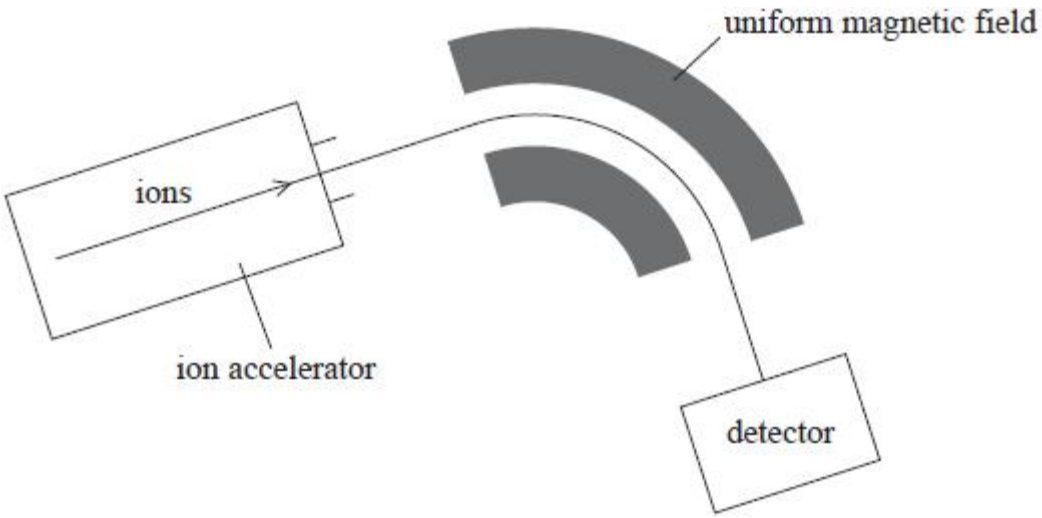
Student:_____
Max. Marks : 19 Marks **Time : 19 Minutes**

Q1.

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.

After passing through the velocity selector the ion beam enters a region of uniform magnetic flux density 0.35 T with the ions travelling at right angles to the field direction.

(i) Explain why the ions travel in a circular path.

(2)

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(ii) Calculate the radius of the circular path.

(2)

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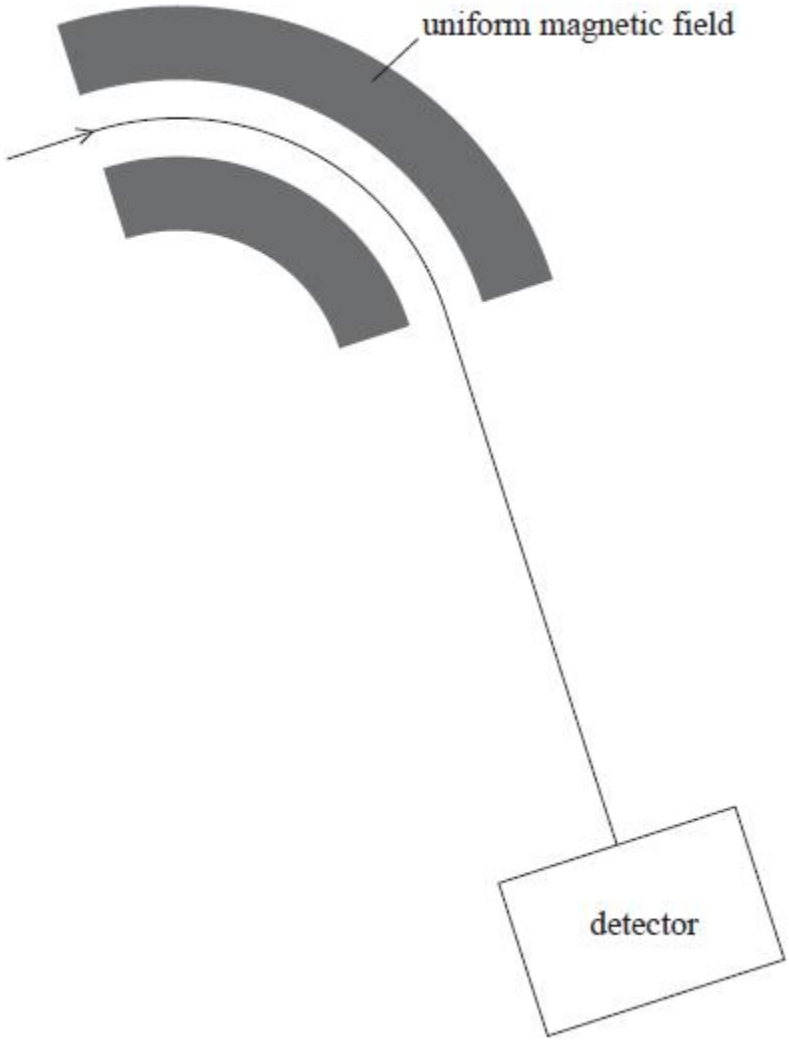
Radius = ...

(iii) The diagram shows the path of the chlorine-35 ions in the field. Chlorine-37 ions enter the magnetic field with the same velocity.



1. Add another line to the diagram to show the path of these chlorine-37 ions.

(1)

2. Explain any differences in the paths.

(2)

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(Total for question = 7 marks)

Q2.

The bubble chamber photograph shows tracks made by a proton and a pion. The proton and pion were both

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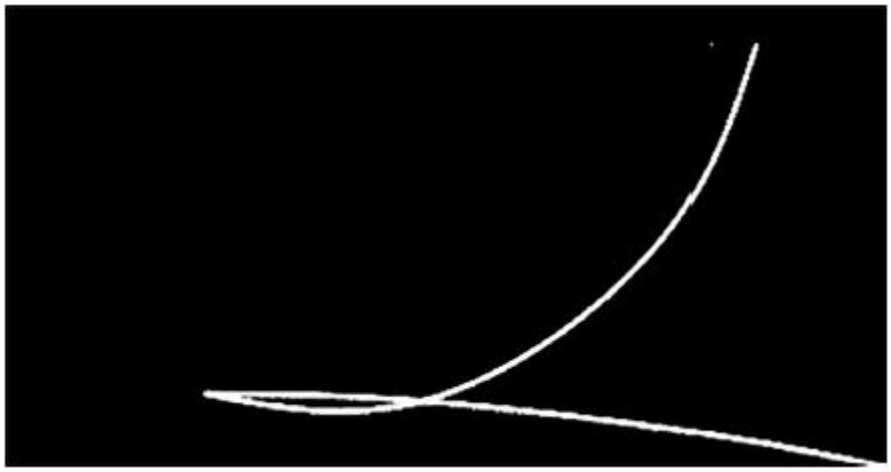
created by the decay of a lambda particle. No other particles were produced.



* Explain how observations and measurements from the photograph can be used to establish information about the lambda particle.

(6)

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(Total for question = 6 marks)

Q3.

The bubble chamber photograph shows tracks made by a proton and a pion. The proton and pion were both created by the decay of a lambda particle. No other particles were produced.

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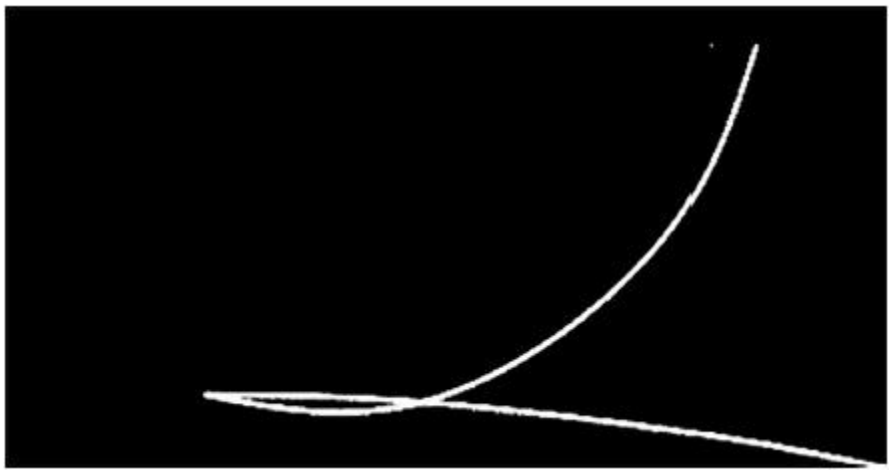

The rest mass of the lambda particle is 1115 MeV / c^2.

(i) Calculate this mass in kg.

(3)

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Mass = ... kg

(ii) The rest mass of a proton is 940 MeV / c^2. The rest mass of a pion is 140 MeV / c^2.

The kinetic energy of the lambda particle just before decay is 4.95 GeV.
Calculate the total kinetic energy of the proton and pion in MeV.

(3)

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Total kinetic energy = ... MeV

(Total for question = 6 marks)

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