Name of the Student:_____
Max. Marks : 25 Marks **Time : 25 Minutes**

Q1.

Read the following extract and then answer the questions that follow.

Powdery dust, the by-product of fearsome meteor storms that pounded the Moon, coats much of the lunar surface. A build-up of this dust could damage sensitive machinery.

Scientists theorise that lunar dust must be electrostatically charged by ultraviolet solar radiation from the Sun. When ultraviolet radiation hits the Moon's "day side", the half that faces the Sun, it knocks electrons out of atoms in the lunar soil.

(a) Describe the particle model of ultraviolet radiation that explains how it can "knock electrons out of atoms".

(3)

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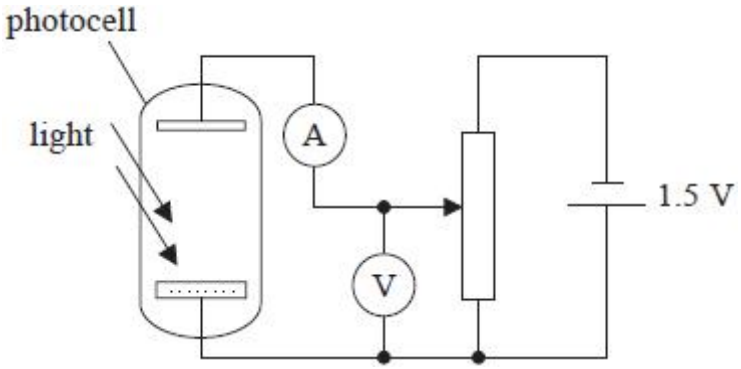
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(b) A teacher uses the arrangement below to demonstrate that electrons can be knocked out of a metal surface in a photocell by visible light.

The arrangement can also be used to measure the maximum kinetic energy of these electrons.



(i) Explain how the potential divider circuit can produce a range of values from 0 to 1.5 V on the voltmeter.

(3)

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(ii) The potential difference on the voltmeter is increased until the ammeter reading is zero.
The voltmeter reads 0.6 V at this instant.
State the maximum kinetic energy of the electrons in eV.

(1)

Maximum kinetic energy = ... eV

(c) Discuss whether the photocell arrangement in part (b) gives a valid demonstration of how dust particles become charged on the Moon.

(4)

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(Total for question = 11 marks)

Q2.

Over one hundred years ago, Rutherford supervised a series of experiments using a source of alpha particles and thin gold foil.

The initial kinetic energy of an alpha $\left({}^{4}_{2}\alpha\right)$ particle is 7.3×10^{-13} J.

(i) In a textbook, it states that an alpha particle with this energy would be brought to rest when it reached a distance of 5.0×10^{-14} m from the centre of the gold nucleus $\left({}^{197}_{79}\mathrm{Au}\right)$.

Deduce whether this statement is correct.

(4)

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(ii) Determine the initial momentum of the alpha particle.

(3)

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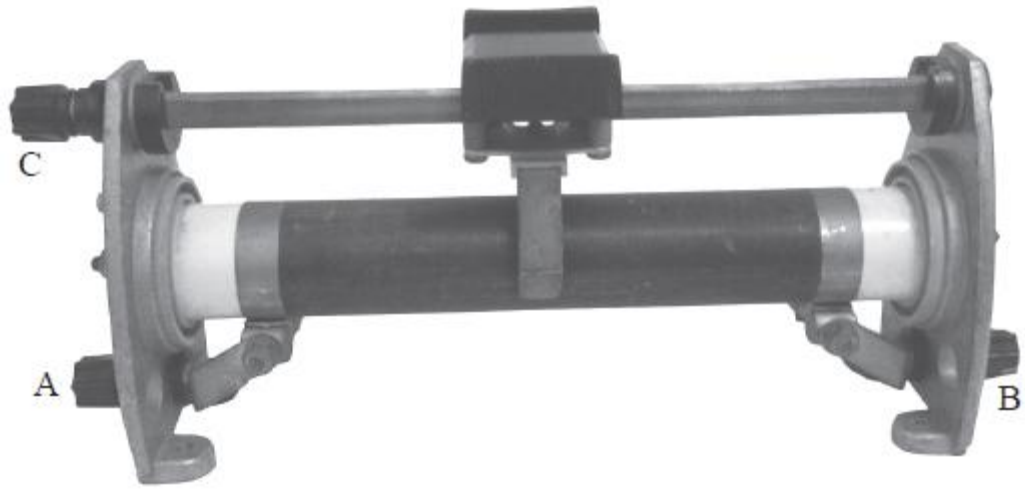
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Initial momentum = ...

(Total for question = 4 marks)

Q3.

Photograph 1 shows a rheostat (a variable resistor).



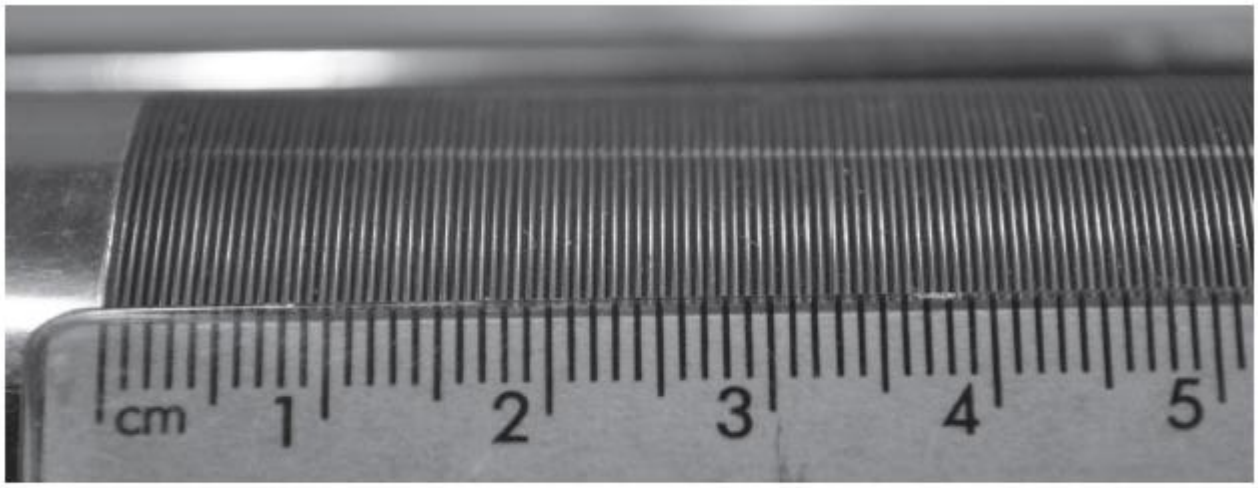
Photograph 1

The rheostat is made of a long resistance wire coiled around an insulating cylinder. The turns of wire are also separated from each other by insulation of negligible thickness. The ends of the wire are connected to the sockets A and B at either end and there is a sliding contact in the centre connected to the socket C. The resistance between A and C is varied by moving the sliding contact.

(a) A student decides to determine the resistivity of the material from which the wire is made by measuring the dimensions of the wire and its resistance.

Photograph 2 shows a section of the rheostat and a scale.

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Photograph 2

(i) Take measurements from the photograph and use them to show that the cross-sectional area of the wire is about 2×10^{-7} m^2.

(3)

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(ii) Calculate the resistivity of the material from which the wire is made.
resistance of wire = 22 Ω
length of wire = 12 m

(3)

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Resistivity = ...

(iii) Suggest an advantage for the student of using a photograph rather than taking direct measurements.

(1)

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(b) The coil of the rheostat is 10.2 cm long. A potential difference of 12 V is applied across AB and the slider C is 7.0 cm from the end of the coil near A.

(2)

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Potential difference = ...

(Total for question = 9 marks)

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