DPP-2 (MOTION OF A CHARGE PARTICLE INSIDE MAGNETIC FIELD)

1. A proton moving with a constant velocity passes through a region of space without any change in its velocity. If $\vec{E}$ and $\vec{B}$ represent the electric and magnetic fields respectively, then this region of space may have

(a) $E = 0, B = 0$ (b) $E = 0, B \neq 0$ (c) $E \neq 0, B = 0$ (d) $E \neq 0, B \neq 0$

2. A uniform electric field and a uniform magnetic field are produced, pointed in the same direction. An electron is projected with its velocity pointing in the same direction

(a) The electron will turn to its right
(b) The electron will turn to its left
(c) The electron velocity will increase in magnitude
(d) The electron velocity will decrease in magnitude

3. Two particles *X* and *Y* having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describes circular path of radius R_1 and R_2 respectively. The ratio of mass of *X* to that of *Y* is

(a) $\left(\frac{R_1}{R_2}\right)^{1/2}$ (b) $\frac{R_2}{R_1}$ (c) $\left(\frac{R_1}{R_2}\right)^2$ (d) $\frac{R_1}{R_2}$

4. A proton (mass *m* and charge +*e*) and an $\alpha -$particle (mass 4*m* and charge +2*e*) are projected with the same kinetic energy at right angles to the uniform magnetic field. Which one of the following statements will be true
(a) The $\alpha -$particle will be bent in a circular path with a small radius that for the proton
(b) The radius of the path of the $\alpha -$particle will be greater than that of the proton
(c) The $\alpha -$particle and the proton will be bent in a circular path with the same radius
(d) The $\alpha -$particle and the proton will go through the field in a straight line

5. A proton of mass $1.67 \times 10^{-27}\,kg$ and charge $1.6 \times 10^{-19}\,C$ is projected with a speed of $2 \times 10^6\,m/s$ at an angle of $60°$ to the $X-$axis. If a uniform magnetic field of 0.104 *Tesla* is applied along $Y-$axis, the path of proton is

(a) A circle of radius = 0.2 *m* and time period $\pi \times 10^{-7}\,s$

(b) A circle of radius = 0.1 *m* and time period $2\pi \times 10^{-7}\,s$

(c) A helix of radius = 0.1 *m* and time period $2\pi \times 10^{-7}\,s$

(d) A helix of radius = 0.2 *m* and time period $4\pi \times 10^{-7}\,s$

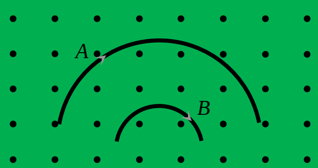
6. A proton, a deuteron and an $\alpha -$particle having the same kinetic energy are moving in circular trajectories in a constant magnetic field. If r_p, r_d and r_α denote respectively the radii of the trajectories of these particles, then

(a) $r_\alpha = r_p < r_d$ (b) $r_\alpha > r_d > r_p$ (c) $r_\alpha = r_d > r_p$ (d) $r_p = r_d = r_\alpha$

7. The radius of curvature of the path of a charged particle moving in a static uniform magnetic field is
(a) Directly proportional to the magnitude of the charge on the particle
(b) Directly proportional to the magnitude of the linear momentum of the particle
(c) Directly proportional to the kinetic energy of the particle
(d) Inversely proportional to the magnitude of the magnetic field

8. Two particles *A* and *B* of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively, and the trajectories are as shown in the figure. Then

(a) $m_A v_A < m_B v_B$
(b) $m_A v_A > m_B v_B$



(c) $m_A < m_B$ and $v_A < v_B$

(d) $m_A = m_B$ and $v_A = v_B$

9. A charged particle is released from rest in a region of steady uniform electric and magnetic fields which are parallel to each other the particle will move in a

(a) Straight line (b) Circle (c) Helix (d) Cycloid

10. A particle of charge -16×10^{-18} *coulomb* moving with velocity $10\ ms^{-1}$ along the *x*-axis enters a region where a magnetic field of induction *B* is along the *y*-axis, and an electric field of magnitude $10^4\ V/m$ is along the negative *z*-axis. If the charged particle continues moving along the *x*-axis, the magnitude of *B* is

(a) $10^{-3}\,Wb/m^2$ (b) $10^3\,Wb/m^2$ (c) $10^5\,Wb/m^2$ (d) $10^{16}\,Wb/m^2$

11. An electric field of 1500 V/m and a magnetic field of 0.40 $weber/meter^2$ act on a moving electron. The minimum uniform speed along a straight line the electron could have is

(a) $1.6\times10^{15}\ m/s$ (b) $6\times10^{-16}\ m/s$

(c) $3.75\times10^3\ m/s$ (d) $3.75\times10^2\ m/s$

12. An electron (mass = 9.1×10^{-31} *kg*; charge = 1.6×10^{-19} *C*) experiences no deflection if subjected to an electric field of 3.2×10^5 *V/m*, and a magnetic fields of 2.0×10^{-3} *Wb/m²*. Both the fields are normal to the path of electron and to each other. If the electric field is removed, then the electron will revolve in an orbit of radius

(a) 45 *m* (b) 4.5 *m* (c) 0.45 *m* (d) 0.045 *m*

13. An ionized gas contains both positive and negative ions. If it is subjected simultaneously to an electric field along the +*x* direction and a magnetic field along the +*z* direction, then

(a) Positive ions deflect towards +*y* direction and negative ions towards –*y* direction

(b) All ions deflect towards +*y* direction

(c) All ions deflect towards –*y* direction

(d) Positive ions deflect towards –*y* direction and negative ions towards +*y* direction

14. An electron moves with speed 2×10^5 *m/s* along the positive *x*-direction in the presence of a magnetic induction $B=\hat{i}+4\hat{j}-3\hat{k}$ (in *Tesla*.) The magnitude of the force experienced by the electron in Newton's is (charge on the electron = 1.6×10^{-19} *C*)

(a) 1.18×10^{-13} (b) 1.28×10^{-13}

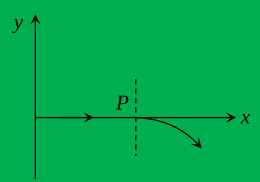
(c) 1.6×10^{-13} (d) 1.72×10^{-13}

15. A particle of mass *m* and charge *q* moves with a constant velocity *v* along the positive *x* direction. It enters a region containing a uniform magnetic field *B* directed along the negative *z* direction, extending from $x = a$ to $x = b$. The minimum value of *v* required so that the particle can just enter the region $x > b$ is

(a) $qb\,B/m$ (b) $q(b-a)B/m$

(c) $qa\,B/m$ (d) $q(b+a)B/2m$

16. For a positively charged particle moving in a *x-y* plane initially along the *x*-axis, there is a sudden change in its path due to the presence of electric and/or magnetic fields beyond P. The curved path is shown in the *x-y* plane and is found to be non-circular. Which one of the following combinations is possible



(a) $\vec{E}=0; \vec{B}=b\hat{i}+c\hat{k}$ (b) $\vec{E}=a\hat{i}; \vec{B}=c\hat{k}+a\hat{i}$

(c) $\vec{E}=0; \vec{B}=c\hat{j}+b\hat{k}$ (d) $\vec{E}=a\hat{i}; \vec{B}=c\hat{k}+b\hat{j}$

17. Two very long, straight and parallel wires carry steady currents I and I respectively. The distance between the wires is d. At a certain instant of time, a point charge q is at a point equidistant from the two wires in the plane of the wires. Its instantaneous velocity v is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is

(a) $\dfrac{\mu_0 Iqv}{2\pi d}$ (b) $\dfrac{\mu_0 Iqv}{\pi d}$ (c) $\dfrac{2\mu_0 Iqv}{\pi d}$ (d) 0

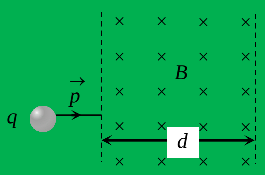
18. A particle with charge q, moving with a momentum p, enters a uniform magnetic field normally. The magnetic field has magnitude B and is confined to a region of width d, where $d < \dfrac{p}{Bq}$, The particle is deflected by an angle θ in crossing the field

(a) $\sin\theta = \dfrac{Bqd}{p}$

(b) $\sin\theta = \dfrac{p}{Bqd}$

(c) $\sin\theta = \dfrac{Bp}{qd}$

(d) $\sin\theta = \dfrac{pd}{Bq}$



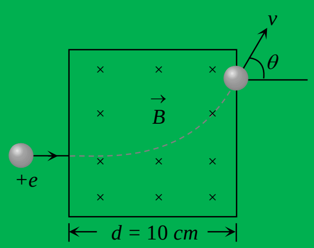
19. A proton accelerated by a potential difference $500\ KV$ moves though a transverse magnetic field of $0.51\ T$ as shown in figure. The angle θ through which the proton deviates from the initial direction of its motion is

(a) 15^o

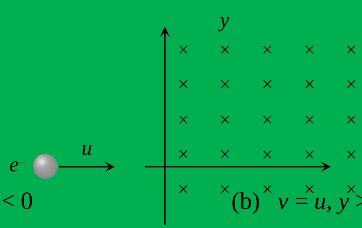
(b) 30^o

(c) 45^o

(d) 60^o



20. An electron moving with a speed u along the positive x-axis at $y = 0$ enters a region of uniform magnetic field $\vec{B} = -B_0\hat{k}$ which exists to the right of y-axis. The electron exits from the region after some time with the speed v at co-ordinate y, then



(a) $v > u, y < 0$ (b) $v = u, y > 0$ (c) $v > u, y > 0$ (d) $v = u, y < 0$