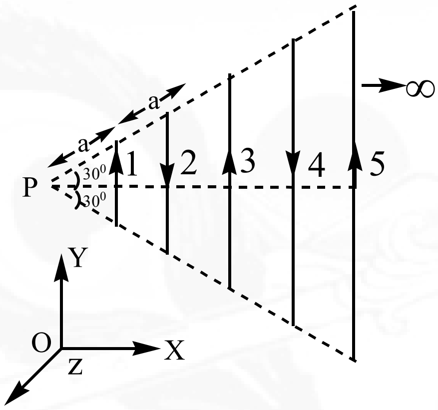
PHYSICS

1. Infinite number of straight wires each carrying current I are equally placed as shown in fig. Adjacent wires have current in opposite direction. Net magnetic field at point P is



1) $\frac{\mu_0 I \log_e 2}{4\pi\sqrt{3}a}\hat{K}$ 2) $\frac{\mu_0 I \log_e 4}{4\pi\sqrt{3}a}\hat{K}$ 3) $\frac{\mu_0 I \log_e 4}{2\pi\sqrt{3}a}\left(-\hat{K}\right)$ 4) Zero

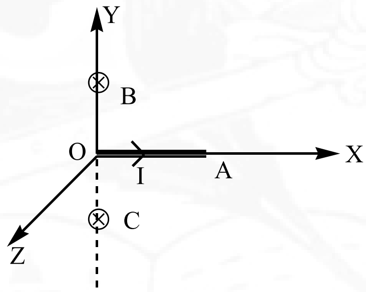
2. A thin isolated wire forms a plane spiral consisting of a large number N of closely packed turns through which a direct current I is flowing. The radii of the internal and external loops are a and b. The magnetic moment of the spiral for the given current is

1) $\frac{\pi N I}{3}\left(a^2+b^2\right)$ 2) $\frac{\pi NI}{b+a}\frac{\left(b^3-a^3\right)}{3}$ 3) $\frac{\pi N I}{3}\left(a^2+ab+b^2\right)$ 4) $\frac{\pi N I}{b-a}\frac{\left(b^3+a^3\right)}{3}$

3. A beam of protons with a velocity $4\times10^5 m/s$ enters a uniform magnetic field of 0.3 tesla at an angle of 60^0 to the magnetic field. The pitch of the helical path taken by the proton beam in magnetic field is $\left[m_p = 1.67\times10^{-27} kg\right]$

1) 4.38 cm 2) 2.19 cm 3) 21.9 cm 4) 0.44 cm

4. A straight wire OA of length l carrying a current I is placed along x – axis. Two infinitely long straight wires B and C each extending from z = - ∞ to + ∞ are fixed at y = - a and y = + a respectively, as shown in given figure. If the wires B and C each carry a current I into the plane of the paper, the force acting on the wire OA will be



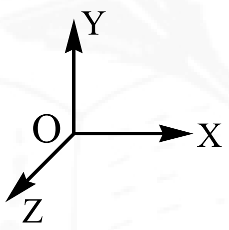
1) $\left[\frac{\mu_0 I^2}{2\pi}\log_e\left(\frac{\ell^2+a^2}{a^2}\right)\right]\left(-\hat{k}\right)$ 2) $\left[\frac{\mu_0 I^2}{4\pi}\log_e\left(1-\frac{\ell^2}{a^2}\right)\right]\left(-\hat{k}\right)$

3) $\left[\frac{\mu_0 I^2}{2\pi}\log_e\left(1+\frac{4\ell^2}{a^2}\right)\right]\left(+\hat{k}\right)$ 4) $\left[\frac{\mu_0 I^2}{4\pi}\log_e\left(\frac{4\ell^2-a^2}{a^2}\right)\right]\left(-\hat{k}\right)$

5. Earth's magnetic field at a place is 0.36 G, and the angle of dip is 30^0. A telephone cable at that place has four long straight horizontal wires carrying a current of 1.0 A each in the same direction east to west. The magnetic declination is nearly zero. The resultant magnetic fields at points 4.0 cm below the cable is (nearly)

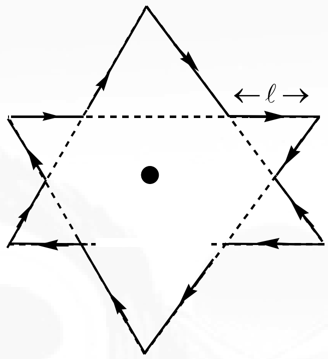
1) 0.54 G 2) 0.21 G 3) 0.32 G 4) 0.36G

6. A long straight wire along the z-axis carries a current in the negative z-direction. The magnetic field vector $\vec{B}$ at a point having coordinates (x, y) in the z = 0 plane is



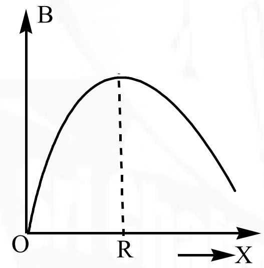
1) $\frac{\mu_0 I\left(y\hat{i}-x\hat{j}\right)}{2\pi\left(x^2+y^2\right)}$ 2) $\frac{\mu_0 I\left(x\hat{i}+y\hat{j}\right)}{2\pi\left(x^2+y^2\right)}$ 3) $\frac{\mu_0 I\left(x\hat{j}-y\hat{i}\right)}{2\pi\left(x^2+y^2\right)}$ 4) $\frac{\mu_0 I\left(x\hat{j}+y\hat{i}\right)}{2\pi\left(x^2+y^2\right)}$

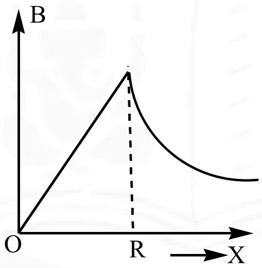
7. A star shaped loop (with l = length of each section) carries current I, as shown in given figure. Magnetic field at the centroid of the loop is

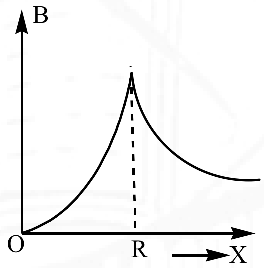


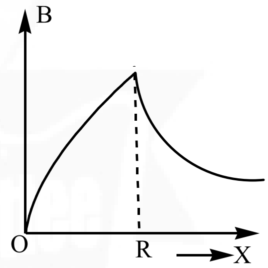
1) $\frac{3\mu_0 i}{\pi \ell}$ 2) $\frac{3\mu_0 i}{2\pi \ell}$ 3) $\left(3-\sqrt{3}\right)\frac{\mu_0 i}{\pi \ell}$ 4) $\left(3+\sqrt{3}\right)\frac{\mu_0 i}{2\pi \ell}$

8. A current passes through a straight cylindrical conductor of radius R, uniformly distributed over its cross section. The variation of magnetic field B along a transverse distance x from the axis of conductor is shown in the given curves. Choose the correct option.

1) 

2) 

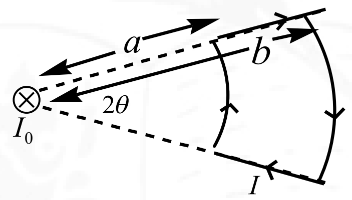


4) 

9. A circular loop of radius r carrying a current I is held at the centre of another circular loop of radius R, (R >>r), bigger loop carries current I_0. The plane of smaller loop makes an angle of 30^0 with the plane of bigger loop. If the smaller loop is held fixed in this position by applying a single force F at a point on its periphery. The maximum magnitude of this force would be

1) $\frac{\mu_0 \pi I I_0 r}{4R}$ 2) $\frac{\mu_0 \pi I I_0 r^2}{2R^2}$ 3) $\frac{\mu_0 \pi I\ I_0 r}{2R}$ 4) $\frac{\mu_0 I\ I_0 r}{2\pi R}$

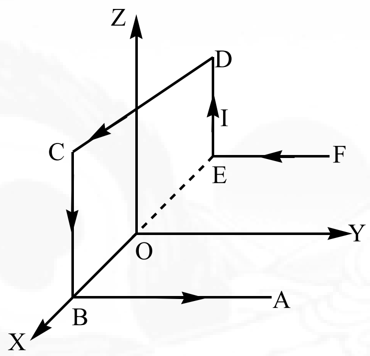
10. A loop with current I is in the field of a long straight wire with current I_0. The plane of the loop is perpendicular to the straight wire. The moment of Ampere's forces acting on this loop is, (dimensions of the system is shown in figure)



1) $\frac{\mu_0 I I_0 (b-a)\sin\theta}{2\pi}$ 2) $\frac{\mu_0 I I_0 (b-a)\cos\theta}{4\pi}$

3) $\frac{3\mu_0 I I_0 (b-a)\sin\theta}{2\pi}$ 4) $\frac{\mu_0 I I_0 (b-a)\sin\theta}{\pi}$

11. A wire ABCDEF with each side of length L bent as shown in given figure and carrying a current I is placed in a uniform magnetic field B parallel to positive Y-direction. The force experienced by the wire is

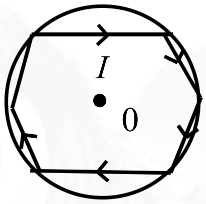


1) BIL along +Z direction
2) 2BIL along +Y direction
3) 4BIL Along + X direction
4) BIL along +X direction

12. The number of turns per unit length of a solenoid is 900 per meter. Solenoid has a core of a material with relative permeability 500. The windings of the solenoid are insulated from the core and carry a current of 2 amp. Magnetization M of the material of the core of solenoid is (nearly)

1) $4\times10^{5} A/m$ 2) $2\times10^{5} A/m$ 3) $9\times10^{5} A/m$ 4) $6\times10^{5} A/m$

13. A current I flows along a thin wire shaped as a regular polygon with n sides which can be inserted in a circle of radius R. the magnitude of magnetic field at the centre of polygon is



1) $\frac{\mu_0 nI}{2R}\sin\frac{\pi}{n}$ 2) $\frac{\mu_0 nI}{2\pi R}\tan\frac{\pi}{n}$ 3) $\frac{\mu_0 nI}{4\pi R}\tan\frac{\pi}{n}$ 4) $\frac{\mu_0 nI}{4R}\sin\frac{\pi}{n}$

14. A charged particle moves in a region with velocity, $\vec{V}=\hat{i}+3\hat{j}$. At a point in that region, it produces an electric fields given by $\vec{E}=2\hat{k}$, the magnetic field at that point will be. (c= velocity of light)

1) $\frac{1}{c^2}\left(6\hat{i}-2\hat{j}\right)$ 2) $\frac{1}{c^2}\left(2\hat{i}-6\hat{j}\right)$ 3) $c^2\left(2\hat{i}+6\hat{j}\right)$ 4) $\frac{1}{c^2}\left(6\hat{i}+2\hat{j}\right)$

15. A proton moving with velocity $\vec{V_1} = 2\hat{i}$ m/s at a point in a magnetic field experiences a magnetic force $\vec{F_1} = 2\hat{j}$N, if the proton is moving with a velocity $\vec{V_2} = 2\hat{j}m/s$ at the same point, it experiences magnetic force $\vec{F_2} = +2\hat{i}N$, if proton were moving with a velocity $\vec{V_3} = 2\hat{k}\,m/s$ at the same point then magnetic force acting on the proton at that point will be

1) $2\hat{k}\,N$ 2) $1\hat{k}\,N$ 3) zero N 4) $2\hat{i}\,N$

16. Two mutually perpendicular conductors carrying currents I_1 *and* I_2 lie in one plane. Locus of the point at which the magnetic induction is zero, is a

1) Circle with centre as the point of intersection of the conductors

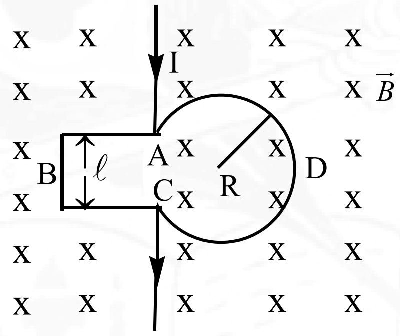
2) Parabola with vertex as the point of intersection of the conductors

3) Straight line passing through the point of intersection of the conductors

4) Rectangular hyperbola

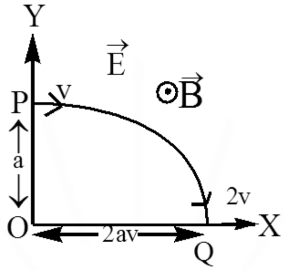
17. The figure shows a conducting loop ABCDA placed in a uniform magnetic field perpendicular to its plane. The part ABC is 3/4th portion of the square of side length 'l'. The part ADC is a circular are of radius R. The points A and C are connected to a battery which supplies a current I to the circuit.

The magnetic force on the loop due to the file B is



1) Zero 2) BIl 3) BI2R 4) $\frac{BI\ell R}{\ell + R}$

18. A particle of charge +q and mass m moving under the influence of a uniform electric field $E\hat{i}$ and a uniform magnetic field $B\hat{k}$ follows a trajectory from P to Q as shown in given figure. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$. For the given situation four statements are given



A) $E = \frac{3}{4}\left(\frac{mv^2}{qa}\right)$

B) Rate of work done by the electric field at P is $\frac{3}{4}\left(\frac{mv^3}{a}\right)$

C) Rate of work done by the electric field at P is zero

D) Rate of work done by both the fields at Q is zero

Choose the correct statement (s)

1) A and B only
2) A, C and D only
3) A, B and D only
4) A and C only

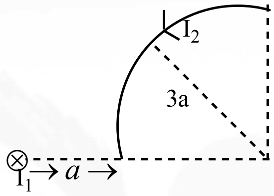
19. A sample of paramagnetic salt containing 1.8×10^{24} atomic dipoles each of dipole moment $1.5\times10^{-23}JT^{-1}$, is placed under a homogenous magnetic field of 0.60 T and cooled to a temperature of 4.2K. the degree of magnetic saturation achieved is equal to 20%. Find total dipole moment of this sample for a magnetic field of 0.96 T and a temperature of 3.0 K, considering validity of curies's law.

1) $21.8JT^{-1}$ 2) $12.1\ JT^{-1}$ 3) $18.4\ JT^{-1}$ 4) $55.2\ JT^{-1}$

20. The coil of a moving coil galvanometer having area (0.02 x 0.08) m^2 consists of 200 turns and is suspended in a radial magnetic field of 0.2 T. If the restoring couple per unit twist of suspension fiber is 10^{-6} Nm per degree. What is the maximum current that can be measured by this galvanometer, if the scale can give maximum deflection of 30^0

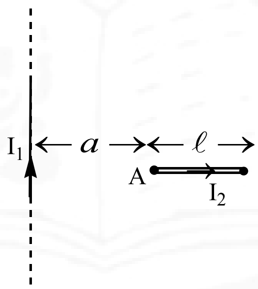
1) $4.69\times10^{-4}A$ 2) $2.35\times10^{-4}A$ 3) $4.69\times10^{-3}A$ 4) $7.81\times10^{-6}A$

21. A long straight wire carrying current I_1 is situated perpendicular to the plane of paper A thin wire bent in the form of a quarter ring of radius 3a is situated near to long straight wire, in the plane of paper as shown in given figure through which I_2 current is flowing. Find the force acting on the quarter ring.



1) $\frac{\mu_0 I_1 I_2}{2\pi}\log_e 5$ 2) $\frac{\mu_0 I_1 I_2}{2\pi}\log_e \frac{5}{3}$ 3) $\frac{\mu_0 I_1 I_2}{2\pi}\log_e 4$ 4) $\frac{\mu_0 I_1 I_2}{2\pi}\log_e 2$

22. A straight uniform thin rod of mass m, Length l, carrying a current I_2 is placed near an infinitely Long wire carrying current I_1 as shown in given figure. Rod is free to rotate about one of its ends, A as shown in given figure. Angular acceleration of rod is found to be $\frac{n\mu_0 I_1 I_2}{4\pi m\ell^2}\left[\ell - a\log_e\left(\frac{a+\ell}{a}\right)\right]$. The value of n is



1) 3 2) 4 3) 2 4) 6

23. Three straight long parallel conductors namely A, B and C carry currents 2, 3 and 4A respectively. The distance between A and C is 20 cm. If all the conductors carry current in the same direction, find where should B be placed so that the net force acting on it may be zero.

1) $\frac{20}{3}$ cm from A 2) $\frac{20}{3}$ cm from C 3) $\frac{10}{3}$ cm from A 4) $\frac{10}{3}$ cm from C

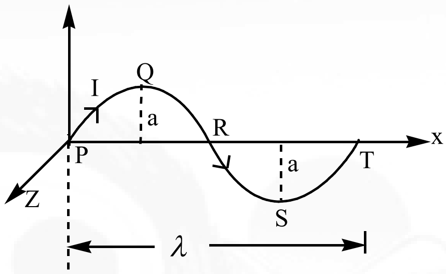
24. A beam of collimated cathode rays travelling with a speed of $2.5\times10^{6} m/s$ enter a region of crossed electric and magnetic fields and emerge undeviated from this region . If B = 0.04 T, the magnitude of electric field is

1) $2.5\times10^{8} V/m$ 2) $1.25\times10^{10} V/m$ 3) $2\times10^{3} V/m$ 4) $10^{5} V/m$

25. A coil of moving coil galvanometer has area of cross section $2\times10^{-3} m^{2}$ and number of turns 100. It is suspended in a radial magnetic field of 0.5T with a suspension wire of restoring couple per unit twist 10^{-2} Nm/degree. The current sensitivity of the galvanometer is

1) 10 degree / A 2) 20 degree / A 3) 50 degree / A 4) 25 degree / A

26. A conductor PQRST shaped as shown, carries a current I. It is placed in the xy plane with the ends P and T on the x – axis. A uniform magnetic field of magnitude B exists in the region. The force acting on it will be



1) zero, if B is in the y – direction

2) λ BI in Z direction if B is in the y – direction

3) λ BI in Y direction if B is in the z – direction

4) 2aBI, if B is in the x – direction.

27. A horizontal straight conductor of mass m and Length l is placed in a uniform vertical magnetic field of magnitude B. An amount of charge Q passed through the rod in a very short time such that the conductor begins to move only after all the charges has passed through it. Its initial velocity will be

1) B Q l m 2) $\frac{BQ}{\ell m}$ 3) $\frac{BQ\ell}{m}$ 4) $\frac{B\ell}{mQ}$

28. On a smooth inclined plane of inclination 60^0 with horizontal, a horizontal rod parallel to the edge of inclined plane is kept. The mass of rod is 10 gm and length is 9.8 cm. The current passing through rod is $\sqrt{3}$ amp. To keep the rod stationary on the plane, the value of uniform magnetic field induction applied vertically downwards will be

1) 1T   2) 3T   3) $\sqrt{3}$ T   4) 2T

29. A particle with charge q is projected successively along x-axis and y – axis with the same speed V. The force on the particle in these situations is given by $\overrightarrow{F_1} = VqB\left[\left(-\frac{1}{2}\right)\hat{j} + \left(\frac{\sqrt{3}}{2}\right)\hat{k}\right]$ and $\overrightarrow{F_2} = VqB\left[\left(\frac{1}{2}\right)\hat{i}\right]$ respectively. The direction of the magnetic induction $\vec{B}$ is

1) 30^0 with the y – axis   1) 30^0 with the x – axis

1) 30^0 with the z – axis   4) 60^0 with the x – axis

30. Two identical charged particles enter a uniform magnetic field with same speed but at angles 30^0 and 60^0 with magnetic field. If a, b and c be the ratio of their time periods, radii and pitches of the helical paths then,

1) abc = 1   2) abc > 1   3) abc < 1   4) ab = c