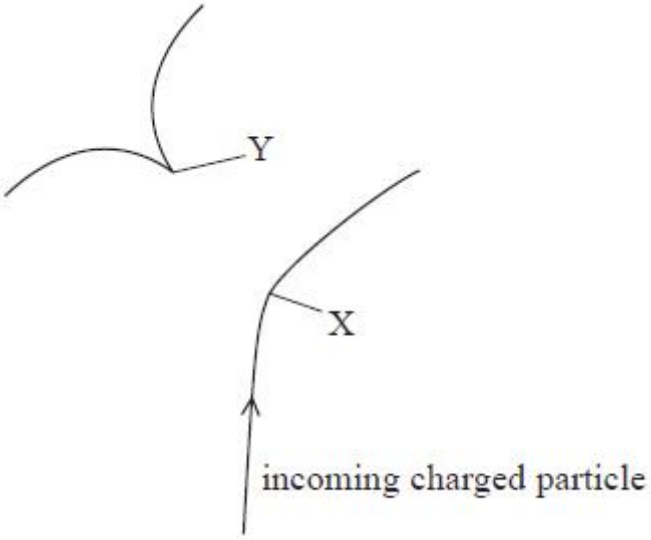
Student:_____
Max. Marks : 18 Marks **Time : 18 Minutes**

Q1.

The diagram shows the tracks produced in a bubble chamber.



At X an incoming charged particle interacts with a stationary proton.

Describe and explain what can be deduced about the interaction at X and subsequent events. You may add to the diagram to help your answer.

(5)

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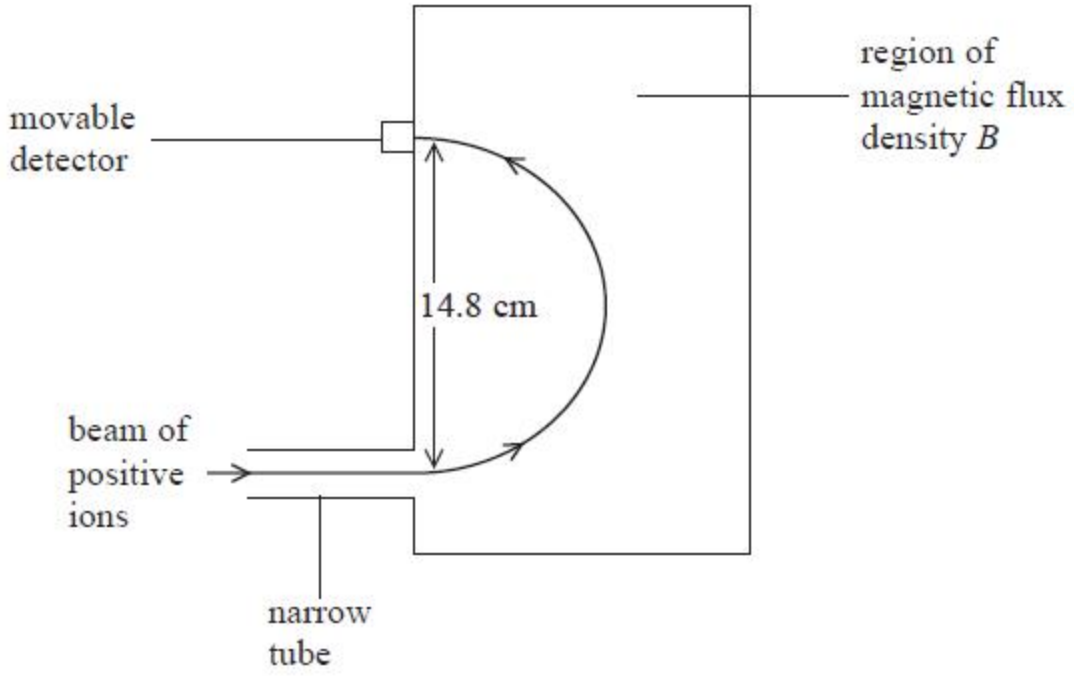
Q2.

A mass-spectrometer is an instrument that is used to measure the masses of molecules. Molecules of a gas are ionised and travel through a vacuum in a narrow tube. The ions enter a region of uniform magnetic flux density *B* where they are deflected in a semicircular path as shown.



(a) State why it is necessary for the molecules to be ionised.

(1)

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(b) State the direction of the magnetic field.

(1)

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(c) The ions have a charge of $+e$ and a speed of 1.20×10^5 m s^{-1}. When *B* has a value of 0.673 T, the ions are detected at a point where the diameter of the arc is 14.8 cm.

Calculate the mass of an ion.

(3)

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Mass of an ion = ...

(d) Ions with a smaller mass but the same charge and speed are also present in the beam.
On the diagram sketch the path of these ions.

(1)

(Total for question = 6 marks)

Q3.

The photograph is an image of the paths of particles obtained from an early particle detector, the cloud chamber.

Modern particle detectors such as the ones at CERN still work on the basic principle that charged particles cause ionisation of the material through which they pass. These ionisations can be tracked and recorded. Magnetic fields are used to deflect the particles so that their properties can be investigated.

(a) State what is meant by ionisation in this context.

(1)

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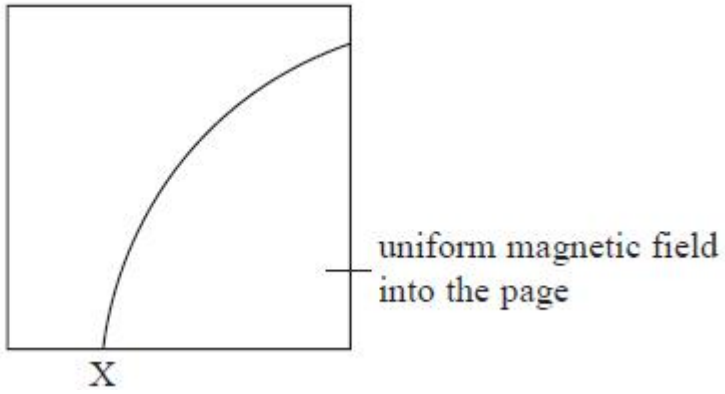
(b) The diagram below shows the ionisation path of a particle when it is in the region of a uniform magnetic field. The particle enters the field at X.



State how we know that the particle is negatively charged.

(1)

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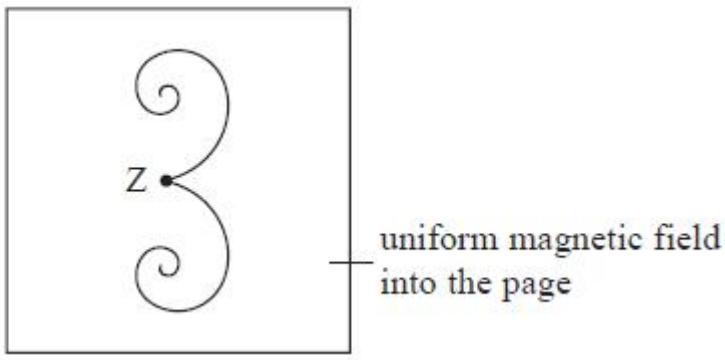
(c) The diagram below shows an event occurring in the same magnetic field.



Point Z is where a high energy photon interaction occurs which causes two particles to be formed. Describe, with reasons, what can be deduced about the photon and the two particles that are formed in this interaction.

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(Total for question = 7 marks)