Practice Question Set For A-Level
Subject : Physics
Paper-1 Topic: Electricity

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Name of the Student:_____
Max. Marks : 24 Marks **Time :** 24 **Minutes**

Q1.

A radioactive source emits alpha particles each with 8.1×10^{-13} J of kinetic energy.

(a) Show that the velocity of an alpha particle with kinetic energy 8.1×10^{-13} J is approximately 2×10^{7} m s^{-1}

specific charge of an alpha particle = 4.81×10^{7} C kg^{-1}

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_____

(2)

(b) The alpha particles travel through air in straight lines with a range of 3.5 cm

Calculate the average force exerted on an alpha particle as it is stopped by the air.

average force = _____ N

(2)

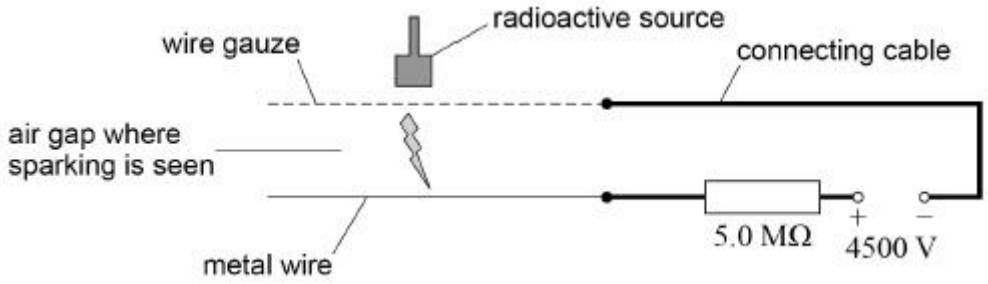
(c) An alpha particle transfers all its kinetic energy to air molecules and produces 5.1×10^{4} ions per centimetre over its range of 3.5 cm

Calculate the average ionisation energy, in eV, of a molecule of air.

ionisation energy = _____ eV

(3)

(d) A spark counter consists of a wire gauze separated from a metal wire by a small air gap. A power supply with an output of 4500 V is connected in series with a 5.0 MΩ resistor and the spark counter as shown in the diagram. When the radioactive source is moved close to the wire gauze, sparking is seen in the air gap.



Sparks are produced when alpha particles produce ionisation in the air gap.

One ionisation event produces a current of 0.85 mA for a time of 1.2 ns

Calculate the number of charge carriers that pass a point in the connecting cable during this ionisation event.

number of charge carriers = _____

(2)

(e) The radioactive source was positioned 10 cm above the wire gauze before being moved slowly towards the wire gauze leading to the ionisation event in part **(d)**.

Discuss how the potential difference across the air gap varied as the radioactive source was moved over this distance.

Assume the power supply has negligible internal resistance.

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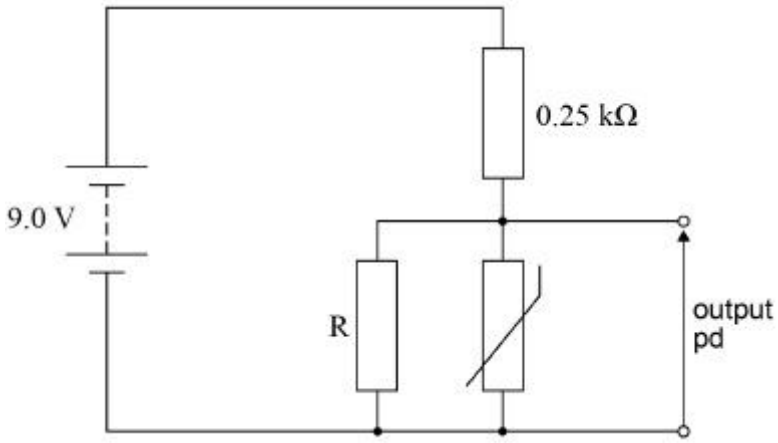
(3)

(Total 12 marks)

Q2.

The diagram shows a circuit designed by a student to monitor temperature changes.



The supply has negligible internal resistance and the thermistor has a resistance of 750 Ω at room temperature. The student wants the output potential difference (pd) at room temperature to be 5.0 V

(a) The 0.25 kΩ resistor is made of 50 turns of wire that is wound around a non-conducting cylinder of diameter 8.0 mm

Resistivity of the wire = 4.2×10^{-7} Ω m

Determine the area of cross-section of the wire that has been used for the resistor.

area of cross-section = _____ m^2

(3)

(b) The student selects a resistor rated at 0.36 W for the 0.25 kΩ resistor in the diagram.

Determine whether this resistor is suitable.

_____

_____

_____

_____

_____

(2)

(c) Determine the value of R that the student should select.

Give your answer to an appropriate number of significant figures.

value of R = _____ Ω

(5)

(d) State and explain the effect on the output pd of increasing the temperature of the thermistor.

_____

_____

_____

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_____

(2)

(Total 12 marks)