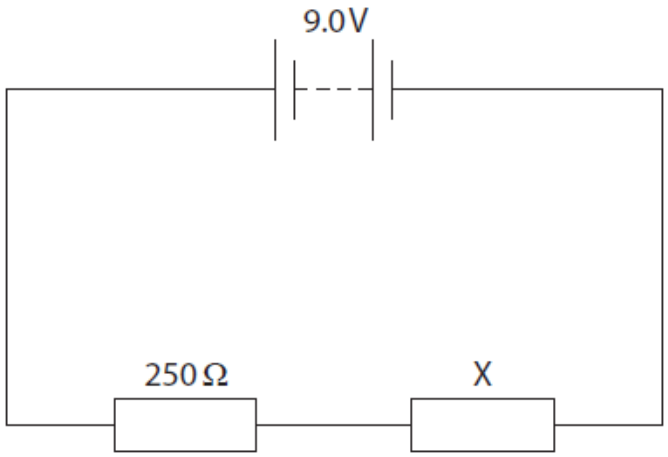
Questions

Q1.

The circuit diagram shows a 9.0 V battery connected in series with a 250 Ω resistor and another resistor, X.



(a) Draw a voltmeter on the circuit diagram to measure the voltage of resistor X.

(2)

(b) The current in the circuit is 0.012 A.

Calculate the resistance of resistor X.

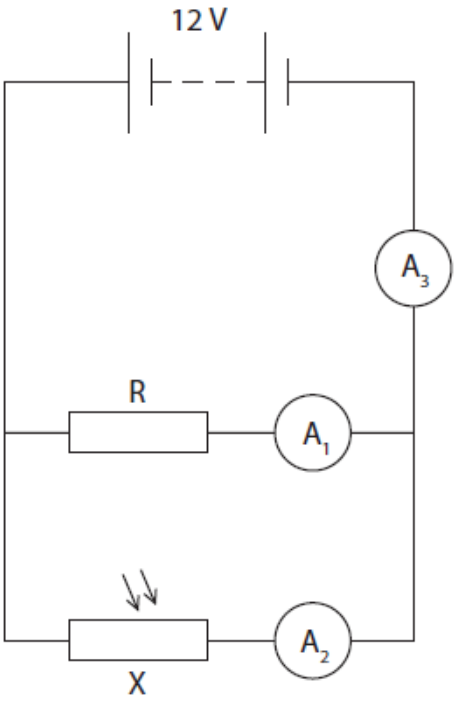
(4)

resistance = ... Ω

(Total for question = 6 marks)

Q2.

A 12 V battery is connected to a component, X, and a fixed resistor, R, as shown



(a) (i) State the name of component X.

(1)

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(ii) Draw a voltmeter on the circuit diagram connected to show the voltage of component X.

(2)

(b) The voltage across component X is 12 V.

The resistor R has a value of 840 Ω.

Show that the current in ammeter A_1 is approximately 0.01 A.

Use the equation

$$\text{voltage} = \text{current} \times \text{resistance}$$

(2)

(c) When the circuit is placed in daylight, the current in A_2 is 0.011 A.

(i) Calculate the value of the current through A_3.

(1)

current = ... A

(ii) Explain what happens to the current through A_3 when the circuit is placed in a darkened room.

(2)

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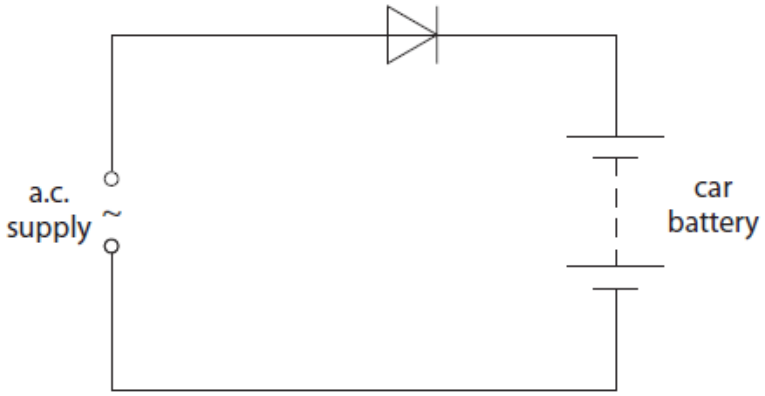
(Total for question = 8 marks)

Q3.

The circuit shows a car battery charging from an alternating current (a.c.) supply.



(a) Sketch a graph to show what is meant by a.c.

(2)

(b) State the reason why the circuit contains a diode.

(1)

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(c) The 12 V car battery is connected to two identical filament lamps so that the voltage across each lamp is 6.0 V.

(i) Draw the circuit diagram.

(2)

(ii) State the equation relating power, current and voltage.

(1)

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(iii) The power of each lamp is 330 mW.

Calculate the current in a lamp.

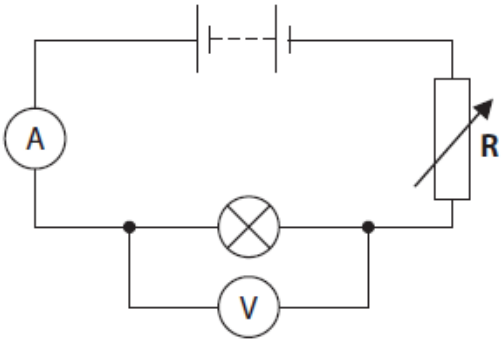
(2)

current = ... A

(Total for question = 8 marks)

Q4.

A student investigates how the resistance of a lamp varies as the current is changed.
She sets up the circuit shown.



(a) Give a reason why component **R** is included in the circuit.

(1)

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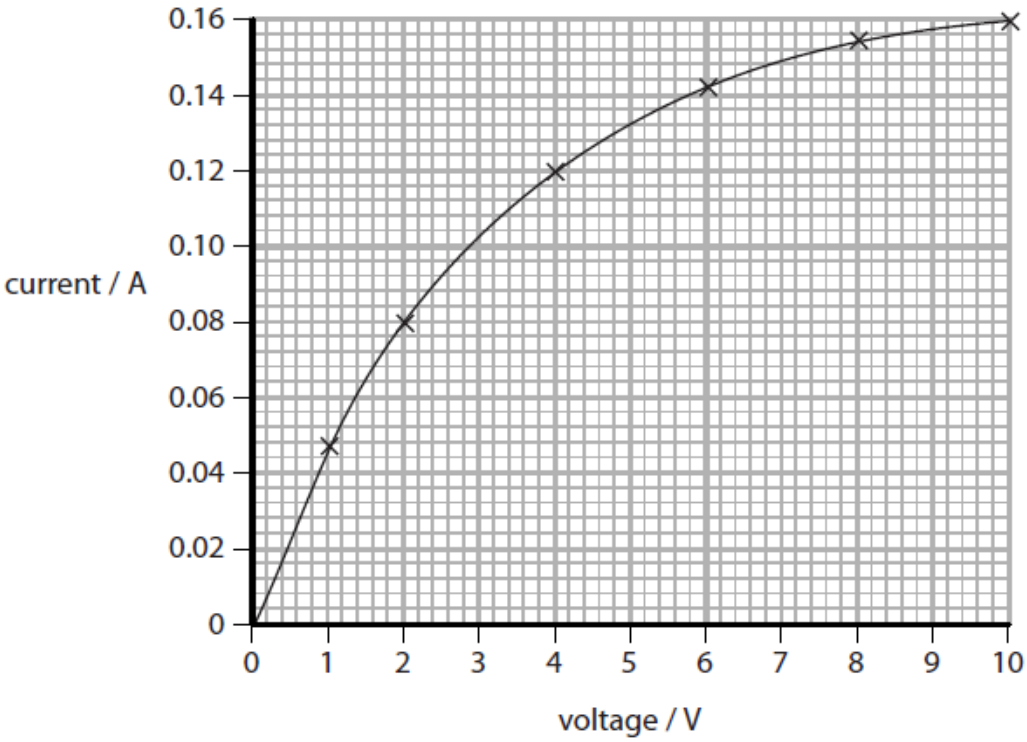
(b) The student draws a graph of his results.



(i) Describe how the current in the lamp changes as the voltage changes.

Use data from the graph to support your answer.

(3)

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(ii) State the relationship between voltage, current and resistance.

(1)

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(iii) Calculate the resistance of the lamp when the voltage is 2.5 V.

(3)

resistance = ... Ω

(c) State what happens to the resistance of a lamp when the current increases.

(1)

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(Total for question = 9 marks)

Q5.

This is a question about alpha particles.

(a) Describe the nature of an alpha particle.

(1)

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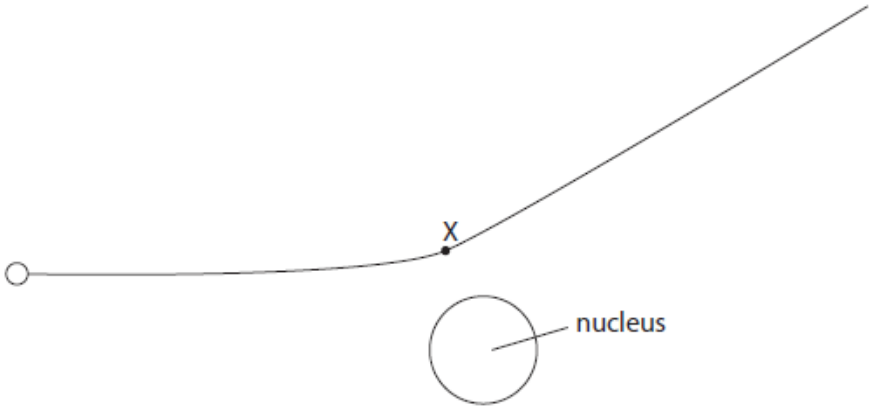
(b) The diagram shows the path of an alpha particle as it passes close to a nucleus.



(i) Draw an arrow from point X to show the force on the alpha particle due to the nucleus.

Label this force Y.

(2)

(ii) Draw an arrow to show the force on the nucleus due to the alpha particle.

Label this force Z.

(2)

(iii) Explain how the path of the alpha particle shows whether the nucleus is positive, negative or neutral.

(3)

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(c) The alpha particle experiences a resultant force of 3.6 N and has a mass of 6.6×10^{-27} kg.

Calculate the acceleration of the alpha particle.

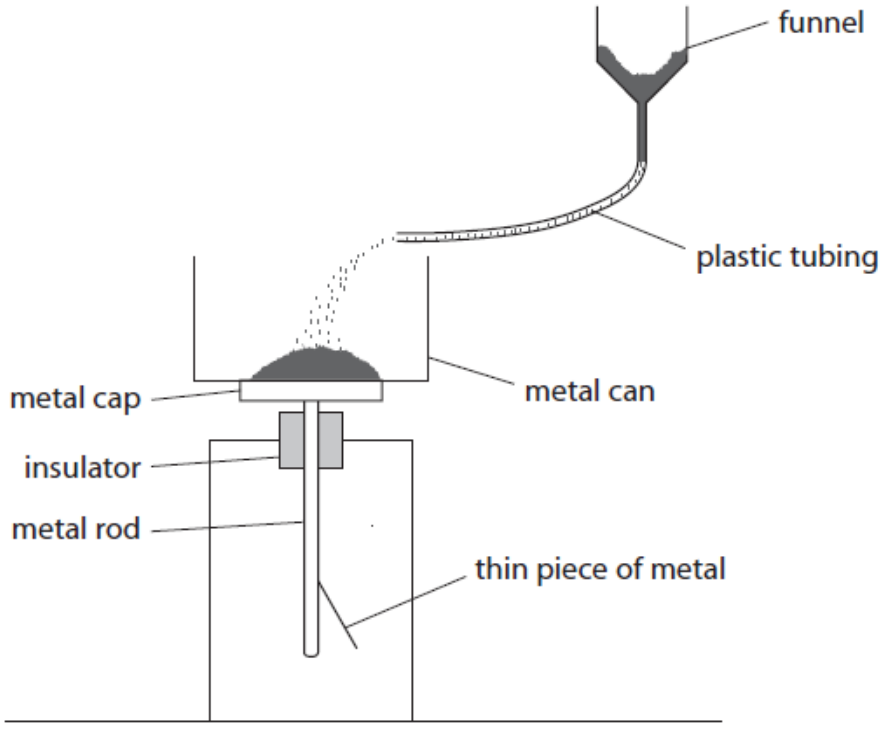
(3)

acceleration = ... m/s^2

(Total for question = 11 marks)

Q6.

A student uses this apparatus to demonstrate the effect of electric charge.



He pours some fine powder into a funnel.

The fine powder moves through a length of plastic tubing and falls into a metal can.

The metal can rests on a metal cap.

The metal cap is connected to a thin piece of metal via a metal rod.

When the powder lands in the can, the thin piece of metal moves away from the metal rod.

(a) Explain why the thin piece of metal moves away from the metal rod.

(4)

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(b) A coulombmeter measures electric charge.

The student connects a coulombmeter to the metal can.

When all the powder has landed in the can, the coulombmeter shows a reading of -9.4×10^{-9} C.

(i) Which statement is true for the metal can?

(1)

☒ **A** it gains negatively charged electrons

☒ **B** it loses negatively charged electrons

☒ **C** it gains positively charged electrons

☒ **D** it loses positively charged electrons

(ii) State the formula linking charge, current and time.

(1)

(iii) It takes a time of 12 s from when the powder starts landing in the metal can until all the powder has landed in the can.

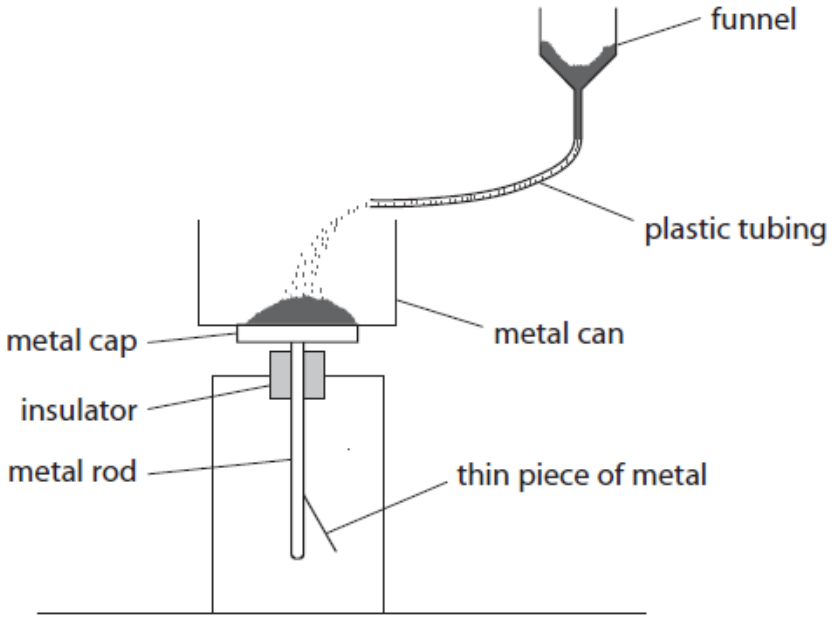
Calculate the mean charging current.

(3)

current = ... A

(c) The student suggests that this demonstration is similar to refuelling an aircraft.

The powder represents the fuel and the metal can represents the fuel tank in the aircraft.



Explain how the student should modify this apparatus to demonstrate how to minimise the dangers when refuelling an aircraft.

You may add to the diagram to help your answer.

(3)

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(Total for question = 12 marks)

Q7.

This question is about electric circuits.

(a) Which quantity is defined as the rate of flow of charge?

(1)

☒ **A** current

☒ **B** power

☒ **C** resistance

☒ **D** voltage

(b) Which quantity is defined as the energy transferred per unit charge passed?

(1)

☒ **A** current

☒ **B** power

☒ **C** resistance

☒ **D** voltage

(c) Diagram 1 shows an electric circuit with two resistors, R and S.

Some of the values of the current are also shown.

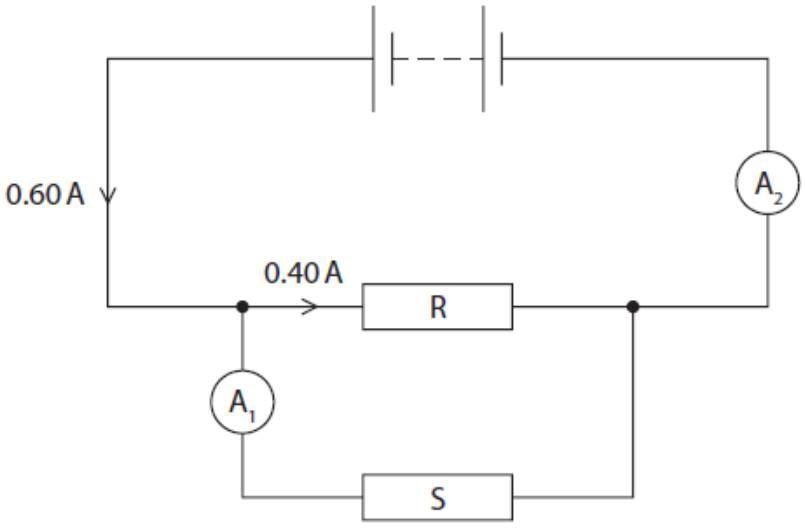

Diagram 1

(i) On Diagram 1, draw a voltmeter to measure the voltage of resistor S.

(2)

(ii) Deduce the readings on the ammeters.

(2)

current measured by A_1 = ... A

current measured by A_2 = ... A

(iii) Resistor R has a resistance of 11 Ω.

Calculate the voltage across resistor R.

(3)

voltage = ... V

(iv) Explain how the voltage across resistor R compares with the voltage across the battery.

(2)

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(d) Diagram 2 shows a different circuit containing a battery, an ammeter and a thermistor.

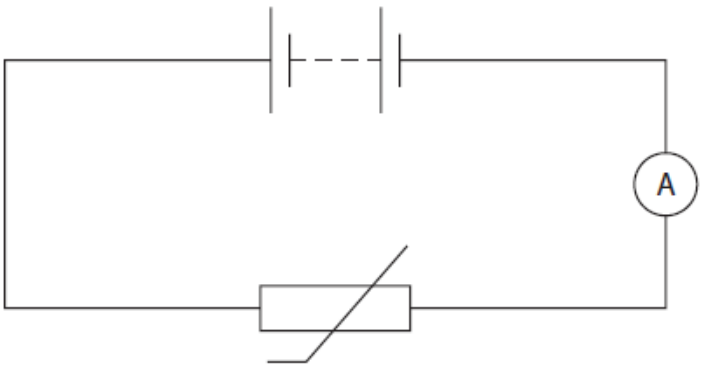

Diagram 2

Explain how the thermistor can be used to vary the current in this circuit.

(3)

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(Total for question = 14 marks)

Q8.

Lightning strikes the Earth frequently and often starts in rain clouds.

Inside the clouds, powerful winds move ice particles and tiny water droplets.

The bottom of the clouds becomes negatively charged and the top becomes positively charged.

(a) Give a reason why the clouds become charged.

(1)

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(b) The ground below the cloud becomes positively charged.

Explain why the ground becomes charged.

You should use ideas about electron movement in your answer.

(2)

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(c) The build-up of charge in the cloud and in the ground causes the air to ionise.

This means that the air becomes a conductor, and a low resistance path from the cloud to the ground is formed.

(i) State what is meant by the term **ionise**.

(1)

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(ii) State the relationship between charge, current and time.

(1)

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(iii) During one lightning strike, the mean current is 32 kA and the mean charge transferred is 15 C.

Calculate the mean time duration of a lightning strike.

(2)

mean time = ... s

(iv) The mean energy transferred during the lightning strike is 510×10^6 J.

Show that the resistance of the air is approximately 1000 Ω.

(4)

(Total for question = 11 marks)

Q9.

(a) (i) A student investigates how current varies with voltage for a metal filament lamp.

Draw a diagram of the circuit that a student could use for this investigation.

(4)

(ii) Describe a method the student could use for their investigation.

(4)

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(b) The student extends the investigation by recording additional data for the lamp.

This is her method.

For each voltage

- switch the current on for 45 seconds
- record the current and colour of the lamp
- calculate the power and the energy transferred by the lamp

The table shows the student's results.

Voltage in V	Current	Power in W	Energy in J	Colour of lamp
0.0	0.00	0.0	0.0	off
2.0	0.40	0.8	36	red
4.0	0.90	3.6		orange
6.0	1.60	9.6	430	yellow
8.0	2.80	22.4	1000	white

(i) State the unit for current.

(1)

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(ii) Calculate the missing value of energy for the voltage of 4.0 V.

Give your answer to 2 significant figures.

(2)

energy = ... J

(iii) The colour of a star is related to its surface temperature.

The Sun is yellow.

Use the student's results to identify a colour for a star that is cooler than the Sun.

(1)

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(Total for question = 12 marks)