**Q 5.** 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 $F_{net} = qe + (v \times B)$.

i. The magnetic forces ($F_m = q\ (v \times B)$, on charge particle, is either zero or Fm 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.