Magnetic Effects of Current and Magnetism Important Questions With Answers

NEET Physics 2023

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1. Two circular coils 1 and 2 are made from the same wire but the radius of the 1^{st} coil is twice that of the 2 nd coil. What potential difference in volts should be applied across them so that the magnetic field at their centres is the same ___________ .

   a) 4 b) 6 c) 2 d) 3

   Solution : -

   Magnetic field due to first coil and second coil is same at centre.

   Then Magnetic field B at center is,

   $B=\frac{\mu_0 I_1}{2(2r)}=\frac{\mu_0 I_2}{2(r)}=\frac{I_1}{I_2}=2$..(i)

   As we know that Resistance of coil is related as, $R=P\frac{l}{A}$

   Where P = resistivity,l= length

   A = area of cross section

   P and A is same for both coil but $l_1=2\pi(2r)$ and $l_2=2\pi(r)$

   If V_1 and V_2 applied across first and second coil then,

   $I_1=\frac{V_1}{R_1}$ and $I_2=\frac{V_2}{R_2}$

   $I_1=\frac{V_1}{\rho\frac{l}{A}}$...(ii)

   $I_2=\frac{V_2}{\rho\frac{l_2}{\pi}}$...(iii)

   From (1), (2) and (3)

   $\frac{V_1}{l_1}\times\frac{l_2}{V_2}=2$

   $\frac{V_1}{\eta_1}\times\frac{l_2}{l_1}=2$

   $\frac{V_1}{V_2}\times\frac{1}{2}=2$

   $\frac{V_1}{v_2}=4 \quad v_1=4V_2$

2. In a certain region of space electric field $\vec{E}$ and magnetic field $\vec{B}$ are perpendicular to each other and an electron enters in region perpendicular to the direction of $\vec{B}$ and $\vec{E}$ both and moves undeflected, then velocity of electron is_____

   a) $\frac{|\vec{E}|}{|\vec{B}|}$ b) $\vec{E}\times\vec{B}$ c) $\frac{|\vec{B}|}{|\vec{E}|}|$ d) $\vec{E},\vec{B}$

   Solution : -

   If force exerted due to electric field is equal to force due to magnetic field, the electron moves straight i.e. undeflected

   $q|\vec{v}||\vec{B}|=q|\vec{E}|\Rightarrow|\vec{v}|=\frac{|\vec{E}|}{|\vec{B}|}$

3. The conversion of a moving coil galvanometer into a voltmeter is done by

a) introducing a resistance of large value in series b) introducing a resistance of small value in parallel c) introducing a resistance oflarge value in parallel d) introducing a resistance of small value in series

4. Electromagnets are made of soft iron because soft iron has:
   a) low retentivity and high coercive force b) high retentivity and high coercive force
   c) low retentivity and low coercive force d) high retentivity and low coercive force

   Solution : -
   Electromagnet are made of soft iron because soft iron has low retentivity and low coercive force or low coercivity.

5. A bar magnet has a magnetic moment of 200 A m^2. The magnet is suspended in a magnetic field of 0.30 N A^{-1} m^{-1}. The torque required to rotate the magnet from its equilibrium position through an angle of 30°, will be :
   a) 30 N m b) $30\sqrt{3}$ N m c) 60 N m d) $60\sqrt{3}$ N m

   Solution : -
   Torque experienced by a magnet suspended in a uniform magnetic field B is given by '$\tau = MB\sin\theta$
   Here, M = 200 A m^2, B = 0.30 N A^{-1} m^{-1} and θ = 30°
   $\tau = 200 \times 0.30 \times \sin 30^0$
   $\tau = 30$ N m

6. The cyclotron frequency υc is given by
   a) $\frac{qB}{2\pi m}$ b) $\frac{MB}{2\pi q}$ c) $\frac{2\pi m}{qB}$ d) $\frac{2\pi B}{qm}$

   Solution : -
   In cyclotron the centripetal force is balanced by magnetic force, then
   qvB=$\frac{mv^2}{R} \Rightarrow \frac{qBr}{m} = v$
   where v = $2\pi r\upsilon_c$
   $\frac{qBr}{m} = 2\pi r\upsilon_c \therefore \upsilon_c = \frac{qB}{2\pi m}$

7. What is the correct value of Bohr magneton?
   a) 8.99 x 10^{-24}A m^2 **b) 9.27 x 10^{-24}A m^2** c) 5.66 x 10^{-24}A m^2 d) 9.27 x 10^{-28}A m^2

   Solution : -
   Bohr Magnetron
   $(\mu_l)_{min} = \mu_B = \frac{e}{4\pi m_e}h$
   Here, e = 1.6 x 10^{-19} C, h = 6.64 x 10^{-34} J s
   me = 9.1 x 10^{-31} kg
   $\therefore \mu_B = \frac{1.60\times10^{-19}\times6.64\times10^{-34}}{4\times3.14\times9.1\times10^{-31}}$=9.27x$10^{-24}$A m^2

8. To convert a 800 m V range milli voltmeter of resistance 40 Ω into a galvanometer of 100 mA range, the resistance to be connected as shunt is :
   a) 10 Ω b) 20 Ω c) 30 Ω d) 40 Ω

   Solution : -
   Current will be i/i_g=1 +G/S
   i.G/V_g=1+G/S
   Putting values, 100 x 10^{-3} x 40/800 x 10^{-3} =1+40/S
   Now shunt resistance 5=10 Ω

9. The work done in moving a dipole from its most stable to most unstable position in a 0.09 T uniform magnetic field is (dipole moment of this dipole = 0.5 A m^2)
   a) 0.07J b) 0.08 J **c) 0.09 J** d) 0.1 J

   Solution : -

Since the most stable position is at θ = 0 and the most unstable position is at θ = 180°, then the work done is given by

$$W = \int_{\theta=0^0}^{\theta=180^0} \tau(\theta)d\theta = \int_{0^0}^{180^0} mB\sin\theta d\theta = -mB[\cos\theta]_0^{180^0}$$
$$= -mB\left[\cos 180^0 - \cos 0^0\right] = -mB\left[-1-1\right]$$
$$= -mB\left[-2\right] = 2 \quad mB$$

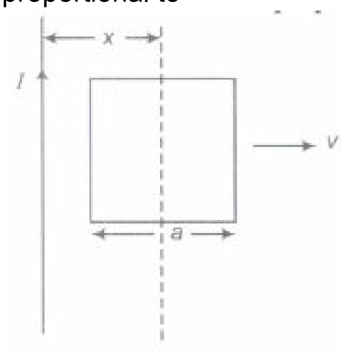
Here, m = 0.5 A m^2 and B = 0.09 T

∴W = 2 x 0.50 x 0.09 = 0.09 J

10. A charged particle moves through a magnetic field in a direction perpendicular to it. Then the __________ .
 a) velocity remains unchanged **b) speed of the particle remains unchanged**
 c) dircction of the particle remains unchanged d) acceleration remains unchanged

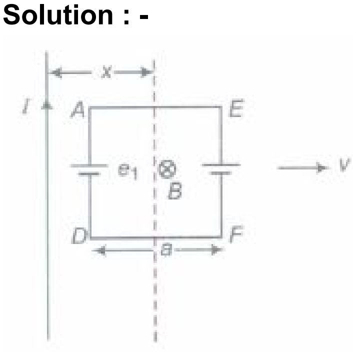
 Solution : -
 As we know magnetic force acts perpendicular to the velocity, So, speed remains constant.

11. A conducting square frame of side a and a long straight wire carrying current I and located in the same plane as shown in the figure. The frame moves to the right with a constant velocity v. The emf induced in the frame will be proportional to



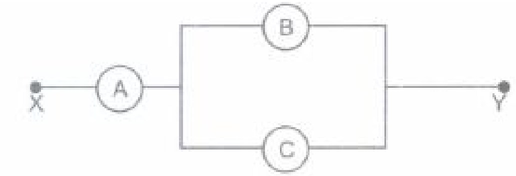
 a) $1/x^2$ b) $1/(2x-a)^2$ c) $1/(2x+a)^2$ **d) 1/(2x-a)(2x+a)**

 Solution : -



 The emf in AD :
 e_1 = (a x $\mu_0$iv)/2π(x - a/2)
 The emf in EF :
 e_2 = (a x μi x c)/2π(x + a/2)
 Net emf = e_1 - e_2
 ⇒ e=$\frac{\mu_0}{2\pi} a \times i \times v \left[\frac{1}{x-\frac{a}{2}} - \frac{1}{x+\frac{a}{2}}\right]$
 e$\propto \frac{1}{(2x-a)(2x+a)}$.

12. A, B and C are voltmeters of resistance R, 1.5 R and 3R respectively as shown in the fig. When some potential difference is applied between X and Y, the voltmeter reading are V_A, V_B and V_C respectively.



a) $V_A = V_B = V_C$ b) $V_A \neq V_B = V_C$ c) $V_A = V_B \neq V_C$ d) $V_A \neq V_B \neq V_C$

Solution : -

$V_A = I \times R = IR$

$V_B = I_1 \times 1.5R$

$V_C = (I - I_1) \times 3R$

Since, $V_B = V_C$

$1.5\, I_1R = (I - I_1)\, 3R$

or $1.5I_1 = I$

So, $V_A = 1.5I_1R$

and $V_C = (1.5I_1 - I_1)\, 3R$

$= 1.5I_1R$

Hence $V_A=V_B=V_C$

13. A bar magnet is oscillating in the Earth's magnetic field with a period T. What happens to this period and motion if this mass is quadrupled

a) Motion remains S.H. with time period = T/2 **b) Motion remains S.H. with time period = 2T**

c) Motion remains S.H. with time period = 4T

d) Motion remains S.H. with time and period remains nearly constant

Solution : -

Now the time period T, $=2\pi\sqrt{I/MB}$

As $I \propto$ mass, then time period:

$T'=2\pi\sqrt{4I/MB} = 2T$

14. If you made a map of magnetic field lines at Melbourne in Australia, then the magnetic field lines seem to be

a) go into the ground **b) come out of the ground** c) maintain a spiral path on the surface of earth

d) move on helical path above the surface of ground

Solution : -

As Melbourne is situated in southern hemisphere where north pole of earth's magnetic field lies therefore magnetic lines of force seem to come out of the ground.

15. **Assertion:** Ampere's circuital law holds for steady currents which do not fluctuate with time.

Reason: Ampere's circuital law is similar to that of Biot-savart's law

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

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

16. **Assertion:** Increasing the current sensitivity of a galvanometer necessarily increases the voltage sensitivity.

Reason: Voltage sensitivity is inversely proportional to current sensitivity.

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

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. **d) If both assertion and reason are false**

Solution : -

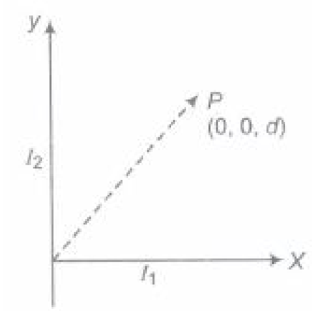
Increasing the current sensitivity may not necessarily increase the voltage sensitivity.

17. **Assertion:** Cyclotron does not accelerate electrons.
Reason: Mass of the electrons is very small
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion.
c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -
Cyclotron is not suitable for accelerating electrons. Due to the small mass, the speed of electrons increases rapidly. Likewise, due to quick relativistic variation in their mass, the electrons get out of step with the oscillating electric field.

18. Two identical long conducting wires AOB and COD are placed at right angle to each other, with one above other such that 'O' is their common point for the two. The wires carry I_1 and I_2 currents, respectively. Point 'P' is lying at distance "d' from 'O' along a direction perpendicular to the plane containing the wires. The magnetic field at the point 'P' will be :
a) $(\mu_0/2\pi d) \times (I_1/I_2)$ b) $(\mu_0/2\pi d) (I_1/I_2)$ c) $(\mu_0/2\pi d) \times (I^2_1-I^2_2)$ **d) $(\mu_0/2\pi d) \times (I^2_1+I^2_2)^{1/2}$**

Solution : -



$B_1 = \mu_0 I_1/2\pi d(-\hat{j})$
$B_2 = \mu_0 I_2/2\pi d(+\hat{i}$
$B=\sqrt{B_1^2+B_2^2}$
$=\mu_0/2\pi d \times \sqrt{I_1^2+I_2^2}$

19. A solenoid of length 0.6 m has a radius of 2 cm and is made up of 600 turns If it carries a current of 4 A, then the magnitude of the magnetic field inside the solenoid is
a) 6.024×10^{-3} T b) 8.024×10^{-3} T **c) 5.024×10^{-3} T** d) 7.024×10^{-3} T

Solution : -
Here, n=$\frac{600}{0.6}$=1000 turns/m, 1=4A
1= 0.6 m, r = 0.02 m $\therefore \frac{1}{r}$=30 i.e.l >> r
Hence, we can use long solenoid formula, then
$\therefore$B =$\mu_0 nI$ = $4\pi \times 10^{-7} \times 10^3 \times 4 = 50.24 \times 10^{-4}$
= 5.024×10^{-3} T

20. A coil of one turn is made of a wire of certain length and then from the same length a coil of two turns is made. If the same current is passed in both the cases, then the ratio of the magnetic induction at their centres will be___
a) 2: 1 **b) 1: 4** c) 4: 1 d) 1: 2

Solution : -
Magnetic induction at the centre of current carrying coil of N turns carrying current is given by
$B=\frac{\mu_0 Ni}{2r}$ ... (i)
Suppose the length of the wire be L.

Case I For coil of one turn, let radius be r_1.
$\therefore L = 2\mathrm{p}r_1 \times N$
or $r_1 = \frac{L}{2\pi \times N} = \frac{L}{2\pi}$
(Q N=1)
Case II For coil of two turns, let radius be r_2
$\therefore L = 2\mathrm{p}r_2 \times N$
or $r_2 = \frac{L}{2\pi \times N} = \frac{L}{2\pi \times 2} \quad (\mathrm{Q}N = 2)$
or $r_2 = \frac{r_1}{2}$
By comparing two different cases from Eq. (i),
$\frac{B_1}{B_2} = \frac{N_1}{r_1} \times \frac{r_2}{N_2}$ or $\frac{B_1}{B_2} = \frac{1 \times \frac{r_1}{2}}{r_1 \times 2}$
$\frac{B_1}{B_2} = \frac{1}{4}$
$\therefore \frac{B_1}{B_2} = \frac{1}{4}$

21. The earth behaves as a magnet with magnetic field pointing approximately from the geographic
a) North to South **b) South to North** c) East to West d) West to East

22. A circular coil of radius 10 crn having 100 turns carries a current of 3.2 A. The magnetic field at the center of the coil is
a) 2.01 x 10^{-3} T b) 5.64 x 10^{-3} T c) 2.64 x 10^{-4} T d) 5.64 x 10^{-4} T

Solution : -
AS B=$\frac{\mu_0 NI}{2R}$,Here N = 100, 1= 3.2 A,
R = 10 cm = 10 x 10^{-2}m
$\therefore B = \frac{4\pi \times 10^{-7} \times 100 \times 3.2}{2 \times 0.1}$2.01x$10^{-3}$ T

23. A circular loop of radius 3 cm is having a current of 12.5 A. The magnitude of magnetic field at a distance of 4 cm on its axis is
a) 5.65 x 10^{-5} T b) 5.27 x 10^{-5} T c) 6.54 x 10^{-5} T d) 9.20 x 10^{-5} T

Solution : -
B = $\frac{\mu_o I R^2}{2(R^2+x^2)^{3/2}}$
Here, I = 12.5 A, R = 3 cm = 3 x 10^{-2} m
x = 4 cm = 4 x 10^{-2} m
$\therefore B = \frac{4\pi \times 10^{-7} \times 12.5 \times (3 \times 10^{-2})^2}{2[(3 \times 10^{-2})^2 + (4 \times 10^{-2})^2]^{3/2}}$ = 5.65 x 10^{-5} T

24. Which of the following is not showing the essential difference between electrostatic shielding by a conducting shell and magnetostatic shielding?
a) Electrostatic field lines can end on charges and conductors have free charges.
b) Magnetic field lines can end but conductors cannot end them.
c) Lines of magnetic field cannot end on any material and perfect shielding is not possible.
d) Shells of high permeability materials can be used to divert lines of magnetic field from the interior region.

Solution : -
Option (a), (c) and (d) all are correct about electrostatic shielding and magneto static shielding.

25. **Assertion:** The energy of a charged particle moving in a uniform magnetic field does not change.
Reason: Work done by the magnetic field on a charge particle is zero.
a) If both assertion and reason are true and reason is the correct explanation of assertion.
b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.   d) If both assertion and reason are false.

Solution : -

The force on a charged particle moving in a uniform magnetic field always acts in direction perpendicular to the direction of motion of the charge. As work done by magnetic field on the charge is zero, [W = FS cosθ], so the energy of the charged particle does not change.

26. A solenoid has core of a material with relative permeability 500 and its windings carry a current of 1 A. The number of turns of the solenoid is 500 per metre. The magnetization of the material is nearly

a) 2.5×10^3 A m^{-1} **b) 2.5×10^5 A m^{-1}**   c) 2.0×10^3 A m^{-1} d) 2.0×10^5 A m^{-1}

Solution : -

Here, n = 500 turns/m

I = 1 A, μ_r = 500

Magnetic intensity, H = nI = 500 m^{-1} x 1 A = 500 A m^{-1}

As μ_r = 1 + χ

where χ is the magnetic susceptibility of the material

or χ = (μ_r - 1)

Magnetisation, M = χH

= (μ_r - 1)H = (500 - 1) x 500 A m^{-1}

= 499 x 500 A m^{-1} = 2.495×10^5 A m^{-1}

= 2.5×10^5 A m^{-1}

27. An electron enters a region where magnetic field (B) and electric field (E) are mutually perpendicular, then______

a) it will always move in the direction of B   b) it will always move in the direction of E

c) it always possess circular motion   **d) it can go undeflected also**

Solution : -

The force experienced by a charged particle moving in space where both electric and magnetic fields exist is called Lorentz force.

Due to both electric and magnetic fields, the total force experienced by the charged particle will be given by,

$\mathbf{F} = \mathbf{F}_e + \mathbf{F}_m = q\mathbf{E} + q(\mathbf{v} \times \mathbf{B})$

$= q(\mathbf{E} + \mathbf{v} \times \mathbf{B})$

When $\mathbf{v}, \mathbf{E}$ and $\mathbf{B}$ are mutually perpendicular to each other.

In this situation, if $\mathbf{E}$ and $\mathbf{B}$ are such that $\mathbf{F} = \mathbf{F}_\mathrm{e} + \mathbf{F}_\mathrm{m} = 0$, then acceleration in the particle, $\mathbf{a} = \frac{\mathbf{F}}{m} = 0.$

It means particle will go undeflected.

28. The inner and outer radius of a toroid core are 28 cm and 29 cm respectively and around the core 3700 turns of a wire are wounded. If the current in the wire is 10A, then the magnetic field inside the core of the toroid is

a) 2.60×10^{-2} T   b) 2.60×10^{-3} T   c) 4.52×10^{-2} T   d) 4.52×10^{-3} T

Solution : -

The number of turns per unit length for the given toroid n = $\frac{N}{2\pi r_{av}}$

The average radius of toroid

$r_{av} = \frac{28+29}{2}$ =28.5 cm = 28.5×10^{-2} m

$\therefore n = \frac{3700}{2 \times 3.14 \times 28.5 \times 10^{-2}}$ =2067.27≈2067

Now,B = $\mu_0 nI$= 4n x 10^{-7} x 2067 x 10

= 259615.2 x 10^{-7} T = 2.60×10^{-2}T

29. A paramagnetic liquid is taken in a U-tube and arranged so that one of its limbs is kept between pole pieces of the magnet. The liquid level in the limb

a) goes down   **b) rises up**   c) remains same   d) first goes down and then rise

Solution : -

The liquid rises up in the part of the tube which is between the poles.

30. A charged particle is moving in a cyclotron, what effect on the radius of path of this charged particle will occur when the frequency of the radio frequency field is doubled?

a) It will also be doubled. b) It will be halved. c) It will be increased by four times.

d) It will remain unchanged.

Solution : -

As frequency of revolution in a cyclotron

$v_c = \frac{qB}{2\pi m}$ is independent of r.

So the radius of path in the dees will remain unchanged. When the frequency is changed.

31. **Assertion:** Magnetic field due to current carrying solenoid is independent of its length and crosssectional area.

Reason: The magnetic field inside the solenoid is uniform.

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

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

Magnetic field due to a solenoid having n number of turns per metre and carrying current I is B =μ0nI which is independent of the length and area of cross section of the solenoid. The magnetic field inside the solenoid is uniform.

32. A charged particle with charge q enters a region of constant, uniform and mutually orthogonal fields $\vec{E}$ and $\vec{B}$ with a velocity v perpendicular to both $\vec{E}$ and $\vec{B}$, and comes out without any change in its magnitude or direction. Then

a) $\vec{v}$=$\vec{B}$x$\vec{E}$/E^2 **b) $\vec{v}$=$\vec{E}$x$\vec{B}$/B^2** c) $\vec{v}$=$\vec{B}$x$\vec{E}$/B^2 d) $\vec{v}$=$\vec{E}$x$\vec{B}$/E^2

Solution : -

When E and Jj are perpendicular and velocity has no change then qE = qvB i.e., v =$\frac{E}{B}$.The two forces oppose eachother so, v is along $\vec{E}$x $\vec{B}$ i.e., $\vec{v}$= -$\frac{\vec{E}\times\vec{B}}{B^2}$ As $\vec{E}$ and $\vec{B}$are perpendicular to each other

$\frac{\left|\vec{E}\times\vec{B}\right|}{B^2}$=$\frac{EBsin90^o}{B^2} = \frac{E}{B}$

33. Which of the following is not correct about relative magnetic permeability (μ_r)?

a) It is a dimensionless pure ratio. b) For vacuum medium its value is one.

c) For ferromagnetic materials μ_r >> 1 **d) For paramagnetic materials μ_r > 1**

Solution : -

Relative magnetic permeability

$\mu_r = \frac{magnetic\ permeability\ of\ material(\mu)}{permeability\ of\ free\ space(\mu_0)}$

It is a dimensionless pure ratio and For paramagnetic materials μ_r > 1

34. A coil having magnetic moment 15 A m^2 placed in a uniform magnetic field of 4 T in the horizontal direction exists such that initially the axis of coil is in the direction of the field. If the coil is rotated by 45° and the moment of inertia of the coil is 0.5 kg m^2 then the angular speed acquired by the coil is

a) 20 rad s^{-1} b) 10 rad s^{-1} **c) 8.34 rad s^{-1}** d) 4.5 rad s^{-1}

Solution : -

Since $\tau = I\frac{d\omega}{d\theta} = mBsin\theta$ --------------(i)

Now, $\frac{d\omega}{d\theta}\frac{d\theta}{dt} = \omega\frac{d\omega}{d\theta}$ -------------------(ii)

then, from (i) and (ii)

$I\omega \frac{d\omega}{d\theta} = mBsin\theta; I\omega d\omega = mBsin\theta d\theta$

Integrating both sides

$I\int_0^{\omega f} \omega d\omega = mB\int_0^{45^o} sin\theta d\theta$

$I\left[\frac{\omega^2}{2}\right]_0^{\omega_f} = mB[-cos\theta]_{0^o}^{45^o}$

$\frac{1}{2}I\omega_f^2 = -mB[cos45^o - cos0^o]$

$= -mB\left[\frac{1}{\sqrt{2}} - 1\right] = 0.29\ mB$

$\omega_f^2 = \frac{2\times0.29mB}{I} = \frac{2\times0.29\times15\times4}{0.50}$

$\omega_f^2 = 69.6; \omega_f = \sqrt{69.6}$=8.34 rad^{-1} s^{-1}

35. Which of the following property shows the property of ferromagnetic substances?

a) The ferromagnetic property depends on temperature.

b) The ferromagnetic property does not depend on temperature.

c) At high enough temperature ferromagnet becomes a diamagnet.

d) At low temperature ferromagnet becomes a paramagnet

36. **Assertion:** Electron revolves around a positively charged nucleus like a planet revolvesaround the sun.

Reason: The force acting in both the cases is of same kind.

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

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. **d) If both assertion and reason are false.**

Solution : -

The force in the case of electron-nucleus is electrostatic force or Coulomb force and the force in case of planet - sun is gravitational.

37. A proton and an a-particle enter in a uniform magnetic field perpendicularly with same speed. The ratio of time periods of both particle $\left(\frac{T_p}{T_\alpha}\right)$ will be

a) 1: 2 b) 1: 3 c) 2: 1 d) 3: 1

Solution : -

The time period of revolution of a charged particle in a magnetic field is

T=$\frac{2\pi m}{Bq}$

For proton, mp = m, q_p = q ; Tp=$\frac{2\pi m}{Bq}$

Now, for a-particle, m_α = 4m, q_α = 2q

$\therefore T_\alpha = \frac{2\pi(4m)}{B(2q)} = 2\left(\frac{2\pi m}{Bq}\right) \Rightarrow \frac{T_P}{T_\alpha} = \frac{1}{2}$

38. Which of the following independent quantities is not used to specify the earth's magnetic field?

a) Magnetic declination (θ). b) Magnetic dip (δ). c) Horizontal component of earth's field (B_H).

d) Vertical component of earth's field (B_V).

Solution : -

Vertical component of earth's field (B_V) is not used to specify the earth's magnetic field.

39. Which of the following material is used in making the core of a moving coil galvanometer?

a) Copper b) Nickel **c) Iron** d) Both (a) and (b)

Solution : -

Soft iron is used in making the core of moving coil galvanometer, because it has high initial permeability and low hysteresis loss.

40. **Assertion:** A galvanometer can be used as a voltmeter to measure the voltage across a given section of the circuit.

Reason: For this it must be connected in parallel with that section of the circuit

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

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false.   d) If both assertion and reason are false

41. A circular coil of 20 turns and 10cm radius is placed in a uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in the coil is 5 A, cross-sectional area is 10-5m2 and coil is made up of copper wire having free electron density about 10^{29} m^{-3}, then the average force on each electron in the coil due to magnetic field is

a) 2.5×10^{-25}N   **b) 5×10^{-25}N**   c) 4×10^{-25}N   d) 3×10^{-25}N

Solution : -

Force on each electron,

$ev_dB = \frac{IB}{nA}$

Here, I = 5 A, B = 0.1 T, n = 10^{29} m^{-3}, $\begin{bmatrix} \therefore & 1 = neAv_d \\ \therefore & ev_d = \frac{1}{nA} \end{bmatrix}$

A = 10^{-5} m^2

So, $F = \frac{5 \times 0.1}{10^{29} \times 10^{-5}} = 5 \times 10^{-25}$ N

42. A galvanometer of resistance, G is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is____

a) $\frac{S^2}{(S+G)}$ b) $\frac{SG}{(S+G)}$ **c)** $\frac{G^2}{(S+G)}$ d) $\frac{G}{(S+G)}$

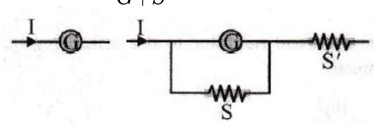
Solution : -

In this case, the resistance of the galvanometer should be equal to the net resistance.

$\therefore G = \left(\frac{GS}{G+S}\right) + S'$

$\Rightarrow G - \frac{GS}{G+S} = S'$

$\therefore S' = \frac{G^2}{G+S}$

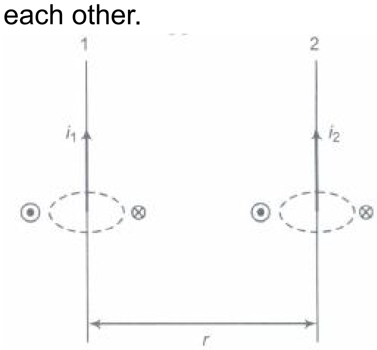


43. Two wires are held perpendicular to the plane of paper at 5 m apart. They carry currents of 2.5 A and 5A in same direction. Then the magnetic field strength B at a point midway between the wires will be:

a) $(\mu_0/4\pi)$ T   **b) $(\mu_0/2\pi)$ T**   c) $(3\mu_0/2\pi)$ T   d) $(3\mu_0/4\pi)$ T

Solution : -

As per Maxwell right hand rule, magnetic field at right hand of wire 1 is perpendicular to paper which is shown by 1⊗. Also, magnetic field at left hand of wire 2 is perpendicular to paper coming out, so two fields are opposite to each other.



Hence net magnetic field,

$B=B_1-B_2$
$=\frac{\mu_0}{2\pi}\frac{i_1}{r_2}-\frac{\mu_0}{2\pi}\frac{i_2}{r_2}$
At mid point, r_1-r_2 =r=5/2 =2.5
$B=\frac{\mu_0}{2\pi}\left(\frac{i_1}{r}-\frac{i_2}{r}\right)$
$=\frac{\mu_0}{2\pi}\left(\frac{5}{2.5}-\frac{2.5}{2.5}\right)$
$=(\mu_0/2\pi)(2-1) =(\mu_0/2\pi)T$

44. The magnitude of the magnetic field at the centre of the tightly wound 150 turn coil of radius 12 ern carrying a current of 2 A is

a) 18 G b) 19.7 G **c) 15.7 G** d) 17.7 G

Solution : -

Here, N= 150, R = 12 cm = 12 x 10^{-2} m, 1= 2 A
$\therefore B=\frac{\mu_o NI}{2R}=\frac{2\pi\times10^{-7}\times150\times2}{12\times10^{-2}}$=1.57x$10^{-3}$ T
=1.57 x 10^{-3} T = 15.7 x 10^{-4} T = 15.7 G

45. A voltmeter has resistance of 2000 ohms and it can measure upto 2V. If we want to increase its range to 10 V, then the required resistance in series will be :

a) 2000 Ω b) 4000 Ω c) 6000 Ω **d) 8000 Ω**

Solution : -

If maximum reading of voltmeter is 2 V at 2000 Ω, then current running through it is:
2V = I x (2000 Ω)
I= 0.001 A
Now when current stays same, then to increase maximum reading of voltage to 10V by connecting a resistor in series would result as:
10V = (.001A) x (2000 Ω + R)
On solving R = 8000 Ω

46. A magnet of magnetic moment M and pole strength m is divided in two equal parts, then magnetic moment of each part will be :

a) M **b) M/2** c) M/4 d) 2M

Solution : -

If a bar magnet is cut along its axis having length l, then
New pole strength
m' = m/2
New length l' = l
Now new magnetic moment will be:
M' = (m/2) x l = ml/2 = M/2
If the bar magnet is cut perpendicular to its axis, then
New pole strength m' = m
New length l'=l/2
So, new magnetic moment:
M' = m x l/2 = ml/2 =M/2

47. A circular loop of radius R carrying a current I is placed in a uniform magnetic field B perpendicular to the loop. The force on the loop is

a) $2\pi RIB$ b) $2\pi RI^2B^3$ c) πR^2IB **d) zero**

48. A paramagnetic sample shows a net magnetisation of 8 Am^{-1} when placed in an external magnetic field of 0.6 T at a temperature of 4 K. When the same sample is placed in an external magnetic field of 0.2 T at a temperature of 16 K, the magnetisation will be

a) $\frac{32}{3} Am^{-1}$ **b)** $\frac{2}{3} Am^{-1}$ c) $6 Am^{-1}$ d) $2.4 Am^{-1}$

49. A short bar magnet has a magnetic moment of 0.39 JT^{-1}. The magnitude and direction of the magnetic field produced by the magnet at a distance of 20 cm from the centre of the magnet on the equatorial line of the magnet is

a) 0.049 G, N-S direction b) 4.95 G, S-N direction c) 0.0195 G, S-N direction d) 19.5 G, N-S direction

Solution : -

Here, m = 0.39 JT^{-1} ,d = 20 cm = 0.2 m On the equatorial line of magnet

$B \frac{\mu_0}{4\pi} \cdot \frac{2m}{d^3} = 10^{-7} \times \frac{0.39}{(0.2)^3} = \frac{0.39 \times 10^{-7}}{2^3 \times 10^{-3}} = \frac{0.39}{8} \times 10^{-4}$

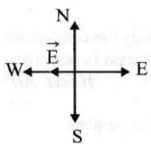
=0.049 x 10^{-4} T, N-S direction

=0.049 G, N-S direction

50. When a proton is released from rest in a room, it starts with an initial acceleration a_0 towards west. When it is projected towards north with a speed v_0 it moves with an initial acceleration $3a_0$ towards west. The electric and magnetic fields in the room are respectively_____

a) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ down b) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ up c) $\frac{ma_0}{e}$ east, $\frac{3ma_0}{ev_0}$ down d) $\frac{ma_0}{e}$ west, $\frac{2ma_0}{ev_0}$ up

Solution : -



When moves with an acceleration a_0 towards west, electric field

$E = \frac{F}{q} = \frac{ma_0}{e} (\text{ West })$

When moves with an acceleration $3a_0$ towards east, magnetic field

$B = \frac{2ma_0}{ev_0}$ (downward)