Q. 1 Two charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field $\mathbf{B} = B_0 \hat{\mathbf{k}}$.

(a) They have equal z-components of momenta
(b) They must have equal charges
(c) They necessarily represent a particle, anti-particle pair
(d) The charge to mass ratio satisfy

$$\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$$

K Thinking Process

The uniqueness of helical path is determined by its pitch which is given by

$$\text{Pitch} = \frac{2\pi mv\cos\theta}{qB}$$

Ans. ***(d)*** For given pitch d correspond to charge particle, we have

$$\frac{q}{m} = \frac{2\pi v\cos\theta}{qB} = \text{constant}$$

Since, charged particles traverse identical helical paths in a completely opposite sense in a uniform magnetic field **B**, LHS for two particles should be same and of opposite sign. Therefore,

$$\left(\frac{e}{m}\right)_1 + \left(\frac{e}{m}\right)_2 = 0$$

Note *Consider e in place of q in solution.*