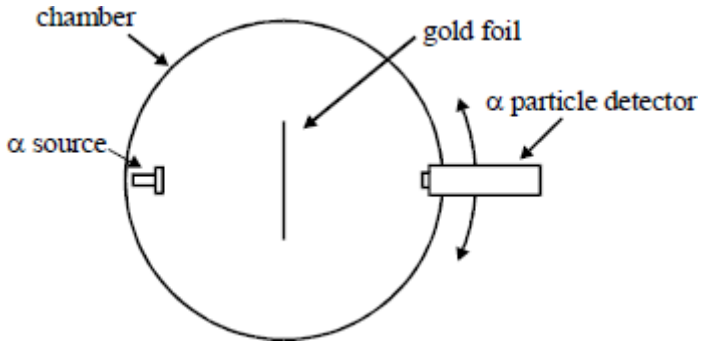
Name of the Student:_____
Max. Marks : 23 Marks **Time : 23 Minutes**

Q1.

The diagram below shows the apparatus used to investigate Rutherford scattering, in which α particles are fired at a gold foil.



(a) Why is it essential for there to be a vacuum in the chamber?

_____

_____

(2)

(b) What observations made with this apparatus support each of the following conclusions? No explanation is required.

(i) The nuclear radius of gold is much smaller than its atomic radius.

_____

_____

(ii) Most of the mass of an atom of gold is contained in its nucleus.

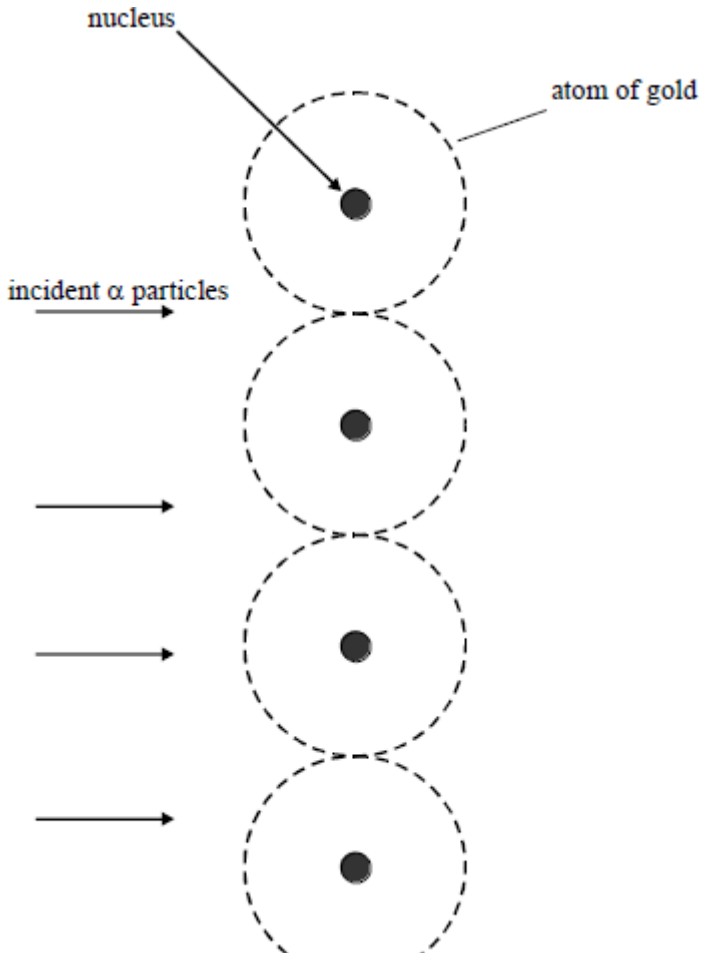
_____

_____

(3)

(c) The drawing below shows α particles incident on a layer of atoms in a gold foil.

On this figure draw the complete path followed by **each** of the α particles shown.

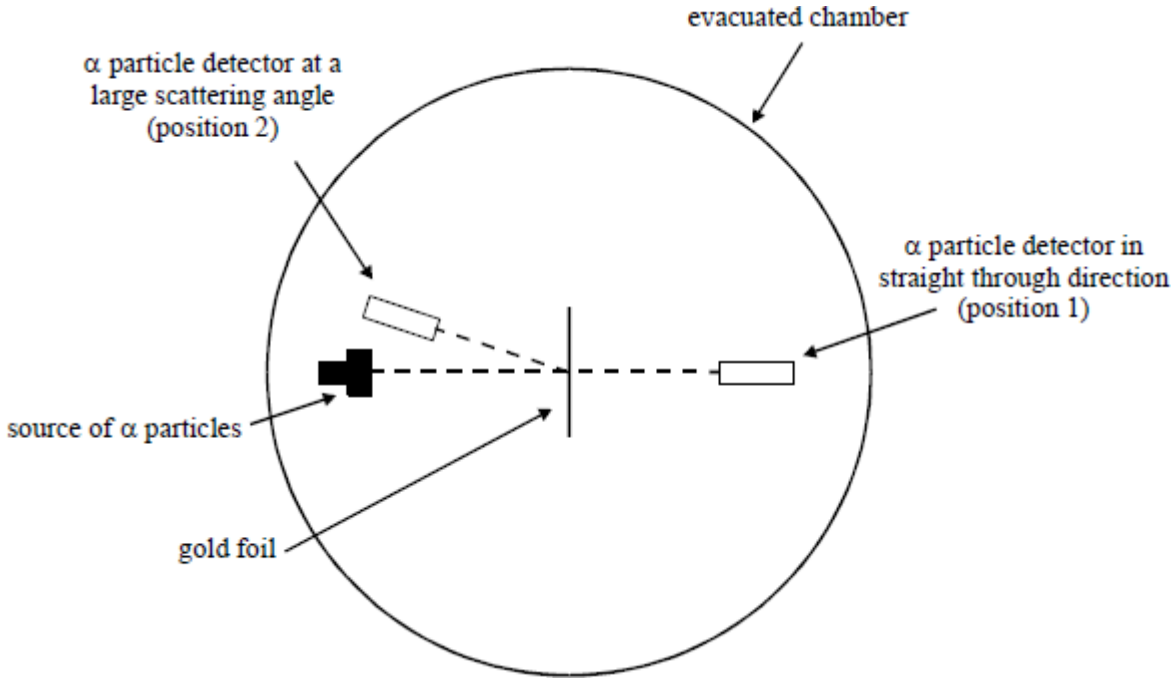


(3)

(Total 8 marks)

Q2.

The figure below represents an experiment on Rutherford scattering in which α particles are directed at a gold foil. The detector is shown in two positions in the evacuated chamber.



(a) Why is it necessary to remove the air from the apparatus?

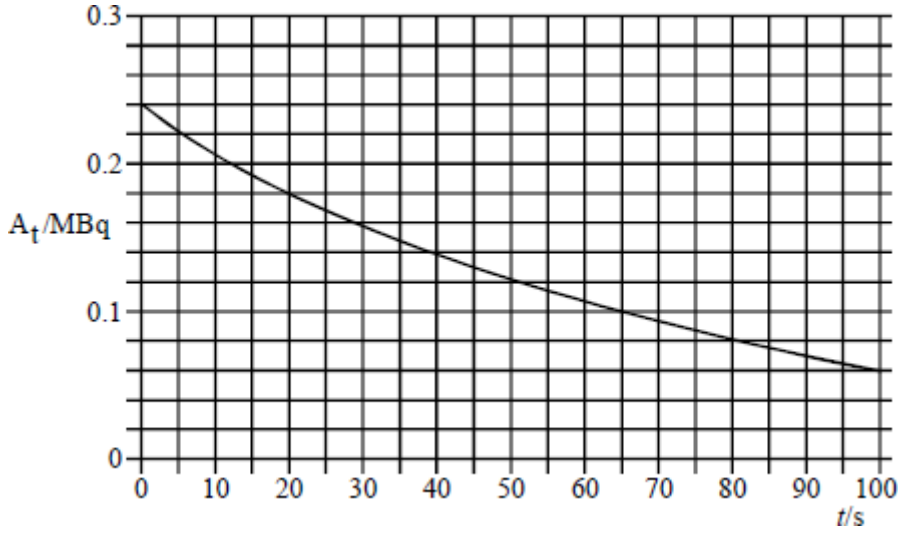
(b) Explain why the gold foil should be very thin.

(c) Explain why the count rate from the α particle detector in position 1 is much greater than that in position 2.
What can be deduced from this observation about the structure of the atom and the properties of the nucleus of gold?

(Total 6 marks)

Q3.

A radioactive nuclide decays by emitting α particles. The graph shows how the rate of decay A_t of the source changes with time t.



(a) Determine

(i) the half-life of the nuclide,

(ii) the decay constant,

(iii) the initial number of undecayed nuclei present at time $t = 0$.

_____

_____

_____

(5)

(b) Each decay releases 1.0×10^{-12} J. For the time interval between $t = 30$ s and $t = 80$ s, calculate

(i) the number of nuclei which decay,

_____

_____

(ii) the energy released.

_____

_____

(4)
(Total 9 marks)