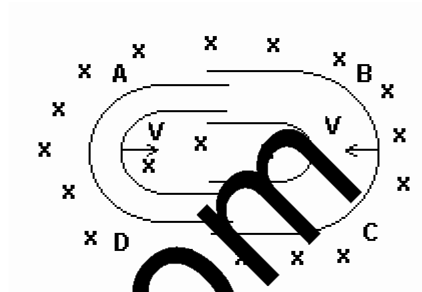
16 - MAGNETIC EFFECTS OF CURRENTS

(Answers at the end of all questions)

1) One conducting U tube can slide inside another as shown in the figure, maintaining electrical contacts between the tubes. The magnetic field B is perpendicular to the plane of the figure. If each tube moves towards the other at a constant speed V, then the emf induced in the circuit in terms of B, I and V where I is the width of each tube, will be



(a) - BIV (b) BIV (c) 2BIV (d) zero

[AIEEE 2005]

2) Two thin, long, parallel wires, separated by a distance 'd' carry a current 'i' A in the same direction. They will

(a) repel each other with a force of $\frac{\mu_0 i^2}{2\pi d}$ (b) attract each other with a force of $\frac{\mu_0 i^2}{2\pi d}$

(c) repel each other with a force of $\frac{\mu_0 i^2}{2\pi d^2}$ (d) attract each other with a force of $\frac{\mu_0 i^2}{2\pi d^2}$

[AIEEE 2005]

3) A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is

(a) $\frac{2\pi q^2 B}{m}$ (b) $\frac{2\pi mq}{B}$ (c) $\frac{2\pi m}{qB}$ (d) $\frac{2\pi qB}{m}$ [AIEEE 2005]

4) A uniform electric field and a uniform magnetic field are acting along the same direction in a certain region. If an electron is projected along the direction of the fields with a certain velocity, then

(a) its velocity will increase (b) its velocity will decrease

(c) it will turn towards left of direction of motion

(d) it will turn towards right of direction of motion. [AIEEE 2005]

5) Two concentric coils each of radius equal to 2π cm are placed at right angles to each other. 3 ampere and 4 ampere are the currents flowing in each coil respectively. The magnetic induction in weber / m^2 at the centre of the coils will be

(μ_0 = $4\pi \times 10^{-7}$ Wb / Am)

(a) 10^{-5} (b) 12×10^{-5} (c) 7×10^{-5} (d) 5×10^{-5} [AIEEE 2005]

6) A current I ampere flows along an infinitely long straight thin walled tube, then the magnetic induction at any point inside the tube is

(a) infinite (b) zero (c) $\frac{\mu_0}{4\pi} . \frac{2i}{r}$ tesla (d) $\frac{2i}{r}$ tesla [AIEEE 2004]

7) A long wire carries a steady current. It is bent into a circle of one turn and the magnetic field at the centre of the coil is B. It is then bent into a circular loop of n turns. The magnetic field at the centre of the coil will be

(a) nB (b) $n^2 B$ (c) 2nB (d) $2n^2 B$ [AIEEE 2004]

(Answers at the end of all questions)

8) The magnetic field due to a current carrying circular loop of radius 3 cm at a point on the axis at a distance of 4 cm from the centre is 54 μT. What will be its value at the centre of the loop ?

(a) 250 μT (b) 150 μT (c) 125 μT (d) 75 μT [AIEEE 2004]

9) Two long conductors, separated by a distance d carry currents I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its direction is reversed. The distance is also increased to 3d. The new value of the force between them is

(a) - 2F (b) F / 3 (c) - 2F / 3 (d) - F / 3 [AIEEE 2004]

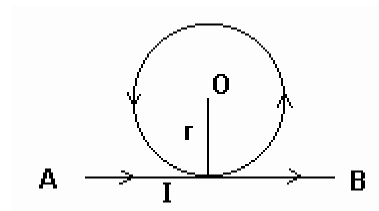
10) A particle of mass m and charge q moving with velocity $\vec{v}$ describes a circular path of radius r when subjected to a uniform transverse magnetic field of induction $\vec{B}$. The work done by the field, when the particle completes one full circle, is

(a) zero (b) $2\pi v^2 m$ (c) $2\pi vqB$ (d) $2\pi rqB$ [AIEEE 2003]

11) A part of a long wire carrying a current I is bent into a circle of radius r as shown in the figure. The net magnetic field at the centre O of the circular loop is

(a) $\frac{\mu_0 I}{4r}$ (b) $\frac{\mu_0 I}{2r}$ (c) $\frac{\mu_0 I}{2\pi r}(1+\pi)$ (d) $\frac{\mu_0 I}{2\pi r}(\pi - 1)$

[AIEEE 2002]

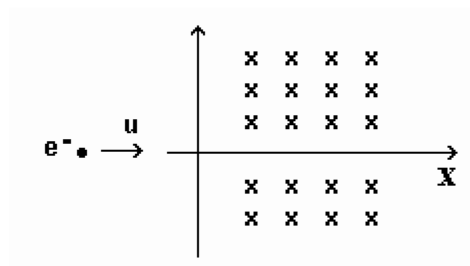


12) An electron moving with a speed u along the positive x-axis at y = 0 enters a region of uniform magnetic field $\vec{B} = B_0$ [illegible] which exists to the right of y-axis. The electron exits from the region after some time with the speed v at ordinate y, then

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

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

[IIT 2004]



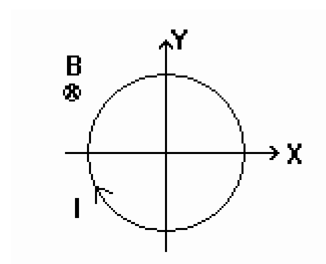
13) A conducting loop carrying a current I is place in a uniform magnetic field pointing into the plane of the paper as shown. The loop will have a tendency to

(a) contract (b) expand

(c) move towards positive x-axis

(d) move towards negative x-axis

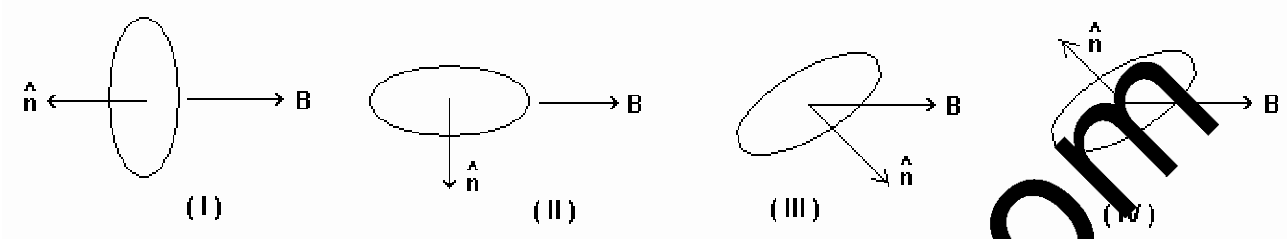
[IIT 2003]



14) A short-circuited coil is placed in a time-varying magnetic field. Electrical power is dissipated due to the current induced in the coil. If the number of turns were to be quadrupled and the wire radius halved, the electrical power dissipated would be

(a) halved (b) the same (c) doubled (d) quadrupled [IIT 2002]

15) A current carrying loop is placed in a uniform magnetic field in four different orientations, I, II, III and IV. Arrange them in a decreasing order of potential energy.



(a) I > III > II > IV (b) I > II > III > IV
(c) I > IV > II > III (d) III > IV > I > II [IIT 2003]

16) 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, etending from x = a to x = b. The minimum value of v required so that the particle can just enter the region x > b is

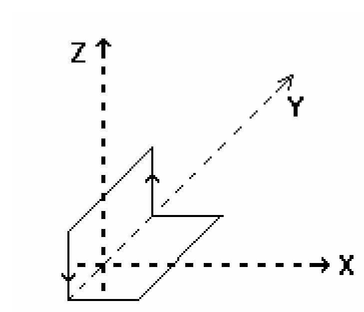
(a) $\frac{qbB}{m}$ (b) $\frac{q(b-a)B}{m}$ (c) $\frac{qaB}{m}$ (d) $\frac{q(b+a)B}{2m}$ [IIT 2002]

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

(a) $\frac{\mu_0 i(y\hat{i} - x\hat{j})}{2\pi(x^2+y^2)}$ (b) $\frac{\mu_0 i(x\hat{i} + y\hat{j})}{2\pi(x^2+y^2)}$ (c) $\frac{\mu_0 i(x\hat{j} - y\hat{i})}{2\pi(x^2+y^2)}$ (d) $\frac{\mu_0 i(x\hat{i} - y\hat{j})}{2\pi(x^2+y^2)}$

[IIT 2002]

18) A non-planar loop of conducting wire carrying a current I is placed as shown in the figure. Each of the straight sections of the loop is of length 2a. The magnetic field due to this loop at the point P (a, 0, a) points in the direction



(a) $\frac{1}{\sqrt{2}}(-\hat{j} + \hat{k})$ (b) $\frac{1}{\sqrt{3}}(-\hat{j} + \hat{k} + \hat{i})$

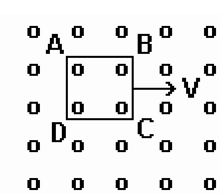
(c) $\frac{1}{\sqrt{3}}(\hat{i} + \hat{j} + \hat{k})$ (d) $\frac{1}{\sqrt{2}}(\hat{i} + \hat{k})$

[IIT 2001]

19) A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is

(a) $\frac{\mu_0 NI}{b}$ (b) $\frac{2\mu_0 NI}{a}$ (c) $\frac{\mu_0 NI}{2(b-a)} \ln\frac{b}{a}$ (d) $\frac{\mu_0 NI}{2(b+a)} \ln\frac{b}{a}$ [IIT 2001]

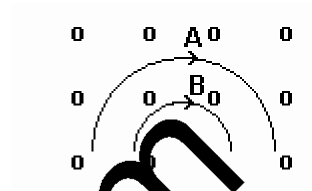
20) A metallic square loop ABCD is moving in its own plane with velocity V in a uniform magnetic field perpendicular to its plane as shown in the figure. Electric field is induced



(a) in AD, but not in BC (b) in BC, but not in AD
(c) neither in AD nor in BC (d) in both AD and BC
[IIT 2001]

(Answers at the end of all questions)

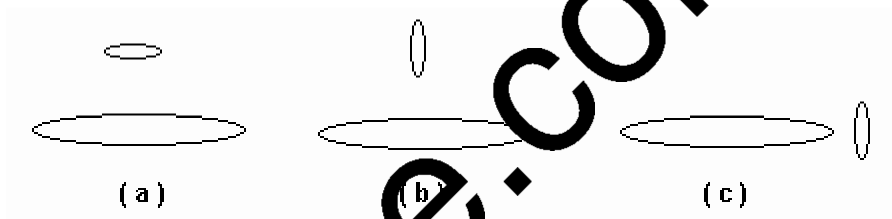
21) Two particles A and B of masses m_A and m_B respectively and having the same charge are moving in a plane. A uniform magnetic field exists perpendicular to this plane. The speeds of the particles are v_A and v_B respectively and the trajectories are as shown in the figure. Then



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

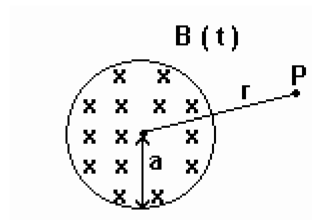
(c) $m_A < m_B$ and $v_A < v_B$ (d) $m_A = m_B$ and $v_A = v_B$ [IIT 2001]

22) Two circular coils can be arranged in any of the three situations shown in the figure. Their mutual inductance will be



(a) maximum in situation (a) (b) maximum in situation (b)
(c) maximum in situation (c) (d) the same in all situations

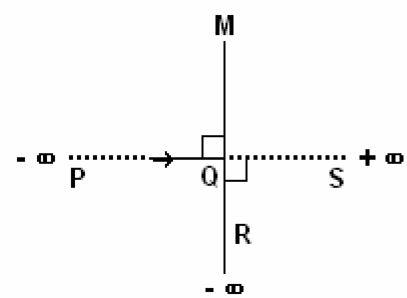
23) A uniform but time-varying magnetic field B (t) exists in a circular region of radius a and is directed into the plane of the paper as shown. The magnitude of the induced electric field at point P at a distance r from the centre of the circular region



(a) is zero (b) decreases as $\frac{1}{r}$

(c) increases as r (d) decreases as $\frac{1}{r^2}$ [IIT 2000]

24) An infinitely long conductor PQR is bent to form a right angle as shown. A current I flows through PQR. The magnetic field due to this current at the point M is H_1. Now, another infinitely long conductor QS is connected to Q so that the current is I / 2 in QR as well as in QS, the current in PQ remaining unchanged. The magnetic field at M is now H_2. The ratio H_1 / H_2 is given by



(a) 1 / 2 (b) 1 (c) 2 / 3 (d) 2 [IIT 2000]

25) A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude f its magnetic moment to that of its angular momentum depends on

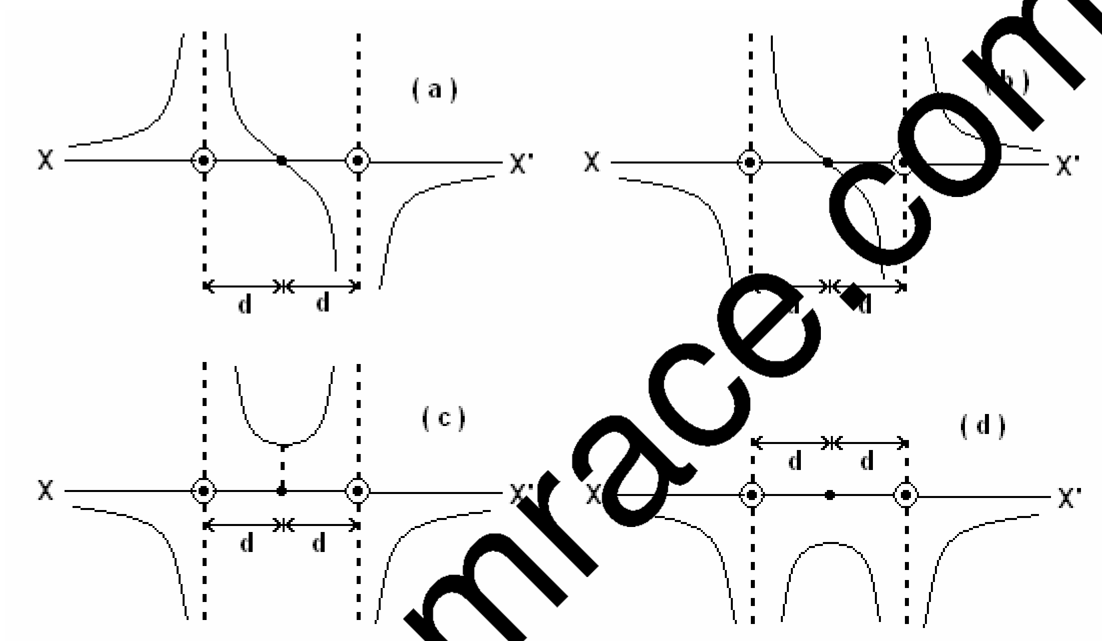
(a) ω and q (b) ω, q and m (c) q and m (d) ω and m [IIT 2000]

26) 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 +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
[IIT 2000]

(Answers at the end of all questions)

27) 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 [IIT 2000]



28) A charged particle is released from rest in a region of steady and 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 [IIT 1999]

29) A circular loop of radius R, carrying current I, lies in x-y plane with its centre at the origin. The total magnetic flux through x-y plane is
(a) directly proportional to I (b) directly proportional to R
(c) directly proportional to R^2 (d) zero [IIT 1999]

30) Two particles, each of mass m and charge q, are attached to the two ends of a light rigid rod of length 2R. The rod is rotated at constant angular speed about a perpendicular axis passing through its centre. The ratio of the magnitudes of the magnetic moment of the system and its angular momentum about the centre of the rod is
(a) $q / 2m$ (b) q / m (c) $2q / m$ (d) $q / \pi m$ [IIT 1998]

31) Two very long straight parallel wires carry steady currents I and -I respectively. The distance between the wires id 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 on this instant is

(a) $\frac{\mu_o I qv}{2\pi d}$ (b) $\frac{\mu_o I qv}{\pi d}$ (c) $\frac{2\mu_o I qv}{\pi d}$ (d) 0 [IIT 1998]

(Answers at the end of all questions)

32) A proton, a deuteron and an α-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) $r_p = r_d = r_\alpha$ [IIT 1997]

33) H^+, He^+ and O^{++} all having the same kinetic energy pass through a region in which there is a uniform magnetic field perpendicular to their velocity. The masses of H^+, He^+ and O^{++} are 1 amu, 4 amu and 16 amu respectively. Then

(a) H^+ will be deflected most (b) O^{++} will be deflected most

(c) H^+ and O^{++} will be deflected equally (d) all will be deflected equally

[IIT 1994]

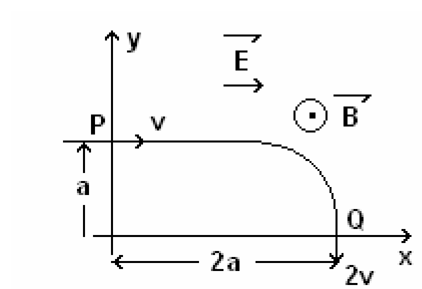
34) A current I flows along the length of an infinitely long, straight, thin-walled pipe. Then

(a) the magnetic field at all points inside the pipe is the same, but not zero
(b) the magnetic feld at any point inside the pipe is zero
(c) the magnetic field is zero only on the axis of the pipe
(d) the magnetic field is different at different points inside the pipe [IIT 1993]

35) A micrometer has a resistance of 100 Ω and a full scale range of 50 μA. It can be used as a voltmeter or as a higher range ammeter provided a resistance is added to it. Pick the correct range and resistance combination (s).

(a) 50 V range with 10 kΩ resistance in series
(b) 10 V range with 200 kΩ resistance in series
(c) 5 mA range with 1 Ω resistance in parallel
(d) 10 mA range with 1 Ω resistance in parallel [IIT 1991]

36) 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 the figure. The velocities at P and Q are $v\hat{i}$ and $-2v\hat{j}$. Which of the following statement (s) is / are correct ?



(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 [IIT 1991]

37) Two particles X and Y having equal charges, after being accelerated through the same potential difference, enter a region of uniform magnetic field and describe circular paths of radii R_1 and R_2 respectively. The ratio of the mass of X to that of Y is

(a) $(R_1 / R_2)^{1/2}$ (b) R_2 / R_1 (c) $(R_1 / R_2)^2$ (d) R_1 / R_2 [IIT 1988]

(Answers at the end of all questions)

38) Two thin long parallel ires separated by a distance ' b ' are carrying a current ' i ' amp. each. The magnitude of the force per unit length exerted by one wire on the other is

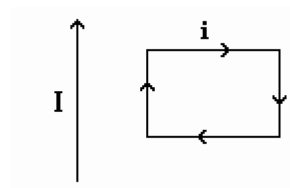
(a) $\frac{\mu_o i^2}{b^2}$ (b) $\frac{\mu_o i^2}{2 \pi b}$ (c) $\frac{\mu_o i}{2 \pi b}$ (d) $\frac{\mu_o i}{2 \pi b^2}$ [IIT 1986]

39) A proton moving with a constant velocity passes through a region of space without any change in its velocity. If E and B represent electric and magnetic fields respectively, this region of space may have

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

[IIT 1985]

40) A rectangular loop carrying a current I is situated near a long straight wire such that the wire is parallel to one of the sides of the loop and is in the plane of the loop. If a steady current I is established in the wire as shown in the figure, the loop will



(a) rotate about an axis parallel to the wire
(b) move away from the wire (c) move towards the wire
(d) remain stationary [IIT 1985]

41) A conducting circular loop of radius r carries a constant current i. It is placed in a uniform magnetic field $\vec{B}_o$ such that $\vec{B}_o$ is perpendicular to the plane of the loop. The magnetic force acting on the loop is

(a) $i r B_o$ (b) $2 \pi i r B_o$ (c) zero (d) $\pi i r B_o$ [IIT 1983]

Answers

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
c	b	c	b	d	b	b	a	c	a	c	d	b	b	c	b	a	d	c	d

21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
b	a	b	c	c	c	c	a	d	a	d	a	a,c	c,d	b,c	a,b,d	c	b	a,b,d	c

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c