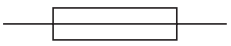
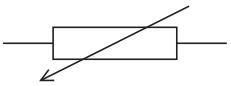
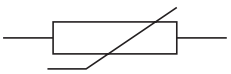
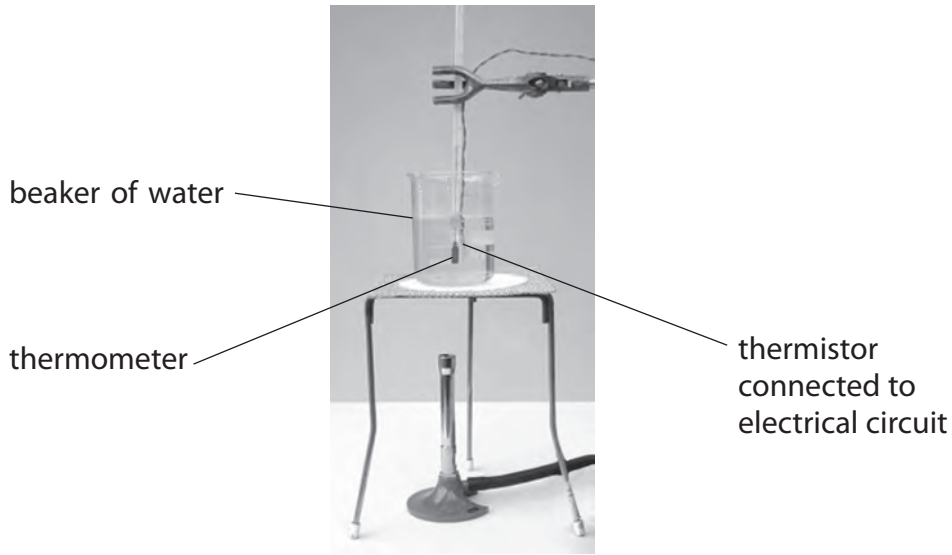
1 A student investigates the resistance of a thermistor.

(a) Which of these is the correct symbol for a thermistor

(1)

☒	**A**	
☒	**B**	
☒	**C**	
☒	**D**	

(b) The student uses this apparatus to investigate how the resistance of a thermistor changes with temperature.



(i) Explain why the student places the thermistor in a beaker of water.

(2)

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(ii) The student also uses a voltmeter and an ammeter.

How should the voltmeter and the ammeter be connected in his circuit?

(1)

	Voltmeter	Ammeter
☒ **A**	in parallel across the power supply	in parallel across the thermistor
☒ **B**	in parallel across the thermistor	in series with the thermistor
☒ **C**	in series with the power supply	in series with the thermistor
☒ **D**	in series with the thermistor	in parallel across the thermistor

(c) The table shows the student's results.

Temperature in °C	Resistance in Ω
0	10 000
10	7 060
20	5 000
40	2 670
60	2 350
80	1 080
100	609

(i) Plot a graph of these results on the grid.

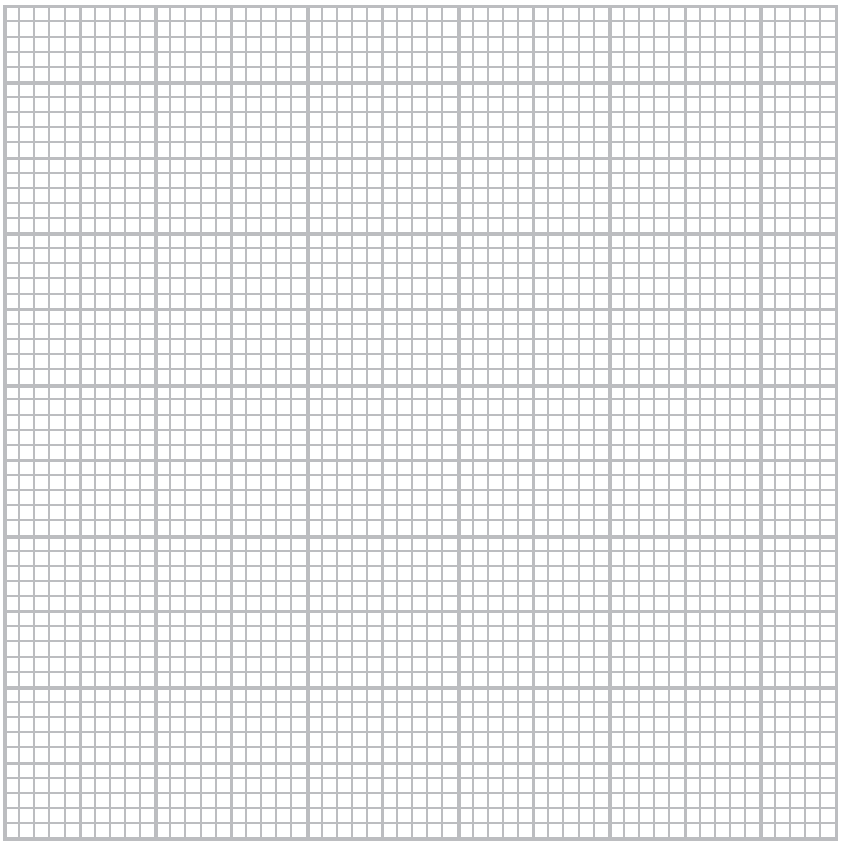
(4)

(ii) Circle the anomalous point on the graph.

(1)

(iii) Draw a curve of best fit.

(1)



(d) (i) Why is the maximum temperature in the student's investigation limited to 100 °C?

(1)

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(ii) Suggest how the student obtains readings below room temperature.

(1)

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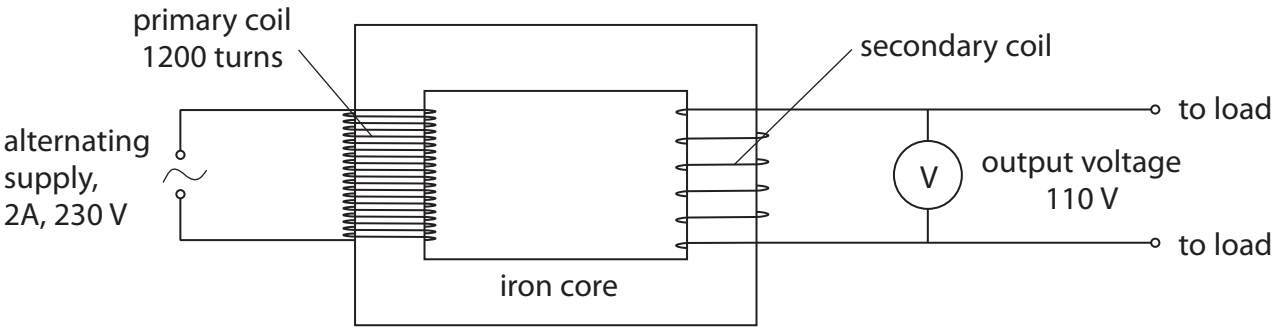
(Total for Question 1 =12 marks)

2 The diagram shows a transformer that is 100% efficient.



(a) (i) State the equation linking input power and output power for the transformer.

(1)

(ii) Calculate the output current of the transformer.

(2)

output current = ... A

(b) (i) State the equation linking input voltage, output voltage and turns ratio for the transformer.

(1)

(ii) Calculate the number of turns on the secondary coil of the transformer.

(2)

number of turns = ...

(c) Explain how a transformer works.

In your answer, you should include the reasons for using

- two coils
- an iron core
- an alternating supply

(5)

(Total for Question 2 = 11 marks)

3 A soldering iron is a tool used when joining electronic components in a circuit.

It has an electric heater.

(a) Soldering iron A operates when connected to the mains supply.

Soldering iron A

Soldering iron A is labelled 230 V, 30 W.

(i) What does **30 W** tell you about the energy transfer in the soldering iron?

(2)

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(ii) This soldering iron has an earth connection.

Explain how an earth connection protects the user.

(2)

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(b) Soldering iron B is connected to a low voltage power supply.

Soldering iron B

Soldering iron B is labelled 24 V, 70 W.

A student says:

I think that both soldering irons need a 3 A fuse.

(i) Use information from the soldering iron labels to evaluate this statement.

(3)

(ii) There is a step-down transformer in the power supply for soldering iron B.

Describe the structure of a step-down transformer.

You may draw a labelled diagram to help your answer.

(3)

(Total for Question 3 = 10 marks)

4 A student has some LEDs connected in a circuit. They emit light of different colours.

(a) (i) The different colours of light are waves which must have

(1)

☒ **A** the same amplitude in free space

☒ **B** the same frequency in free space

☒ **C** the same speed in free space

☒ **D** the same wavelength in free space

(ii) When an LED is on, it shows that

(1)

☒ **A** there must be alternating current in the circuit

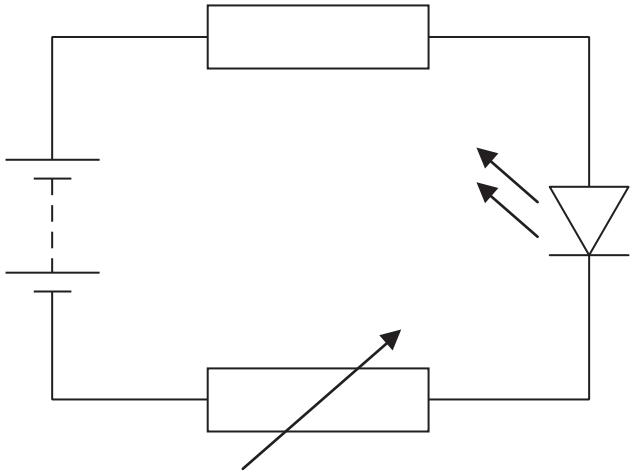
☒ **B** there must be a current in the circuit

☒ **C** there is a fault in the LED

☒ **D** a fuse has blown

(b) An LED needs a minimum voltage to make it emit light.

The student investigates this minimum voltage using the circuit shown.



(i) The student uses a voltmeter to measure the voltage across the LED.

Add this voltmeter to the circuit diagram.

(2)

(ii) The student gradually increases the voltage across the LED and records the minimum voltage at which the LED emits light.

The results for some different LEDs are shown in the table.

Colour of light from LED	Minimum voltage in V
Red	1.7
Blue	3.6
Yellow	2.1
Orange	2.0
Green	3.0

Display the results of the student's investigation on the grid.

(4)

(iii) The student concludes:

The minimum voltage depends on the wavelength of the light emitted.

Evaluate the student's conclusion.

(2)

(Total for Question 4 = 10 marks)

5 This question is about static electricity.

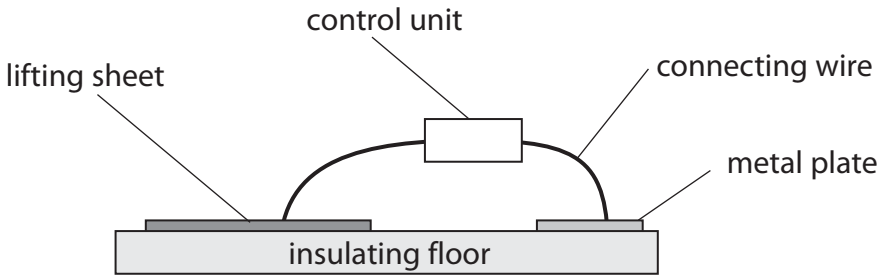
(a) Which of these materials is an electrical conductor?

(1)

- ☒ **A** paper
- ☒ **B** plastic
- ☒ **C** silver
- ☒ **D** wood

(b) A forensic scientist uses an electrostatic dust print lifter (EDPL) to take impressions of footprints.

The diagram shows a simplified EDPL and a description of how it works.



This is how it works

A lifting sheet is placed over the footprint.

The metal plate is placed near it.

The control unit applies a voltage of 10 kV between the lifting sheet and the metal plate.

The lifting sheet becomes negatively charged and the metal plate becomes positively charged.

A dust print forms on the lower surface of the lifting sheet.

Use the idea of charge movement to explain how the lifting sheet becomes negatively charged and the metal plate becomes positively charged.

(2)

(c) The photograph shows a typical dust print on a lifting sheet.

Suggest why dust particles are lifted off the floor on to the lifting sheet.

(2)

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(d) This photograph shows a charged polythene rod placed next to a stream of water flowing from a tap.

Suggest why the water is deflected.

(2)

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(Total for Question 5 = 7 marks)

6 A washing machine has an electric motor and an electric heater.

The resistance of the heater is 22 Ω.

The mains voltage is 230 V.

(a) (i) State the equation linking voltage, current and resistance.

(1)

(ii) Show that the current in the heater is about 10 A when it is working.

(2)

(b) The washing machine is fitted with a fuse rated at 13 A.

(i) Explain why the washing machine is fitted with a fuse.

(2)

(ii) When the motor is working, the current in it is 1.74 A.

Explain why it would **not** be sensible to replace the 13 A fuse with a 2 A fuse.

(2)

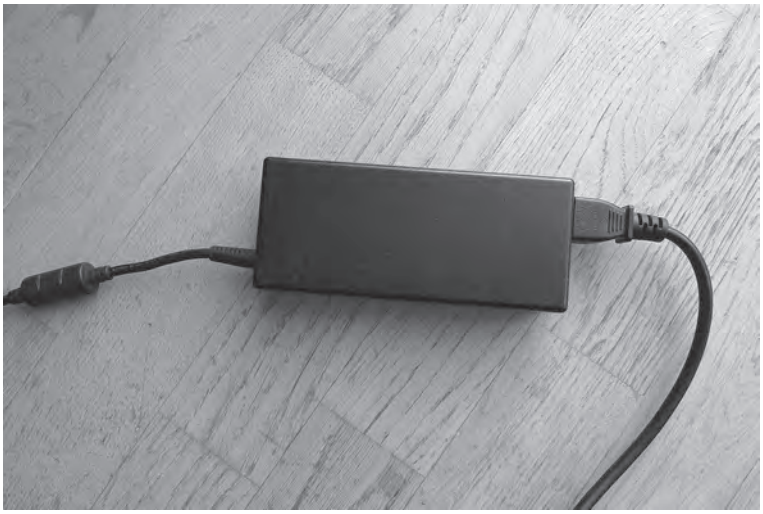
(Total for Question 6 = 7 marks)

7 Explain how the transmission of electrical power is made more efficient by using step-up and step-down transformers.

(5)

(Total for Question 7 = 5 marks)

8 A laptop battery charger contains a step-down transformer.



(a) The number of turns on the primary coil of a step-down transformer is

(1)

- ☒ **A** the same as the number of secondary turns
- ☒ **B** more than the number of secondary turns
- ☒ **C** less than the number of secondary turns
- ☒ **D** zero

(b) This transformer is designed to reduce the voltage from 230 V to 12 V.

The primary current is 0.25 A.

(i) State the equation linking primary voltage, primary current, secondary voltage and secondary current for a transformer.

(1)

(ii) Calculate the secondary current, assuming that the transformer is 100% efficient.

(2)

Secondary current ..... A

(c) A student notices that the charger becomes warm when it is working.

Suggest how this will affect the output of the transformer.

(2)

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(Total for Question 8 6 marks)