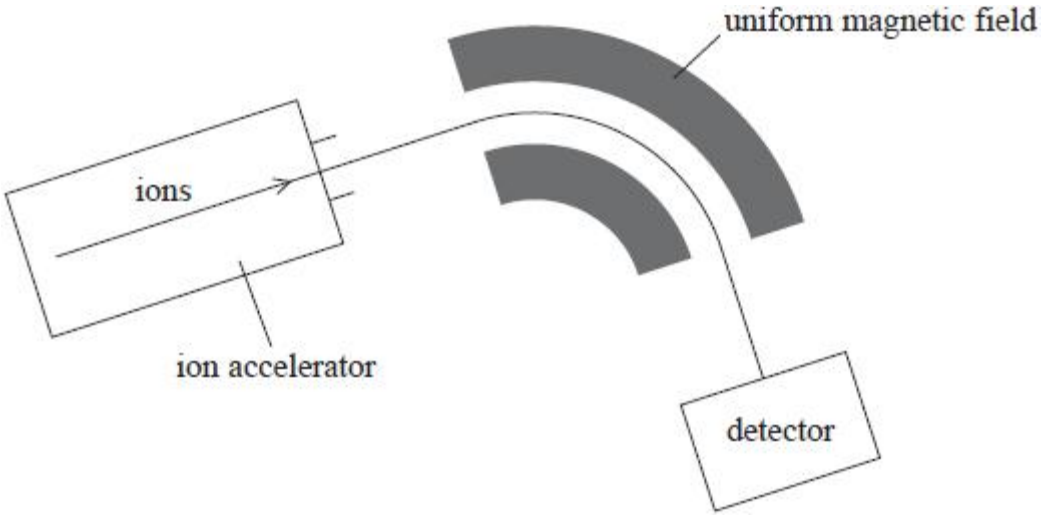
Student:_____
Max. Marks : 11 Marks **Time : 11 Minutes**

Q1.

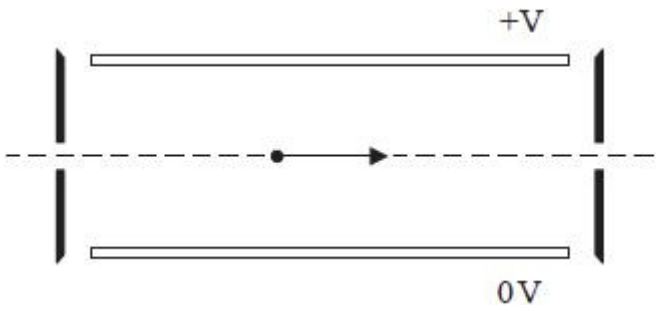
Mass spectrometry is a technique used to separate ions based on their charge to mass ratio.

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.

In most mass spectrometers the ions are passed through a velocity selector, after being accelerated, to produce a beam of ions of a particular velocity.
The velocity selector consists of a pair of parallel plates, across which a potential difference (p.d.) is applied to create an electric field.



In one mass spectrometer the plates are 2.5 cm apart and a p.d. of 135 V is applied.

A magnetic field is also applied to produce a force on the ions in the opposite direction to the force from the electric field. For one particular speed the ions travel in a straight line and emerge from the selector.

(i) Add to the diagram to indicate the directions of the electric field and the magnetic field.

(2)

(ii) The magnetic flux density applied to the velocity selector is 24.5 mT.

Deduce whether this magnetic flux density is suitable to produce a beam of chlorine-35 ions of speed 2.2×10^5 m s^{-1}.

(4)

.....

.....

.....

.....

.....

.....

(Total for question = 6 marks)

Q2.

An electron and an alpha particle enter a uniform magnetic field which is acting perpendicular to their motion. The electron is travelling at four times the velocity of the alpha particle. The force on the electron is *F*.

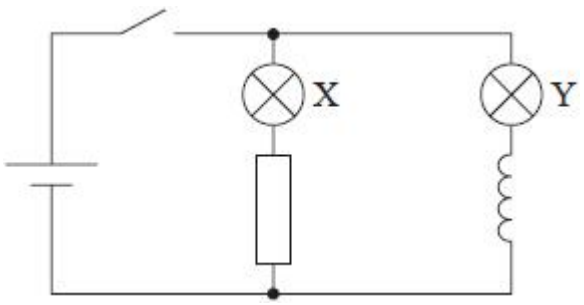
The force on the alpha particle is

- ☒ **A** *F*/2
- ☒ **B** *F*
- ☒ **C** 4*F*
- ☒ **D** 16*F*

(Total for question = 1 mark)

Q3.

A circuit is set up as shown in the diagram. Lamps X and Y are identical.
The coil has a soft iron core. The resistor and the coil have the same resistance.



The switch is closed and lamp X lights instantly.

Which statement best describes lamp Y after the switch is closed?

(1)

☒ **A** Lights after a delay with a final brightness less than X

☒ **B** Lights after a delay with a final brightness the same as X

☒ **C** Lights instantly with less brightness than X

☒ **D** Lights instantly with the same brightness as X

(Total for question = 1 mark)

Q4.

Answer the question with a cross in the box you think is correct (☒). If you change your mind about an answer, put a line through the box (☒) and then mark your new answer with a cross (☒).

A wire carries an alternating current of peak value 3 A.

Which of the following is the root-mean-square value of this current?

☒ **A** 1.5 A

☒ **B** 2.1 A

☒ **C** 4.2 A

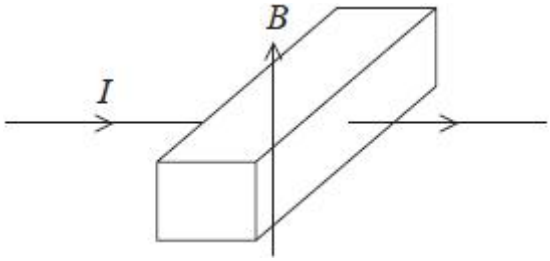
☒ **D** 9.0 A

(Total for question = 1 mark)

Q5.

Some liquids conduct electricity. This property can be used to pump these liquids through pipes.

A short section of a rectangular pipe containing a liquid is shown in the diagram. The pipe is placed in a magnetic field of flux density *B* and a current *I* is passed through the liquid as shown.



Add an arrow to the diagram above to show the direction in which the liquid will move.

(1)

(Total for question = 1 mark)

Q6.

A conductor of length 50 mm carries a current of 3.0 A at 30º to a magnetic field of magnetic flux density 0.40 T.

The magnitude of the magnetic force acting on the conductor is

- ☒ **A** 0.030 N
- ☒ **B** 0.050 N
- ☒ **C** 30 N
- ☒ **D** 52 N

(Total for question = 1 mark)