4. Moving charges and Magnetism

Course: JEE Main/NEET/GUJCET Worksheet: 1 Subject: PHYSICS

NCERT Synchronised

4.4.1 Velocity selector

1. A solid metal cube of edge length $2\ cm$ is moving in a positive y-direction at constnt speed of $6\ m/s$. There is uniform magnetic field of $0.1\ T$ in the positive z-direction. The potential difference between the two faces of the cube perpendicular to the x-axis, is

(A) $12\ mV$ (B) $2\ mV$ (C) $6\ mV$ (D) $1\ mV$ **[JEE Main 2019]**

4.4.2 Cyclotron

2. A particle having the same charge as of electron moves in a circular path of radius $0.5\ cm$ under the influence of a magnetic field of $0.5\ T$. If an electric field of $100\ V/m$ makes it to move in a straight path, then the mass of the particle is (Given charge of electron $=1.6\times10^{-19}\ C$)

(A) $9.1\times10^{-31}\ Kg$ (B) $1.6\times10^{-27}\ Kg$ (C) $1.6\times10^{-19}\ Kg$ (D) $2.0\times10^{-24}\ Kg$ **[JEE Main 2019]**

3. In an experiment, electrons are accelerated, from rest, by applying a voltage of $500\ V$. Calculate the radius of the path if a magnetic field $100\ mT$ is then applied. [Charge of electron $=1.6\times10^{-19}\ C$, Mass of the electron $=9.1\times10^{-31}\ Kg$]

(A) $7.5\times10^{-3}\ m$ (B) $7.5\ m$ (C) $7.5\times10^{-2}\ m$ (D) $7.5\times10^{-4}\ m$ **[JEE Main 2019]**

4. A proton and an α – particle (with their masses in the ratio of 1:4 and charges in the ratio of 1:2) are accelerated from rest through a potential difference V. If a uniform magnetic field (B) is set up perpendicular to their velocities, the ratio of the radii $r_p : r_\alpha$ of the circular paths described by them will be

(A) $1:3$ (B) $1:2$ (C) $1:\sqrt{3}$ (D) $1:\sqrt{2}$ **[JEE Main 2019]**

5. A proton, an electron, and a Helium nucleus, have the same energy. They are in circular orbits in a plane due to magnetic field perpendicular to the plane. Let r_p, r_e and r_{He} be their respective radii, then,

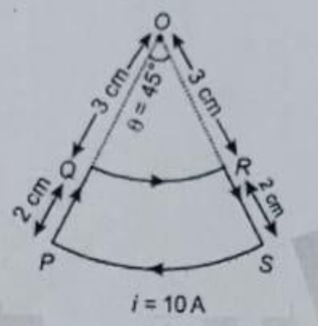
(A) $r_e > r_p = r_{He}$ (B) $r_e < r_p = r_{He}$ (C) $r_e < r_p < r_{He}$ (D) $r_e > r_p > r_{He}$ **[JEE Main 2019]**

4.6 Magnetic Field on the Axis of a Circular Current Loop

6. A thin ring of $10\ cm$ radius carries a uniformly distributed charge. The ring rotates at constant angular speed of $4\pi\ rad\ s^{-1}$ about its axis, perpendicular to its plane. If the magnetic field at its centre is $3.8\times10^{-9}\ T$, then the charge carried by the ring is close to $\left(\mu_0 = 4\pi\times10^{-7}\ N/A^2\right)$

(A) $2\times10^{-6}\ C$ (B) $3\times10^{-5}\ C$ (C) $4\times10^{-5}\ C$ (D) $7\times10^{-6}\ C$ **[JEE Main 2019]**

7. A current loop, having two circular arcs joined by two radial lines is shown in the figure. It carries a current of $10A$. The magnetic field at point O will be close to



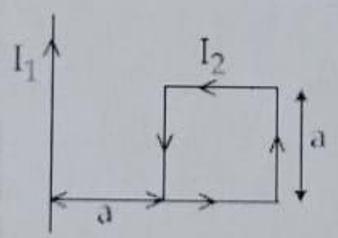
(A) $1.5\times10^{-7}\ T$ (B) $1.0\times10^{-5}\ T$ (C) $1.5\times10^{-5}\ T$ (D) $1.0\times10^{-7}\ T$

[JEE Main 2019]

8. One of the two identical conducting wires of length L is bent in the form of a circular loop and the other one into a circular coil of N identical turns. If the same current is passed in both, the ratio of the magnetic field at the centre of the loop (B_L) to that at the centre of the coil (B_C), i.e. $\frac{B_L}{B_C}$ will be

(A) $\frac{1}{N}$ (B) N^2 (C) N (D) $\frac{1}{N^2}$ **[JEE Main 2019]**

9. A rigid square loop of side 'a' and carrying current I_2 is lying on a horizontal surface near a long current I_1 carrying wire in the same plane as shown in figure. The net force on the loop due to the wire will be:

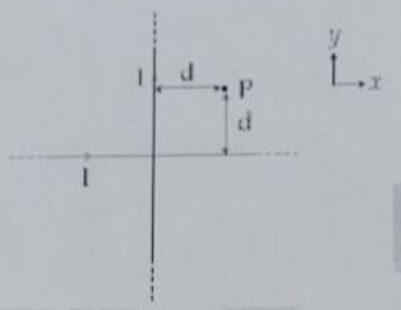


(A) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{2\pi}$ (B) Attractive and equal to $\frac{\mu_0 I_1 I_2}{3\pi}$

(C) Repulsive and equal to $\frac{\mu_0 I_1 I_2}{4\pi}$ (D) Zero **[JEE Main 2019]**

4.7 Ampere's Circuital Law

10. Two very long, straight, and insulated wires are kept at 90^0 angle from each other in xy – plane as shown in the figure.



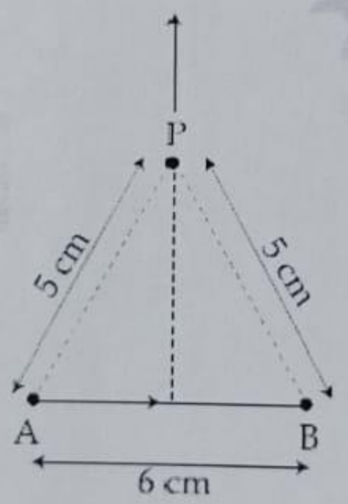
These wires carry currents of equal magnitude I , whose directions are shown in the figure. The net magnetic field at point P will be:

(A)Zero (B)$-\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (C)$-\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ (D)$\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$ **[JEE Main 2019]**

11. The magnitude of the magnetic field at the center of an equilateral triangular loop of side $1\ m$ which is carrying a current of $10\ A$ is: [Take $\mu_0 = 4\pi \times 10^{-7}\ \text{NA}^{-2}$]

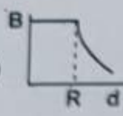
(A)$18\ \mu T$ (B)$9\ \mu T$ (C)$3\ \mu T$ (D)$1\ \mu T$ **[JEE Main 2019]**

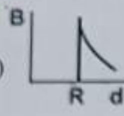
12. Find the magnetic field at point P due to a straight line segment AB of length $6\ cm$ carrying a current of $5\ A$. (See figure) $\left(\mu_0 = 4\pi \times 10^{-7}\text{N-A}^{-2}\right)$

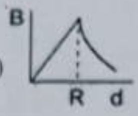


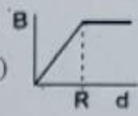
(A)$2.0\times10^{-5}T$ (B)$1.5\times10^{-5}T$ (C)$3.0\times10^{-5}T$ (D)$2.5\times10^{-5}T$ **[JEE Main 2019]**

13. A cylindrical conductor of radius R is carrying a constant current. The plot of the magnitude of the magnetic field, B with the distance d from the centre of the conductor, is correctly represented by the figure

(A) 

(B) 

(C) 

(D) 

[NEET 2019]

4.8.1 The solenoid

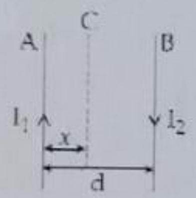
14. There are 50 turns per cm length in a very long solenoid. It carries a current of $2.5\ A$. The magnetic field at its centre on the axis is .... T.

(A) $4\pi \times 10^{-3}$ (B) $2\pi \times 10^{-3}$ (C) $6\pi \times 10^{-3}$ (D) $5\pi \times 10^{-3}$ [GUJCET 2019]

4.8.2 The toroid

4.9 Force between Two Parallel Currents, the Ampere

15. Two wires A & B are carrying currents I_1 & I_2 as shown in the figure. The separation between them is d. A third wire C carrying a current I is to be kept parallel to them at a distance x from A such tht the net force acting on it is zero. The possible values of x are:



(A) $x = \left(\frac{I_1}{I_1 - I_2}\right)d$ and $x = \left(\frac{I_2}{I_1 + I_2}\right)d$ (B) $x = \left(\frac{I_2}{I_1 + I_2}\right)d$ and $x = \left(\frac{I_2}{I_1 - I_2}\right)d$

(C) $x = \left(\frac{I_1}{I_1 + I_2}\right)d$ and $x = \left(\frac{I_2}{I_1 - I_2}\right)d$ (D) $x = \pm\frac{I_1 d}{(I_1 - I_2)}$ [JEE Main 2019]

4.10 Torque on Current Loop, Magnetic Dipole

16. A circular coil having N turns and radius r carries a current I. It is held in the XZ plane in a magnetic field $B\hat{i}$. The torque on the coil due to the magnetic field is :

(A) $\frac{B\pi r^2 I}{N}$ (B) $\frac{Br^2 I}{\pi N}$ (C) $B\pi r^2 IN$ (D) Zero [JEE Main 2019]

4.10.2 Circular current loop as a magnetic dipole

17. A square loop is carrying a steady current I and the magnitude of its magnetic dipole moment is m. If this square loop is changed to a circular loop and it carries the same current, the magnitude of the magnetic dipole moment of circular loop will be:

(A) $\frac{2m}{\pi}$ (B) $\frac{4m}{\pi}$ (C) $\frac{m}{\pi}$ (D) $\frac{3m}{\pi}$ [JEE Main 2019]

4.11 The Moving Coil Galvanometer

18.A moving coil galvanometer has a coil with 175 turns and area $1\ cm^2$. It uses a torsion band of torsion constant 10^{-6} N – m/rad .The coil is placed in a magnetic field parallel to its plane.The coil deflects by 1^0 for a current of $1\ mA$. The value of B (in Tesla) is approximately :

(A) 10^{-4} (B) 10^{-2} (C) 10^{-1} (D) 10^{-3} **[JEE Main 2019]**

19.A moving coil galvanometer allows a full scale current of $10^{-4}\ A$. A series reristance of $2\ M\Omega$ is required to convert the above galvanometer into a voltmeter of range $0-5$ V . Therefore the value of shunt resistance required to convert the above galvanometer into an ammeter of range $0-10$ mA is:

(A) $500\,\Omega$ (B) $100\,\Omega$ (C) $200\,\Omega$ (D) $10\,\Omega$ **[JEE Main 2019]**

20. A moving coil galvanometer, having a resistance G , produces full scale deflection when a current I_g flows throught it.This galvanometer can be converted into (i) an ammeter of range 0 to $I_0\ (I_0 > I_g)$ by connecting a shunt resistance R_A to it and (ii) into a voltmeter of range 0 to $V\ (V = GI_0)$ by connecting a series resistance R_V to it. Then,

(A) $R_A R_V = G^2\left(\frac{I_0 - I_g}{I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{(I_0 - I_g)}\right)^2$ (B) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$

(C) $R_A R_V = G^2\left(\frac{I_g}{I_0 - I_g}\right)$ and $\frac{R_A}{R_V} = \left(\frac{I_0 - I_g}{I_g}\right)^2$ (D) $R_A R_V = G^2$ and $\frac{R_A}{R_V} = \frac{I_g}{(I_0 - I_g)}$

[JEE Main 2019]

21. The dimensional formula of effective torsional constant of spring is ......

(A) $M^0 L^0 T^0$ (B) $M^1 L^2 T^{-2}$ (C) $M^1 L^2 T^{-2} A^{-2}$ (D) $M^1 L^2 T^{-3}$ **[GUJCET 2019]**