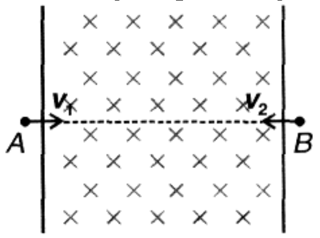
DPP – 3 (Magnetic Field & Force)

Video Solution on Website:- https://physicsaholics.com/home/courseDetails/97

Video Solution on YouTube:- https://youtu.be/AlqRysIjOXs

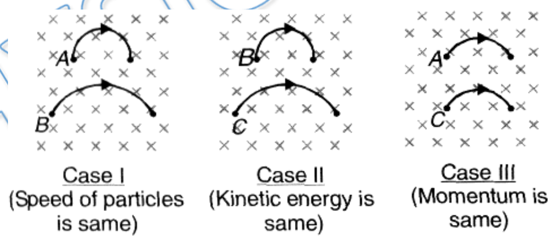
Written Solution on Website:- https://physicsaholics.com/note/notesDetalis/51

Q 1. Two particles A and B of same mass and having charges of same magnitude but of opposite nature are thrown in a region of magnetic field (as shown) with speeds v_1 and v_2 ($v_1 > v_2$). At the time particle A escapes out of the magnetic field, angular momentum of particle B w.r.t. particle A is proportional to (Assume both the particles escape in the region from where they respectively entered the field)



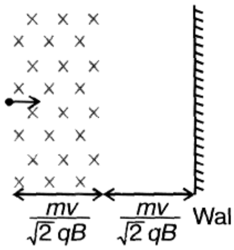
(a) $v_1 + v_2$
(b) $v_1 - v_2$
(c) $v_1^2 - v_2^2$
(d) $v_1^2 + v_2^2$

Q 2. Trajectories of three particles A , B and C projected perpendicular to a uniform transverse magnetic field in three different cases are shown in figure. A, B and C can be



(a) ${}^1_1H$, ${}^4_2He$, ${}^2_1H$
(b) ${}^1_1H$, ${}^2_1H$, ${}^4_2He$
(c) ${}^2_1H$, ${}^4_2He$, ${}^1_1H$
(d) ${}^4_2He$, ${}^1_1H$, ${}^2_1H$

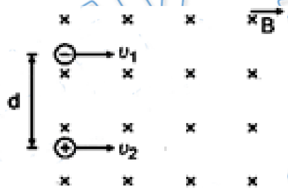
Q 3. A particle of mass m and charge q enters a region of magnetic field (as shown) with speed v. There is a region in which the magnetic field is absent, as shown. The particle after entering the region collides elastically with a rigid wall. Time after which the velocity of particle becomes antiparallel to its initial velocity is



(a) $\frac{m}{2qB}(\pi+4)$ (b) $\frac{m}{qB}(\pi+2)$
(c) $\frac{m}{4qB}(\pi+2)$ (d) $\frac{m}{4qB}(2\pi+3)$

Q 4. A uniform magnetic field $\vec{B} = B_0\hat{j}$ exists in space. A particle of mass m and charge q is projected towards negative x-axis with speed v from a point (d 0, 0). The maximum value of v for which the particle does not hit the y-z plane is:
(a) $\frac{2Bq}{dm}$ (b) $\frac{Bqd}{m}$ (c) $\frac{Bq}{2dm}$ (d) $\frac{Bqd}{2m}$

Q 5. Two identical particles having the same mass m and charges +q and -q separated by a distance d enter in uniform magnetic field B directed perpendicular to paper inwards with speeds v_1 and v_2 as shown in figure. The particles will not collide if: (Ignore electrostatic force)

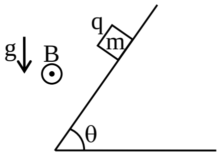


(a) $d > \frac{m}{Bq}(v_1+v_2)$ (b) $d < \frac{m}{Bq}(v_1+v_2)$
(c) $d < \frac{2m}{Bq}(v_1+v_2)$ (d) $v_1 = v_2$

Q 6. A charged particle having charge q experience a force $\vec{F}_1 = q(-\hat{j}+\hat{k})$ N in a magnetic field $\vec{B}$ when it has a velocity $\vec{v}_1 = 1\hat{\imath}$ m/s. The force becomes $\vec{F}_1 = q(\hat{\imath}-\hat{k})$ N when the velocity is changed to $\vec{v}_2 = 1\hat{j}$ m/s. The magnetic induction vector at that point is :
(a) $(\hat{\imath}+\hat{j}+\hat{k})T$ (b) $(\hat{\imath}-\hat{j}-\hat{k})T$
(c) $(-\hat{\imath}-\hat{j}+\hat{k})T$ (d) $(\hat{\imath}+\hat{j}-\hat{k})T$

Q 7. A charged particle is projected with velocity v_0 along positive x-axis. The magnetic field B is directed along negative z-axis between x = 0 and x = L. The particle emerges out (at x = L) at an angle of 60° with the direction of projection. Find the velocity with which the same particle is projected (at x =0) along positive x-axis so that when it emerges out (at x = L), the angle made by it is 30° with the direction of projection:
(a) $2v_0$ (b) $v_0/2$ (c) $v_0/\sqrt{3}$ (d) $v_0\sqrt{3}$

Q 8. A block of mass m & charge q is released on a long smooth inclined plane. Magnetic field B is constant, uniform, horizontal and parallel to surface as shown. Find the time from start when block loses contact with the surface –



(a) $\frac{m\cos\theta}{qB}$ (b) $\frac{m\,cosec\theta}{qB}$

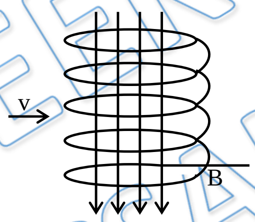
(c) $\frac{m\cot\theta}{qB}$ (d) none of these

Q 9. Two particles of charges +Q and –Q are projected from the same point with a velocity v in a region of uniform magnetic field B such that the velocity vector makes an angle θ with the magnetic field. Their masses are M and 2M, respectively. Then, they will meet again for the first time at a point whose distance from the point of projection is-

(a) 2πMv cos θ/QB (b) 8 π Mv cos θ /QB

(c) π Mv cos θ /QB (d) 4 π Mv cos θ /QB

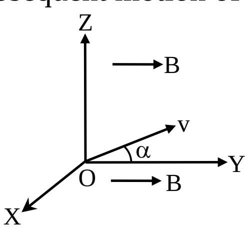
Q 10. A direct current flowing through the winding of a long cylindrical solenoid of radius R produces in it a uniform magnetic field of induction $\vec{B}$. An electron flies into the solenoid along the radius between its turns (at right angles to the solenoid axis) at a velocity $\vec{v}$ (Figure). After a certain time, the electron deflected by the magnetic field leaves the solenoid. Determine the time *t* during which the electron moves in the solenoid.



(a) $\frac{m}{eB}\tan^{-1}\frac{eBR}{mv}$ (b) $\frac{2m}{eB}\tan^{-1}\frac{eBR}{mv}$

(c) $\frac{m}{eB}\tan^{-1}\frac{mv}{eBR}$ (d) $\frac{2m}{eB}\tan^{-1}\frac{mv}{eBR}$

Q 11. In a region of space, a uniform magnetic field B exists in the y-direction. A proton is fired from the origin, with its initial velocity v making a small angle α with the y-direction in the y-z plane. In the subsequent motion of the proton –



(a) its x-coordinate can never be positive

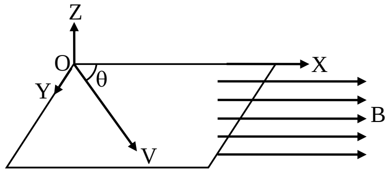
(b) its x-and z-coordinates cannot both be zero at the same time

(c) its z-coordinate can never be negative

(d) its y-coordinate will be proportional to the square of its time of flight

Q 12. A charged particle is moving with constant speed in a horizontal x-y plane in a straight line as shown. Suddenly a uniform magnetic field is switched on parallel to

X-axis, when particle is at origin. What must be the value of θ so that particle passes through point P (L, 0, –H) in the minimum possible time ?



(a) $\theta = \tan^{-1}\left(\frac{\pi H}{2L}\right)$

(b) $\theta = \tan^{-1}\left(\frac{\pi H}{4L}\right)$

(c) $\theta = \tan^{-1}\left(\frac{\pi H}{3L}\right)$

(d) $\theta = \tan^{-1}\left(\frac{2\pi H}{3L}\right)$

Q 13. A charged particle of specific charge (charge/mass) α is released from origin at time t =0 with velocity $\vec{v} = v_0(\hat{\imath} + \hat{\jmath})$ in uniform magnetic field $\vec{B} = -B_0\hat{\imath}$. Co-ordinates of the particle at time t = $\frac{\pi}{B_0\alpha}$ are :

(a) $\left(\frac{v_0}{2B_0\alpha}, \frac{\sqrt{2}v_0}{\alpha B_0}, \frac{-v_0}{B_0\alpha}\right)$ (b) $\left(\frac{-v_0}{2B_a\alpha}, 0, 0\right)$

(c) $\left(0, \frac{2v_0}{B_0\alpha}, \frac{v_0\pi}{2B_0\alpha}\right)$ (d) $\left(\frac{v_0\pi}{B_0\alpha}, 0, \frac{-2v_0}{B_0\alpha}\right)$

Q 14. Two very long straight parallel wires carry steady currents i and 2i in opposite directions. 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 $\vec{v}$ is perpendicular to this plane. The magnitude of the force due to the magnetic field acting on the charge at this instant is:

(a) $\frac{\mu_0 iqv}{2\pi d}$ (b) $\frac{\mu_0 iqv}{\pi d}$ (c) $\frac{3\mu_0 iqv}{2\pi d}$ (d) zero

Answer Key

Q.1 c	**Q.2 a**	**Q.3 a**	**Q.4 b**	**Q.5 c**
Q.6 a	**Q.7 d**	**Q.8 c**	**Q.9 d**	**Q.10 b**
Q.11 a	**Q.12 a**	**Q.13 d**	**Q.14 d**	