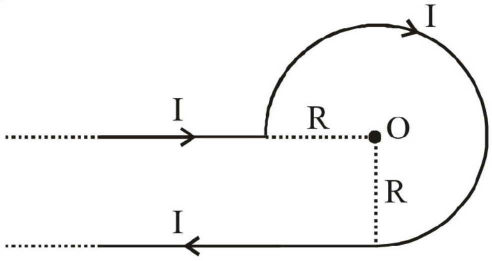
NEET kaka JEE

PHYSICS

Magnetic Effect of Electric Current

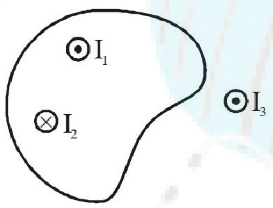
Q.1 **Magnetic field at the centre O due to the given structure is**



(a) $\frac{\mu_0 I}{4R}\left[\frac{3}{2}+\frac{1}{\pi}\right]\odot$ (b) $\frac{\mu_0 I}{2R}\left[3+\frac{1}{\pi}\right]\otimes$

(c) $\frac{\mu_0 I}{4R}\left[\frac{3}{2}+\frac{1}{\pi}\right]\otimes$ (d) $\frac{\mu_0 I}{4R}\left[3+\frac{2}{\pi}\right]\odot$

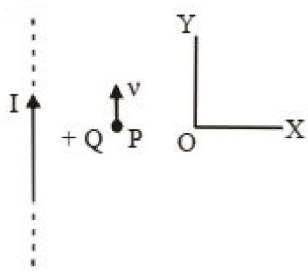
Q.2 **If $\vec{B}_1, \vec{B}_2$ and $\vec{B}_3$ are the magnetic field due to I_1, I_2 and I_3, then in Ampere's circuital law $\oint \vec{B}\times d\vec{\ell}=\mu_0 I$, $\vec{B}$ is**



(a) $\vec{B}=\vec{B}_1-\vec{B}_2$ (b) $\vec{B}=\vec{B}_1+\vec{B}_2+\vec{B}_3$

(c) $\vec{B}=\vec{B}_1-\vec{B}_2+\vec{B}_3$ (d) $\vec{B}=\vec{B}_3$

Q.3 **A charge Q moves parallel to a very long straight wire carrying a current I as shown. The force on the charge is**



(a) Opposite to OX (b) Along OX

(c) Opposite to OY (d) Along OY

Q.4 **If two straight current carrying wires are kept perpendicular to each other almost touching, then the wires**

(a) Attract each other

(b) Repel each other

(c) Remain stationary

(d) Become parallel to each other

Q.5 **A charged particle enters a uniform magnetic field perpendicular to it. The magnetic field**

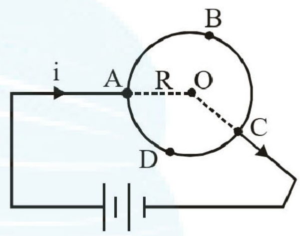
(a) Increases the speed of the particle

(b) Decreases the kinetic energy of the particle

(c) Changes the direction of motion of the particle

(d) Both (a) & (c)

Q.6 **A uniform circular wire loop is connected to the terminals of a battery. The magnetic field induction at the centre due to ABC portion of the wire will be (length of ABC = l_1, length of ADC = l_2)**



(a) $\frac{\mu_0}{2R}\frac{i l_1 l_2}{(l_1+l_2)^2}$ (b) $\frac{\mu_0}{2\pi R^2}\frac{i l_2}{(l_1+l_2)}$

(c) $\frac{\mu_0}{2R}\frac{i(l_1+l_2)}{(l_1 l_2}$ (d) Zero

Q.7 **A particle of mass m, charge Q and kinetic energy T enters a transverse uniform magnetic field of induction $\vec{B}$. After 3 seconds the kinetic energy of the particle will be**

(a) 4T (b) 3T

(c) 2T (d) T

Q.8 **An electron moves in a circular orbit with a uniform speed v. It produces a magnetic field B at the centre of the circle. The radius of the circle is proportional to**

(a) $\sqrt{\frac{B}{v}}$ (b) $\frac{B}{v}$

(c) $\sqrt{\frac{v}{B}}$ (d) $\frac{v}{B}$

Q.9 **When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that**

(a) Angle between them is either zero or 180°

(b) Angle between them is necessarily 90°

(c) Angle between them can have any value other than 90°

(d) Angle between them can have any value other than zero and 180°

Q.10 A positively charged particle moving due East enters a region of uniform magnetic field directed vertically upwards. This particle will

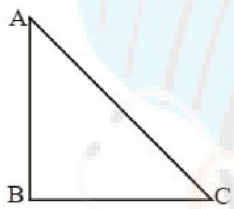
(a) Move in a circular path with a decreased speed

(b) Move in a circular path with a uniform speed

(c) Get deflected in vertically upward direction

(d) Move in circular path with an increased speed

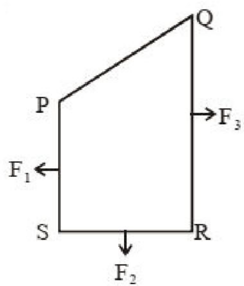
Q.11 A current carrying closed loop in the form of a right angle isosceles triangle ABC is placed in a uniform magnetic field acting along AB. If the magnetic force on the arm BC is $\vec{F}$, the force on the arm AC is



(a) $\sqrt{2}\vec{F}$ (b) $-\sqrt{2}\vec{F}$

(c) $-\vec{F}$ (d) $\vec{F}$

Q.12 A closed loop PQRS carrying a current is placed in a uniform magnetic field. If the magnetic forces on segments PS, SR and RQ are F_1, F_2 and F_3 respectively and are in the plane of the paper and along the directions shown, the force on the segment QP is



(a) $F_3 - F_1 + F_2$ (b) $F_3 - F_1 - F_2$

(c) $\sqrt{(F_3 - F_1)^2 + F_2^2}$ (d) $\sqrt{(F_3 - F_1)^2 - F_1^2}$

Q.13 To convert a galvanometer into a voltmeter one should connect a

(a) High resistance in series with galvanometer

(b) Low resistance in series with galvanometer

(c) High resistance in parallel with galvanometer

(d) Low resistance in parallel with galvanometer

Q.14 A galvanometer having a coil resistance of 60 Ω shows full scale deflection when a current of 1.0 A passes through it. It can be converted into an ammeter to read currents upto 5.0 A by

(a) Putting in parallel a resistance of 15 Ω

(b) Putting in parallel a resistance of 240 Ω

(c) Putting in series a resistance of 15 Ω

(d) Putting in series a resistance of 240 Ω

Q.15 In an ammeter 0.2% of main current passes through the galvanometer. If resistance of galvanometer is G, the resistance of ammeter will be

(a) $\frac{1}{499}G$ (b) $\frac{499}{500}G$

(c) $\frac{1}{500}G$ (d) $\frac{500}{499}G$

Q.16 Statement I : The trajectory of a charge when it is projected perpendicular to an electric field is a parabola.

Statement II : A moving charge entering parallel to the magnetic field lines moves in a circular path.

(a) Both statements are correct

(b) Both statements are incorrect

(c) Statement I is correct & II is incorrect

(d) Statement I is incorrect & II is correct

Q.17 Statement I : Like currents repel and unlike currents attract each other (in conductor).

Statement II : Magnetic force acts in the direction of current.

(a) Both statements are correct

(b) Both statements are incorrect

(c) Statement I is correct & II is incorrect

(d) Statement I is incorrect & II is correct

Q.18 **The magnetic field of given length of wire for single turn coil at its centre is B then its value for two turns coil for the same wire is**

(a) $\frac{B}{4}$ (b) $\frac{B}{2}$

(c) 4B (d) 2B

Q.19 **Assertion :** Ampere's circuital law' is not independent of the Biot-Savart's law.

Reason : Ampere's Circuital law can be derived from the Biot-Savart law.

(a) Assertion and reason both are true and the reason is correct explanation of assertion.

(b) Assertion and reason both are true but reason is not correct explanation of assertion.

(c) Assertion is true but reason is wrong.

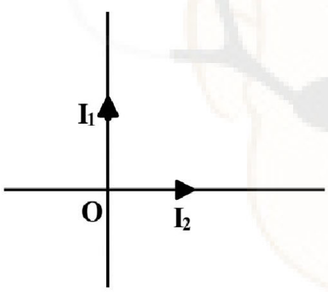
(d) Assertion and reason both are wrong.

Q.20 **A straight section PQ of a circuit lies along the X-axis from $x=-\frac{a}{2}$ to $x=\frac{a}{2}$ and carries a steady current i. The magnetic field due to the section PQ at a point x = +a will be**

(a) Proportional to a (b) Proportional to a^2

(c) Proportional to 1/a (d) Zero

Q.21 **Two long wires carrying current are kept crossed (not joined at O). The locus where magnetic field is zero is –**



(a) $I_1=\frac{x}{y}I_2$ (b) $I_1=\frac{y}{x}I_2$

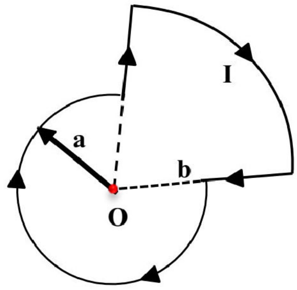
(c) $I_1=I_2$ (d) $I_1=-I_2$

Q.22 **The magnetic field $\overrightarrow{dB}$ due to a small current element $\vec{dl}$ at a distance $\vec{r}$ and element carrying current i is**

(a) $\overrightarrow{dB}=\frac{\mu_0}{4\pi}i^2\left(\frac{\vec{dl}\times\vec{r}}{r}\right)$ (b) $\overrightarrow{dB}=\frac{\mu_0}{4\pi}i^2\left(\frac{\vec{dl}\times\vec{r}}{r^3}\right)$

(c) $\overrightarrow{dB}=\frac{\mu_0}{4\pi}i\left(\frac{\vec{dl}\times\vec{r}}{r^3}\right)$ (d) $\overrightarrow{dB}=\frac{\mu_0}{4\pi}i^2\left(\frac{\vec{dl}\times\vec{r}}{r^2}\right)$

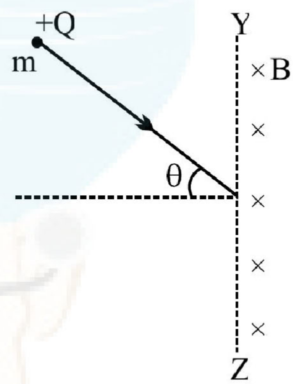
Q.23 **The magnetic induction at the centre O is ?**



(a) $\frac{3\mu_0 I}{8a}+\frac{\mu_0 I}{8b}\odot$ (b) $\frac{3\mu_0 I}{8a}+\frac{\mu_0 I}{8b}\otimes$

(c) $\frac{\mu_0 I}{8a}+\frac{\mu_0 I}{8b}\odot$ (d) $\frac{\mu_0 I}{8a}-\frac{\mu_0 I}{8b}\otimes$

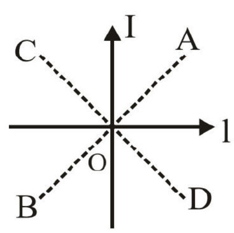
Q.24 **A particle with charge +Q and mass m enters a magnetic field of magnitude B, existing only to the right of the boundary YZ. The direction of the motion of the particle is perpendicular to the direction of B. Let $T=2\pi\frac{m}{QB}$. The time spent by the particle in the field will be**



(a) Tθ (b) 2Tθ

(c) $T\left(\frac{\pi+2\theta}{2\pi}\right)$ (d) $T\left(\frac{\pi-2\theta}{2\pi}\right)$

Q.25 **Two equal electric currents are flowing perpendicular to each other as shown in the figure. Lines AB and CD are perpendicular to each other and symmetrically placed with respect to the currents. Where do we expect the resultant magnetic field to be zero?**



(a) On CD (b) On AB

(c) On both OD and BO (d) On both AB and CD

Q.26 **An electron having a charge e moves with a velocity v in positive x direction. A magnetic field acts on it in positive y direction. The force on the electron acts in (where outward direction is taken as positive z-axis).**

(a) Negative direction of y-axis

(b) Positive direction of y-axis

(c) Positive direction of z-axis

(d) Negative direction of z-axis

Q.27 **If a proton enters perpendicularly to a magnetic field with velocity v , then time period of revolution is T. If proton enters with velocity 2v, then time period will be**

(a) T (b) 2 T

(c) 3 T (d) 4 T

Q.28 **A proton, a deutron and an α-particle accelerated through the same potential difference enter a region of uniform magnetic field, moving at right angles to it. What is the ratio of their kinetic energy?**

(a) 1 : 1 : 2 (b) 2 : 2 : 1

(c) 1 : 2 : 1 (d) 2 : 1 : 1

Q.29 **A particle of mass m carrying charge q is accelerated by a potential difference V. It enters perpendicularly in a region of uniform magnetic field B and executes circular arc of radius R, then $\frac{q}{m}$ equals**

(a) $\frac{2V}{B^2R^2}$ (b) $\frac{V}{2BR}$

(c) $\frac{VB}{2R}$ (d) $\frac{mV}{BR}$

Q.30 **The correct expression for Lorentz force is**

(a) $q[\vec{E}+(\vec{B}\times\vec{v})]$ (b) $q[\vec{E}+(\vec{v}\times\vec{B})]$

(c) $q(\vec{v}\times\vec{B})$ (d) $q\vec{E}$

Q.31 **If a charged particle enters perpendicularly in the uniform magnetic field then**

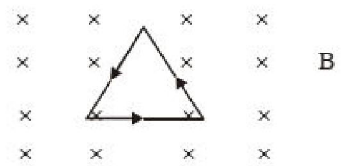
(a) Energy remains constant but momentum changes

(b) Energy and momentum both remains constant

(c) Momentum remains constant but energy changes

(d) Neither energy nor momentum remains constant

Q.32 **A wire is bent in the form of an equilateral triangle of side 100 cm and carries a current of 2 A. It is placed in a magnetic field of induction 2.0 T directed perpendicular into the plane of paper. The direction and magnitude of magnetic force acting on each side of the triangle will be**



(a) 2 N, normal to the side towards the centre of the triangle

(b) 2 N, normal to the side away from the centre of the triangle

(c) 4 N, normal to the side towards the centre of the triangle

(d) 4 N, normal to the side away from the centre of the triangle

Q.33 **A negative charge is coming towards the observer. The direction of the magnetic field produced by it will be (as seen by observer)**

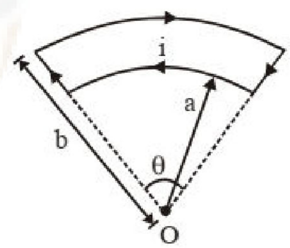
(a) Clockwise

(b) Anti-clockwise

(c) In the direction of motion of charge

(d) In the direction opposite to the motion of charge

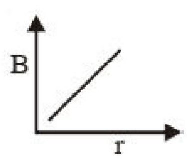
Q.34 **The figure below shows a current loop having two circular arcs joined by two radial lines. The magnetic field at O is**

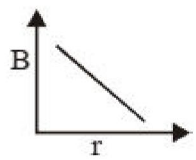


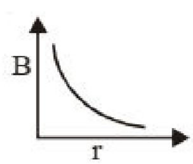
(a) $\frac{\mu_0 i\theta}{2\pi ab}(b-a)$ (b) $\frac{\mu_0 i\theta}{4\pi ab}(b-a)$

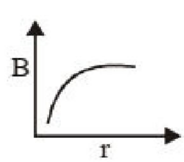
(c) Zero (d) $\frac{\mu_0 i\theta}{3\pi ab}(b+a)$

Q.35 **Which one of the following graphs shows the variation of magnetic induction B with distance r from a long wire carrying a current?**

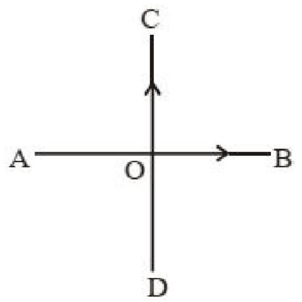
(a) 

(b) 

(c) 

(d) 

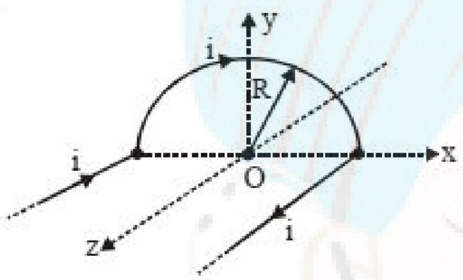
Q.36 Two straight long conductors AOB and COD are perpendicular to each other and carry currents i_1 and i_2. The magnitude of the magnetic induction at a point P at a distance d from the point O in a direction perpendicular to the plane ABCD is



(a) $\frac{\mu_0}{2\pi d}(i_1 + i_2)$ (b) $\frac{\mu_0}{4\pi d}(i_1 - i_2)$

(c) $\frac{\mu_0}{2\pi d}(i_1^2 + i_2^2)^{1/2}$ (d) $\frac{\mu_0}{2\pi d}\left[\frac{i_1 i_2}{i_1 + i_2}\right]$

Q.37 The magnetic induction at the point O, if the wire carries a current i, is



(a) $\frac{\mu_0 i}{2R}$ (b) $\frac{\mu_0 i}{2\pi R}$

(c) $\frac{\mu_0 i(\pi^2 + 4)^{1/2}}{4\pi R}$ (d) $\frac{\mu_0 i(\pi^2 + 4)}{4\pi R}$

Q.38 The net charge in a current carrying wire is zero still magnetic field exerts a force on it, because a magnetic field exerts force on

(a) Stationary charge

(b) Moving charge

(c) A positive charge only

(d) A negative charge only

Q.39 The number of turns per unit length of a long solenoid is 10. If its average radius is 5 cm and it carries a current of 10 A, then the ratio of flux densities obtained at the centre and at the end on the axis will be

(a) 1 : 2 (b) 2 : 1

(c) 1 : 1 (d) 1 : 4

Q.40 Numerically 1 gauss = x tesla, then x is

(a) 10^{-4} (b) 10^{4}

(c) 10^{8} (d) 10^{-8}

Q.41 The net charge in a current carrying wire is zero still magnetic field exerts a force on it, because a magnetic field exerts force on

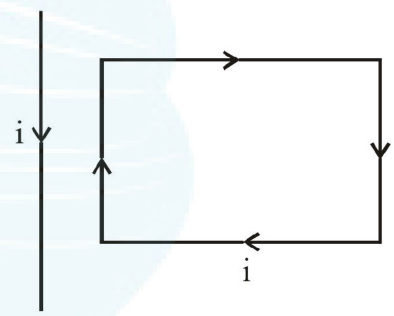
(a) Stationary charge

(b) Moving charge

(c) A positive charge only

(d) A negative charge only

Q.42 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, 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

Q.43 A square loop of side l is kept in a uniform magnetic field B such that its plane makes an angle α with $\vec{B}$. The loop carries a current i. The torque experienced by the loop in this position is

(a) B i l^2 (b) B i $l^2 \sin\alpha$

(c) B i $l^2 \cos\alpha$ (d) Zero

Q.44 The effective radius of a circular coil is R and number of turns is N. The current through it is i ampere. The work done in rotating the coil by angle of 180° in an external magnetic field B will be (initially plane of coil is perpendicular to magnetic field)

(a) πNiR^2B (b) $2\pi NiR^2B$

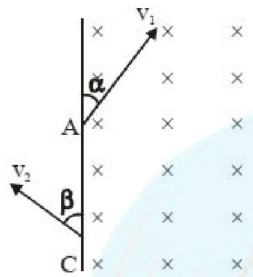
(c) $\frac{(2NiB)}{\pi R^2}$ (d) Zero

Q.45 If an electron revolves around a nucleus in a circular orbit of radius R with frequency n, then the magnetic field produced at the centre of the nucleus will be

(a) $\frac{\mu_0 en}{2R}$ (b) $\frac{\mu_0 en}{4\pi R}$

(c) $\frac{4\pi\mu_0 en}{R}$ (d) $\frac{4\pi\mu_0 e}{Rn}$

Q.46 A particle of charge –q and mass m enters a uniform magnetic field $\vec{B}$ at A with speed v_1 at an angle α and leaves the field at C with speed v_2 at an angle β as shown. Then



(a) $\alpha = \beta$

(b) $v_1 = v_2$

(c) Particle remains in the field for time

$$t = \frac{2m(\pi - \alpha)}{qB}$$

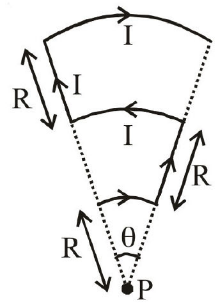
(d) All of these

Q.47 A particle of charge per unit mass α is released from origin with a velocity $\vec{v} = v_0\hat{i}$ in a uniform magnetic field $\vec{B} = -B_0\hat{k}$. If the particle passes through (0, y, 0) then y is equal to

(a) $-\frac{2v_0}{B_0\alpha}$ (b) $\frac{v_0}{B_0\alpha}$

(c) $\frac{2v_0}{B_0\alpha}$ (d) $-\frac{v_0}{B_0\alpha}$

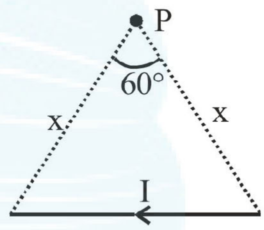
Q.48 Magnetic field at P due to given structure is



(a) $\left(\frac{\mu_0}{4\pi}\right)\frac{I\theta}{2R}$ (b) $\frac{\mu_0}{4\pi}\frac{6I\theta}{5R}$

(c) $\left(\frac{\mu_0}{4\pi}\right)\frac{5I\theta}{6R}$ (d) $\left(\frac{\mu_0}{4\pi}\right)\frac{2I\theta}{R}$

Q.49 A straight wire of finite length carrying current I subtends an angle of 60° at point P as shown. The magnetic field at P is



(a) $\frac{\mu_0 I}{2\sqrt{3}\pi x}$ (b) $\frac{\mu_0 I}{2\pi x}$

(c) $\frac{\sqrt{3}\mu_0 I}{2\pi x}$ (d) $\frac{\mu_0 I}{3\sqrt{3}\pi x}$

Q.50 A proton and an alpha particle enter the same magnetic field which is perpendicular to their velocity. If they have same kinetic energy then ratio of radii of their circular path is

(a) 1 : 1 (b) 1 : 2

(c) 2 : 1 (d) 1 : 4

Solution

1. (c)

$B = B_{\text{due to circular arc}} + B_{\text{due to straight wires}}$

$= \frac{\mu_0 i}{2R}\left(\frac{3\pi}{2.(2\pi)}\right) + \frac{\mu_0 i}{4\pi R}$

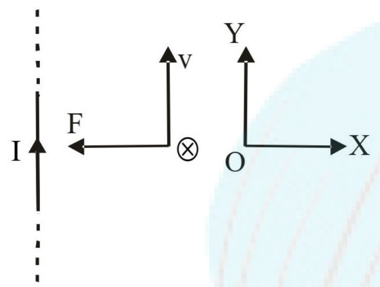
$\Rightarrow B = \frac{\mu_0 i}{4R}\left[\frac{3}{2} + \frac{1}{\pi}\right] \otimes$

2. (b)

$\vec{B}$ is due to all the currents existing anywhere and I_{enclosed} is the current enclosed in the loop.

$\vec{B} = \vec{B}_1 + \vec{B}_2 + \vec{B}_3$

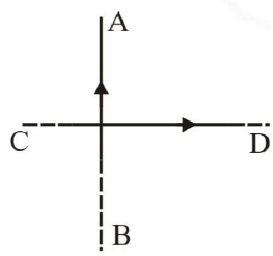
3. (a)



$F = q(\vec{v} \times \vec{B})$

Using right hand thumb rule F will be opposite to OX.

4. (d)



Due to wire AB, wire CD will experience torque due to which it will become parallel to AB.

5. (c)

Magnetic force $\vec{F} \perp \vec{V}$

$\Rightarrow$ No work is done by magnetic field so speed and kinetic energy cannot be changed by magnetic field but it can deflect the particle

6. (a)

Let current in part ABC is i_1

and in part ADC is i_2

$i_1 = \frac{i l_2}{l_1 + l_2}$ (As ABC and ADC part are in parallel connection)

and angle subtended by ABC at centre O will be

$= \left(\frac{2\pi}{l_1 + l_2}\right)(l_1)$

so using $B = \frac{\mu_0 i}{2R}\left(\frac{\theta}{2\pi}\right)$

$B = \frac{\mu_0}{2R}\left(\frac{i l_2}{l_1 + l_2}\right)\frac{2\pi}{(l_1 + l_2)}\frac{(l_1)}{2\pi}$

7. (d)

Due to magnetic field the charge willl move in circular path, so magnitude of velocity remains constant. Hence $\vec{B}$ does not change kinetic energy.

8. (c)

$B = \frac{\mu_0}{4\pi}\frac{q(\vec{v} \times \vec{r})}{r^3}$

$\Rightarrow B = \frac{\mu_0}{4\pi}\frac{qv}{r^2}$

$r \propto \sqrt{\frac{v}{B}}$

9. (d)

$F = q(\vec{v} \times \vec{B}) = qvB\sin\theta$

$F \neq 0,\ \sin\theta \neq 0,\ \Rightarrow \theta \neq 0°, 180°$

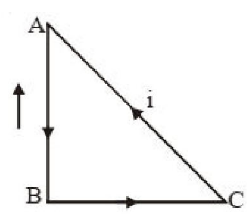
10. (b)

In uniform $\vec{B}$, if charge enters perpendicular to the magnetic field. It will execute circular motion with uniform speed.

11. (c)

Net force on the loop = 0

Force on wire AB is zero because it is along magnetic field. Hence Foce on AC = –(Force on BC) $= -\vec{F}$



12. (c)

Net force on loop will be zero in uniform magnetic field

So, force on QP will balance other forces

$\therefore F_{QP} = \sqrt{(F_3 - F_1)^2 + F_2^2}$

13. (a)

A high resistance is connected in series with the galvonometer so that least amount of current flows through it and we get very accurate reading.

14. (a)

$$R_s = \frac{R_g}{\frac{i}{i_g}-1} = \frac{60}{\frac{5}{1}-1} = 15\Omega$$

15. (c)

$0.2\ G = 100\ R_A$

$$\therefore \quad R_A = \frac{G}{500}$$

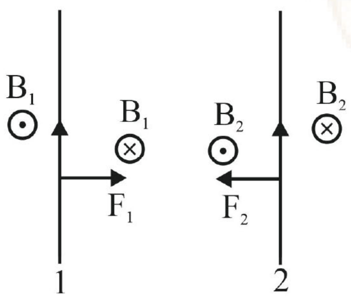
16. (c)

If the charged particle is positively charged then it will experience force in the direction of electric field and if the particle is negatively charged then it will experience force opposite to the direction of electric field in both the cases the force is acting perpendicular to the direction of velocity hence particle will follow parabolic path.

If a charged particle moves parallel to the magnetic field then the force experienced by it will be zero as

$$\theta = 0^\circ \quad [F_B = q(\vec{v}\times\vec{B})]$$

17. (b)



We can find the direction of force acting an each wire using fleming's left hand rule.

$F_1 \rightarrow$ force on 1 due to field B_2

$F_2 \rightarrow$ force on 2 due to field B_1

We can say that forces are attractive in nature and force acts perpendicular to the direction of flow of current.

18. (c)

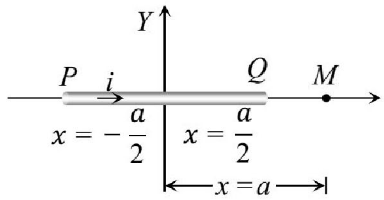
$$B = N\frac{\mu_0 i}{2R} \quad B' = 2N\frac{\mu_0 i}{2(R/2)} = 4N\frac{\mu_0 i}{2R} = 4B$$

19. (a)

Results of Biot's savart's law can be derived from ampere circuital law hence both are dependent on each other.

20. (d)

Magnetic field at a point on the axis of a current carrying wire is always zero.

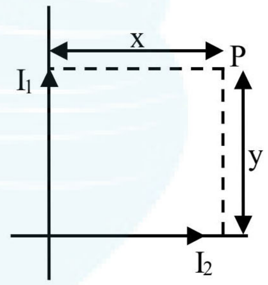


21. (a)

Magnetic field could be zero in 1st or 3rd quadrant.

$$\frac{\mu_0 I_1}{2\pi x} = \frac{\mu_0 I_2}{2\pi y}$$

$$\text{or} \quad I_1 = \frac{x}{y} I_2$$



22. (b)

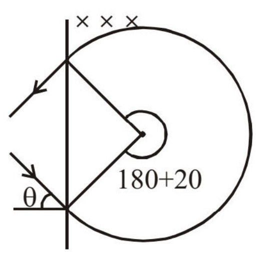
$$\vec{dB} = \frac{\mu_0 i}{4\pi}\left(\frac{\vec{dl}\times\vec{r}}{r^3}\right)$$

23. (b)

$$B = \frac{3}{4}\left[\frac{\mu_0 I}{2a}\right] + \frac{1}{4}\left[\frac{\mu_0 I}{2b}\right] \otimes$$

$$B = \frac{3\mu_0 I}{8a} + \frac{\mu_0 I}{8b} \otimes$$

24. (c)



Fraction of circular path in the magnetic field

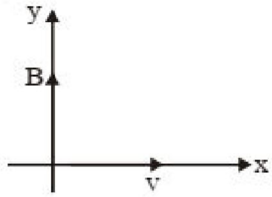
$$= \left(\frac{\pi + 2\theta}{2\pi}\right)$$

$$\text{Time taken} = \left(\frac{\pi + 2\theta}{2\pi}\right)T$$

25. (b)

On line AB, as in this region magnetic field will be in opposite direction due to both the wires.

26. (d)



$\vec{F} = -e(\vec{v} \times \vec{B}) = -e(v\hat{i} \times B\hat{j}) = -evB\hat{k}$

or by using right hand thumb rule

$\vec{F}$ will be in $-z$ direction.

27. (a)

$T = \dfrac{2\pi m}{qB} \Rightarrow$ independent of v.

28. (a)

K.E. = qV V is same for all

K.E. $\propto$ q

So, $K.E._p : K.E_d : K.E_\alpha = 1 : 1 : 2$

29. (a)

$$R = \frac{\sqrt{2mk}}{qB} = \frac{\sqrt{2mqV}}{qB}$$

$$\Rightarrow R = \frac{\sqrt{2V}}{B}\sqrt{\frac{m}{q}} \Rightarrow \frac{q}{m} = \frac{2V}{R^2B^2}$$

30. (b)

$\vec{F} = q[\vec{E} + (\vec{v} \times \vec{B})]$

31. (a)

Work done by magnetic force will always be zero as $\vec{F} \perp \vec{v}$

so using work energy theorem

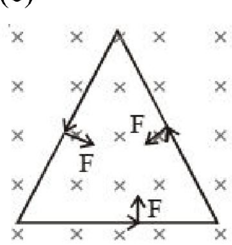
$W_{all} = \Delta K$

$W = 0$

$\Rightarrow K = \text{constant}$

$\vec{p}$ change as direction of velocity changes.

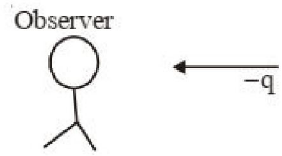
32. (c)



$\vec{F} = i(\vec{l} \times \vec{B}) = 2(1)(2) = 4$ N

Normal to side towards centre of triangle.

33. (a)



$\vec{B}$ will be clockwise as seen by observer.

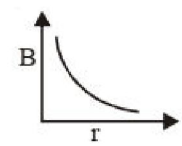
34. (b)

$$\vec{B} = \vec{B}_1 - \vec{B}_2 = \frac{\mu_0 i}{2a}\left(\frac{\theta}{2\pi}\right) - \frac{\mu_0 i}{2b}\left(\frac{\theta}{2\pi}\right) = \frac{\mu_0 i\theta}{4\pi}\left(\frac{1}{a} - \frac{1}{b}\right)$$

35. (c)

$B = \dfrac{\mu_0 i}{2\pi r}$

$B \propto \dfrac{1}{r}$

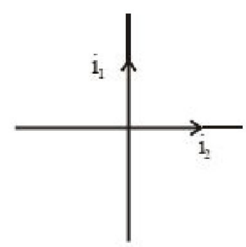


36. (c)

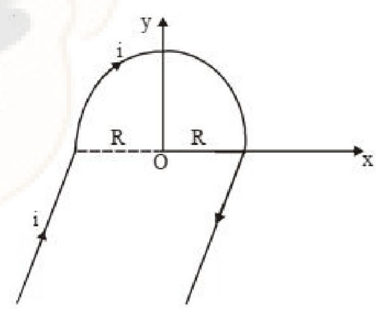
$\Rightarrow \vec{B} = \vec{B}_1 + \vec{B}_2$

$\vec{B} = \dfrac{\mu_0 i_1}{2\pi d}\hat{i} - \dfrac{\mu_0 i_2}{2\pi d}\hat{j}$

$|\vec{B}| = \dfrac{\mu_0}{2\pi d}\sqrt{i_1^2 + i_2^2}$



37. (c)



Due to straight wires $\vec{B}_1$ at O

$$B_1 = \frac{\mu_0 i}{4\pi R}(-\hat{j}) + \frac{\mu_0 i}{4\pi R}(-\hat{j}) = -\frac{\mu_0 i}{2\pi R}\hat{j}$$

Due to semicircle $\vec{B}_2 = -\dfrac{\mu_0 i}{4R}\hat{k}$

$$\text{Net } |\vec{B}| = |\vec{B}_1 + \vec{B}_2| = \sqrt{\left(\frac{\mu_0 i}{2\pi R}\right)^2 + \left(\frac{\mu_0 i}{4R}\right)^2}$$

$$= \frac{\mu_0 i}{2R}\sqrt{\frac{1}{\pi^2} + \frac{1}{4}} = \frac{\mu_0 i}{2R(2\pi)}\sqrt{\pi^2 + 4}$$

38. (b)

$\vec{F} = q(\vec{v} \times \vec{B})$

Moving charge are only electrons and magnetic field exert force on moving charges only.

39. (b)

$\vec{B}_{centre} = \mu_0 ni \qquad n = 10$

$\vec{B}_{end} = \dfrac{\mu_0 ni}{2}$

$\dfrac{\vec{B}_{centre}}{\vec{B}_{end}} = \dfrac{\mu_0 ni}{\left(\dfrac{\mu_0 ni}{2}\right)} = \dfrac{2}{1}$

40. (a)

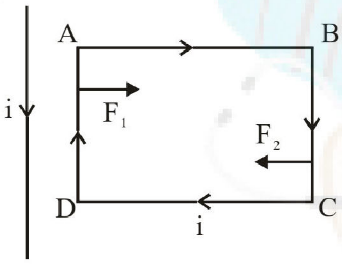
1 gauss = 10^{-4} T

41. (b)

$\vec{F} = q(\vec{v} \times \vec{B})$

Moving charge are only electrons and magnetic field exert force on moving charges only.

42. (b)



Force on AB and CD will be zero and for AD and BC

$F_1 > F_2$

$\Rightarrow$ Loop moves away from wire.

43. (c)

$\tau = \overrightarrow{M} \times B$

$\overrightarrow{M} = iA = il^2$

$\Rightarrow \tau = il^2 B\sin(90 - \alpha) = Bil^2 \cos\alpha$

44. (b)

$W = \Delta U = U_f - U_i$

$= -Ni\pi R^2 B\cos 180° - (-Ni(\pi R^2)B\cos 0°)$

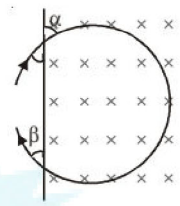
$= 2\pi NiR^2 B$

45. (a)

Current $(i) = \dfrac{q}{T} = q\left(\dfrac{1}{T}\right) = qn$

So, $\bar{B} = \dfrac{\mu_0 i}{2R} = \dfrac{\mu_0 (ne)}{2R}$

46. (d)



As the magnetic field is uniform the charge comes out symmetrically.

$\beta = \alpha$

The speed is constant during the motion.

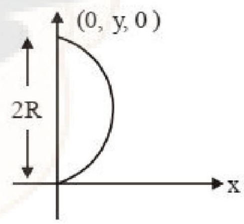
$v_1 = v_2 \ (\because F_m \perp v)$

$T = \dfrac{2\pi m}{qB}$

time spent in magnetic field

$T' = \dfrac{(2\pi - 2\alpha)}{2\pi} \times \dfrac{2\pi m}{qB} = \dfrac{2(\pi - \alpha)m}{qB}$

47. (c)



$\dfrac{q}{m} = \alpha$

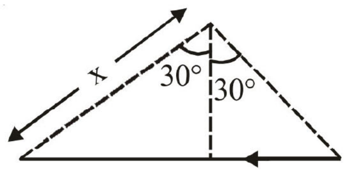
$y = 2R = 2\left(\dfrac{mv}{qB}\right) = \dfrac{2v_0}{\alpha B_0}$

48. (c)

$\vec{B}_P = \dfrac{\mu_0 I\theta}{4\pi R} + \dfrac{\mu_0 I\theta}{4\pi(3R)} - \dfrac{\mu_0 I\theta}{4\pi(2R)}$

$\vec{B}_P = \dfrac{\mu_0 I\theta}{4\pi R}\left[1 + \dfrac{1}{3} - \dfrac{1}{2}\right] = \dfrac{5}{6}\left(\dfrac{\mu_0 I\theta}{4\pi R}\right)$

49. (a)



$$B = \frac{\mu_0 I}{4\pi x \cos 30^\circ}[\sin 30^\circ + \sin 30^\circ]$$

$$B = \frac{\mu_0 I}{4\pi x\left(\frac{\sqrt{3}}{2}\right)}\left(\frac{1}{2}+\frac{1}{2}\right) = \frac{\mu_0 i}{2\sqrt{3}\pi x}$$

50. (a)

$r = \frac{\sqrt{2mk}}{qB}$ here k is same, so $r \propto \frac{\sqrt{m}}{q}$

So, $\frac{r_p}{r_\alpha} = \sqrt{\frac{m_p}{m_\alpha}} \times \frac{q_\alpha}{q_p} = \sqrt{\frac{1}{4}} \times \frac{2}{1} = 1:1$