TEST

JEE Mains PYQS Moving Charges & magnetism (Physics Master Academy)

QUESTIONS

SECTIONS

1. Section A - 30 Questions

Section 1 : Section A - 30 Questions

SECTION INSTRUCTIONS

This section contains 30 MCQs. +4 for every correct answer and - 1 for every incorrect answer

1 A light beam is described by $E = 800 \sin\omega\left(t - \frac{x}{c}\right)$. An electron is allowed to move normal to the propagation of light beam with a speed of $3\times10^{7} ms^{-1}$. What is the maximum magnetic force exerted on the electron?

- $1.28\times10^{-18}N$
- $1.28\times10^{-21}N$
- $12.8\times10^{-17}N$
- $12.8\times10^{-18}N$

Correct: +4 · Incorrect: -1

2 Two ions having same mass have charges in the ratio 1:2. They are projected normally in a uniform magnetic keld with their speeds in the ratio 2:3. The ratio of the radii of their circular trajectories is

- 1:4
- 4:3
- 3:1
- 2:3

3 A proton and an α-particle, having kinetic energies Kp and K_α respectively enter into a magnetic keld at right angles. The ratio of the radii of trajectory of proton to that of α-particle is 2:1. The ratio of K_p: K_α is

- 1:8
- 8:1
- 1:4
- 4:1

Correct: +4 · Incorrect: -1

4 A charge Q is moving $\acute{dl}$ distance in the magnetic keld $\acute{B}$. Find the value of work done by $\acute{B}$.

- -1
- zero
- 1
- inknite

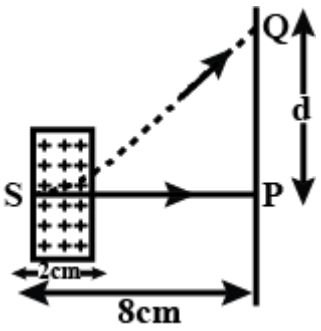
Correct: +4 · Incorrect: -1

5 A beam of protons with speed 4×10^5 ms^{-1} enters a uniform magnetic keld of 0.3T at an angle of 60° to the magnetic keld. The pitch of the resulting helical path of the protons is close to(Mass of proton = 1.67×10^{-27}kg, charge of the proton = 1.69×10^{-19}C)

- 2cm
- 5cm
- 12cm
- 4cm

Correct: +4 · Incorrect: -1

6 An electron, moving along x axis with the initial energy of 100eV, enters a region of magnetic keld $\vec{B} = (1.5\times10^3\text{T})\hat{k}$ at S (see kg). The keld extends between x = 0 and x = 2cm. The electron is detected at the point Q on a screen placed 18cm away from the point S. The distance d between P and Q (on the screen is): (Electron's charge = 1.6×10^{-19}C, mass of electron = 9.1×10^{-31}kg)



- 11.65cm
- 12.87cm
- 1.22cm
- 2.25cm

Correct: +4 · Incorrect: -1

7 An electron, a proton and an alpha particle having the same kinetic energy are moving in a circular orbits of radii r_e, r_p, r_α respectively in a uniform magnetic keld B. The relation between r_e, r_p, r_α is

- $r_e > r_p = r_\alpha$
- $r_e < r_p = r_\alpha$
- $r_e < r_p < r_\alpha$
- $r_e < r_\alpha < r_p$

Correct: +4 · Incorrect: -1

8 A uniform conducting wire of length 24a, and resistance R is wound up as a current carrying coil in the shape of an equilateral triangle of side 'a' and then in the form of a square of side 'a'. The coil is connected to a voltage source V_0. The ratio of magnetic moment of the coils in t case of equilateral triangle to that for square is 1:
√
y where y is ____

- 1
- 2
- 3
- 4

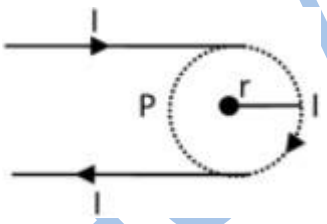
Correct: +4 · Incorrect: -1

9 The fractional change in the magnetic keld intensity at a distance 'r' from centre of the axis of current carrying a coil of radius 'a' to the magnetic keld intensity at the centre of the same coil is (take r <a)

- $\frac{3}{2}\frac{a^2}{r^2}$
- $\frac{2}{3}\frac{a^2}{r^2}$
- $\frac{2}{3}\frac{r^2}{a^2}$
- $\frac{3}{2}\frac{r^2}{a^2}$

Correct: +4 · Incorrect: -1

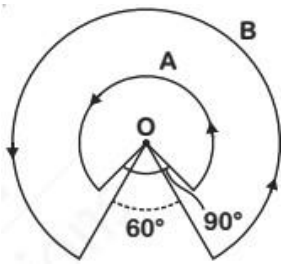
10 A hairpin like shape as shown in kgure is made by bending a long current carrying wire. What is the magnitude of a magnetic keld at point P which lies on the centre of the semicircle?



- $\frac{\mu_0 I}{4\pi r}(2+\pi)$
- $\frac{\mu_0 I}{4\pi r}(2-\pi)$
- $\frac{\mu_0 I}{2\pi r}(2-\pi)$
- $\frac{\mu_0 I}{2\pi r}(2+\pi)$

Correct: +4 · Incorrect: -1

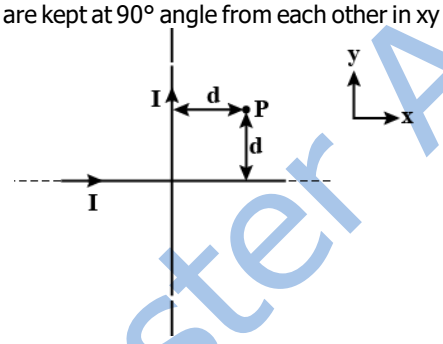
11 A wire A, bent in the shape of an arc of a circle, carrying a current of 2A and having radius 2cm and another wire B, also bent n the shape of arc of a circle, carrying a current of 3A and having radius of 4cm, are placed as shown in kgure. The ratio of the magnetic keld due to the wires A and B at the common centre O is:



- 4:6
- 6:4
- 2:5
- 6:5

Correct: +4 · Incorrect: -1

12 Two very long, straight and insulated wires are kept at 90° angle from each other in xy plane as shown in the kgure:

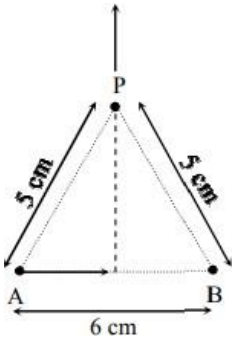


These wires carry currents of equal magnitude I, whose directions are shown in the kgure. The net magnetic keld at point P will be

- zero
- $\frac{-\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$
- $\frac{+\mu_0 I}{\pi d}(\hat{z})$
- $\frac{\mu_0 I}{2\pi d}(\hat{x}+\hat{y})$

Correct: +4 · Incorrect: -1

13 Find the magnetic keld at point P due to a straight line segment AB of length 6cm carrying a current of 5A (see kgure) ($\mu_0 = 4\pi \times 10^{-7}$ NA^{-2})



- 2.0×10^{-5}T
- 1.5×10^{-5}T
- 3.0×10^{-5}T
- 2.5×10^{-5}T

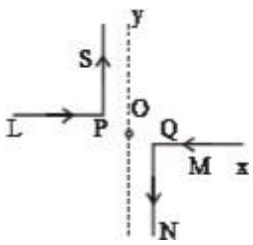
Correct: +4 · Incorrect: -1

14 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

- $\frac{m}{\pi}$
- $\frac{3m}{\pi}$
- $\frac{2m}{\pi}$
- $\frac{4m}{\pi}$

Correct: +4 · Incorrect: -1

15 As shown in kgure, two inknitely long, identical wires are bent by 90° and placed in such a way that the segments LP and QM are along the x axis, while segments PS and QN are parallel to the y axis. If OP = OQ = 4cm, and the magnitude of the magnetic keld at O is 10^{-4}T, and the two wires carry equal currents (see kgure), the magnitude of the current in each wire and the direction of the magnetic keld at O will be ($\mu_0 = 4\pi \times 10^{-7}$ NA^{-2})



- 20A, perpendicular out of the page
- 40A, perpendicular out of the page
- 20A, perpendicular into the page
- 40A, perpendicular into the page

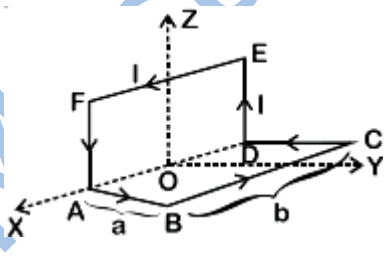
Correct: +4 · Incorrect: -1

16 The dipole moment of a circular loop carrying a current I is m and the magnetic keld at the centre of the loop is B_1. When the dipole moment is doubled by keeping the current constant, the magnetic keld at the centre of the loop is B_2. The ration B_1/B_2 is

- 2
- $\sqrt{3}$
- $\sqrt{2}$
- $1/\sqrt{2}$

Correct: +4 · Incorrect: -1

17 A wire carrying current I is bent in the shape ABCDEFA as shown where rectangle ABCDA and ADEFA are perpendicular to each other. If the sides of the rectangles are of lengths a and b, then the magnitude and direction of magnetic moment of the loop ABCDEFA is



- $abI\,, along\left(\frac{\hat{j}}{\sqrt{2}}+\frac{\hat{k}}{\sqrt{2}}\right)$
- $\sqrt{2}abI\,, along\left(\frac{\hat{j}}{\sqrt{2}}+\frac{\hat{k}}{\sqrt{2}}\right)$
- $\sqrt{2}abI\,, along\left(\frac{\hat{j}}{\sqrt{5}}+\frac{2\hat{k}}{\sqrt{5}}\right)$
- $abI\,, along\left(\frac{\hat{j}}{\sqrt{5}}+\frac{\widehat{2k}}{\sqrt{5}}\right)$

Correct: +4 · Incorrect: -1

18 A small circular loop of conducting wire has radius a and carries current I. It is placed in a uniform magnetic keld B perpendicular to its plane such that when rotated slightly about its diameter and released, it starts performing simple harmonic motion of time period T. If the mass of the loop is m then:

- $T=\sqrt{\frac{2m}{IB}}$
- $T=\sqrt{\frac{\pi m}{2IB}}$
- $T=\sqrt{\frac{2\pi m}{IB}}$
- $T=\sqrt{\frac{\pi m}{IB}}$

Correct: +4 · Incorrect: -1

19 A charge q is spread uniformly over an insulated loop of radius r. If its is rotated with an angular velocity ω with respect to normal axis then the magnetic moment of loop is

- $\frac{1}{2}q\omega r^2$
- $\frac{4}{3}q\omega r^2$
- $\frac{3}{2}q\omega r^2$
- $q\omega r^2$

Correct: +4 · Incorrect: -1

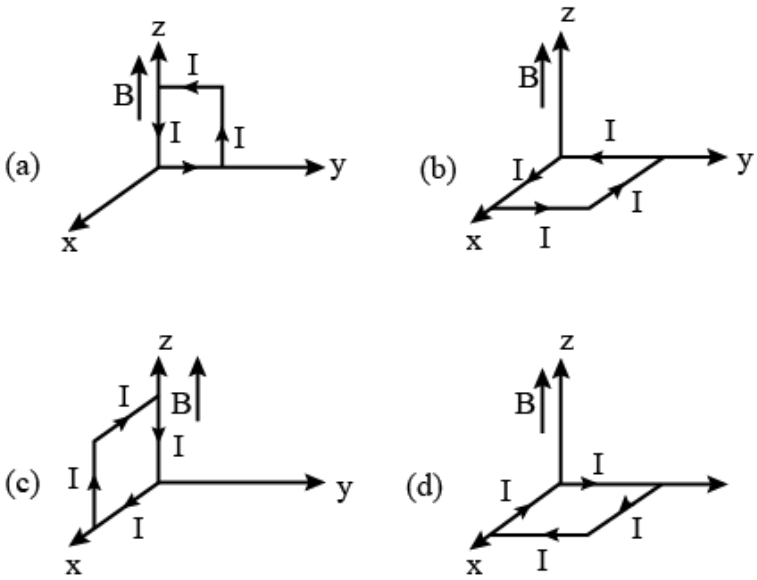
20 Two coaxial solenoids of different radius carry current I in the same direction. $\vec{F}_1$ be the magnetic force on the inner solenoid due to the outer one and $\vec{F}_2$ be the magnetic fore on the outer solenoid due to the inner one. Then

- $\vec{F}_1$ is radially inwards and $\vec{F}_2 = 0$
- $\vec{F}_1$ is radially outwards and $\vec{F}_2 = 0$
- $\vec{F}_1 = \vec{F}_2 = 0$

○ $\vec{F}_1$ is radially inwards and $\vec{F}_2$ is radially outwards

Correct: +4 · Incorrect: -1

21 A rectangular loop of sides 10cm and 5cm carrying a current I of 12A is placed in different orientations as shown in kgures given below:



If there is a uniform magnetic keld of 0.3T in the positive z direction, in which orientations the loop would be in (i) stable equilibrium and (ii) unstable equilibrium?

○ (b) and (d) respectively

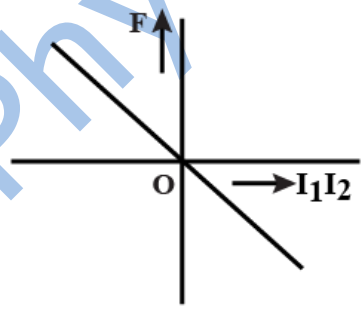
○ (b) and (c) respectively

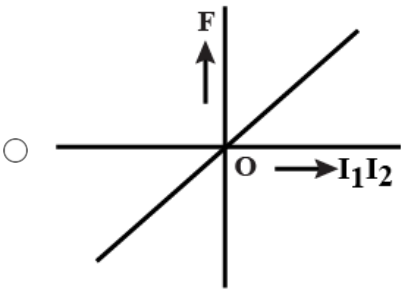
○ (a) and (b) respectively

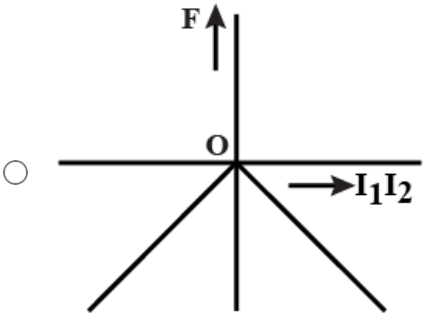
○ (a) and (c) respectively

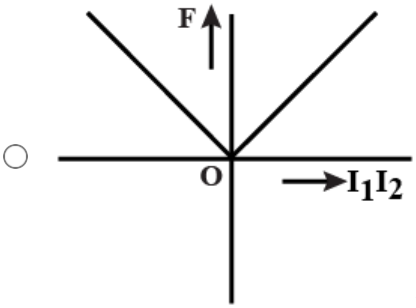
Correct: +4 · Incorrect: -1

22 Two long straight parallel wires carrying (adjustable) current I_1 and I_2 are kept at a distance of d apart. If the force 'F" between the two sires is taken as 'positive' when the wires repel each other and 'negative' when the wires attract each other, the graph showing the dependence of 'f' on the product I_1, I_2 would be

○ 







Correct: +4 · Incorrect: -1

23 Consider a galvanometer shunted with 5Ω resistance and 2% of current passes through it. What is the resistance of the given galvanometer?

- 300 Ω
- 344 Ω
- 245 Ω
- 226 Ω

Correct: +4 · Incorrect: -1

24 For full scale deflection of total 50 divisions, 50mV voltage is required in galvanometer. The resistance of galvanometer if its current sensitivity is 2div/mA will be

- ○ 1 Ω
- ○ 5 Ω
- ○ 4 Ω
- ○ 2 Ω

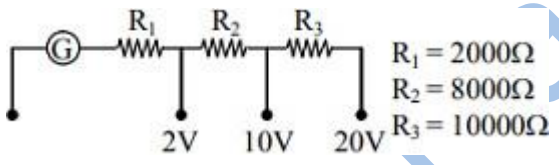
Correct: +4 · Incorrect: -1

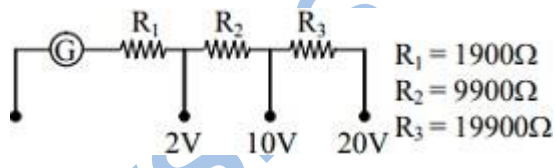
25 A galvanometer is used in laboratory for detecting the null point in electrical experiments. If on passing a current of 6mA it produces a deflection of 2°, its kgure of merit is close to

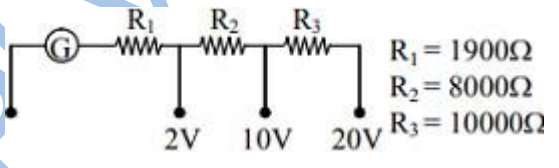
- ○ 333°A/div
- ○ 6×10^{-3}A/div
- ○ 666°A/div
- ○ 3×10^{-3}A/div

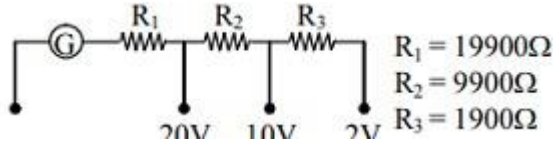
Correct: +4 · Incorrect: -1

26 A galvanometer of resistance 100 Ω has 50 divisions on its scale and has sensitivity of 20 μA/division. It is to be converted to a voltmeter with three ranges of 0-2V, 0-10V and 0-20V. The appropriate circuit to do so is

- ○ 

- ○ 

- ○ 

- ○ 

Correct: +4 · Incorrect: -1

27 A moving coil galvanometer having a resistance G produces full scale deflection when a current I_g flows through 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

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

Correct: +4 · Incorrect: -1

28 A moving coil galvanometer has resistance 50Ω and it indicates full deflection at 4mA current. A voltmeter is made using this galvanometer and a 5k Ω resistance. The maximum voltage that can be measured using this voltmeter wil be close to

- 40V
- 50V
- 20V
- 10V

Correct: +4 · Incorrect: -1

29 The resistance of galvanometer 50 ohm and the maximum current which can be passed through it is 0.002 A. What resistance must be connected to it order to convert it into an ammeter of range 0 – 0.5A?

- 0.5 ohm
- 0.002 ohm
- 0.02 ohm
- 0.2 ohm

Correct: +4 · Incorrect: -1

30 A galvanometer having a coil resistance of 100 Ω gives a full scale deflection when a current of 1mA is passed through it. The value of the resistance, which can convert this galvanometer into ammeter giving full scale deflection for a current of 10A is

- 0.1 Ω
- 3 Ω
- 0.01 Ω
- 2 Ω

Correct: +4 · Incorrect: -1

TEST

JEE Mains PYQS Moving Charges & magnetism (Physics Master Academy)

ANSWERS

SECTIONS

1. Section A - 30 Questions

Section 1 : Section A - 30 Questions

1 12.8×10^{-18}N

2 4:3

3 4:1

4 zero

5 4cm

6 12.87cm

7 $r_e < r_p = r_\alpha$

8 3

9 $\frac{3}{2}\frac{r^2}{a^2}$

10 $\frac{\mu_0 I}{4\pi r}(2+\pi)$

11 6:5

12 zero

13 1.5×10^{-5}T

14 $\frac{4m}{\pi}$

15 20A, perpendicular into the page

16 $\sqrt{2}$

17 $\sqrt{2}abI, along\left(\frac{\hat{j}}{\sqrt{2}}+\frac{\hat{k}}{\sqrt{2}}\right)$

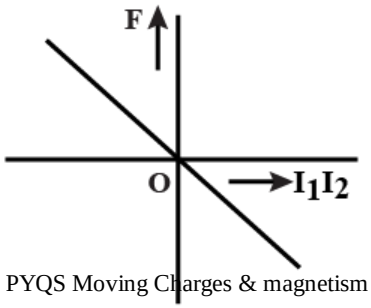
18 $T=\sqrt{\frac{2\pi m}{IB}}$

19 $\frac{1}{2}q\omega r^2$

20 $\vec{F}_1=\vec{F}_2=0$

21 (b) and (d) respectively

22

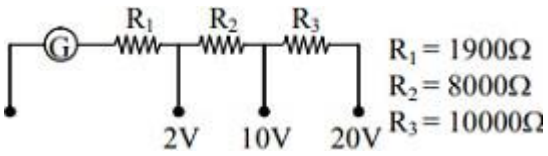


23 245 Ω

24 2 Ω

25 3×10^{-3}A/div

26



27 $R_A R_V = \frac{G^2 \wedge R_A}{R_V} = \left(\frac{I_g}{I_0 - I_g}\right)^2$

28 20V

29 0.2 ohm

30 0.01 Ω