FORCE ON A MOVING CHARGE IN UNIFORM ELECTRIC AND MAGNETIC FIELDS, CYCLOTRON

1. A charged particle moving with velocity 5 x 10^3 m/s passes un-deflected through electric and magnetic fields. Magnetic field is 2.0 tesla. The electric field intensity is:
   (a) 1 x 10^3 N/C (b) 4 x 10^3 N/C (c) 8 x 10^3 N/C **(d)** 10 x 10^{-3} N/C
2. A proton of velocity $(4\hat{\imath} + 2\hat{\jmath})$ m/s enters a field of magnetic induction $(3\hat{\jmath} + 4\hat{k})$ tesla. The acceleration produced in the proton in m/s^2 is (specific charge of proton = 0.96 x 10^8 C/kg):
   (a) 3.84 x10^8 $(2\hat{\imath} - 4\hat{\jmath} + 3\hat{k})$ (b) 3.84 x10^8 $(3\hat{\imath} - 4\hat{\jmath} + 6\hat{k})$ (c) 2.88 x10^8 $(2\hat{\imath} - 4\hat{\jmath} + 8\hat{k})$ (d) 3.84 x10^8 $(3\hat{\imath} + 5\hat{\jmath} + 3\hat{k})$
3. Two particles P and Q having equal charges are accelerated through the same potential difference. Then these particles enter a region of uniform magnetic field and describes circular path of radius R_1 and R_2 respectively. The ratio of mass of P to that of Q is:
   (a) $\left(\frac{R_1}{R_2}\right)^2$ (b) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (c) $\frac{R_1}{R_2}$ (d) $\frac{R_2}{R_1}$
4. A proton and an α-particle having same momentum enter a region of uniform magnetic field, moving at right angles to the field. The ratio of radii of their paths is:
   (a) 2 : 3 (b) 1 : 1 (c) 1 : 3 **(d)** 2 : 1
5. If the velocity of the charged particle is doubles and strength of magnetic field is halved, then radius becomes:
   (a) 2 times **(b)** 4 times (c) 8 times (d) 16 times
6. When a positively charged particle enters into a uniform magnetic field with uniform speed, its trajectory can be: (i) a straight line (ii) a circle (iii) a helix. The correct answer is:
   (a) (i) only (b) (i) or (ii) (c) (i) or (iii) **(d)** any one of (i), (ii) and (iii)
7. Two charged particles X and Y having the same charge, mass and speed enter into a magnetic field in such a way that the initial path of X makes an angle of 60° and that of Y makes an angle of 90° with the field. Then the trajectory of:
   (a) Y will have smaller radius of curvature than that of X (b) both will have the same curvature **(c)** X will have smaller radius of curvature than that of Y (d) both will move along the direction of their original velocities
8. Two particles X and Y having equal charges + 2 C, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii 5 cm and 3 cm respectively. The ratio of mass of X to that of Y is:
   (a) 3/5 (b) 3/8 **(c)** 25/9 (d) 8/3
9. A strong magnetic field is applied on a stationary electron. Then the electron:
   (a) remains stationary (b) moves in the direction of the field (c) moves perpendicular to the direction of the field (d) moves opposite to the direction of the field
10. A charged particle is moving in a circular orbit of radius 6 cm with a uniform speed of 3 x 10^6 m/s under the action of a uniform magnetic field 2 x 10^{-4} Wb/m^2 at right angles to the plane of the orbit. The charge to mass ratio of the particle is:
    (a) 2.5 x 10^9 C/kg (b) 5 x 10^{11} C/kg **(c)** 2.5 x 10^{11} C/kg (d) 5 x 10^{12} C/kg
11. A proton and an α-particle enter a uniform magnetic field perpendicularly with the same speed. If proton takes 5 μs is to make 5 revolutions, then the periodic time for the α-particle would be:
    (a) 5 μs **(b)** 2 μs (c) 1 μs (d) 0.5 μs

12. A neutron, a proton, an electron and an α-particle enter a region of uniform magnetic field with the same velocities. The magnetic field is perpendicular and directed into the plane of the paper. The tracks of the particles are labelled in the figure. The electron follows the track:
    (a) A (b) B (c) C **(d)** D
13. Two ions having masses in the ratio 1: 2 and charges 2: 3 are projected into a uniform magnetic field at right to it with speeds in the ratio 3: 4. The ratio of the radii circular paths along which the two particles move is:
    (a) 9: 16 (b) 4: 9 (c) 3: 16 (d) 1:1
14. The magnitude of the magnetic field required to accelerate protons (mass = 1.67×10^{-27} kg) in a cyclotron that is operated at an oscillator frequency 12 MHz approximately:
    (a) 0.8 T (b) 1.6 T (c) 2.0 T (d) 3.T