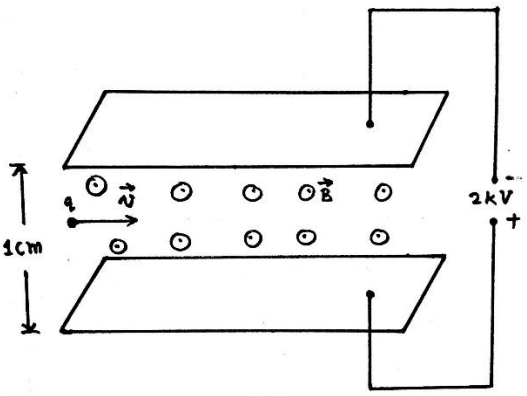
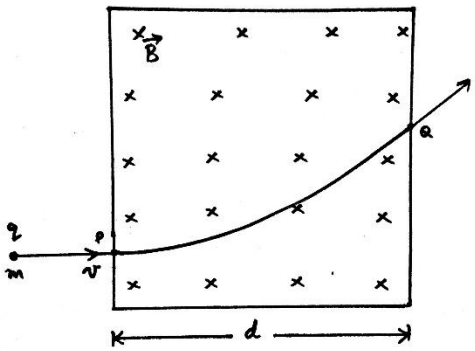
MOVING CHARGES AND MAGNETISM

1. The potential difference of 2.0 kV is applied across the horizontal plates of a parallel plate capacitor with a plate separation 1 cm. There exists a normal magnetic field asshown in the figure. A particle with a specific charge +1 x 10^{-4} C/kg moves with a speed of 2 x 10^{6} ms^{-1} between the plates without deflection. The magnetic field in the region is (g = 10 ms^{-2}):



a. 0.1 T b. 0.05 T c. 1 T d. 0.5 T

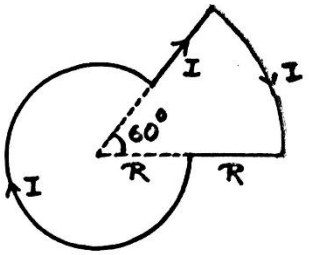
2. A charge q of mass m enters the region of magnetic field B with a velocity v as in the figure. If the charge comes out of the region in a time $\pi m/6qB$, the width of the region d is:



a. $mv/4qB$ c. $mv/3qB$

b. $mv/2qB$ d. mv/qB

3. The magnetic field at point O in the figure is:



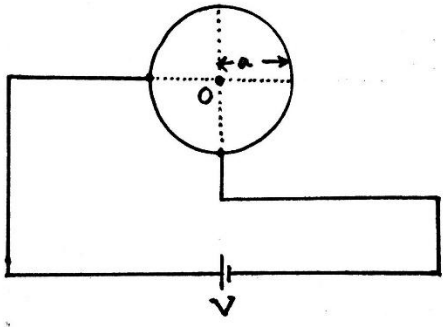
a. $11\mu_0 I/24R$

b. $7\mu_0 I/24R$

c. $\mu_0 I/6R$

d. $\mu_0 I/2R$

4. A wire of uniform cross-section is made a circular coil of radius a and is connected to a potential difference of V. If the resistance of the wire is R, the magnetic field at O is:



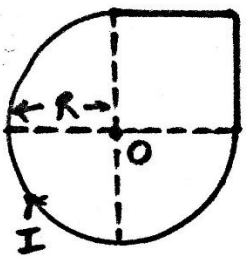
a. $\mu_0 V/2Rr$

b. $\mu_0 V/Rr$

c. $3\mu_0 V/32Rr$

d. zero

5. The magnetic field at point O in the figure is:



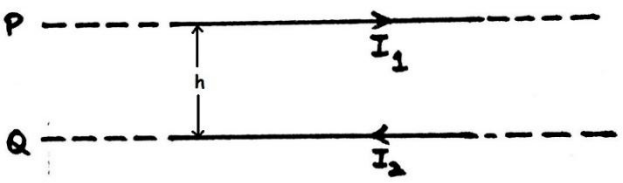
a. $\frac{\mu_o I}{4R}\left\{\frac{3}{2}-\frac{\sqrt{2}}{\pi}\right\}$ c. $\frac{3\mu_o I}{8R}$

b. $\frac{\mu_o I}{2R}\left\{\frac{3}{2}+\frac{\sqrt{2}}{\pi}\right\}$ d. $\frac{\mu_o I}{4R}\left\{\frac{3}{2}+\frac{\sqrt{2}}{\pi}\right\}$

6. The magnetic field in a region is given by: $\vec{B} = 5\hat{\imath} + \hat{\jmath} - 2\hat{k}$. If the acceleration of the particle at an instant is $2\hat{\imath} + 4\hat{\jmath} + c\hat{k}$, the value of c is:

   a. 3 b. 7 c. 28 d. 12

7. In the figure, a uniform wire P is free to move vertically and wire Q is fixed. P is in equilibrium against gravity. If P is slightly displaced vertically, its period of oscillations is:

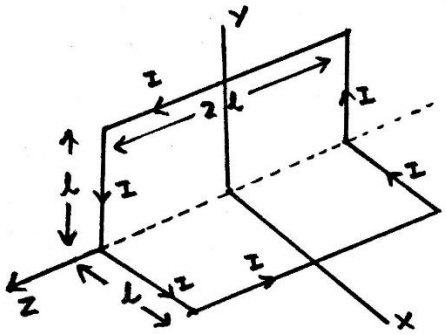


   a. $2\pi\sqrt{h/g}$ b. $\pi\sqrt{h/g}$ c. $4\pi\sqrt{h/g}$ d. $2\pi\sqrt{2h/g}$

8. A charge with a velocity $\vec{v} = 3\hat{\imath} - \hat{\jmath} + \hat{k}$ enters a region of uniform magnetic field $B = B_0(\hat{\imath} + 4\hat{\jmath} + \hat{k})$. The nature of path of the particle is:

   a. a parabola b. a helix c. a straight line d. a circle

9. The magnetic moment of the given current carrying loop is:



   a. $4Il^2$

   b. $2\sqrt{2}Il^2$

   c. $2Il^2$

   d. $4\sqrt{2}Il^2$

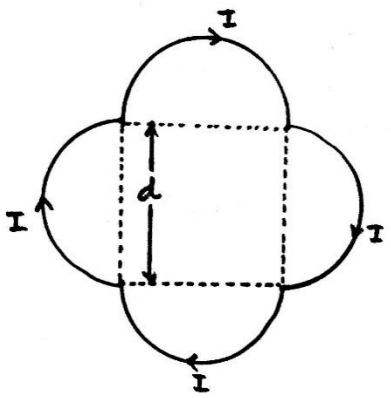
10. A spherical shell of radius R has a charge Q distributed uniformly over it. The shell is spinning with a uniform angular velocity of ω about its diameter. The magnetic moment of the shell is:

    a. $QR^2\omega/3$ b. $4QR^2\omega/3$ c. $2QR^2\omega/3$ d. zero

11. A half – toroid of an area of cross – section A toroidal radius of R carries a current I. The number of turns in the half – toroid is N. The magnetic moment of the half – toroid is:

    a. NIA/π b. $NIA/2\pi$ c. $2NIA/\pi$ d. $NIA^2/\pi R^2$

12. The loop shown in the fig. is placed in X–Y plane. If there exists a uniform magnetic field $\vec{B} = a\hat{\imath} + b\hat{\jmath} + c\hat{k}$. The magnitude of the torque on the loop is:



    a. $2.57Id^2\sqrt{a^2 - b^2}$

    b. $2.57Id^2\sqrt{a^2 + b^2}$

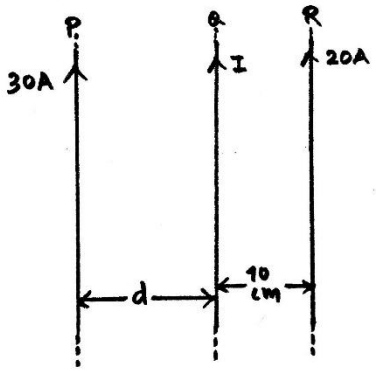
    c. $2.57Id^2(b - a)$

    d. $2.57Id^2(b + a)$

13. A steady current I flows through a wire PQR having a shape of right triangle with $PQ = 3x$, $PR = 4x$ and right angled at P. If the magnitude of the magnetic field at P is $k\frac{\mu_0 I}{48\pi x}$, the value of k is:

a. 5 b. 6 c. 7 d. 8

14. In the figure, if the force on the wire Q is zero, the distance d is:



a. 10 *cm*

b. 15 *cm*

c. 20 *cm*

d. 25 *cm*

15. Two protons move parallel to each other with equal speed of 300 km/s. The ratio of magnetic and electrical interaction between them is:

a. 10^6 b. 10^{-6} c. 10^3 d. 10^{-3}

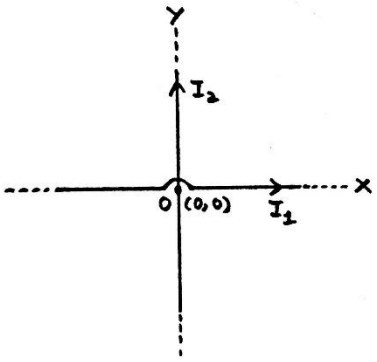
16. A tightly wound spiral with N turns carries a current I. The inner and the outer radius of the spiral are a and b respectively. The magnetic field at the center is:

a. $\frac{\mu_0 NI}{2(b-a)}\log\frac{b}{a}$ b. $\frac{\mu_0 NI}{2(b-a)}\log\frac{a}{b}$ c. $\frac{\mu_0 NI}{2(b-a)}$ d. $\frac{\mu_0 NI}{2}\left(\frac{1}{a}-\frac{1}{b}\right)$

17. A proton and an α – particle accelerated by the same potential difference from rest enter into a region of uniform magnetic field normal to the field. The ratio of radii of the path of the proton to that of α – particle will be:

a. $1:\sqrt{2}$ b. $\sqrt{2}:1$ c. $1:2$ d. $2:1$

18. Two infinitely long straight wires carrying currents I_1 and I_2 are placed in $X-Y$ plane as shown in the figure. The equation of set of all points with zero magnetic field are:



a. straight line with unit positive slope

b. straight line with slope I_1/I_2

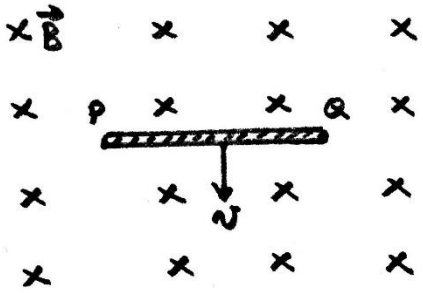
c. straight line with slope I_2/I_1

d. straight line with unit negative slope

19. The current density in a straight uniform wire of radius R varies with the distance r from the axis as$j(r) = kr^2$. The magnetic field at a distance s from axis inside the wire is:

a. $2\mu_0 ks^3$ b. $\mu_0 ks^3/2$ c. $\mu_0 ks^3/4$ d. $4\mu_0 ks^3$

20. In the figure, a conductor of length l is moving with a velocity in a magnetic field B with a velocity v. Which one of the following statements is true:



a. P is at higher potential w. r. t. Q

b. Q is at higher potential w. r. t. P

c. The p. d. between P and Q is zero

d. The p. d. between P and Q is Bl^2v

21. A long solenoid carrying a current produces a magnetic field of B along its axis. If the current is doubled and the number of turns per cm are halved, the new magnetic field is:

a. B b. $2B$ c. $4B$ d. $0.5B$

22. The current in the winding on a toroid is 2.0 A. There are 400 turns and the mean circumferential length is 40 cm. If the inside magnetic field is 0.1 T, the relative permeability is nearly:

a. 10 b. 20 c. 30 d. 40

23. If the energy gained by the proton after acceleration in a cyclotron is E, the energy attained by the a – particle in the cyclotron will be:

a. 4 E b. 2 E c. E d. 0.25 E

24. If the magnetic field at the center of a circular current loop of radius 3 cm is B, the magnetic field at a distance of 4 cm on the axis of the loop will be:

a. $27B/125$ b. $54B/125$ c. $27B/250$ d. $9B/25$

25. A voltmeter of resistance 2000 Ω has a range of 4 V. To increase its range to 10 V, the value of the series resistance is:

a. 3000 Ω b. 800 Ω c. 6000 Ω d. 5000 Ω

Keys

1	B	6	B	11	C	16	A	21	A
2	B	7	A	12	B	17	A	22	D
3	A	8	D	13	C	18	C	23	C
4	D	9	B	14	B	19	C	24	A
5	D	10	A	15	B	20	B	25	D