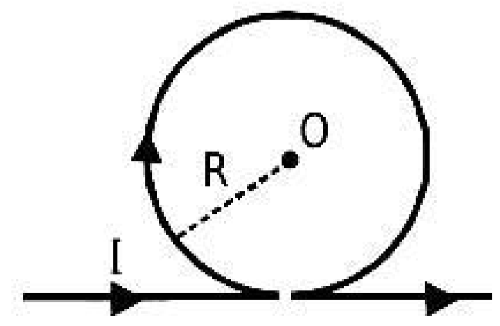
MAGNETIC EFFECTS OF CURRENT, HOME WORK SHEET-1

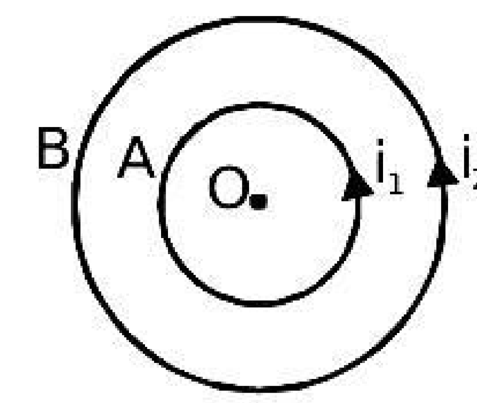
Magnetic Force on Current Carrying Conductor and Magnetic Torque on Current Carrying Loop

1. An infinitely long straight conductor is bent into the shape as shown in figure. It carries a current I ampere and the radius of the circular loop is r meter. Then the magnetic induction at the centre of the circular part is :-



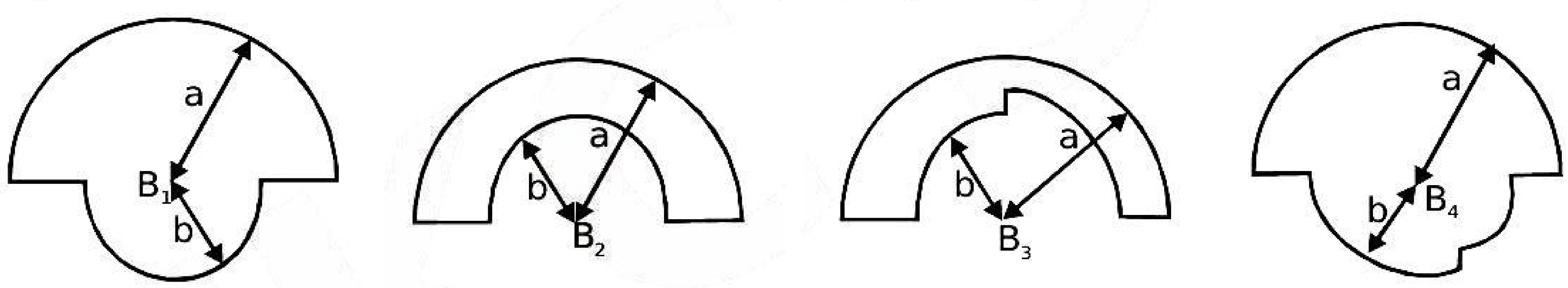
(A) Zero (B) ∞ (C) $\frac{\mu_0}{4\pi}\frac{2I}{r}(\pi+1)$ (D) $\frac{\mu_0}{4\pi}\frac{2I}{r}(\pi-1)$

2. A and B are two concentric circular conductors of centre O and carrying current i_1 and i_2 as shown in the diagram. If ratio of their radii is 1:2 and ratio of the flux densities at O due to A and B is 1:3 then the value of $\frac{i_1}{i_2}$ will be :-



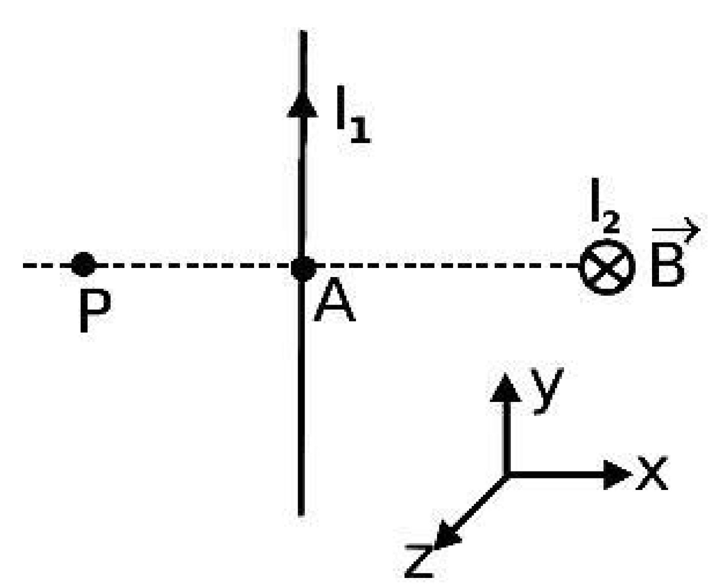
(A) $\frac{1}{2}$ (B) $\frac{1}{3}$ (C) $\frac{1}{4}$ (D) $\frac{1}{6}$

3. In the loops shown, all curved sections are either semicircles or quarter circles. All the loops carry the same current. The magnetic fields at the centres have magnitudes B_1, B_2, B_3 and B_4



(A) B_4 is maximum. (B) B_3 is minimum. (C) $B_4 > B_1 > B_2 > B_3$ (D) $B_1 > B_4 > B_3 > B_2$

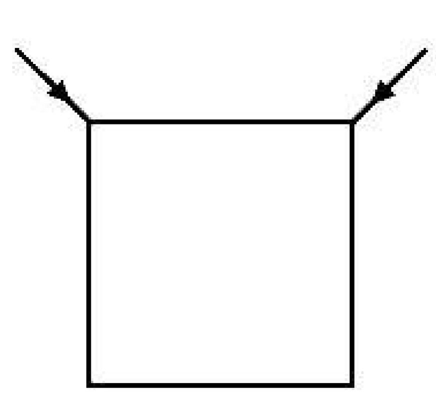
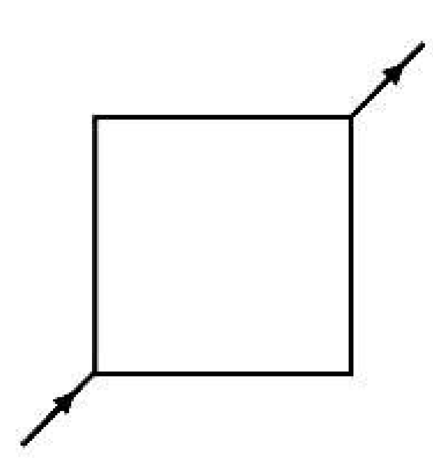
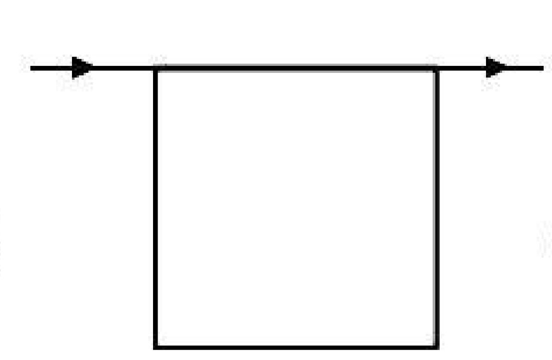
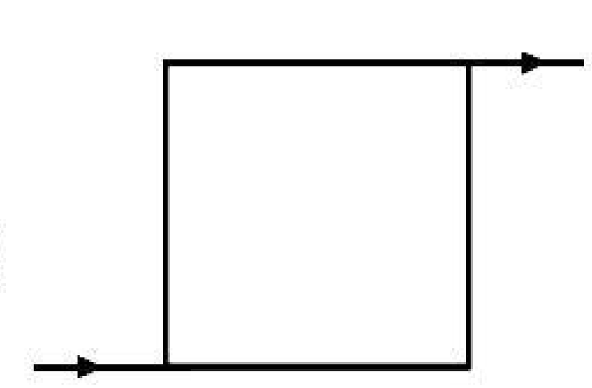
4. Two infinitely long linear conductors are arranged perpendicular to each other and are in mutually perpendicular planes as shown in figure. If I_1=2A along the y-axis and I_2 = 3A along –ve z-axis and AP = AB = 1cm. The value of magnetic field strength $\vec{B}$ at P is



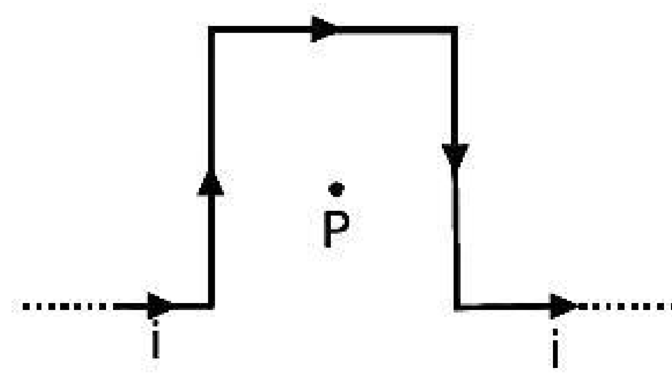
(A) $(3\times10^{-5}\ T)\hat{j} + (-4\times10^{-5}\ T)\hat{k}$ (B) $(3\times10^{-5}\ T)\hat{j} + (4\times10^{-5}\ T)\hat{k}$

(C) $(4\times10^{-5}\ T)\hat{j} + (3\times10^{-5}\ T)\hat{k}$ (D) $(-3\times10^{-5}\ T)\hat{j} + (4\times10^{-5}\ T)\hat{k}$

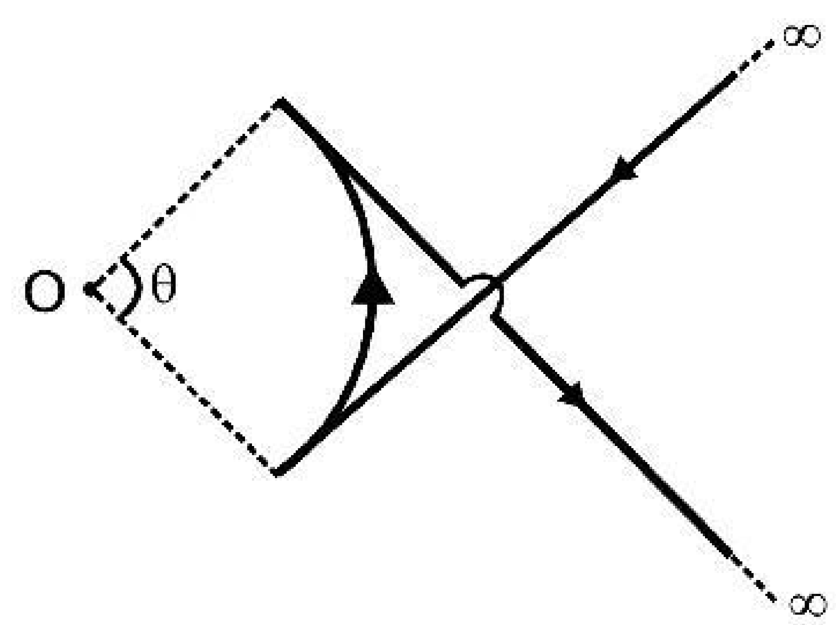
5. Current flows through uniform, square frames as shown. In which case is the magnetic field at the centre of the frame not zero?

(A)  (B)  (C)  (D) 

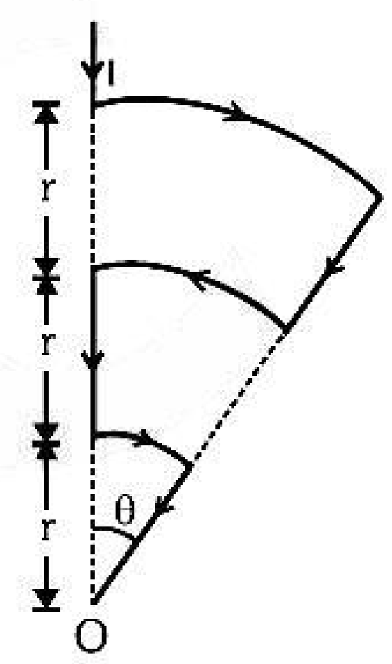
6. Find the magnetic field at the centre P of square of side a shown in figure.



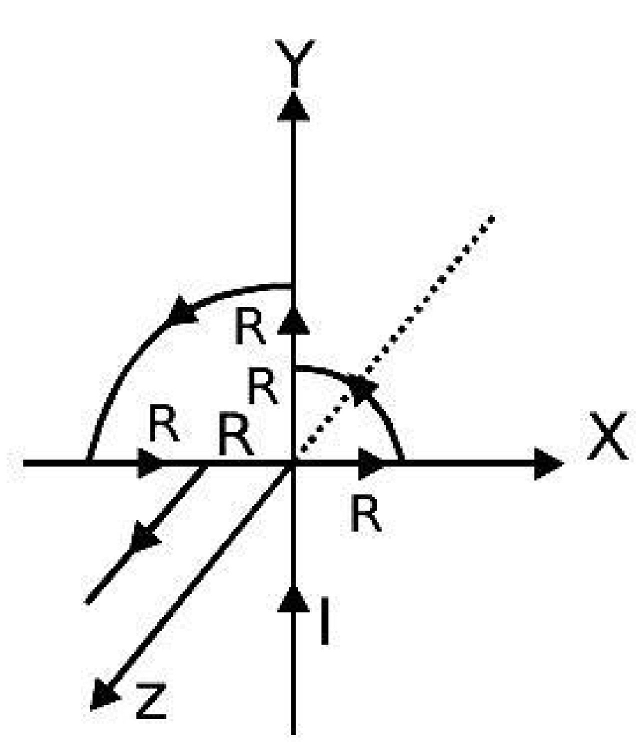
7. If magnetic field at point O is zero then find out the value of θ.



8. A conductor carrying a current I is shown in the figure. Calculate the magnetic field intensity at the point O (common centre of all the three arcs).



18. Find the magnetic induction at the origin in the figure shown.



ANSWERS

HOME WORK SHEET-1

1. D	2. D	3. A	4. B	5. C
6. $\frac{(2\sqrt{2}-1)\mu_0 i}{\pi a}$	7. 2 radian	8. $\frac{5\mu_0 I\theta}{24\pi r}\otimes$	9. $\frac{\mu_0 I}{4R}\left(\frac{3}{4}\hat{k}+\frac{1}{\pi}\hat{j}\right)$	

MAGNETIC EFFECTS OF CURRENT, HOME WORK SHEET-2

Amper's law

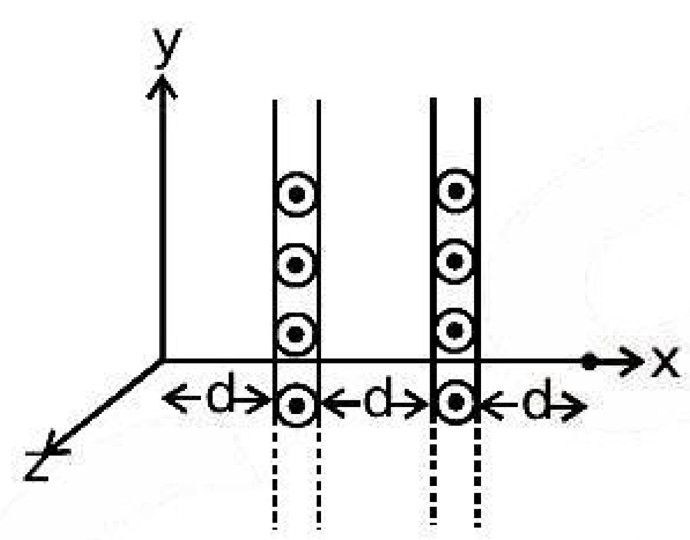
1. A current i A flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is-

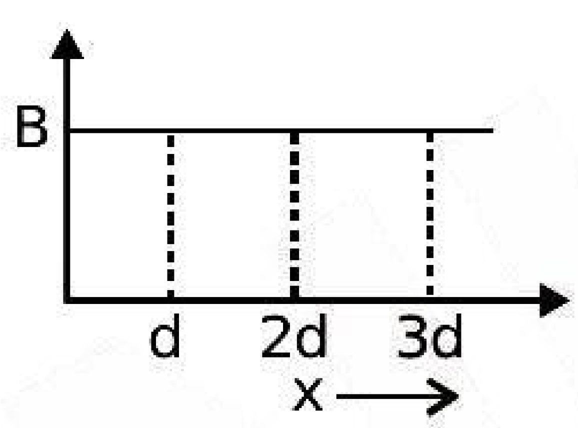
(1) infinite (2) zero (3) $\frac{\mu_0}{4\pi}.\frac{2i}{r}T$ (4) $\frac{2i}{r}T$

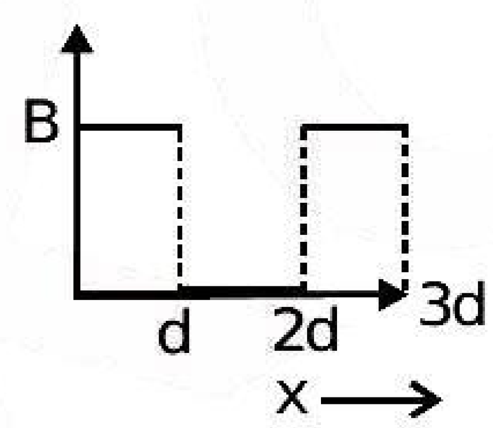
2. A long straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross-section. The ratio of the magnetic field at a/2 and 2a is-

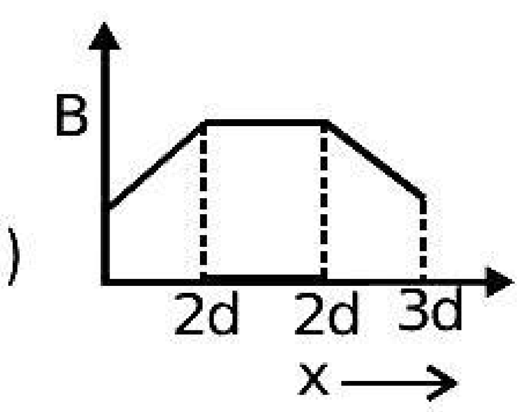
(1) $\frac{1}{4}$ (2) 4 (3) 1 (4) $\frac{1}{2}$

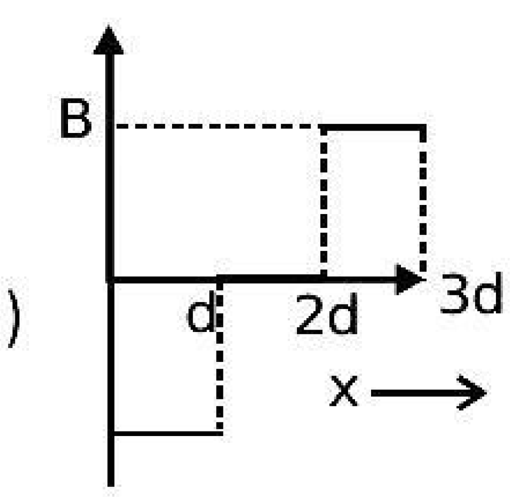
3. Two large conducting current planes perpendicular to x–axis are placed at (d, 0) and (2d, 0) as shown in figure. Current per unit width in both the planes is same and current is flowing in the outward direction. The variation of magnetic induction as function of 'x' ($0 \le x \le 3d$) is best represented by–



(A) 

(B) 

(C) 

(D) 

4. A current I flows along the length of an infinitely long, straight, thin walled pipe. Then-

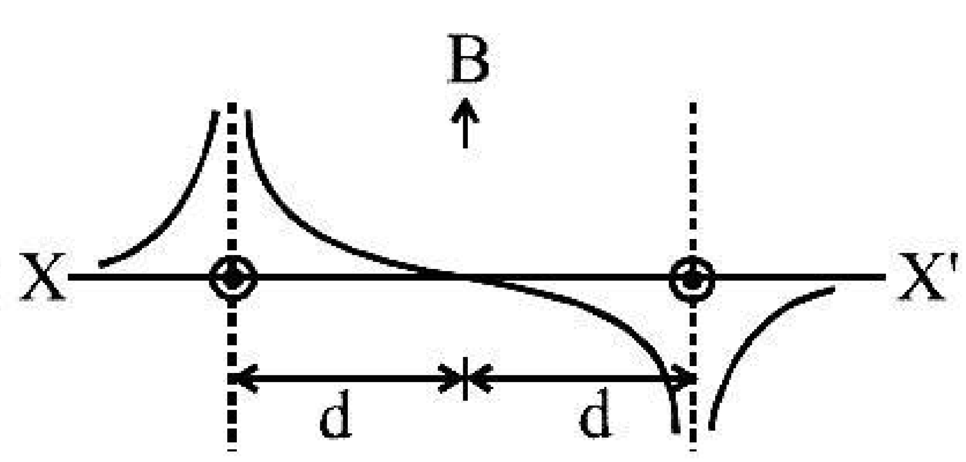
(1) the magnetic field is zero only on the axis of the pipe

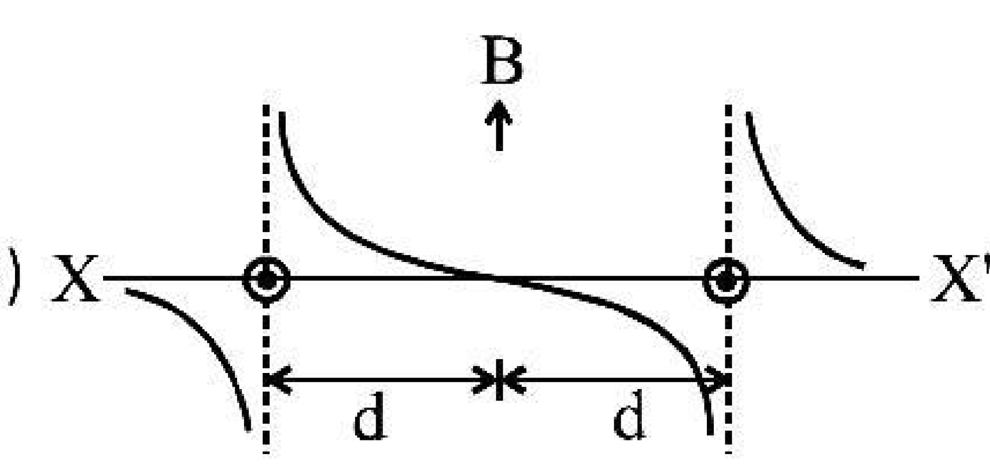
(2) the magnetic field is different at different points inside the pipe

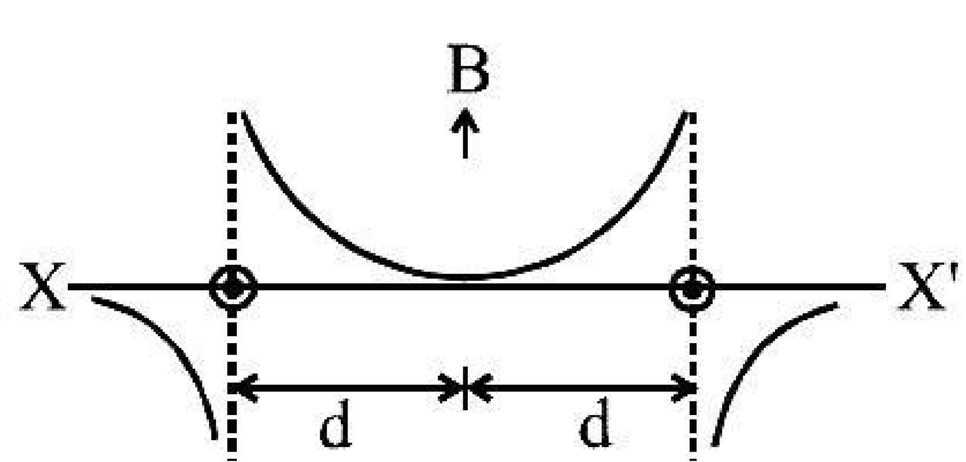
(3) the magnetic field at any point inside the pipe is zero

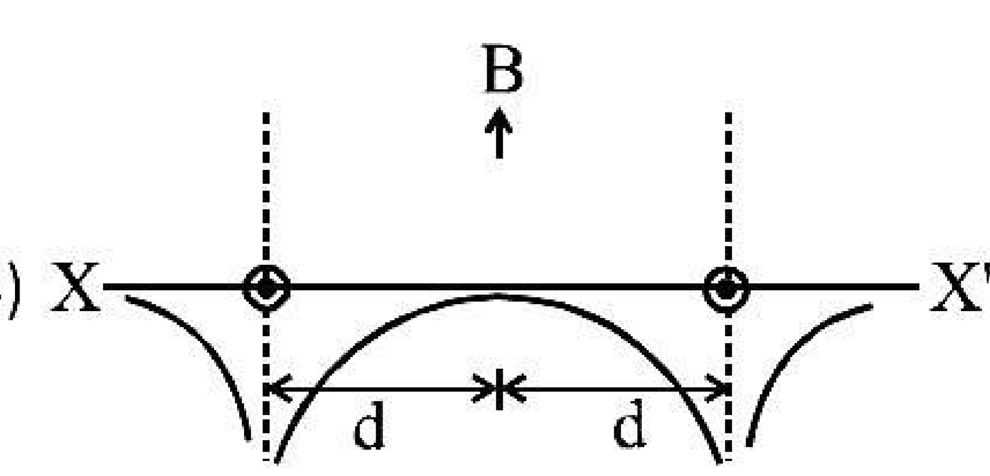
(4) the magnetic field at all points inside the pipe is the same, but not zero

5. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX' is given by:-

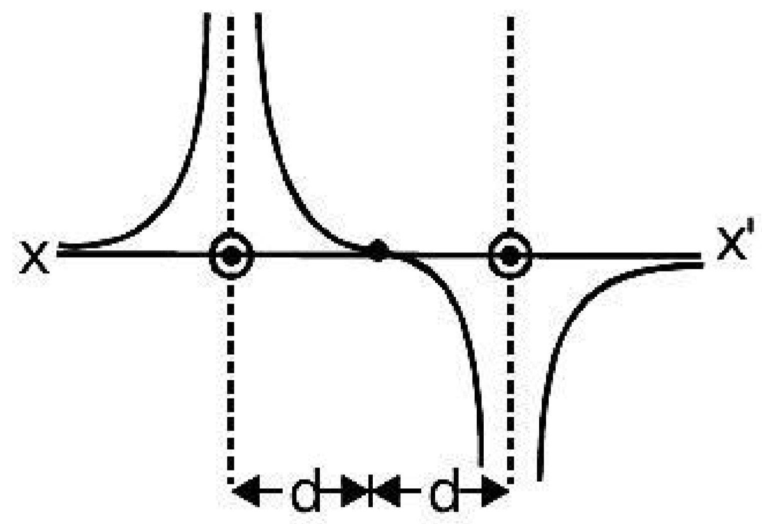
(1) 

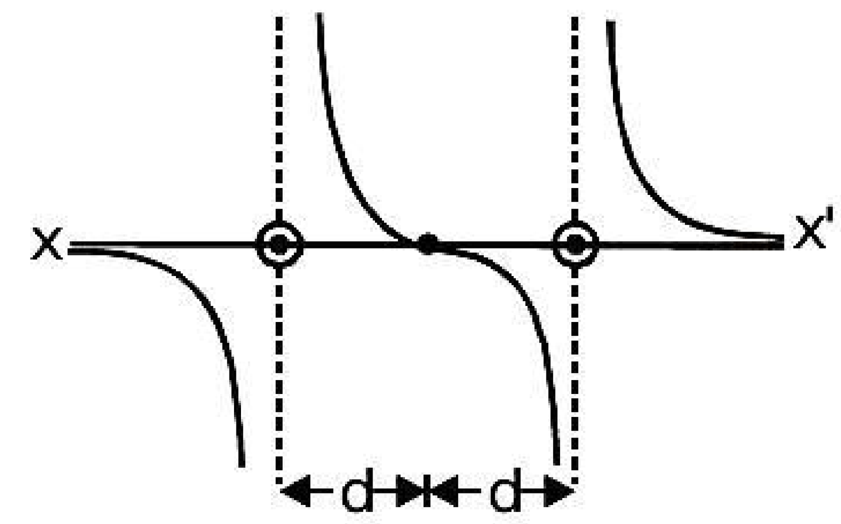
(2) 

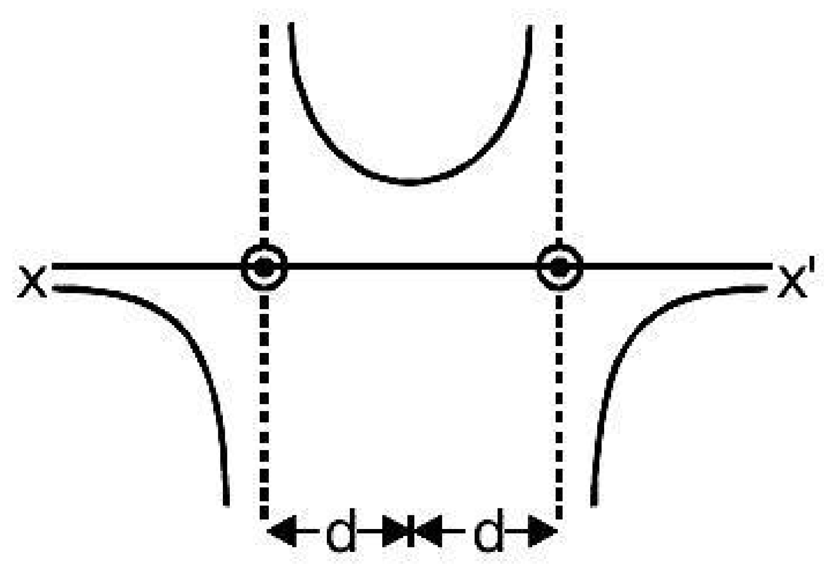
(3) 

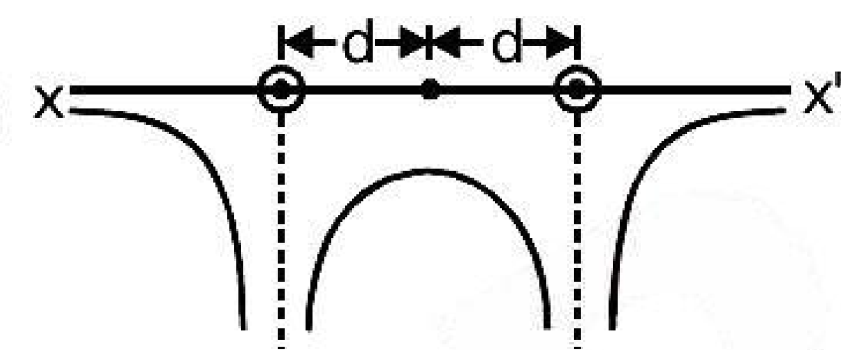
(4) 

6. Two long parallel wires are at a distance 2d apart. They carry steady equal currents flowing out of the plane of the paper as shown. The variation of the magnetic field B along the line XX' is given by :

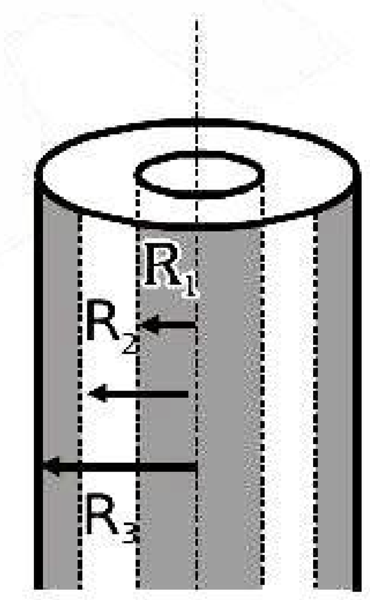
(A)


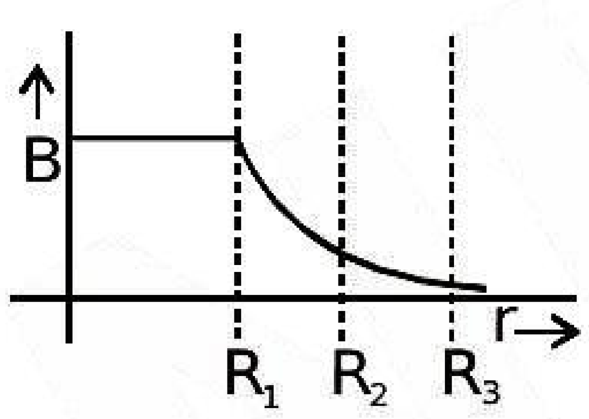
(B)


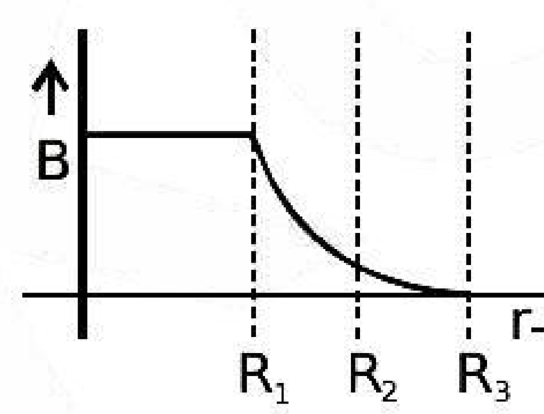
(C)


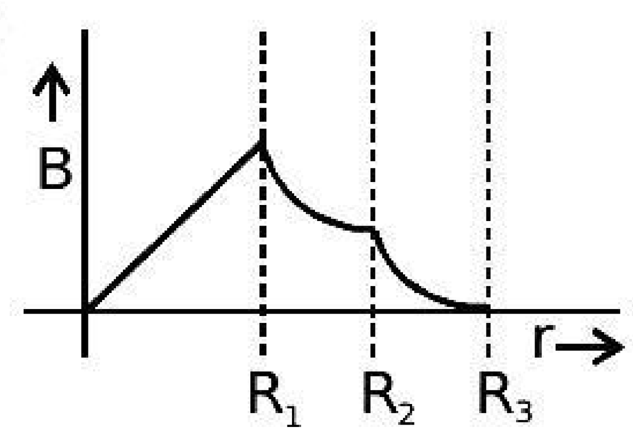
(D)


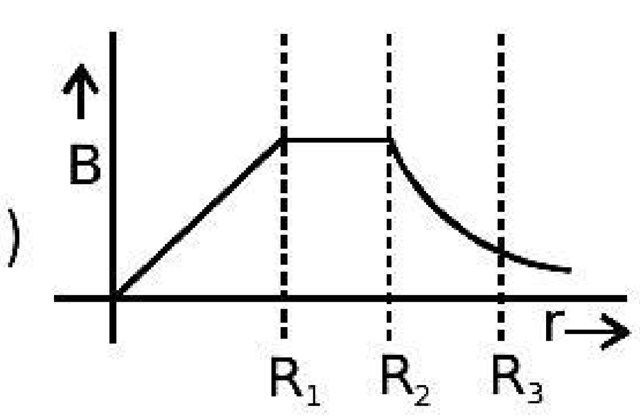
7. A coaxial cable is made up of two conductors. The inner conductor is solid and is of radius R_1 and the outer conductor is hollow of inner radius R_2 and outer radius R_3. The space between the conductors is filled with air. The inner and outer conductors are carrying currents of equal magnitudes and in opposite directions. Then the variation of magnetic field with distance from the axis is best plotted as



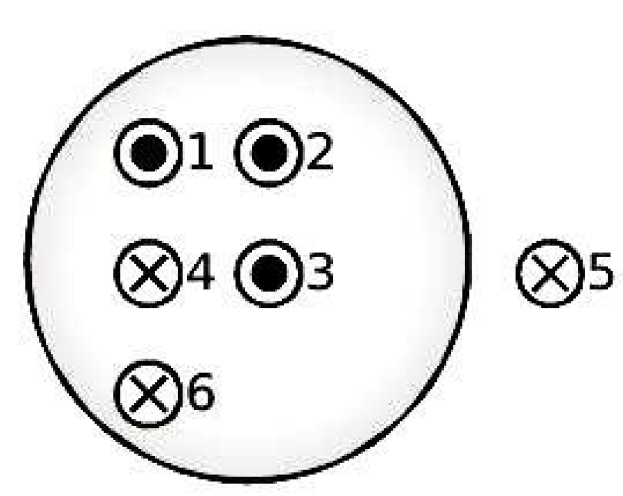
(A)


(B)


(C)


(D)


8. Six wires of current $I_1 = 1A$, $I_2 = 2A$, $I_3 = 3A$, $I_4 = 1A$, $I_5 = 5A$ and $I_6 = 4A$ cut the page perpendicularly at the points 1, 2, 3, 4 and 6 respectively as shown in the figure. Find the value of the integral $\oint \vec{B}.d\vec{\ell}$ around the closed path.



ANSWERS

HOME WORK SHEET-2

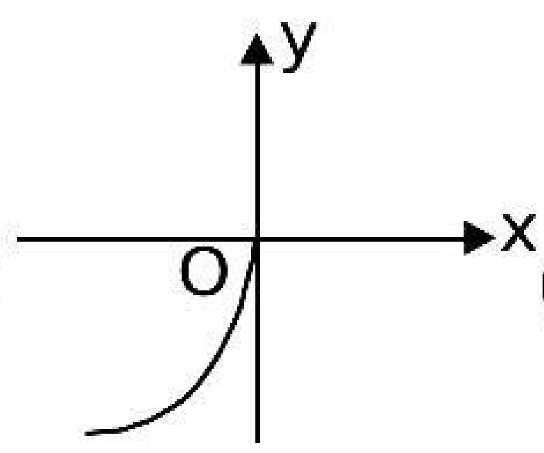
1. B 2. C 3. D 4. C 5. B

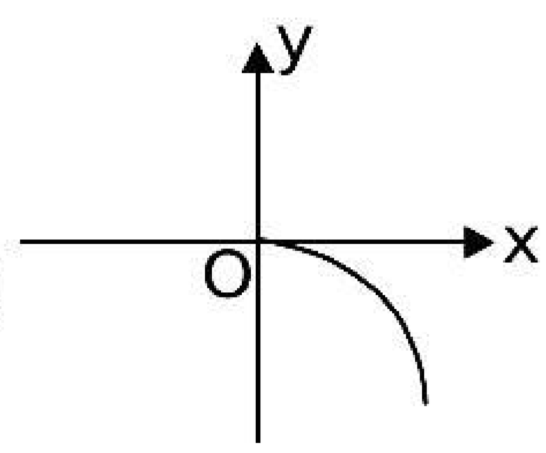
6. B 7. C 8. $\mu_0 \frac{\text{weber}}{\text{meter}}$

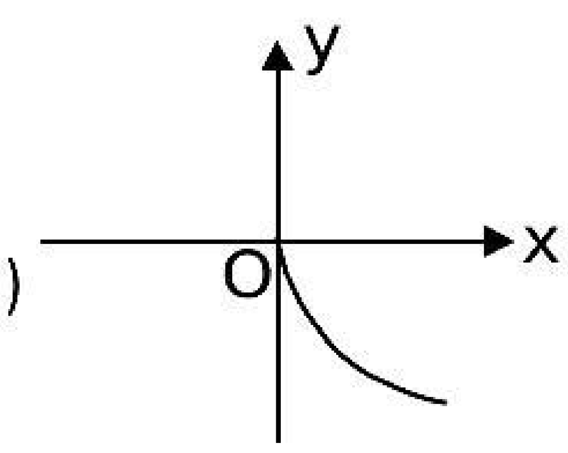
MAGNETIC EFFECTS OF CURRENT, HOME WORK SHEET-3

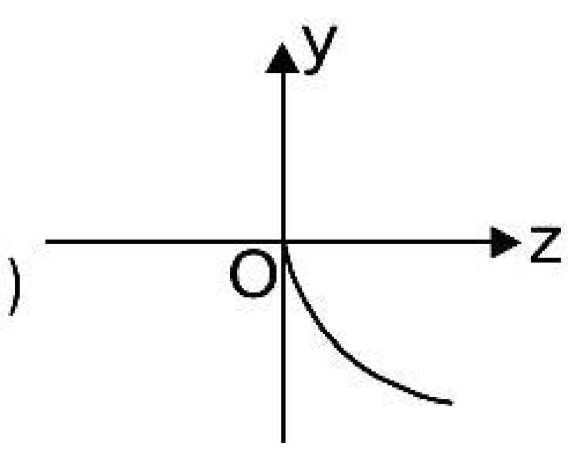
Magnetic Force on Charged Particle

1. In a region of space uniform electric field is present as $\vec{E} = E_0\hat{j}$ and uniform magnetic field is present as $\vec{B} = B_0\hat{k}$. An electron is released from rest at origin. Which of the following best represents the path followed by electron after release.

(A) 

(B) 

(C) 

(D) 

2. A particle of specific charge (charge/mass) α starts moving from the origin under the action of an electric field $\vec{E} = E_0\hat{i}$ and magnetic field $\vec{B} = B_0\hat{k}$. Its velocity at (x_0, y_0, 0) is $(4\hat{i} - 3\hat{j})$. The value of x_0 is

(A) $\frac{13\alpha E_0}{2B_0}$ (B) $\frac{16\alpha B_0}{E_0}$ (C) $\frac{25}{2\alpha E_0}$ (D) $\frac{5\alpha}{2B_0}$

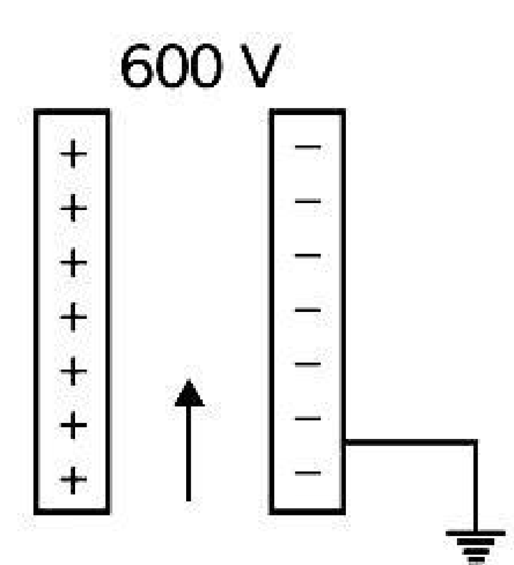
3. A conductor of length ℓ and mass m is placed along the east–west line on a table. Suddenly a certain amount of charge is passed through it and it is found to jump to a height h. The earth's magnetic induction is B. The charge passed through the conductor is

(A) $\frac{1}{Bmgh}$ (B) $\frac{\sqrt{2gh}}{B\ell m}$ (C) $\frac{gh}{B\ell m}$ (D) $\frac{m\sqrt{2gh}}{B\ell}$

4. A charged particle of specific charge α is released from origin at time t = 0 with velocity $\vec{v} = v_0(\hat{i} + \hat{j})$ in uniform magnetic field $\vec{B} = B_0\hat{i}$. Coordinates 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) $\left(\frac{-v_0}{2B_0\alpha}, 0, 0\right)$ (C) $\left(0, \frac{2v_0}{B_0\alpha}, \frac{v_0\pi}{2B_0\alpha}\right)$ (D) $\left(\frac{v_0\pi}{B_0\alpha}, 0, \frac{-2v_0}{B_0\alpha}\right)$

5. A potential difference of 600 V is applied across the plates of a parallel plate condenser. The separation between the plates is 3 mm. An electron projected vertically, parallel to the plates, with a velocity of 2×10^6 m/s moves undeflected between the plates. Find the magnitude and direction of the magnetic field in the region between the condenser plates.
(Neglect the edge effects). (Charge of the electron = 1.6×10^{-19}C)



6. A proton beam passes without deviation through a region of space where there are uniform transverse mutually perpendicular electric and magnetic field with E and B. Then the beam strikes a grounded target. Find the force imparted by the beam on the target if the beam current is equal to I.

ANSWERS

HOME WORK SHEET-3

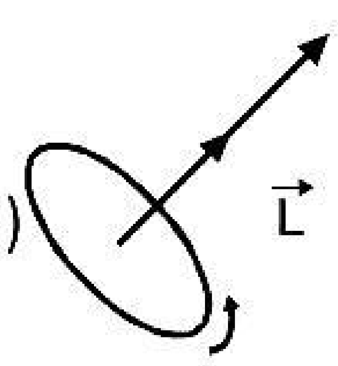
1. C   2. C   3. D   4. D

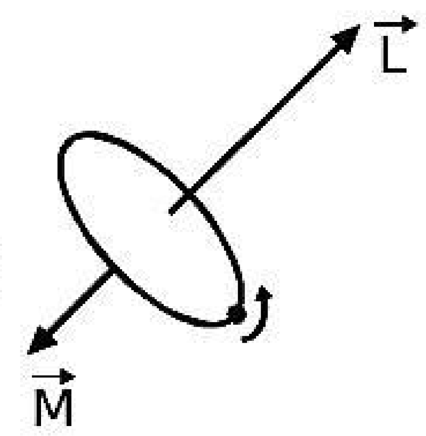
5. 0.1 t (perpendicular to paper inwards)   6. $\frac{mEI}{Be}$

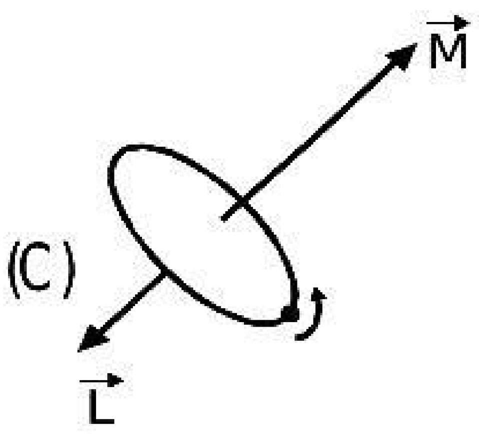
MAGNETIC EFFECTS OF CURRENT, HOME WORK SHEET-4

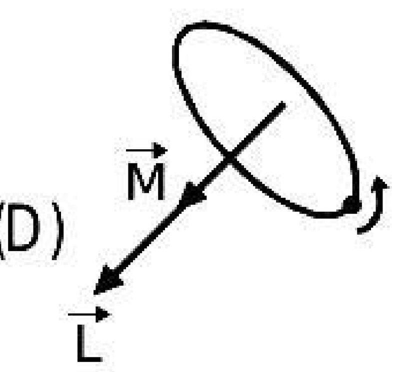
Magnetic Force on Current Carrying Conductor and Magnetic Torque on Current Carrying Loop

1. A negatively charged particle is revolving in a circle of radius r. Out of the following which one figure represents the correct directions of $\vec{L}$ and $\vec{M}$ ($\vec{L}$ is angular momentum of particle; $\vec{M}$ is magnetic moment of the particle).

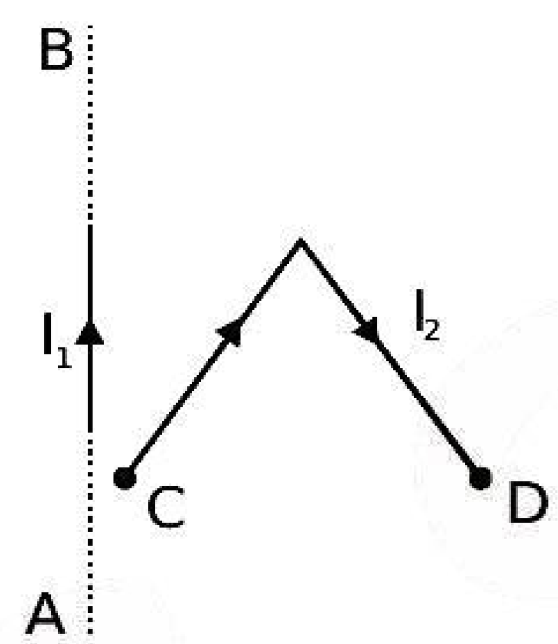
(A) 

(B) 

(C) 

(D) 

2. In the figure shown a current I_1 is established in the long straight wire AB. Another wire CD carrying current I_2 is placed in the plane of the paper. The line joining the ends of this wire is perpendicular to the wire AB. The force on the wire CD is

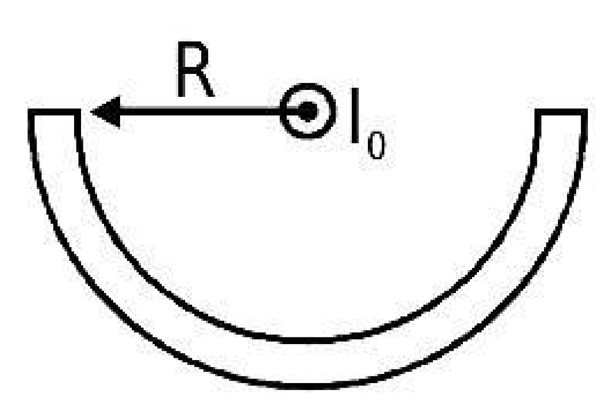


(A) zero (B) towards left (C) directed upwards (D) none of these

3. A magnetic needle lying parallel to a magnetic field requires W unit of work to turn it through 60°. The torque needed to maintain the needle in this position will be–

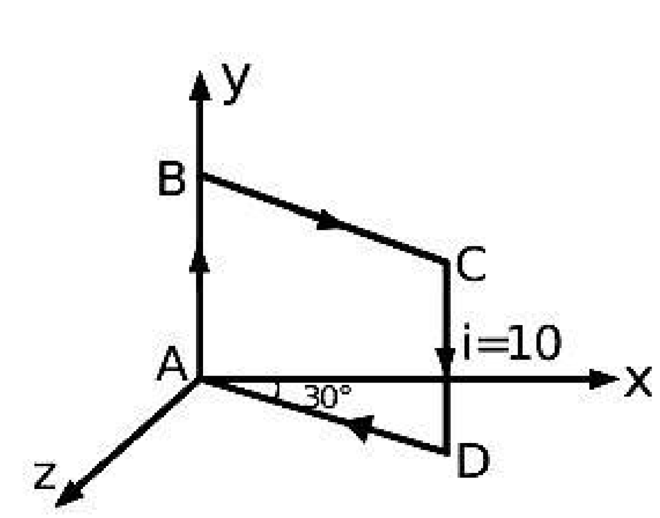
(A) $\sqrt{3}$ W (B) W (C) $(\sqrt{3}/2)$W (D) 2W

4. Shown in the figure is a very long semi-cylindrical conducting shell of radius R an dcarrying a current i. An infinitely long straight current carrying conductor is lying along the axis of the semi-cylinder. If th current flowing through the straight wire be i_0, then the force per unit length on the conducting wire is



(A) $\frac{\mu_0 i i_0}{\pi^2 R}$ (B) $\frac{\mu_0 i i_0}{\pi R^2}$ (C) $\frac{\mu_0 i^2 i_0}{\pi^2 R}$ (D) none of these

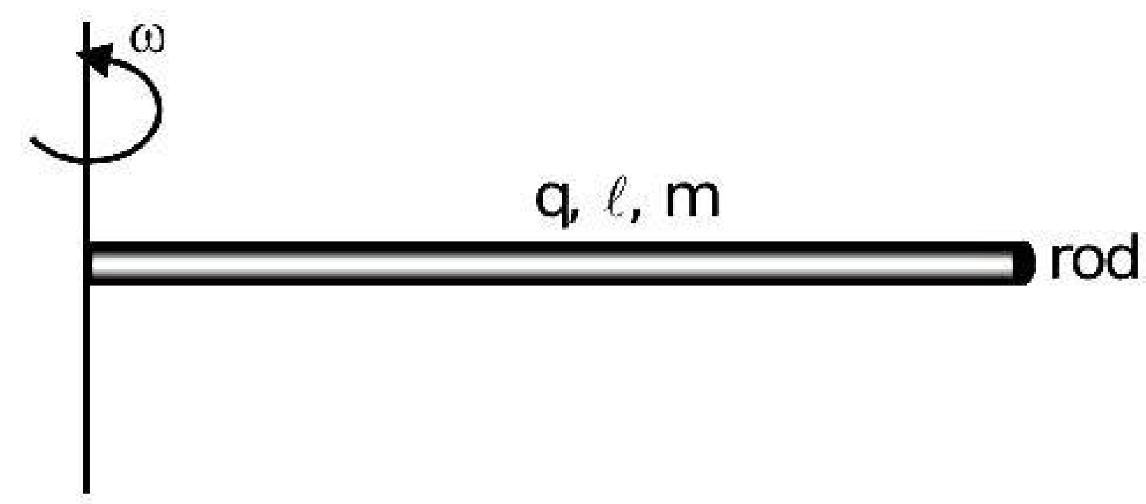
5. Figure shows a square current carrying loop ABCD of side 10 cm and current i = 10 A. The magnetic moment $\vec{M}$ of the loop is



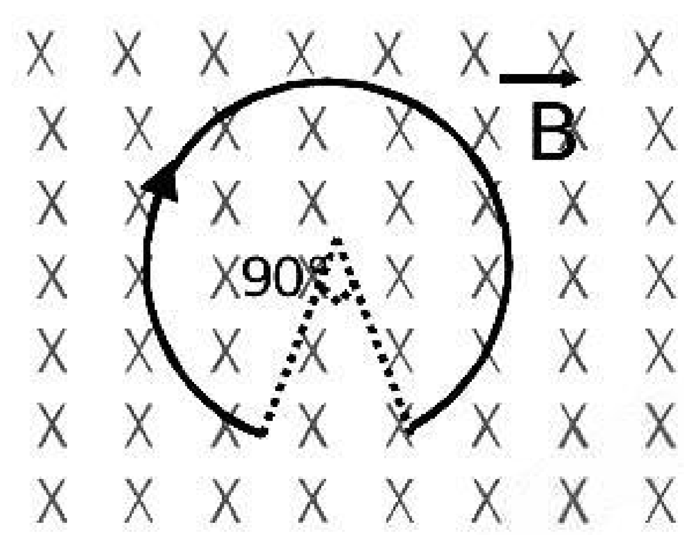
(A) $(0.05)(\hat{i} - \sqrt{3}\hat{k})$ A – m^2 (B) $(0.05)(\hat{j} + \hat{k})$ A – m^2

(C) $(0.05)(\sqrt{3}\hat{i} + \hat{k})$ A – m^2 (D) $(\hat{i} + \hat{k})$ A – m^2

6. Calculate magnetic moment of shown system.



7. An arc of a circular loop of radius R is kept in the horizontal plane and a constant magnetic field B is applied in the vertical direction as shown in the figure. If the arc carries current I then find the force on the arc.



ANSWERS

HOME WORK SHEET-4

1. B	2. D	3. A	4. A	5. A
6. $\frac{q\omega\ell^2}{6}$	7. $\sqrt{2}IRB$			