

QUES 02:-

A cubical region of space is filled with some uniform electric and magnetic fields. An electron enters the cube across one of its faces with velocity v and a positron enters via opposite face with velocity $-v$. At this instant.

- a. the electric forces on both the particles cause identical accelerations.
- b. the magnetic forces on both the particles cause equal accelerations.
- c. both particles gain or loose energy at the same rate.
- d. the motion of the centre of mass (CM) is determined by B alone.

Sol. (b), (c) and (d) are correct.

Key concept: This problem is based upon the single moving charge placed with some uniform electric and magnetic fields in space. Then they experience a force called Lorentz force is given by the relation $F_{\text{net}} = qe + (v \times B)$.

- i. The magnetic forces ($F_m = q(v \times B)$), on charge particle, is either zero or F_m is perpendicular to v (or component of v) which in turn revolves particles on a circular path with uniform speed. In both cases, particles have equal accelerations.
- ii. Due to the same electric force ($F_e = qE$) which is in opposite direction (because of the sign of charge) both the particles gain or loss energy at the same rate.
- iii. There is no change of the Centre of Mass (CM) of the particles, therefore the motion of the Centre of Mass (CM) is determined by B alone.