Name of the Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

(a) A solar panel of area 2.5 m^2 is fitted to a satellite in orbit above the Earth. The panel produces a current of 2.4 A at a potential difference of 20 V when solar radiation is incident normally on it.

(i) Calculate the electrical power output of the panel.

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(ii) Solar radiation on the satellite has an intensity of 1.4 kW m^{-2}. Calculate the efficiency of the panel.

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(4)

(b) The back-up power system in the satellite is provided by a radioactive isotope enclosed in a sealed container which absorbs the radiation from the isotope. Energy from the radiation is converted to electrical energy by means of a thermoelectric module.

(i) The isotope has an activity of 1.1×10^{14} Bq and produces α particles of energy 5.1 MeV. Show that the container absorbs energy from the α particles at a rate of 90 J s^{-1}.

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(ii) The isotope has a half-life of 90 years. Calculate the decay constant λ of this isotope.

(iii) The mass number of the isotope is 239.
Calculate the mass of isotope needed for an activity of 1.1×10^{14} Bq.

(7)

(Total 11 marks)

Q2.

In an experiment to investigate the structure of the atom, α particles are directed normally at a thin metal foil which causes them to be scattered.

(a) (i) In which direction will the number of α particles per second be a maximum?

(ii) State what this result suggests about the structure of the atoms in the metal.

(2)

(b) A small number of α particles are scattered through 180°.

Explain what this suggests about the structure of the atoms in the metal.

(2)

(c) The figure shows the path of an α particle passing near a nucleus.

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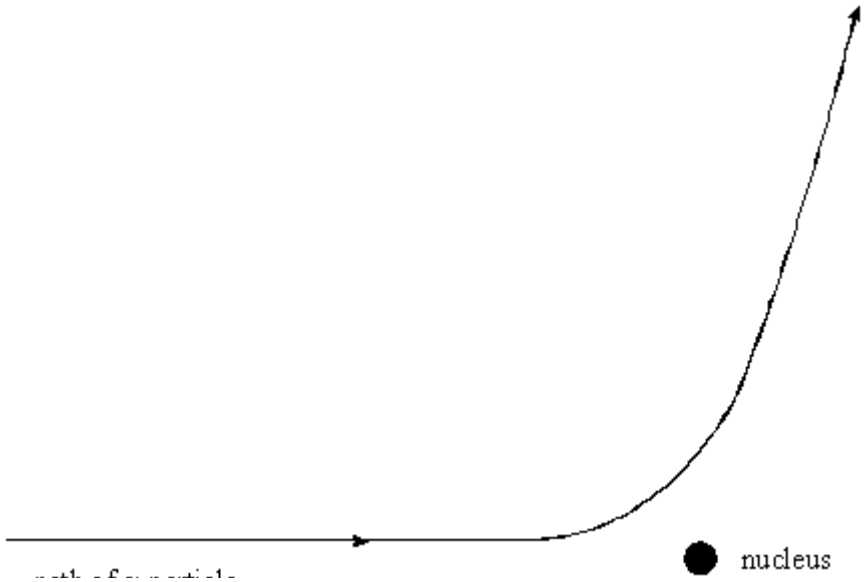

(i) Name the force that is responsible for the deflection of the α particle.

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(ii) Draw an arrow on the diagram in the direction of the force on the α particle in the position where the force is a maximum.

(iii) The nucleus is replaced with one which has a larger mass number and a smaller proton number.

Draw on the diagram the path of an α particle that starts with the same velocity and position as that of the α particle drawn.

(4)
(Total 8 marks)

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