Name: _____

Electricity

Questions

Date:

Time:

Total marks available:

Total marks achieved: _____

Questions

Q1.

A volt can be defined as a

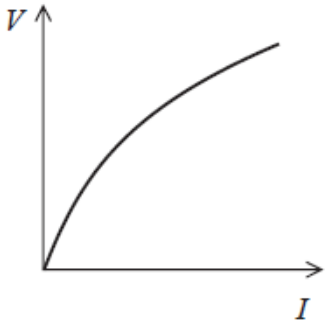
(1)

- ☒ **A** coulomb per joule.
- ☒ **B** coulomb per second.
- ☒ **C** joule per coulomb.
- ☒ **D** joule per second.

(Total for question = 1 mark)

Q2.

The graph shows how potential difference *V* varies with current *I* for a circuit component.



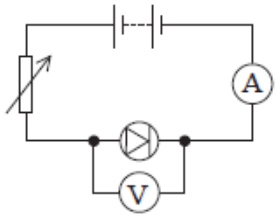
Which of the following could be the circuit component?

- ☒ **A** copper wire
- ☒ **B** filament lamp
- ☒ **C** fixed resistor
- ☒ **D** thermistor

(Total for question = 1 mark)

Q3.

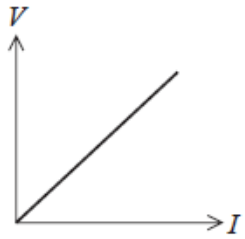
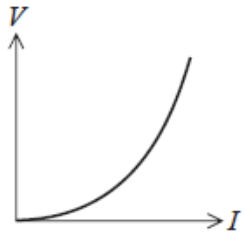
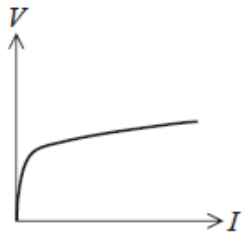
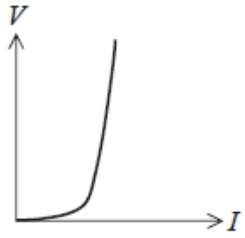
A student carried out an experiment to investigate the current-potential difference characteristics of a diode using the circuit below.



He plotted the graph of potential difference *V* on the *y*-axis against the corresponding current *I* on the *x*-axis.

Which graph would be obtained by the student?

(1)

☒ **A**	
☒ **B**	
☒ **C**	
☒ **D**	

(Total for question = 1 mark)

Q4.

Which of the following expresses the volt in SI base units?

☒ **A** kg m^2 s^{-2} C^{-1}

☒ **B** kg m^2 s^{-3} C

☒ **C** kg m^2 s A^{-1}

☒ **D** kg m^2 s^{-3} A^{-1}

(Total for question = 1 mark)

Q5.

An ampere can be expressed as

☒ **A** C s^{-1}

☒ **B** J C^{-1}

☒ **C** V W^{-1}

☒ **D** V Ω

(Total for question = 1 marks)

Q6.

Which of the following is a correct unit for resistance?

☒ **A** J C^{-1}

☒ **B** V C^{-1} s^{-1}

☒ **C** J C^{-2} s

☒ **D** J C^{-2} s^{-1}

(Total for question = 1 mark)

Q7.

All electrical components have resistance.

In which of the following situations would the resistance of the stated component **not** increase?

☒ **A** Increasing the current through a filament lamp.

☒ **B** Increasing the temperature of a metal wire.

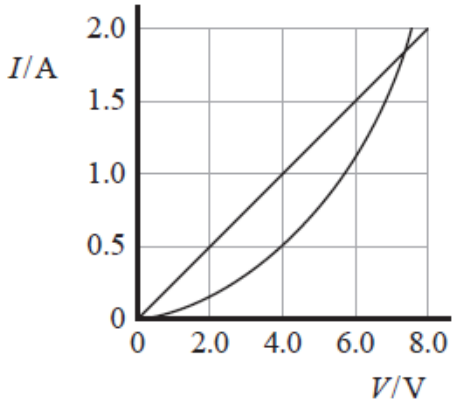
☒ **C** Increasing the temperature of a negative temperature coefficient thermistor.

☒ **D** Reversing the direction of a diode in forward bias in a circuit.

(Total for question = 1 mark)

Q8.

The current-potential difference graphs for a resistor and a thermistor are shown.



The resistor and thermistor are connected in series to a 6 V battery.

What is the current, in amps, in the resistor?

(1)

☒ **A** 0.5

☒ **B** 1.0

☒ **C** 1.5

☒ **D**

D 2.0

(Total for question = 1 mark)

Q9. A current of 0.2 A flows through a lamp for 3 hours.

The total charge passing through the lamp in this time is

- **A** 2160 C
- **B** 600 C
- **C** 36 C
- **D** 0.6 C

(Total for Question = 1 mark)

Q10.

A rechargeable cell stores a maximum energy of 4200 J. The cell has an e.m.f. of 1.5 V and after 2.0 hours use the cell is completely discharged.

Assuming the e.m.f. stays constant, the charge passing through the cell during this time is

- **A** 1400 C
- **B** 2800 C
- **C** 5600 C
- **D** 6300 C

(Total for question = 1 mark)

Q11.

The current in a filament lamp is 250 mA.

How much charge flows through the lamp in 3 minutes?

- ☒ **A** 0.75 C
- ☒ **B** 45 C
- ☒ **C** 750 C
- ☒ **D** 45 000 C

(Total for question = 1 mark)

Q12.

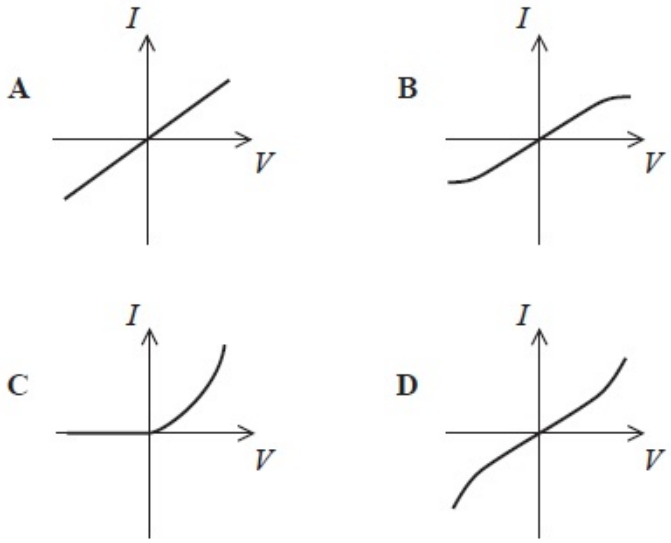
An electric torch uses two 1.5 V cells. The torch bulb is marked 2.4 V, 270 mA.

What is the resistance of the torch bulb?

- ☒ **A** 0.81Ω
- ☒ **B** 0.65Ω
- ☒ **C** 8.9Ω
- ☒ **D** 11Ω

(Total for question = 1 mark)

Q13. Which of the following current – potential difference (*I*–*V*) graphs shows the correct behaviour for a filament bulb?



☒ **A**

☒ **B**

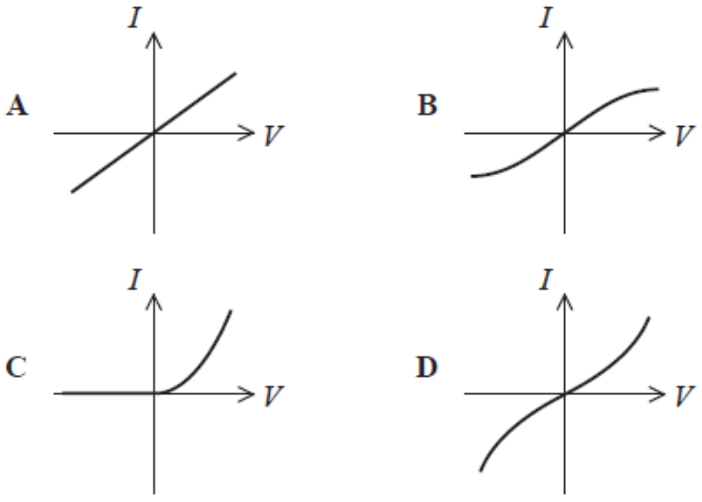
☒ **C**

☒ **D**

(Total for Question = 1 mark)

Q14.

Which of the following current-potential difference (*I*-*V*) graphs correctly shows the behaviour of a diode?



☒ **A**

☒ **B**

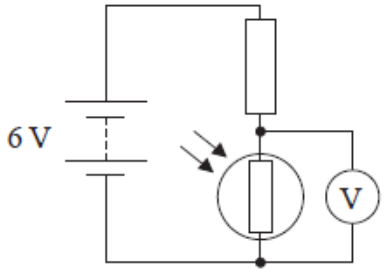
☒ **C**

☒ **D**

(Total for question = 1 mark)

Q15.

A light-dependent resistor (LDR) and resistor are connected in series with a 6V battery as shown. A voltmeter measures the potential difference across the LDR.



In daylight the voltmeter reads 3.0V.

Which reading is most likely if the circuit is now in total darkness?

(1)

☒ **A** a little above 0 V

☒ **B** a little below 3 V

☒ **C** a little above 3 V

☒ **D** a little below 6 V

(Total for question = 1 mark)

Q16.

A student is deriving an equation for the total resistance of resistors in series.

She writes the following steps but does not justify them.

Step 1 $V = V_1 + V_2$
Step 2 *but* $V = IR$
Step 3 *so* $IR = I_1R_1 + I_2R_2$
Step 4 *but* $I = I_1 = I_2$
Step 5 *Therefore* $R = R_1 + R_2$

Which step is justified using conservation of charge?

(1)

☒ **A** Step 1

☒ **B** Step 2

☒ **C** Step 3

☒ **D** Step 4

(Total for question = 1 mark)

Q17.

A light dependent resistor and a negative temperature coefficient thermistor are connected in series.

Which of the following combinations of illumination and temperature will result in the highest combined resistance?

(1)

☒ **A** dark and cold

☒ **B** dark and hot

☒ **C** light and cold

☒ **D** light and hot

(Total for question = 1 mark)

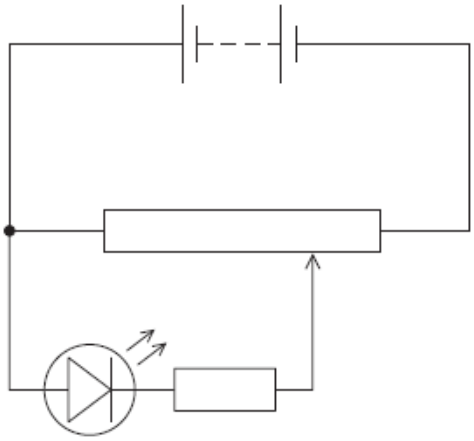
Q18. When a semiconductor has its temperature increased from room temperature, its resistance usually decreases because

- **A** the electrons are moving faster.
- **B** the lattice atoms vibrate with greater amplitude.
- **C** the lattice atoms vibrate with smaller amplitude.
- **D** the number of charge carriers per unit volume increases.

(Total for Question = 1 mark)

Q19.

A student wanted to plot a graph of current against potential difference for a light emitting diode (LED). He used the circuit shown.



Add an ammeter and a voltmeter to the circuit diagram that would enable the data to be collected.

(1)

(Total for question = 1 mark)

Q20.

A student is taking measurements in order to determine the resistance of a component in a circuit. He connects a voltmeter in parallel with the component and an ammeter in series with the component.

Explain why the voltmeter should have a very high resistance.

(2)

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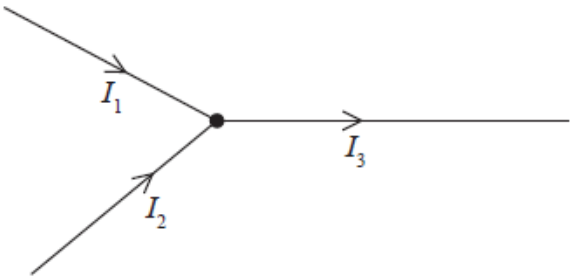
(Total for question = 2 marks)

Q21.

The diagram shows the current in part of an electrical circuit.



State the relationship between I_1, I_2 and I_3 and explain it in terms of charge.

(3)

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(Total for question = 3 marks)

Q22.

A mobile phone is powered by a lithium-ion battery. The information shown is taken from the battery.

3.82 V
6.91 W h

The mobile phone, when purchased, was supplied with a charging plug marked 1 A, 5V. The mobile phone owner lost the original charging plug and replaced it with a charging plug marked 0.5 A, 5 V.

original charging plug
1A, 5 V

replacement charging plug
0.5A, 5 V

By evaluating the information given, discuss the suitability of using the replacement charging plug for this mobile phone. Include references to possible benefits, disadvantages and risks associated with using the replacement charging plug.

(4)

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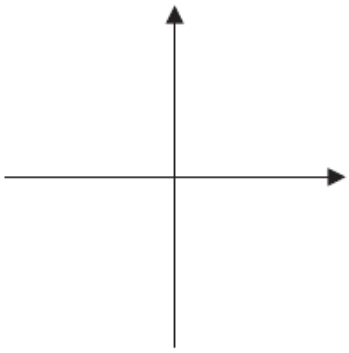
(Total for question = 4 marks)

Q23.

(a) Sketch a graph to show how current varies with potential difference for a filament lamp.



(2)

(b) The temperature of a filament lamp increases as the current through it increases.

Explain this in terms of the structure of a metal.

(3)

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(Total for question = 5 marks)

Q24.

A mobile phone is powered by a lithium-ion battery. The information shown is taken from the battery.

3.82 V
6.91 W h

(i) The watt-hour (W h) is an alternative unit for energy.

Show that the maximum energy that can be stored by the battery is about 25kJ. 1 W h = 3600J

(1)

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(ii) Calculate the maximum charge that the battery can provide.

(2)

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Maximum charge = ...

(iii) The mobile phone 'runs out of charge'.

Calculate the minimum time taken, in hours, for the battery to fully recharge.

charging current = 0.90 A

(3)

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Minimum time = ... hours

(Total for question = 6 marks)

Q25. A rechargeable AA cell is labelled 2.0 Ah (ampere hours), 1.2 V.

(a) Show that Ah is a unit of charge.

(2)

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(b) When charging the cell, the current is 0.19 A and the potential difference is 1.5 V for 10 hours.

Calculate the electrical energy supplied while the cell is being charged.

(2)

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Electrical energy supplied = ...

(c) The maximum charge that can be delivered from a fully charged cell is 7200 C.

Calculate the maximum energy which could be transferred by the cell if the output potential difference remained constant at 1.2 V.

(2)

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Maximum energy = ...

(d) Calculate the efficiency of the charging process.

(3)

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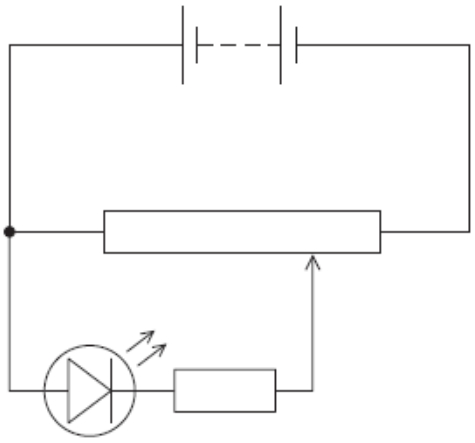
Efficiency = ...

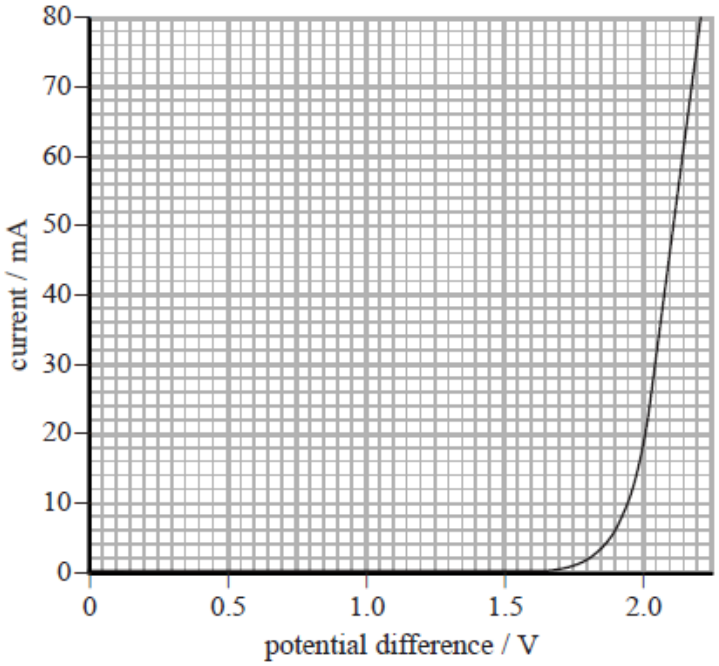
(Total for Question = 8 marks)

Q26.

A student wanted to plot a graph of current against potential difference for a light emitting diode (LED). He used the circuit shown.



The graph of current against potential difference obtained by the student is shown.



(i) The student wrote the following conclusion.

"The graph shows that in general the LED is not an ohmic conductor. However, for potential differences greater than +2 V, Ohm's law is obeyed since the graph is linear in this region."

Criticise the student's conclusion.

(2)

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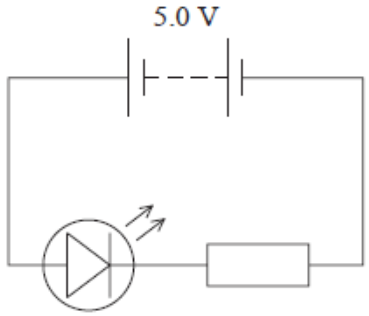
(ii) The student used the LED with a 5.0 V power supply as shown in the circuit.



To be lit to normal brightness the current through the LED must be 18 mA.

Calculate the resistance of the resistor needed in the circuit.

(4)

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Resistance = ...

(Total for question = 6 marks)

Q27.

The instruction booklet for an electric garden shredder includes the following advice.

When using an extension cable, the following dimensions should be observed:

Cross-sectional area of conductor / mm^2	Maximum cable length / m
1.00	40
1.50	60
2.50	100

(a) Describe the relationship between area and length in the table.

(1)

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(b) The cable for the shredder contains two conductors in series, the live wire and the neutral wire. A cable of length 40 m has a total conductor length of 80 m.

(i) Show that the resistance of a copper conductor of length 80 m and cross-sectional area 1.00 mm^2 is about 1.3 Ω.

resistivity of copper = 1.68×10^{-8} Ω m

(2)

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(ii) When in use the current for the shredder is 11 A.
Calculate the rate of energy dissipation by the 40 m, 1.00 mm^2 cable when it is used with the shredder.

(2)

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Rate of energy dissipation = ...

(iii) Calculate the total potential difference across the conductors in the 40 m cable when it is used with the shredder.

(2)

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Potential difference = ...

(c) Suggest why the advice in the instruction booklet is included.

(2)

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(Total for question = 9 marks)

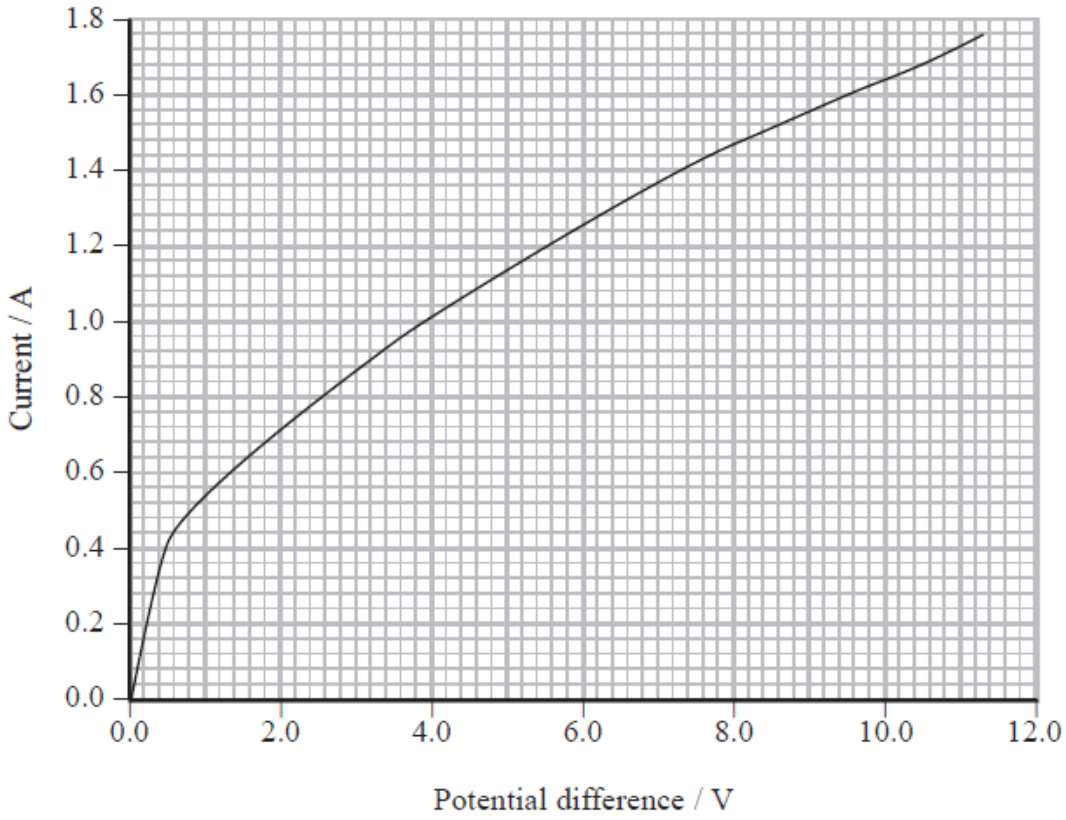
Q28.

A student investigates how the current through a filament light bulb varies with the potential difference across it.

(a) Draw a diagram of a circuit the student could use to obtain suitable measurements for a range of potential difference from 0 V to 12 V.

(3)

(b) The student's results are shown on the graph.



The student decides to draw a tangent to the curve at a potential difference of 6 V and use the gradient of the tangent to determine the resistance of the bulb.

(i) Explain why this is **not** a correct method to determine the resistance.

(2)

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(ii) Calculate the resistance of the bulb when the potential difference across it is 6 V.

(2)

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Resistance = ...

*(c) Describe and explain the change in the resistance of the bulb as the potential difference across it is increased.

(4)

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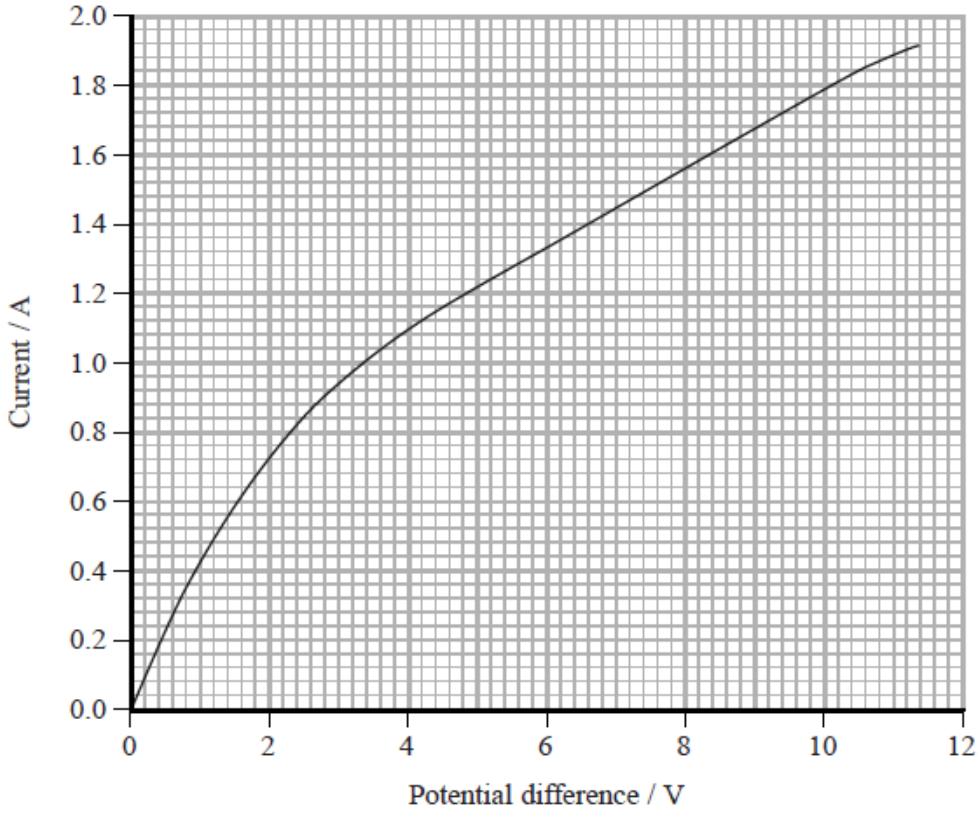
(Total for question = 11 marks)

Q29.

The graph shows how the current through a filament bulb varies with the potential difference across the bulb.



(a) Determine the resistance of the filament bulb when the potential difference is 7.0 V.

(2)

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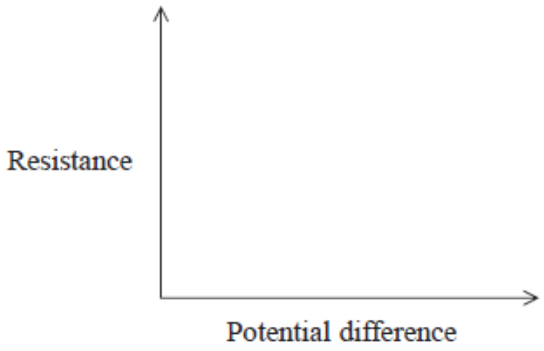
Resistance = ...

(b) Sketch a graph of resistance against potential difference for the filament bulb over the range 0 V to 7 V.

(3)



* (c) Explain the variation of resistance with potential difference for the filament bulb in terms of particle behaviour.

(6)

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(Total for question = 11 marks)