

Student: _____

Max. Marks : 18 Marks

Time : 18 Minutes

Q1.

Early in the twentieth century physicists observed the scattering of alpha particles after they had passed through a thin gold foil. This scattering experiment provided evidence for the structure of the atom.

(a) State why it is necessary to remove the air from the apparatus that is used for this experiment.

(1)

(b) From the results of such an experiment give **two** conclusions that can be deduced about the nucleus of an atom.

(1)

Conclusion 1

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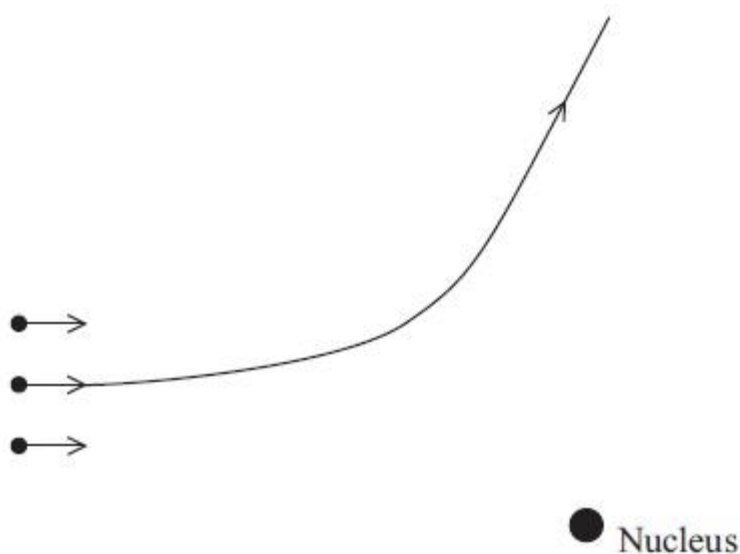
Conclusion 2

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(c) The diagram shows three α -particles, all with the same kinetic energy. The path followed by one of the particles is shown.

Add to the diagram to show the paths followed by the other two particles.

(3)



(Total for question = 6 marks)

Q2.

At the beginning of the 20th century, Rutherford carried out large-angle alpha particle scattering experiments using gold ($^{197}_{79}\text{Au}$) foil.

The vast majority of the alpha particles went straight through the foil whilst a few were deflected straight back. Describe how the model of the atom changed, as a consequence of these experiments.

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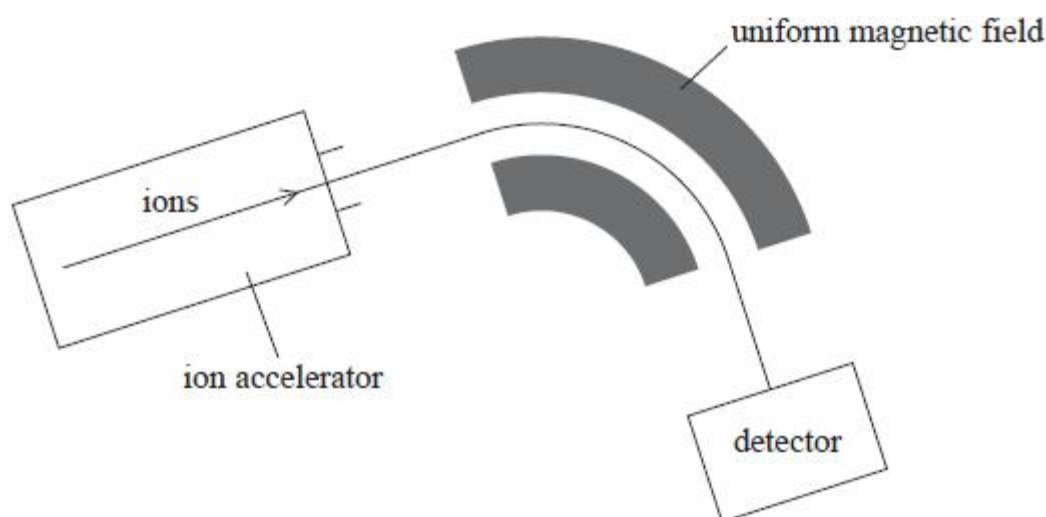
(Total for question = 4 marks)

Q3.

Mass spectrometry is a technique used to separate ions based on their charge to mass ratio.

The atoms in a sample are ionised and then accelerated and formed into a fine beam.

This beam is passed into a region of uniform magnetic field and the ions are deflected by different amounts according to their mass.



Analysis of mass spectrometer data shows that chlorine exists in nature as two isotopes, chlorine-35 and chlorine-37.

In a mass spectrometer, chlorine-35 ions are accelerated through a potential difference of 8.50 kV to produce an ion beam.

Show that the speed of singly ionised chlorine-35 atoms is about $2.2 \times 10^5 \text{ m s}^{-1}$.

mass of an ion of chlorine-35 = 34.97 u

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(Total for question = 4 marks)

Q4.

At the beginning of the 20th century, Rutherford carried out large-angle alpha particle scattering experiments using gold ($^{197}_{79}\text{Au}$) foil.

The vast majority of the alpha particles went straight through the foil whilst a few were deflected straight back. In one experiment the alpha particles had an initial energy of 7.7 MeV.

Calculate the distance of closest approach of the alpha particles to the nucleus of a gold atom. Assume that the gold nucleus remains at rest.

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Distance of closest approach =

(Total for question = 4 marks)