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

Q1.

(a) (i) Why is it necessary to remove the air from the chamber in a Rutherford scattering experiment?

_____

_____

(ii) Give **two** conclusions that can be deduced about the nucleus from the results of such an experiment.

conclusion 1 _____

_____

conclusion 2 _____

_____

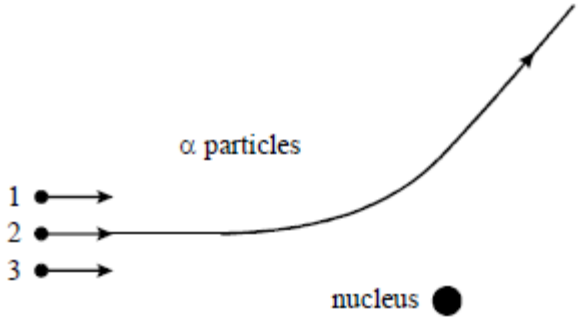
(iii) What force or interaction is responsible for Rutherford scattering?

_____

(4)

(b) The figure shows three α particles, all with the same kinetic energy, directed at a nucleus. The path followed by α particle 2 is given.

Draw lines on the figure to show the paths followed by α particles 1 and 3.



(2)
(Total 6 marks)

Q2.

(a) In the reactor at a nuclear power station, uranium nuclei undergo *induced fission* with *thermal*

neutrons. Explain what is meant by each of the terms in italics.

_____

_____

_____

_____

_____

(3)

(b) A typical fission reaction in the reactor is represented by

$$^{235}_{92}\text{U} + {}^{1}_{0}\text{n} \rightarrow {}^{92}_{36}\text{Kr} + {}^{141}_{56}\text{Ba} + N \text{ neutrons}$$

(i) Calculate N.

_____

(ii) How do the neutrons produced by this reaction differ from the initial neutron that goes into the reaction?

_____

_____

(iii) Calculate the energy released in MeV when one uranium nucleus undergoes fission in this reaction. Use the following data.

mass of neutron = 1.00867 u
mass of ^{235}U nucleus = 234.99333 u
mass of ^{92}Kr nucleus = 91.90645 u
mass of ^{141}Ba nucleus = 140.88354 u
1 u is equivalent to 931 MeV

_____

_____

_____

_____

_____

(5)

(Total 8 marks)

Q3.

(a) State which type of radiation, α, β or γ,

(i) produces the greatest number of ion pairs per mm in air,

_____

(ii) could be used to test for cracks in metal pipes.

_____

_____

(2)

(b) Specific radioisotope sources are chosen for tracing the passage of particular substances through the human body.

(i) Why is a γ emitting source commonly used?

_____

_____

(ii) State why the source should **not** have a very short half-life.

_____

_____

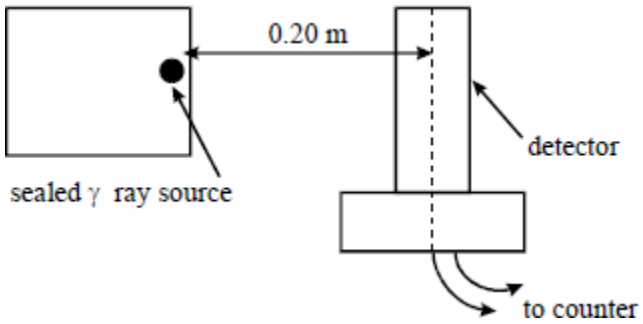
(iii) State why the source should **not** have a very long half-life.

_____

_____

(3)

(c) A detector, placed 0.20 m from a sealed γ ray source, receives a mean count rate of 2550 counts per minute. The experimental arrangement is shown in the diagram below. The mean background radiation is measured as 50 counts per minute.



Calculate the least distance between the source and the detector if the count rate is not to exceed 6000 counts per minute.

_____

_____

_____

_____

_____

_____

_____

_____

(5)
(Total 10 marks)