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Question 1.

Using the concept of Newton's second Law of motion, describe the magnitude and direction of the acceleration of an electron being shot horizontally into a closed space with a uniform field being directed upward.

Answer:

Newton's second Law of motion states that the rate of change of momentum is proportional to the impressed force and takes place in the direction of that force or the acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force and inversely proportional to the mass of the object.

Therefore, on entering the field, there is a vertical downward for acting on the electron. This is because electric force acts in the opposite direction as the electric field and the electric field is directed upward.

The magnitude of the force is given by $F = Eq$ where E is the electric field strength and q is the charge of the electron. No force acts horizontally. Hence, the magnitude of acceleration is written:

$$F = Ma, \quad a = \frac{F}{M} = \frac{Eq}{M}$$ where M = mass, F = force, a = acceleration

$$\Rightarrow a = \frac{Eq}{M}$$

The direction of 'a' is downward just like the way force, F is directed because according to Newton's second law, Force is directly proportional to acceleration.

Question 2.

Describe electric field, magnetic field and electric current with respect to charges.

The electric field is just a way of describing the action at a distance of one charge upon another. Such a field is another example of a force field and is represented by electric lines of force. Electric lines of forces is an imaginary line drawn in a electric field in such a way that the direction at any point gives the direction of the electric field at such a point.

Electric current (I) is defined as the rate of flow of electric charge along a conductor. A steam of moving charges (or electrons) constitute an electric current. We can describe the flow of electric charge along a conductor e.g a metallic wire, by expressing it in terms of the quantity of electric charge Q which moves past each section of the conductor in a given time t. The quantity of charge Q is measured in columbs and the time t in seconds. Hence, Current I is given mathematically by the expression:

$$I = \frac{Q}{t}$$

$$\text{Current} = \frac{\text{Quantity of charge}}{\text{time}}$$

If Q is in coulombs, and t is in seconds, the current I is in Ampere (A). Hence, 1 ampere = 1 coulomb per second.