## PREVIOUS YEARS' QUESTIONS — EXERCISE-II

**1.** In a region, steady and uniform electric and magnetic fields are present. These two fields are parallel to each other. A charged particle is released from rest in this region. The path of the particle will be a- **[AIEEE - 2006]**

(1) helix (2) straight line
(3) ellipse (4) circle

**2.** A long solenoid has 200 turns per cm and carries a current i. The magnetic field at its centre is $6.28 \times 10^{-2}$ weber/m$^2$. Another long solenoid has 100 turns per cm and it carries a current i/3. The value of the magnetic field at its centre is- **[AIEEE - 2006]**

(1) $1.05 \times 10^{-2}$ weber/m$^2$
(2) $1.05 \times 10^{-5}$ weber/m$^2$
(3) $1.05 \times 10^{-3}$ weber/m$^2$
(4) $1.05 \times 10^{-4}$ weber/m$^2$

**3.** Needles $N_1$, $N_2$ and $N_3$ are made of a ferromagnetic, a paramagnetic and a diamagnetic substance respectively. A magnet when brought close to them will- **[AIEEE - 2006]**

(1) attract $N_1$ and $N_2$ strongly but repel $N_3$
(2) attract $N_1$ strongly, $N_2$ weakly and repel $N_3$ weakly
(3) attract $N_1$ strongly, but repel $N_2$ and $N_3$ weakly
(4) attract all three of them

**4.** 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 $\frac{a}{2}$ and 2a is- **[AIEEE - 2007]**

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

**5.** A current I flows along the length of an infinitely long, straight, thin walled pipe. Then- **[AIEEE - 2007]**

(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

**6.** A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity $\vec{V}$ perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in magnitude or direction of $\vec{V}$. Then- **[AIEEE - 2007]**

(1) $\vec{V} = \vec{E} \times \vec{B}/B^2$
(2) $\vec{V} = \vec{B} \times \vec{E}/B^2$
(3) $\vec{V} = \vec{E} \times \vec{B}/E^2$
(4) $\vec{V} = \vec{B} \times \vec{E}/E^2$

**7.** Two identical conducting wires AOB and COD are placed at right angles to each other. The wire AOB carries and electric current $I_1$ and COD carries a current $I_2$. The magnetic field on a point lying at a distance d from O, in a direction perpendicular to the plane of the wires AOB and COD, will be given by- **[AIEEE - 2007]**

(1) $\frac{\mu_0}{2\pi}\left(\frac{I_1+I_2}{d}\right)^{1/2}$ (2) $\frac{\mu_0}{2\pi d}\left(I_1^2+I_2^2\right)^{1/2}$

(3) $\frac{\mu_0}{2\pi d}(I_1+I_2)$ (4) $\frac{\mu_0}{2\pi d}\left(I_1^2+I_2^2\right)$

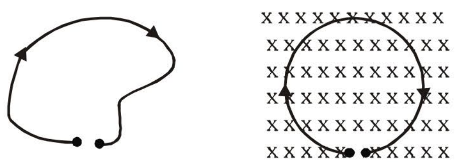
**8.** A Charged particle moves through a magnetic field perpendicular to its direction. Then- **[AIEEE - 2007]**

(1) the momentum changes but the kinetic energy is constant
(2) both momentum and kinetic energy of the particle are not constant
(3) both momentum and kinetic energy of the particle are constant
(4) kinetic energy changes but the momentum is constant

**9.** Relative perimittivity and permeability of a material are $\varepsilon_r$ and $\mu_r$, respectively. Which of the following values of these quantities are allowed for a diamagnetic material? **[AIEEE - 2008]**

(1) $\varepsilon_r = 0.5$, $\mu_r = 1.5$ (2) $\varepsilon_r = 1.5$, $\mu_r = 0.5$
(3) $\varepsilon_r = 0.5$, $\mu_r = 0.5$ (4) $\varepsilon_r = 1.5$, $\mu_r = 1.5$

**10.** A thin flexible wire of length L is connected to two adjacent fixed points and carries a current I in the clockwise direction, as shown in the figure. When the system is put in a uniform magnetic field of strength B going into the plane of the paper, the wire takes the shape of a circle. The tension in the wire is : **[JEE 2010]**



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

**11.** An electric charge + q moves with velocity $\vec{V} = 3\hat{i} + 4\hat{j} + \hat{k}$, in an electromagnetic field given by:

$\vec{E} = 3\hat{i} + \hat{j} + 2\hat{k}$, $\vec{B} = \hat{i} + \hat{j} - 3\hat{k}$.

The y-component of the force experienced by + q is:- **[AIEEE - 2011]**

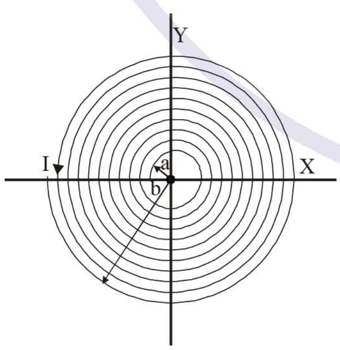
(1) 2 q (2) 11 q (3) 5 q (4) 3q

**12.** A thin circular disk of radius R is uniformly charged with density $\sigma > 0$ per unit area. The disk rotates about its axis with a uniform angular speed $\omega$. The magnetic moment of the disk is :- **[AIEEE - 2011]**

(1) $2\pi R^4\sigma\omega$ (2) $\pi R^4\sigma\omega$

(3) $\frac{\pi R^4}{2}\sigma\omega$ (4) $\frac{\pi R^4}{4}\sigma\omega$

**13.** A long insulated copper wire is closely wound as a spiral of 'N' turns. The spiral has inner radius 'a' and outer radius 'b'. The spiral lies in the X-Y plane and a steady current 'I' flows through the wire. The Z-component of the magnetic field at the center of the spiral is **[IIT-JEE 2011]**




(1) $\frac{\mu_0 NI}{2(b-a)} \ell n\left(\frac{b}{a}\right)$ (2) $\frac{\mu_0 NI}{2(b-a)} \ell n\left(\frac{b+a}{b-a}\right)$

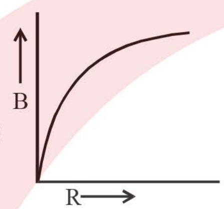
(3) $\frac{\mu_0 NI}{2b} \ell n\left(\frac{b}{a}\right)$ (4) $\frac{\mu_0 NI}{2b} \ell n\left(\frac{b+a}{b-a}\right)$

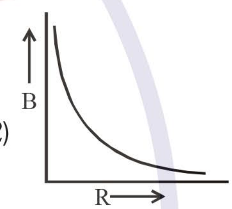
**14.** Proton, Deuteron and alpha particle of the same kinetic energy are moving in circular trajectories in a constant magnetic field. The radii of proton, deuteron and alpha particle are respectively $r_p$, $r_d$ and $r_\alpha$. Which one of the following relations is correct? **[AIEEE - 2012]**

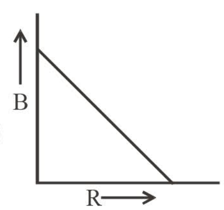
(1) $r_\alpha = r_d > r_p$ (2) $r_\alpha = r_d = r_p$

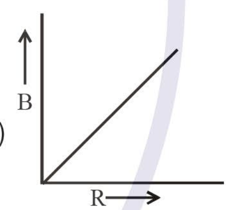
(3) $r_\alpha = r_p < r_d$ (4) $r_\alpha > r_d > r_p$

**15.** A charge Q is uniformly distributed over the surface of non-conducting disc of radius R. The disc rotates about an axis perpendicular to its plane and passing through its centre with an angular velocity $\omega$. As a result of this rotation a magnetic field of induction B is obtained at the centre of the disc. If we keep both the amount of charge placed on the disc and its angular velocity to be constant and vary the radius of the disc then the variation of the magnetic induction at the centre of the disc will be represented by the figure :- **[AIEEE - 2012]**

(1) 


(2) 


(3) 


(4) 


**16.** This question has Statement-1 and Statement-2. Of the four choices given after the statements, choose the one that best describes the two statements.

**Statement-1 :** A charged particle is moving at right angles to a static magnetic field. During the motion the kinetic energy of the charge remains unchanged.

**Statement-2 :** Static magnetic field exert force on a moving charge in the direction perpendicular to the magnetic field. **[AIEEE - 2012 (Online)]**

(1) Statement-1 is true, Statement-2 is true and Statement-2 is the correct explanation of Statement-1.

(2) Statement-1 is true, Statement-2 is true and Statement-2 is not the correct explanation of statement-1.

(3) Statement-1 is true, Statement-2 is false

(4) Statement-1 is false, Statement-2 is true

**17.** Currents of a 10 ampere and 2 ampere are passed through two parallel thin wires A and B respectively in opposite directions. Wire A is infinitely long and the length of the wire B is 2m. The force acting on the conductor B, which is situated at 10 cm distance from A will be :- **[AIEEE - 2012 (Online)]**

(1) $8\pi \times 10^{-7}$ N (2) $8 \times 10^{-5}$ N

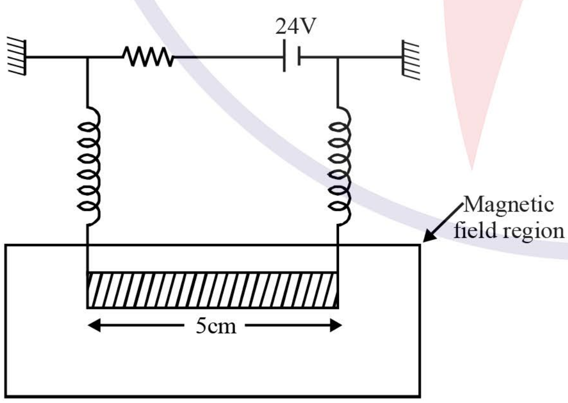
(3) $4\pi \times 10^{-7}$ N (4) $5 \times 10^{-5}$ N

**18.** A proton and deuteron are both accelerated through the same potential difference and enter in a magnetic field perpendicular to the direction of the field. If the deuteron follows a path of radius R, assuming the neutron and proton masses are nearly equal, the radius of the proton's path will be :- **[AIEEE - 2012 (Online)]**

(1) $\sqrt{2}$ R (2) $\frac{R}{\sqrt{2}}$

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

**19.** The circuit in figure consists of wires at the top and bottom and identical metal springs as the left and right sides. The wire at the bottom has a mass of 10 g and is 5 cm long. The wire is hanging as shown in the figure. The spring stretch 0.5 cm under the weight of the wire and the circuit has a total resistance of 12 Ω. When the lower wire is subjected to a static magnetic field, the springs stretch an additional 0.3 cm. The magnetic field is :- **[AIEEE - 2012 (Online)]**



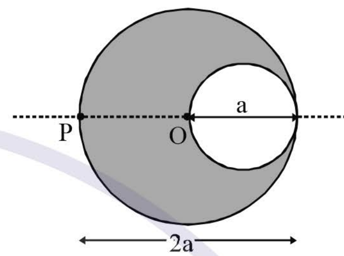

(1) 1.2 T and directed out of page

(2) 0.6 T and directed into the plane of page

(3) 1.2 T and directed into the plane of page

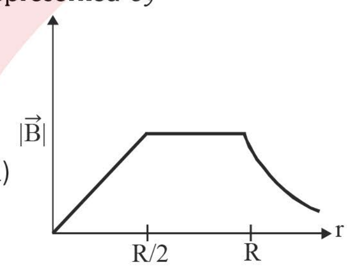
(4) 0.6 T and directed out of page

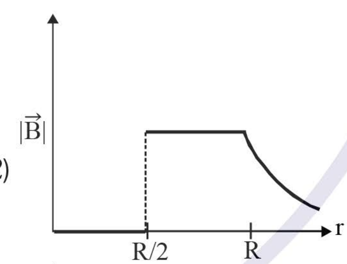
**20.** A cylindrical cavity of diameter a exists inside a cylinder of diameter 2a as shown in the figure. Both the cylinder and the cavity are infinitely long. A uniform current density J flows along the length. If the magnitude of the magnetic field at the point P is given by $\frac{N}{12}\mu_0 aJ$, then the value of N is **[IIT - 2012]**

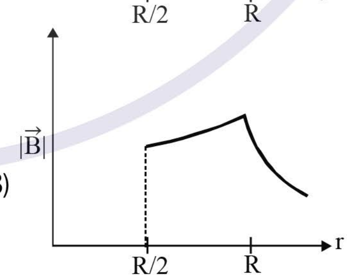


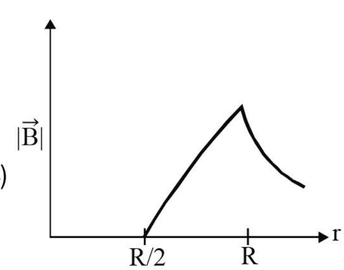

(1) 5 (2) 3 (3) 4 (4) 2

**21.** An infinitely long hollow conducting cylinder with inner radius R/2 and outer radius R carries a uniform current density along its length. The magnitude of the magnetic field, $|\vec{B}|$ as a function of the radial distance r from the axis is best represented by **[IIT-JEE 2012]**

(1) 


(2) 


(3) 


(4) 

**22.** Two short bar magnets of length 1 cm each have magnetic moments 1.20 $Am^2$ and 1.00 $Am^2$ respectively. They are placed on a horizontal table parallel to each other with their N poles pointing towards the South. They have a common magnetic equator and are separated by a distance of 20.0 cm. The value of the resultant horizontal magnetic induction at the mid-point O of the line joining their centres is close to :- (Horizontal component of earth's magnetic induction is $3.6 \times 10^{-5}$ $Wb/m^2$) **[JEE(Main)-2013]**

(1) $3.6 \times 10^{-5}$ $Wb/m^2$

(2) $2.56 \times 10^{-4}$ $Wb/m^2$

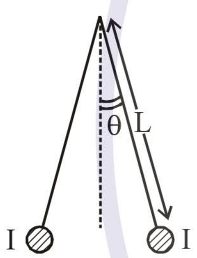
(3) $3.50 \times 10^{-4}$ $Wb/m^2$

(4) $5.80 \times 10^{-4}$ $Wb/m^2$

**23.** The coercivity of a small magnet where the ferromagnet gets demagnetized is $3 \times 10^3$ A $m^{-1}$. The current required to be passed in a solenoid of length 10 cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is : **[JEE(Main)-2014]**

(1) 3A (2) 6 A (3) 30 mA (4) 60 mA

**24.**




Two long current carrying thin wires, both with current I, are held by the insulating threads of length L and are in equilibrium as shown in the figure, with threads making an angle 'θ' with the vertical. If wires have mass λ per unit length then the value of I is:- **[JEE(Main) 2015]**

(g = gravitational acceleration)

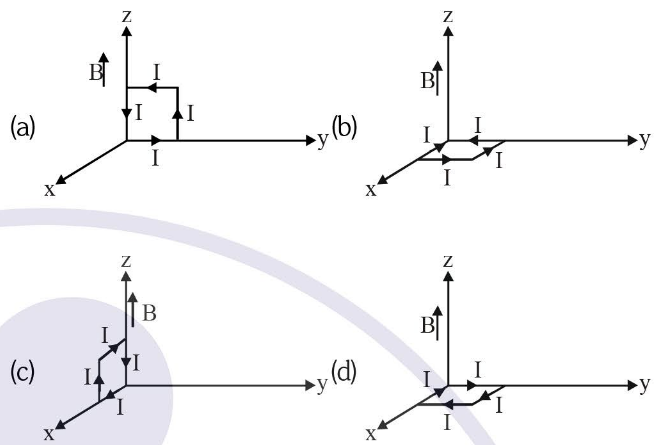
(1) $2\sqrt{\frac{\pi g L}{\mu_0}\tan\theta}$

(2) $\sqrt{\frac{\pi \lambda g L}{\mu_0}\tan\theta}$

(3) $\sin\theta\sqrt{\frac{\pi \lambda g L}{\mu_0 \cos\theta}}$

(4) $2\sin\theta\sqrt{\frac{\pi \lambda g L}{\mu_0 \cos\theta}}$

**25.** A rectangular loop of sides 10 cm and 5 cm carrying a current I of 12 A is place in different orientations as shown in the figures below : **[JEE(Main) 2015]**




If there is a uniform magnetic field of 0.3 T in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium ?

(1) (b) and (d), respectively

(2) (b) and (c), respectively

(3) (a) and (b), respectively

(4) (a) and (c), respectively

**26.** Two coaxial solenoids of different radii carry current I in the same direction. Let $\vec{F_1}$ be the magnetic force on the inner solenoid due to the outer one and $\vec{F_2}$ be the magnetic force on the outer solenoid due to the inner one. Then : **[JEE(Main) 2015]**

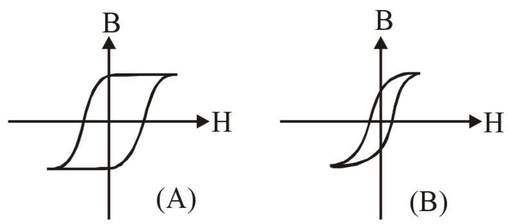
(1) $\vec{F_1}$ is radially inwards and $\vec{F_2} = 0$

(2) $\vec{F_1}$ is radially outwards and $\vec{F_2} = 0$

(3) $\vec{F_1} = \vec{F_2} = 0$

(4) $\vec{F_1}$ is radially inwards and $\vec{F_2}$ is radially outwards.

**27.** Hysteresis loops for two magnetic materials A and B are given below :




These materials are used to make magnets for electric generators, transformer core and electromagnet core. Then it is proper to use ; **[JEE Main-2016]**

(1) B for electromagnets and transformers.
(2) A for electric generators and transformers.
(3) A for electromagnets and B for electric transformers.
(4) A for transformers and B for electric generators.

**28.** Two identical wires A and B, each of length '$l$', carry the same current I. Wire A is bent into a circle of radius R and wire B is bent to form a square of side 'a'. If $B_A$ and $B_B$ are the values of magnetic field at the centres of the circle and square respectively, then the ratio $\frac{B_A}{B_B}$ is : **[JEE Main-2016]**

(1) $\frac{\pi^2}{8\sqrt{2}}$ (2) $\frac{\pi^2}{8}$ (3) $\frac{\pi^2}{16\sqrt{2}}$ (4) $\frac{\pi^2}{16}$

**29.** A magnetic needle of magnetic moment $6.7 \times 10^{-2}$ Am$^2$ and moment of inertia $7.5 \times 10^{-6}$ kg m$^2$ is performing simple harmonic oscillations in a magnetic field of 0.01 T. Time taken for 10 complete oscillations is : **[JEE(Main) 2017]**

(1) 6.98 s (2) 8.76 s
(3) 6.65 s (4) 8.89 s

**30.** The dipole moment of a circular loop carrying a current I, is m and the magnetic field at the centre of the loop is $B_1$. When the dipole moment is doubled by keeping the current constant, the magnetic field at the centre of the loop is $B_2$. The ratio $\frac{B_1}{B_2}$ is : **[JEE Main-2018]**

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

**PREVIOUS YEARS QUESTIONS** — **ANSWER KEY** — **Exercise-II**

| **Que.** | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Ans.** | **2** | **1** | **2** | **3** | **3** | **1** | **2** | **1** | **2** | **3** |
| **Que.** | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| **Ans.** | **2** | **4** | **1** | **3** | **2** | **2** | **2** | **2** | **4** | **1** |
| **Que.** | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| **Ans.** | **4** | **2** | **1** | **4** | **1** | **3** | **1** | **1** | **3** | **2** |