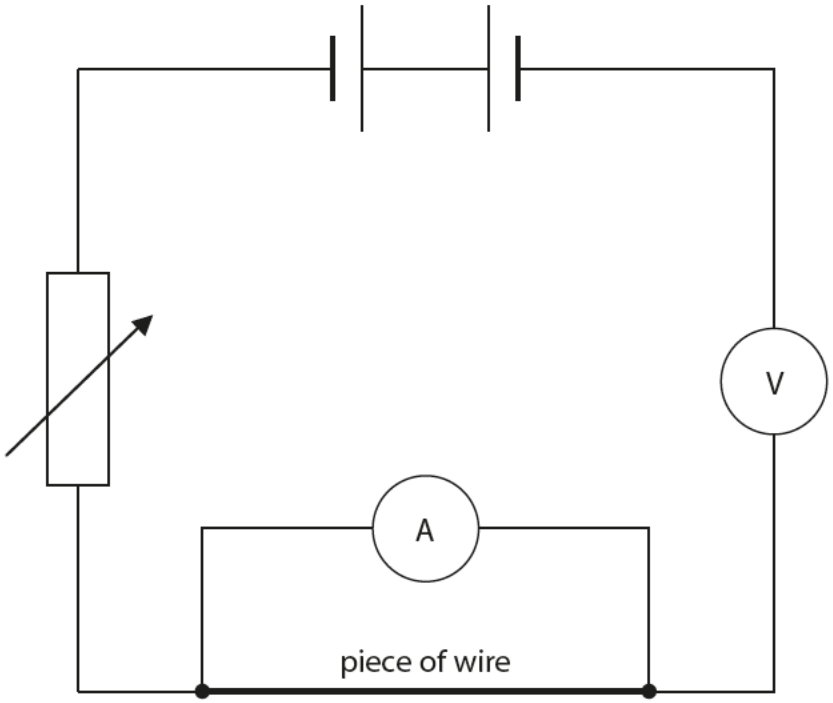
.....

.....

(Total for Question 1 = 6 marks)

2 A student plans to measure the resistance of a piece of wire.

He sets up this circuit and finds that it does not work.



(a) Identify the three errors in the student's circuit.

(3)

1 .....

.....

2 .....

.....

3 .....

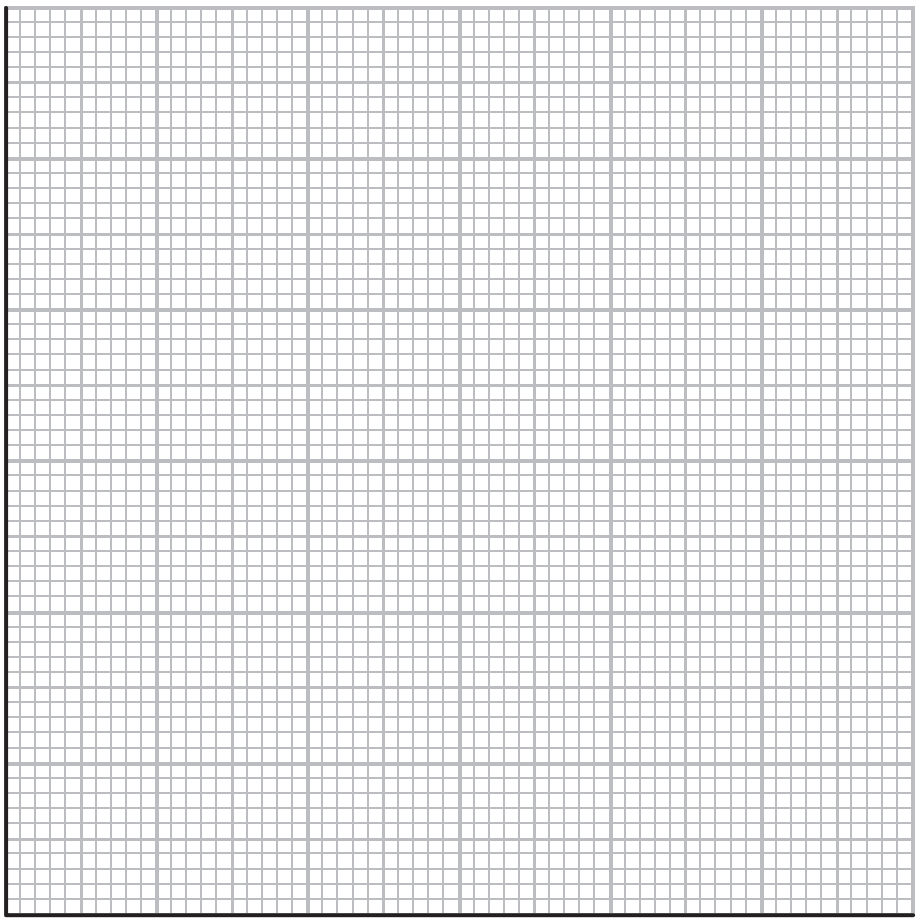
.....

(b) The student uses a correct circuit to obtain these results.

Current in amps	Voltage in volts
0.00	0.0
0.24	1.5
0.71	4.5
0.89	6.0
1.00	7.5
1.10	9.0

(i) Plot a graph to show the relationship between current and voltage for the wire.

(5)



(ii) Find the current when the voltage is 2.5 V.

(1)

.....

(iii) Suggest why the line on the graph curves.

(1)

.....

.....

(iv) Describe what else the student should do to find an accurate value for the resistance of the piece of wire at a constant temperature.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

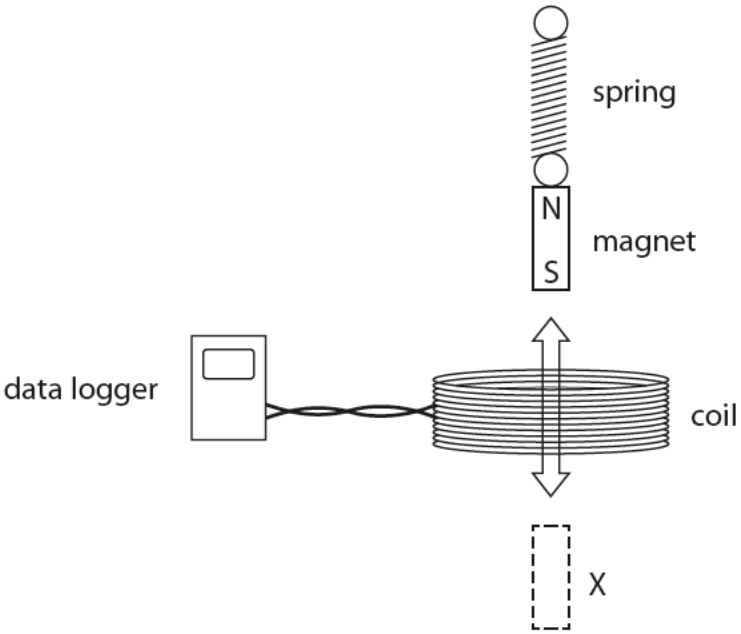
.....

.....

(Total for Question 2 = 14 marks)

3 A student investigates how to produce a voltage.

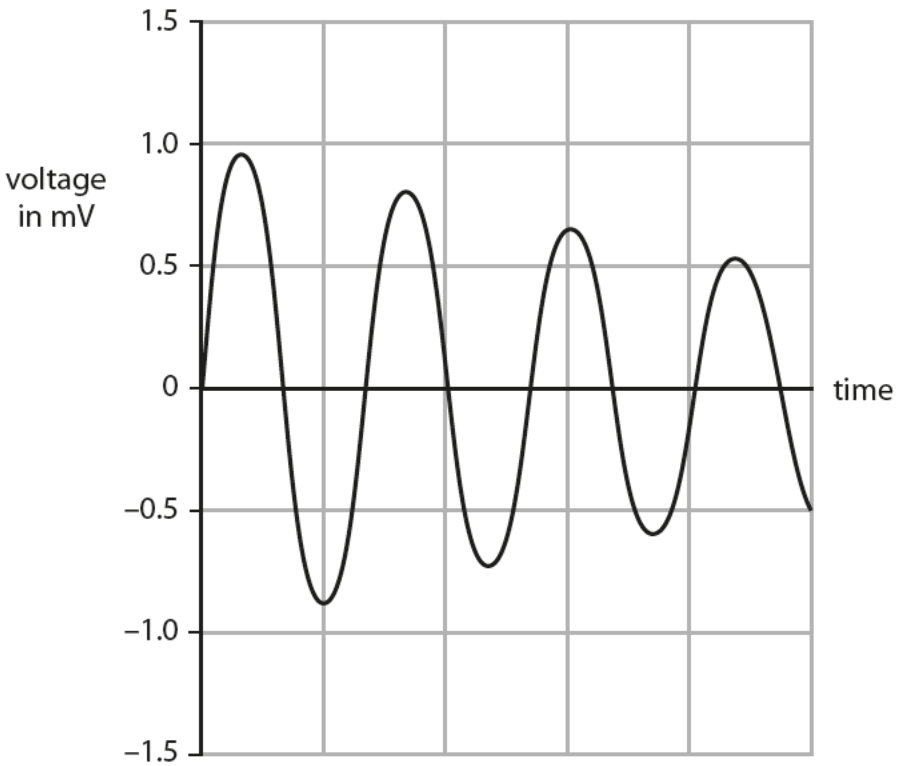
He hangs a magnet from a spring, above a coil that is connected to a data logger.



(a) The student pulls the magnet through the coil to X and then releases it.

The magnet moves up and down through the coil.

The data logger produces this graph of voltage against time.



(i) Explain why the data logger records a varying voltage.

(2)

.....

.....

.....

.....

(ii) Which feature of the graph shows that the voltage is alternating?

(1)

.....

.....

.....

(iii) Suggest why the voltage changes as shown by the graph.

(2)

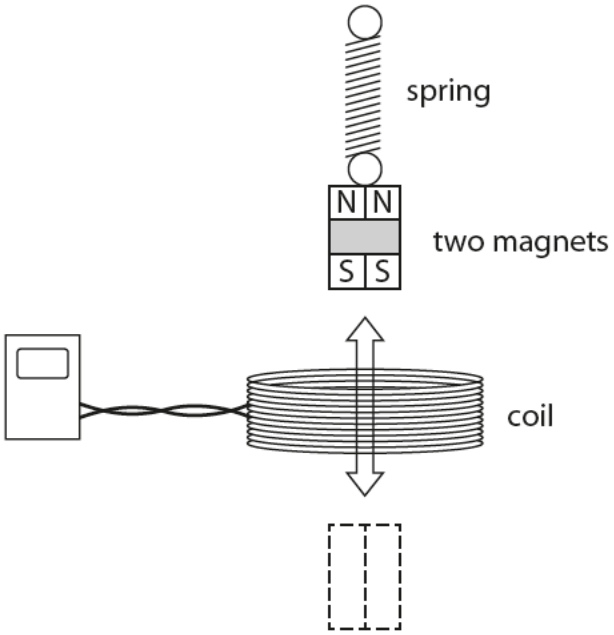
.....

.....

.....

.....

(b) The student repeats the experiment using two magnets taped together.

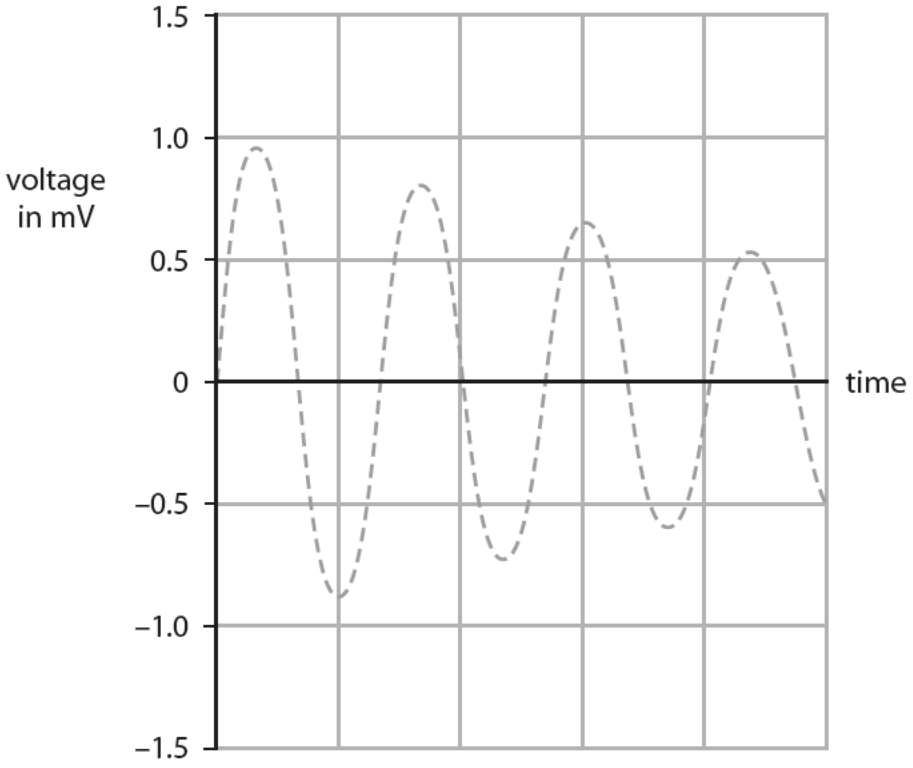


Compared to one magnet, these two magnets take a longer time to move up and down.

The dotted line on the grid shows the original graph for one magnet.

On the same grid, sketch the graph that would be produced using two magnets.

(3)



(Total for Question 3 = 8 marks)

4 A student uses an electric heater to investigate efficiency.

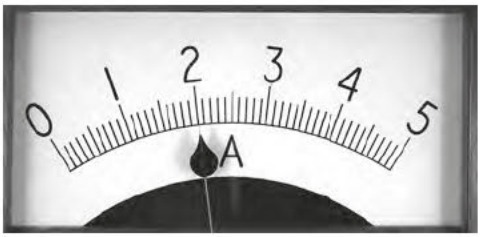
He places the heater in an aluminium block, switches the heater on and measures the temperature of the block each minute for 20 minutes.



(a) The student wants to calculate the electrical energy supplied to the heater.

(i) Complete the table by recording the readings shown on the meters below.

(2)





Current in amps, A	
Voltage in volts, V	

(ii) Show that the energy supplied to the heater in 20 minutes is about 30 000 J.

(3)

(b) The student is told that only 22 000 J are used to raise the temperature of the aluminium block by 25 °C.

(i) State the equation linking efficiency, useful energy output and total energy input.

(1)

(ii) Calculate the efficiency of heating the aluminium block.

(2)

Efficiency .....

(iii) The efficiency of the **heater** will be **higher** than this value.

Suggest why.

(1)

.....

.....

.....

(iv) State **one** way in which the student could increase the efficiency of heating the aluminium block.

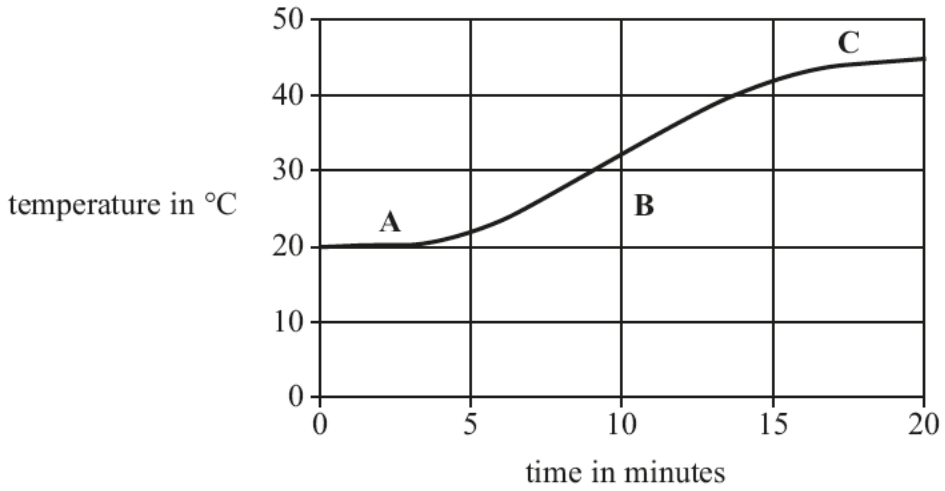
(1)

.....

.....

.....

(c) The graph shows how the temperature of the block increases from 20 °C to 45 °C during the investigation.



Use ideas about heat transfer to help you explain the shape of the graph in

(i) section **A**,

(1)

.....

.....

.....

(ii) section **B**,

(2)

.....

.....

.....

.....

(iii) section **C**.

(2)

.....

.....

.....

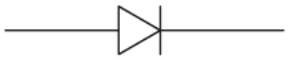
.....

(Total for Question 4 15 marks)

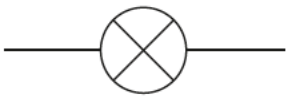
5 (a) The diagram shows some electrical circuit symbols.



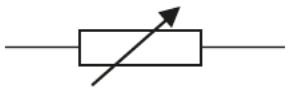
A



B



C



D

(i) Which symbol represents a switch?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(ii) Which symbol represents a diode?

(1)

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) A hairdryer connected to the mains supply takes a current of 5.5 A.

(i) Which of these fuses should be used with the hairdryer?

(1)

- ☒ **A** 3 A
- ☒ **B** 5 A
- ☒ **C** 7 A
- ☒ **D** 13 A

(ii) Expla our answer.

(1)

.....

.....

.....

(iii) The hairdryer has a plastic case so there is no need for an earth wire connection in the plug.

Explain why the hairdryer is still safe to use.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 6 marks)