MAGNETISM

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

(A) $E = 0, B = 0$ (B) $E = 0, B \neq 0$

(C) $E \neq 0, B = 0$ (D) $E \neq 0, B \neq 0$

Choose the most appropriate answer from the options given below :

(1) (A), (B) and (C) only

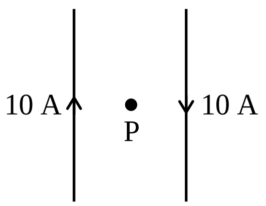
(2) (A), (C) and (D) only

(3) (A), (B) and (D) only

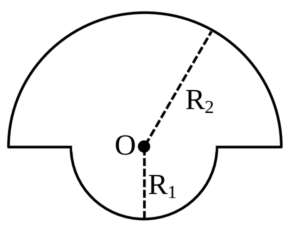
(4) (B), (C) and (D) only

2. Two long, straight wires carry equal currents in opposite directions as shown in figure. The separation between the wires is 5.0 cm. The magnitude of the magnetic field at a point P midway between the wires is _____$\propto$T

(Given : $\propto_0 = 4\pi \times 10^{-7}$ TmA^{-1})



3. The magnetic field at the centre of a wire loop formed by two semicircular wires of radii $R_1 = 2\pi$ m and $R_2 = 4\pi$ m carrying current I = 4A as per figure given below is $\alpha \times 10^{-7}$ T. The value of α is_____. (Centre O is common for all segments)



4. The magnetic potential due to a magnetic dipole at a point on its axis situated at a distance of 20 cm from its center is 1.5×10^{-5}Tm. The magnetic moment of the dipole is __________ Am^2. (Given : $\frac{\propto_0}{4\pi} = 10^{-7}TmA^{-1}$)

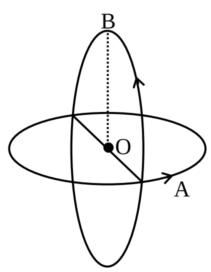
5. Two particles X and Y having equal charges are being accelerated through the same potential difference. Thereafter they enter normally in a region of uniform magnetic field and describes circular paths of radii R_1 and R_2 respectively. The mass ratio of X and Y is :

(1) $\left(\frac{R_2}{R_1}\right)^2$ (2) $\left(\frac{R_1}{R_2}\right)^2$

(3) $\left(\frac{R_1}{R_2}\right)$ (4) $\left(\frac{R_2}{R_1}\right)$

6. A charge of 4.0 $\propto$C is moving with a velocity of 4.0×10^6 ms^{-1} along the positive y-axis under a magnetic field B of strength $(2\hat{k})$ T. The force acting on the charge is $x\hat{i}$ N. The value of x is _______ .

7. Two insulated circular loop A and B radius 'a' carrying a current of 'I' in the anti clockwise direction as shown in figure. The magnitude of the magnetic induction at the centre will be :



(1) $\frac{\sqrt{2}\propto_0 I}{a}$ (2) $\frac{\propto_0 I}{2a}$

(3) $\frac{\propto_0 I}{\sqrt{2}a}$ (4) $\frac{2\propto_0 I}{a}$

8. The horizontal component of earth's magnetic field at a place is $3.5 \cdot 10^{-5}\,T$. A very long straight conductor carrying current of $\sqrt{2}\,A$ in the direction from South east to North West is placed. The force per unit length experienced by the conductor is ……… × 10^{-6} N/m.

9. A ceiling fan having 3 blades of length 80 cm each is rotating with an angular velocity of 1200 rpm. The magnetic field of earth in that region is 0.5 G and angle of dip is 30º. The emf induced across the blades is $N\pi \cdot 10^{-5}\,V$. The value of N is _____ .

10. Match List I with List II.

List-I		List-II	
A.	Gauss's law of magnetostatics	I.	$\oint \vec{E}\cdot d\vec{a} = \frac{1}{\varepsilon_0}\int \rho\, dV$
B.	Faraday's law of electro magnetic induction	II.	$\oint \vec{B}\cdot d\vec{a} = 0$
C.	Ampere's law	III.	$\oint \vec{E}\cdot d\vec{l} = \frac{-d}{dt}\int \vec{B}\cdot d\vec{a}$
D.	Gauss's law of electrostatics	IV.	$\oint \vec{B}\cdot d\vec{l} = \mu_0 I$

Choose the correct answer from the options given below:

(1) A-I, B-III, C-IV, D-II

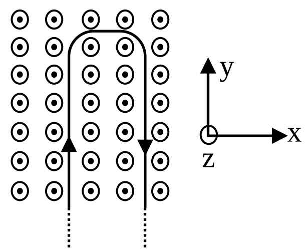
(2) A-III, B-IV, C-I, D-II

(3) A-IV, B-II, C-III, D-I

(4) A-II, B-III, C-IV, D-I

11. The current of 5A flows in a square loop of sides 1 m is placed in air. The magnetic field at the centre of the loop is $X\sqrt{2} \cdot 10^{-7}\,T$. The value of X is _______.

12. A rigid wire consists of a semicircular portion of radius R and two straight sections. The wire is partially immerged in a perpendicular magnetic field $B = B_0\,\hat{j}$ as shown in figure. The magnetic force on the wire if it has a current i is :



(1) $-iBR\,\hat{j}$ (2) $2iBR\,\hat{j}$

(3) $iBR\,\hat{j}$ (4) $-2iBR\,\hat{j}$

13. An electron moves through a uniform magnetic field $\vec{B} = B_0\hat{i} + 2B_0\hat{j}$ T. At a particular instant of time, the velocity of electron is $\vec{u} = 3\hat{i} + 5\hat{j}$ m/s. If the magnetic force acting on electron is $\vec{F} = 5e\hat{k}$ N, where e is the charge of electron, then the value of B_0 is ____ T.

14. A uniform magnetic field of $2 \cdot 10^{-3}\,T$ acts along positive Y-direction. A rectangular loop of sides 20 cm and 10 cm with current of 5 A is Y-Z plane. The current is in anticlockwise sense with reference to negative X axis. Magnitude and direction of the torque is :

(1) $2 \cdot 10^{-4}$ N – m along positive Z –direction

(2) $2 \cdot 10^{-4}$ N – m along negative Z-direction

(3) $2 \cdot 10^{-4}$ N – m along positive X-direction

(4) $2 \cdot 10^{-4}$ N – m along positive Y-direction

15. Two circular coils P and Q of 100 turns each have same radius of π cm. The currents in P and R are 1 A and 2 A respectively. P and Q are placed with their planes mutually perpendicular with their centers coincide. The resultant magnetic field induction at the center of the coils is $\sqrt{x}$ mT, where x = _________.

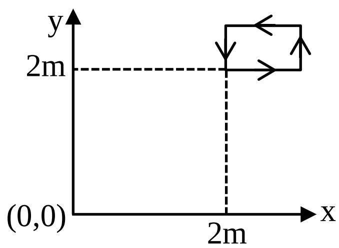
[Use $\mu_0 = 4\pi \cdot 10^{-7}$ TmA^{-1}]

16. A regular polygon of 6 sides is formed by bending a wire of length 4π meter. If an electric current of $4\pi\sqrt{3}$ A is flowing through the sides of the polygon, the magnetic field at the centre of the polygon would be $x \times 10^{-7}$ T. The value of x is ______.

17. A moving coil galvanometer has 100 turns and each turn has an area of 2.0 cm^2. The magnetic field produced by the magnet is 0.01 T and the deflection in the coil is 0.05 radian when a current of 10 mA is passed through it. The torsional constant of the suspension wire is $x \times 10^{-5}$ N-m/rad. The value of x is______.

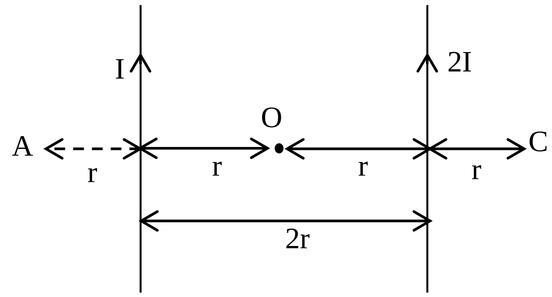
18. An electron is projected with uniform velocity along the axis inside a current carrying long solenoid. Then :
(1) the electron will be accelerated along the axis.
(2) the electron will continue to move with uniform velocity along the axis of the solenoid.
(3) the electron path will be circular about the axis.
(4) the electron will experience a force at 45° to the axis and execute a helical path.

19. The magnetic field existing in a region is given by $B = 0.2(1+2x)\hat{k}$T. A square loop of edge 50 cm carrying 0.5 A current is placed in x-y plane with its edges parallel to the x-y axes, as shown in figure. The magnitude of the net magnetic force experienced by the loop is ______ mN.



20. The magnetic moment of a bar magnet is 0.5 Am^2. It is suspended in a uniform magnetic field of 8×10^{-2} T. The work done in rotating it from its most stable to most unstable position is:
(1) 16×10^{-2} J
(2) 8×10^{-2} J
(3) 4×10^{-2} J
(4) Zero

21. Two parallel long current carrying wire separated by a distance 2r are shown in the figure. The ratio of magnetic field at A to the magnetic field produced at C is $\frac{x}{7}$. The value of x is ______.



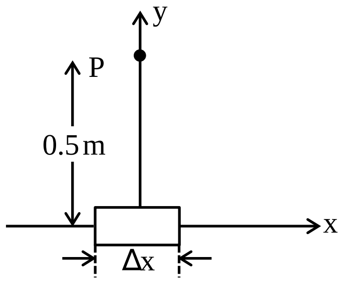
22. In a co-axial straight cable, the central conductor and the outer conductor carry equal currents in opposite directions. The magnetic field is zero.
(1) inside the outer conductor
(2) in between the two conductors
(3) outside the cable
(4) inside the inner conductor

23. A 2A current carrying straight metal wire of resistance 1 Ω, resistivity 2×10^{-6} Ωm, area of cross-section 10 mm^2 and mass 500 g is suspended horizontally in mid air by applying a uniform magnetic field B. The magnitude of B is .... $\times 10^{-1}$ T (given, g = 10 m/s^2)

24. The electrostatic force (F_1) and magnetic force (F_2) acting on a charge q moving with velocity v can be written :
(1) $F_1 = qV.E,\ F_2 = q(B.V)$
(2) $F_1 = qB,\ F_2 = q(B \cdot V)$
(3) $F_1 = qE,\ F_2 = q(V \cdot B)$
(4) $F_1 = qE,\ F_2 = q(B \cdot V)$

25. A solenoid of length 0.5 m has a radius of 1 cm and is made up of 'm' number of turns. It carries a current of 5A. If the magnitude of the magnetic field inside the solenoid is 6.28×10^{-3} T, then the value of m is :

26. An element $\Delta l = \Delta x\hat{i}$ is placed at the origin and carries a large current I = 10A. The magnetic field on the y-axis at a distance of 0.5 m from the elements Δx of 1 cm length is :



(1) 4×10^{-8} T

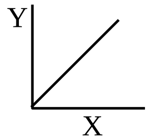
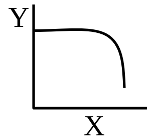
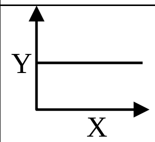
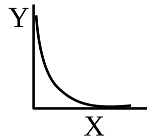
(2) 8×10^{-8} T

(3) 12×10^{-8} T

(4) 10×10^{-8} T

27. A circular coil having 200 turns, 2.5×10^{-4} m^2 area and carrying 100 ∝A current is placed in a uniform magnetic field of 1 T. Initially the magnetic dipole moment (M) was directed along B. Amount of work, required to rotate the coil through 90° from its initial orientation such that M becomes perpendicular to B, is __________ ∝J.

28. Match List-I with List-II

	List-I (Y vs X)		List-II (Shape of Graph)
(A)	Y = magnetic susceptibility X = magnetising field	(I)	
(B)	Y = magnetic field X = distance from centre of a current carrying wire for x < a (where a = radius of wire)	(II)	
(C)	Y = magnetic field X = distance from centre of a current carrying wire for x > a (where a = radius of wire)	(III)	
(D)	Y = magnetic field inside solenoid X = distance from center	(IV)	

Choose the correct answer from the options given below :

(1) (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

(2) (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

(3) (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

(4) (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

29. A coil having 100 turns, area of 5×10^{-3} m^2, carrying current of 1 mA is placed in uniform magnetic field of 0.20 T such a way that plane of coil is perpendicular to the magnetic field. The work done in turning the coil through 90° is _____ ∝J.

30. Paramagnetic substances:

A. align themselves along the directions of external magnetic field.

B. attract strongly towards external magnetic field.

C. has susceptibility little more than zero.

D. move from a region of strong magnetic field to weak magnetic field.

Choose the **most appropriate** answer from the options given below:

(1) A, B, C, D

(2) B, D Only

(3) A, B, C Only

(4) A, C Only

31. An electron with kinetic energy 5 eV enters a region of uniform magnetic field of 3 ∝T perpendicular to its direction. An electric field E is applied perpendicular to the direction of velocity and magnetic field. The value of E, so that electron moves along the same path, is_______ NC^{-1}.

(Given, mass of electron = 9×10^{-31} kg, electric charge = 1.6×10^{-19}C)

32. 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 from axis of the wire is :

(1) 1 : 4 (2) 4 : 1

(3) 1 : 1 (4) 3 : 4

33. The coercivity of a magnet is 5×10^{3} A/m. The amount of current required to be passed in a solenoid of length 30 cm and the number of turns 150, so that the magnet gets demagnetised when inside the solenoid is …………A.

34. Given below are two statements:

Statement (I) : When currents vary with time, Newton's third law is valid only if momentum carried by the electromagnetic field is taken into account.

Statement (II) : Ampere's circuital law does not depend on Biot-Savart's law.

In the light of the above statements, choose the **correct** answer from the options given below:

(1) Both **Statement I** and **Statement II** are false.

(2) **Statement I** is true but **Statement II** is false.

(3) **Statement I** is false but **Statement II** is true.

(4) Both **Statement I** and **Statement II** are true.

35. A square loop of edge length 2 m carrying current of 2 A is placed with its edges parallel to the x-y axis. A magnetic field is passing through the x-y plane and expressed as $\vec{B} = B_0(1 + 4x)\hat{k}$, where B_0 = 5 T. The net magnetic force experienced by the loop is _______ N.

36. A proton and a deutron (q = +e, *m* = 2.0u) having same kinetic energies enter a region of uniform magnetic field B, moving perpendicular to B. The ratio of the radius r_d of deutron path to the radius r_p of the proton path is :

(1) 1 : 1 (2) $1 : \sqrt{2}$

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

37. A straight magnetic strip has a magnetic moment of 44 Am^2. If the strip is bent in a semicircular shape, its magnetic moment will be ………. Am^2. (Given $\pi = \frac{22}{7}$)

SOLUTIONS

1. Ans. (3)

Sol. Net force on particle must be zero i.e.

$qE + qV \cdot B \;\; = 0$

Possible cases are

(i) E & B = 0

(ii) $V \cdot B \;\; = 0, E = 0$

(iii) $qE = -qV \cdot B$

$E \neq 0$ & $B \neq 0$

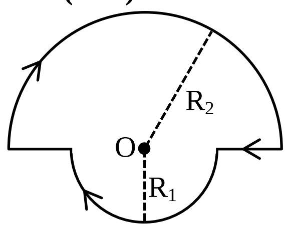
2. Ans. (160)

Sol. $B = \left(\frac{\propto_0 i}{2\pi a}\right) \cdot 2 = \frac{4\pi \cdot 10^{-7} \cdot 10}{\pi \cdot \left(\frac{5}{2} \cdot 10^{-2}\right)}$

$= 16 \cdot 10^{-5} = 160 \propto T$

3. Ans. (3.00)

Sol.



$\frac{\propto_0 i}{2R_2}\left(\frac{\pi}{2\pi}\right) \otimes + \frac{\propto_0 i}{2R_1}\left(\frac{\pi}{2\pi}\right) \otimes$

$\left(\frac{\propto_0 i}{4R_2} + \frac{\propto_0 i}{4R_1}\right) \otimes$

$\frac{4\pi \cdot 10^{-7} \cdot 4}{4 \cdot \pi 4} + \frac{4\pi \cdot 10^{-7} \cdot 4}{4 \cdot \pi 2}$

$= 3 \cdot 10^{-7} = \alpha \cdot 10^{-7}$

$\alpha = 3$

4. Ans. (6)

Sol. $V = \frac{\propto_0}{4\pi} \frac{M}{r^2}$

$\Rightarrow 1.5 \cdot 10^{-5} = 10^{-7} \cdot \frac{M}{(20 \cdot 10^{-2})^2}$

$\Rightarrow M = \frac{1.5 \cdot 10^{-5} \cdot 20 \cdot 20 \cdot 10^{-4}}{10^{-7}}$

$M = 1.5 \times 4 = 6$

5. Ans. (2)

Sol. $R = \frac{mv}{qB} = \frac{p}{qB} = \frac{\sqrt{2m(KE)}}{qB} = \frac{\sqrt{2mqV}}{qB}$

$R \propto \sqrt{m}$

$m \propto R^2$

$\frac{m_1}{m_2} = \left(\frac{R_1}{R_2}\right)^2$

6. Ans. (32)

Sol. $q = 4 \propto C, \; v = 4 \cdot 10^6 \hat{j} \;$ m/s

$B = 2\hat{k} T$

$F = q(v \cdot B)$

$= 4 \cdot 10^{-6} \left(4 \cdot 10^6 \hat{j} \cdot 2\hat{k}\right)$

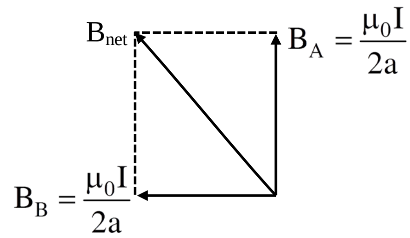
$= 4 \cdot 10^{-6} \cdot 8 \cdot 10^6 \hat{i}$

$F = 32\hat{i}$ N

x = 32

7. Ans. (3)

Sol.



$\because B_{net} = \frac{\sqrt{2} \propto_0 I}{2a}$

8. Ans. (35)

Sol. $B_H = 3.5 \cdot 10^{-5} T$

$F = i \; B\sin\theta \qquad i = \sqrt{2} A$

$\frac{F}{} = iB\sin\theta = \sqrt{2} \cdot 3.5 \cdot 10^{-5} \cdot \frac{1}{\sqrt{2}}$

$= 35 \cdot 10^{-6} N / m$

9. Ans. (32)

Sol. $B_v = B\sin 30 = \frac{1}{4} \cdot 10^{-4}$

$\omega = 2\pi \cdot f = \frac{2\pi}{60} \cdot 1200$ rad / s

$\varepsilon = \frac{1}{2} B_V \omega \;\; ^2$

$= 32\pi \cdot 10^{-5}$ V

10. Ans. (4)

Sol. Maxwell's equation

11. Ans. (40)

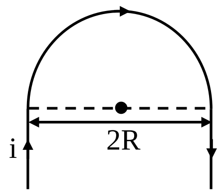
Sol. $B = 4 \cdot \frac{\propto_0 i}{4\pi\left(\frac{1}{2}\right)}\left(\frac{1}{\sqrt{2}} + \frac{1}{\sqrt{2}}\right)$

$= 4 \cdot 10^{-7} \cdot 5 \cdot 2 \cdot \sqrt{2}$

$= 40\sqrt{2} \cdot 10^{-7} T$

12. Ans. (4)

Sol.



Note : Direction of magnetic field is in $+\hat{k}$

$F = i \;\; \times B$

$= 2R$

$F = -2iRB\,j$

13. Ans. (5)

Sol. $F = q(v \times B)$

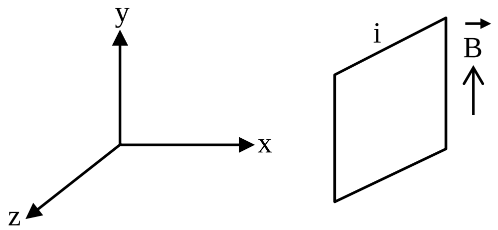
$5e\hat{k} = e(3\hat{i} + 5\hat{j}) \times (B_0\hat{i} + 2B_0\hat{j})$

$5e\hat{k} = e(6B_0\hat{k} - 5B_0\hat{k})$

$\Rightarrow B_0 = 5T$

14. Ans. (2)

Sol.



$M = iA$

$= 5 \times (0.2) \times (0.1)(-\hat{i})$

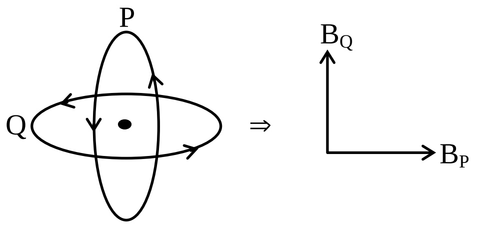
$= 0.1(-\hat{i})$

$\tau = M \times B = 0.1(-\hat{i}) \times (2 \times 10^{-3})(\hat{j})$

$= 2 \times 10^{-4}(-\hat{k})\,N-m$

15. Ans. (20)

Sol.



$B_P = \frac{\mu_0 N i_1}{2r} = \frac{\mu_0 \times 1 \times 100}{2\pi} = 2 \times 10^{-3}\ T$

$B_Q = \frac{\mu_0 N i_2}{2r} = \frac{\mu_0 \times 2 \times 100}{2\pi} = 4 \times 10^{-3}\ T$

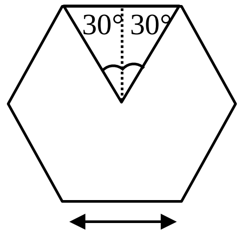
$B_{net} = \sqrt{B_P^2 + B_Q^2}$

$= \sqrt{20}$ mT

x = 20

16. Ans. (72)

Sol.



$\frac{4\pi}{6}$ m

$B = 6\left(\frac{\mu_0 I}{4\pi}\right)$ (sin 30° + sin 30°)

$= 6\,\frac{10^{-7} \times 4 \times \sqrt{3}}{\left(\frac{\sqrt{3} \times 4}{2 \times 6}\right)} = 72 \times 10^{-7}$T

17. Ans. (4)

Sol. τ = BINAsinφ

Cθ = BINAsin90°

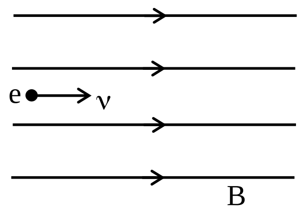
$C = \frac{BINA}{\theta} = \frac{0.01 \times 10 \times 10^{-3} \times 100 \times 2 \times 10^{-4}}{0.05}$

$= 4 \times 10^{-5}$ N-m/rad.

x = 4

18. Ans. (2)

Sol.



Since $v \parallel B$ so force on electron due to magnetic field is zero. So it will move along axis with uniform velocity.

19. Ans. (50)

Sol. Force on segment parallel to x-axis will cancel each other. Hence F_{net} will be due to portion parallel to y-axis.

F = 0.5 × 0.5 × 6 × 0.2 – 0.5 × 0.5 × 0.2 × 5

= 0.5 × 0.5 × 0.2

= 0.25 × 0.2

$= 50 \times 10^{-3}$ N

= 50 mN

20. Ans. (2)

Sol. At stable equilibrium

$U = -mB\cos 0° = -mB$

At unstable equilibrium

$U = -mB\cos 180° = +mB$

$W = \Delta U$

W.D. = 2 mB

$= 2(0.5)\,8 \times 10^{-2} = 8 \times 10^{-2}$ J

21. Ans. (5)

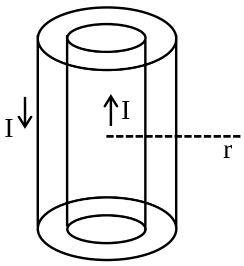
Sol. $B_A = \frac{\propto_0 i}{2\pi} + \frac{\propto_0 (2i)}{2\pi(3r)} = \frac{5\propto_0 i}{6\pi}$

$B_C = \frac{\propto_0 (2i)}{2\pi} + \frac{\propto_0 i}{2\pi(3r)} = \frac{7\propto_0 i}{6\pi}$

$\therefore \frac{B_A}{B_C} = \frac{5}{7} \quad \therefore x = 5$

22. Ans. (3)

Sol.



$\int B.d\ \ = \propto_0 i_{enc} = 0$

$\therefore$ B = 0 outside the cable

23. Ans. (5)

Sol. $R = \frac{\rho}{A} \Rightarrow \frac{2 \cdot 10^{-6} \cdot}{10^{-5}} = 1 \ \Rightarrow = \quad 5$

mg = Bi

$B = \frac{mg}{i} = \frac{5}{2 \cdot 5} = 0.5 = 5 \times 10^{-1}$ Tesla

24. Ans. (3)

Sol. $F_1 = qE$ (Theory)

$F_2 = q(V\ B)$

25. Ans. (500)

Sol. $\mu_0 ni = B$ n = number of turns per unit length

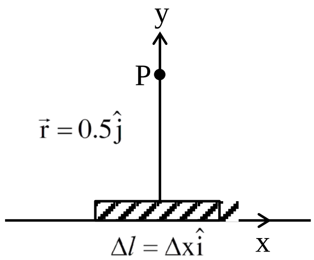
$\mu_0 \left(\frac{m}{\ }\right) i = B$

$m = \frac{B.}{\mu_0 i} = \frac{6.28 \cdot 10^{-3} \cdot 0.5}{12.56 \cdot 10^{-7} \cdot 5}$

m = 500

26. Ans. (1)

Sol.

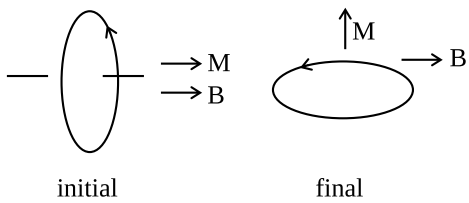


$dB = \frac{\propto_0 I\,(dl \cdot\ r)}{4\pi\ r^3}$ (Tesla)

$= \frac{10^{-7} \cdot 10 \cdot \left(\frac{1}{2} \cdot \frac{1}{100}\right)(+\hat{k})}{\left(\frac{1}{2}\right)^3} = 4 \cdot 10^{-8}\,T\,(+\hat{k})$

27. Ans. (5)

Sol.



We know

$W_{ext} = \Delta U + \Delta KE$

$(P.E. = -M \cdot B)$

$= -M \cdot B_f + M \cdot B_i + 0$

$= -MB\cos 90 + MB\cos 0$

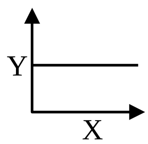
= MB

= NIAB

$= 200 \cdot 100 \cdot 10^{-6} \cdot \frac{5}{2} \cdot 10^{-4} \cdot 1 = 5\propto J$

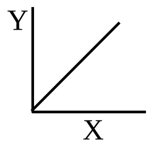
28. Ans. (4)

Sol. (A) Graph between Magnetic susceptibility and magnetising field is :



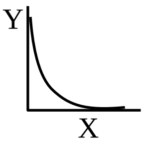
(B) magnetic field due to a current carrying wire for x < a :

$B = \frac{\propto_0\ i\ r}{2\pi a^2}$

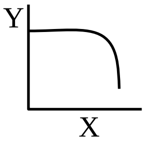


(C) magnetic field due to a current carrying wire for x > a :

$$B = \frac{\mu_0 i}{2\pi a}$$



(D) magnetic field inside solenoid varies as:



29. **Ans. (100)**

Sol. $W = \Delta U = U_f - U_i$

$W = (-\mu B)_f - (-\mu B)_i$

$= 0 + (\mu B)_i$

$= (100 \times 5 \times 10^{-3} \times 1 \times 10^{-3}) \times 0.2$ J

$= 1 \times 10^{-4}$ J $= 100\ \mu$J

30. **Ans. (4)**

Sol. A, C only

31. **Ans. (4)**

Sol. For the given condition of moving undeflected, net force should be zero.

qE = qVB

E = VB

$$= \sqrt{\frac{2 \cdot KE}{m}} \cdot B$$

$$= \sqrt{\frac{2 \cdot 5 \cdot 1.6 \cdot 10^{-19}}{9 \cdot 10^{-31}}} \cdot 3 \quad 10^{-6}$$

= 4 N/C

32. **Ans. (3)**

Sol. $B_1 2\pi \frac{a}{2} = \mu_o \frac{I}{4}$

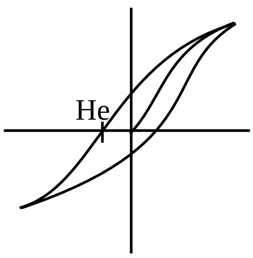
$$B_1 = \frac{\mu_o I}{4\pi a}$$

$B_2 2\pi a = \mu_o I$

$$B_2 = \frac{\mu_o I}{4\pi a}$$

33. **Ans. (10)**

Sol.



$$H_c = \frac{\mu_o n i}{\mu_o}$$

$$5 \times 10^3 = \frac{150}{30} \cdot 100 \cdot i$$

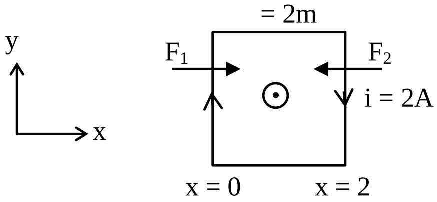
$$\frac{50}{5} = I;\ I = 10$$

34. **Ans. (2)**

Sol. Conceptual.

35. **Ans. (160)**

Sol.



$B(x = 0) = B_0$, $B(x = 2) = 9B_0$

Also, F = i B

$\Rightarrow F_1 = i\ B_0$ & $F_2 = 9i\ B_0$

$F = F_2 - F_1 = 8i\ B_0 = 8 \times 2 \times 2 \times 5$

F = 160 N

36. **Ans. (3)**

Sol. In uniform magnetic field,

$$R = \frac{mv}{qB} = \frac{\sqrt{2m(K.E)}}{qB}$$

Since same K.E

$$R \propto \frac{\sqrt{m}}{q}$$

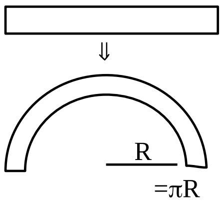
$$\therefore \frac{R_{deutron}}{R_{proton}} = \sqrt{\frac{m_d}{m_p}} \cdot \frac{q_p}{q_d}$$

$= \sqrt{2} \cdot 1$

$\therefore \gamma_d : \gamma_p = \sqrt{2} : 1$

37. **Ans. (28)**

Sol. Magnetic moment of straight wire = mx = 44



Magnetic moment of arc

= m × 2 r

$$= m \times \frac{2}{\pi}$$

$$= \frac{44 \cdot 2}{\pi} = \frac{88}{\pi} = 28$$