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IIT/PMT INSTITUTE

CHAPTER TEST

Subject : Physics **Topic : Magnetic effects of current and Magnetism** **M.M. : 180**

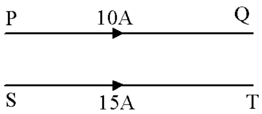
Have patience all things are difficult before they become easy.

Marking Scheme:

(i) Each question is allotted 4 (four) marks for each correct response.

(ii) ¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

Q.1 In the adjoining figure the two parallel wires PQ and ST are at 30 cm apart. The currents flowing in the wires are according to fig. The force acting over a length of 5m of the wires is-



(A) 5×10^{-4} N, (attraction)
(B) 1×10^{-4} N, (attraction)
(C) 5×10^{-4} N, (repulsion)
(D) 1×10^{-4} N, (repulsion)

Q.2 A circular coil 'A' has a radius R and the current flowing through it is I. Another circular coil 'B' has a radius 2R and if 2I is the current flowing through it, then the magnetic fields at the centre of the circular coil are in the ratio of (i.e. B_A to B_B)

(A) 4 : 1 (B) 2 : 1
(C) 3 : 1 (D) 1 : 1

Q.3 An electron and a proton with equal momentum enter perpendicularly into a uniform magnetic field, then –

(A) The path of proton shall be more curved than that of electron.
(B) The path of proton shall be less curved than that of electron.
(C) Both are equally curved.
(D) Path of both will be straight line.

Q.4 A charge moves in a circle perpendicular to a magnetic field. The time period of revolution is independent of –

(A) Magnetic field
(B) Charge
(C) Mass of the particle
(D) Velocity of the particle

Q.5 Two long conductors, separated by a distance d carry current I_1 and I_2 in the same direction. They exert a force F on each other. Now the current in one of them is increased to two times and its directions is reversed. The distance is also increased to 3d. The new value of the force between them is

(A) – 2F (B) F/3
(C) 2F/3 (D) – F/3

Q.6 A charged particle of mass m and charge q travels on a circular path of radius r that is perpendicular to a magnetic field B. The time taken by the particle to complete one revolution is –

(A) $\frac{2\pi qB}{m}$ (B) $\frac{2\pi m}{qB}$

(C) $\frac{2\pi mq}{B}$ (D) $\frac{2\pi q^2 B}{m}$

Q.7 Two thin, long, parallel wires, separated by a distance 'd' carry a current of 'i' A in the same direction. They will

(A) Attract each other with a force of $\frac{\mu_0 i^2}{2\pi d^2}$

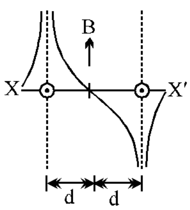
(B) Repel each other with a force of $\frac{\mu_0 i^2}{2\pi d^2}$

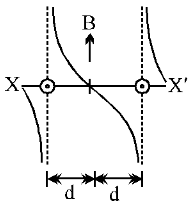
(C) Attract each other with a force of $\frac{\mu_0 i^2}{2\pi d}$

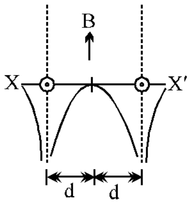
(D) Repel each other with a force of $\frac{\mu_0 i^2}{2\pi d}$

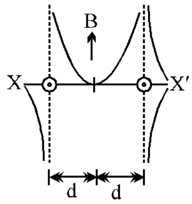
Q.8 A long solenoid has 200 turns per cm and carries a current i. The magnetic field at its centre is 6.28×10^{-2} Weber/m^2. Another long solenoid has 100 turns per cm and it carries a current i/3. The value of the magnetic field at its centre is
(A) 1.05×10^{-3} Weber/m^2
(B) 1.05×10^{-4} Weber/m^2
(C) 1.05×10^{-2} Weber/m^2
(D) 1.05×10^{-5} Weber/m^2

Q.9 Two long parallel wires are at a distance 2d apart. They carry steady equal current flowing out of the plane of the paper as shown. The variation of the magnetic field along the line XX' is given by –

(A) 

(B) 

(C) 

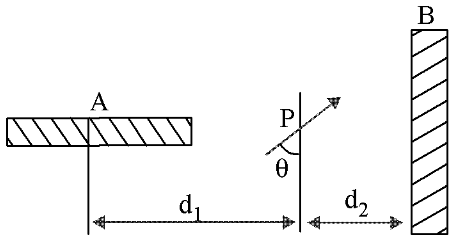
(D) 

Q.10 A frog can be deviated in a magnetic field produced by a current in a vertical solenoid placed below the frog. This is possible because the body of the frog behaves as –
(A) Paramagnetic (B) Diamagnetic
(C) Ferromagnetic (D) Antiferromagnetic

Q.11 A bar magnet of length 0.2 m and pole strength 5 Am is kept in a uniform magnetic induction field of strength 15Wbm^{-2} making an angle of 30° with the field. Find the couple acting on it.
(A) 2.5 Nm (B) 5.5 Nm
(C) 7.5 Nm (D) 9.0 Nm

Q.12 The main difference between electric lines of force and magnetic lines of force is
(A) Electric lines of force are closed curves whereas magnetic lines of force are open curves.
(B) Electric lines of force are open curves whereas magnetic lines of force are closed curves.
(C) Magnetic lines of force cut each other whereas electric lines of force do not cut.
(D) Electric lines of force cut each other whereas magnetic lines of force do not cut.

Q.13 Two magnets A and B are identical and these are arranged as shown in the figure. Their length is negligible in comparison to the separation between them. A magnetic needle is placed between the magnets at point P which gets deflected through an angle θ under the influence of magnets. The ratio of distances d_1 and d_2 will



(A) $(2 \tan \theta)^{1/3}$ (B) $(2 \tan \theta)^{-1/3}$
(C) $(2 \cot \theta)^{1/3}$ (D) $(2 \cot \theta)^{-1/3}$

Q.14 A magnetic needle lying parallel to a magnetic field requires W units of work to turn it through 60°. The torque needed to maintain the needle in this position will be –
(A) W (B) $\frac{\sqrt{3}}{2}$ W
(C) 2 W (D) $\sqrt{3}$ W

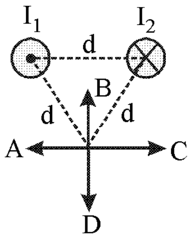
Q.15 The length of a magnet is large compared to its width and breadth. The time period of its oscillation in a vibration magnetometer is 2s. The magnet is cut along its length into three equal parts and these parts are then placed on each other with their life poles together. The time period of this combination will be –
(A) 2s (B) $\frac{2}{3}$ s
(C) $2\sqrt{3}$ s (D) $\frac{2}{\sqrt{3}}$ s

Q.16 A magnetic needle is kept in a non-uniform magnetic field. It experiences–
(A) a torque but not a force
(B) neither a force nor a torque
(C) a force and a torque
(D) a force but not a torque

Q.17 The coercivity of a small magnet where the ferromagnet gets demagnetized is 3×10^3 A/m. The current required to be passed in a solenoid of length 10cm and number of turns 100, so that the magnet gets demagnetized when inside the solenoid, is –

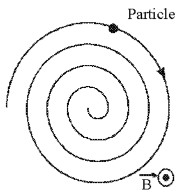
(A) 3A (B) 6A
(C) 30 mA (D) 60 mA

Q.18 The figure shows two long wires carrying equal currents I_1 and I_2 flowing in opposite directions. Which of the arrows labeled A to D correctly represents the direction of the magnetic field due to the wires at a point located at an equal distance d from each wire –



(A) A (B) B
(C) C (D) D

Q.19 A uniform magnetic field is directed out of the page. A charged particle, moving in the plane of the page, follows a clockwise spiral of decreasing radius as shown. A reasonable explanation is –

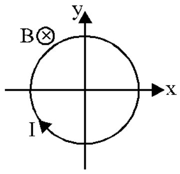


(A) the charge is positive and slowing down.
(B) the charge is negative and slowing down.
(C) the charge is positive and speeding up.
(D) the charge is negative and speeding up.

Q.20 A particle of charge q and mass m moves in a circular orbit of radius r with angular speed ω. The ratio of the magnitude of its magnetic moment to that of its angular momentum depends on -

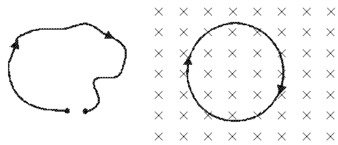
(A) ω and q (B) ω, q and m
(C) q and m (D) ω and m

Q.21 A conducting loop carrying a current I is placed in a uniform magnetic field pointing into the plane of the paper as shown. The loop will have a tendency to :



(A) contract
(B) expand
(C) move towards +ve x-axis
(D) move towards –ve x-axis

Q.22 A thin flexible wire of length L is connected to two adjacent fixed points carries a current I in the clockwise direction, as shown in the figure. When system is put in a uniform magnetic field of strength B going into the plane of paper, the wire takes the shape of a circle. The tension in the wire is –



(A) IBL (B) IBL/π
(C) IBL/2π (D) IBL/4π

Q.23 The magnetic lines of force due to a straight current carrying wire will be:

(A) circular for finite length of wire
(B) circular for semi-infinite wire
(C) circular for infinite wire
(D) all of the above

Q.24 An electron moving in a circular orbit of radius R makes n turns per second. The magnetic field at the centre has magnitude

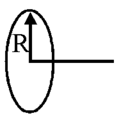
(A) $\frac{2\mu_0 ne}{R}$ (B) $\frac{\mu_0 ne}{2R}$

(C) $\frac{\mu_0 ne}{\pi R}$ (D) zero

Q.25 Two long parallel straight conductors carry current i_1 and i_2 ($i_1 > i_2$). When the currents are in the same direction, the magnetic field at a point midway between the wires is 20μT. If the direction of i_2 is reversed, the field becomes 50μT. The ratio of the currents i_1 / i_2 is :

(A) 5/2 (B) 7/3
(C) 4/3 (D) 5/3

Q.26 Constant current I is flowing through a circular coil of radius R. At what distance from the centre will the magnetic field (on the axis) be maximum



(A) $\frac{R}{\sqrt{2}}$ (B) $\frac{R}{2}$
(C) R (D) zero

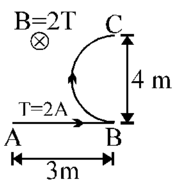
Q.27 There is a horizontal straight wire carrying current from West to East. Magnetic field due to this wire at a point :

(A) above it is towards South
(B) below it is towards North.
(C) below it is downwards
(D) Both (A) and (B)

Q.28 Liquid oxygen remains suspended between two pole faces of a magnet because it is

(A) Diamagnetic (B) Paramagnetic
(C) Ferromagnetic (D) Antiferromagnetic

Q.29 In the figure the force on the wire ABC in the given uniform magnetic field will be (in newtons):



(A) $(3 + 2\pi)\,4$ (B) 20
(C) 28 (D) 17

Q.30 Which of the following statement(s) is/are **false**?

(A) The magnetic force does zero work on a charged particle moving in a magnetic field.
(B) Dry charged pieces of paper are attracted to stationary magnet.
(C) The magnetic torque on a current-carrying coil of wire has its maximum magnitude when the magnetic field is perpendicular to the plane of the coil.
(D) Both (B) and (C)

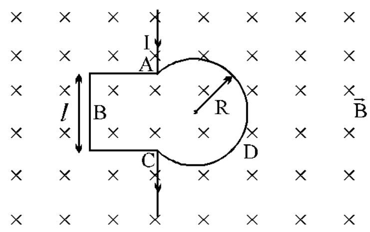
Q.31 A circular coil of 100 turns and effective diameter 20 cm carries a current of 0.5 A. It is to be turned in a magnetic field B = 2T from a position in which θ equals zero to θ equals 180°. The work required in this process is

(A) πJ (B) 2πJ
(C) 4πJ (D) 8πJ

Q.32 Imagine that a current is flowing around this test paper in the anticlockwise direction. If an external magnetic field is in +ve x direction, which edge of the paper would be lifted under the influence of the torque of the magnetic field?

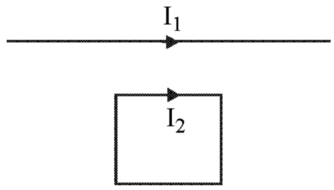
(A) Top edge (B) bottom edge
(C) left edge (D) right edge

Q.33 The figure shows a conducting loop ABCDA placed in a uniform magnetic field perpendicular to its plane. The part ABC is the $(3/4)^{th}$ portion of the square of side length l. The part ADC is a circular arc of radius R. The points A and C are connected to a battery which supply a current I to the circuit. The magnetic force on the loop due to the field B is



(A) zero (B) BI l
(C) 2BIR (D) $\frac{BIR}{l+R}$

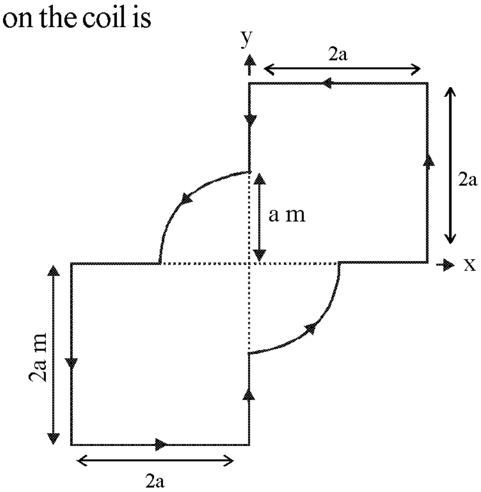
Q.34 A long straight wire carries a steady current I_1. Nearby is a rectangular loop that carries a steady current I_2. The directions of the two currents are shown in the figure.



Which statement is/are **false** ?

(A) The loop is attracted to the wire.
(B) There is no net force on the loop from the wire.
(C) The loop is attracted to the wire if $I_1 > I_2$; otherwise it is repelled.
(D) Both (B) and (C)

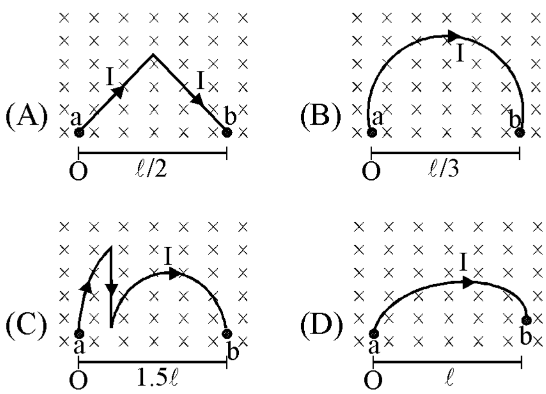
Q.35 A current I flows through a thin wire as shown in the figure. If there exists an external magnetic field B in the same plane of the wire. The torque acting on the coil is



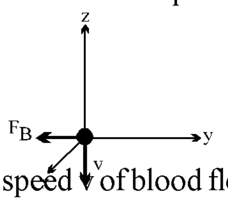
(A) $I\left(\frac{\pi a^2}{2}+8a^2\right)B$ (B) $I\left(\frac{\pi a^2}{2}+4a^2\right)B$

(C) $I(\pi a^2+8a^2)B$ (D) zero

Q.36 Figure shows four wires placed in the same uniform magnetic field B and carrying the same current in which case force acting on the wire is minimum



Q.37 A positively charged particle has a velocity in the negative z direction, as shown in the figure. The Lorentz force on the particle is in the negative y direction. From this observation alone, what can be said about the magnetic field at this point?
(A) Bx is positive
(B) Bx is negative
(C) By is positive
(D) By is negative



Q.38 In order to measure the speed v of blood flowing through an artery, a uniform magnetic field B is applied in a direction perpendicular to the flow and a voltmeter measures the voltage across the diameter D of the artery, at right angles to B. If positive and negative ions in the blood are longitudinally at rest with respect to the flow, the speed of the flow is closet to
(A) v = V/BD (B) v = BD/V
(C) v = VD/B (D) v = B/VD

Q.39 A proton and an alpha particle enter a uniform magnetic field with the same velocity. The period of rotation of the alpha particle will be
(A) four times that of proton
(B) two times that of proton
(C) three times that of proton
(D) the same as that of proton

Q.40 At which place, earth's magnetic field becomes horizontal
(A) Magnetic pole (B) Geographical pole
(C) Magnetic meridian (D) Magnetic equator

Q.41 A bar magnet has a coercivity $4 \times 10^3\ Am^{-1}$. It is desired to demagnetize it by inserting it inside a solenoid 12cm long and having 60 turns. The current carried by the solenoid should be –
(A) 8A (B) 6A
(C) 4.5 A (D) 2A

Q.42 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.43 A coil in the shape of an equilateral triangle of side ℓ is suspended between the pole pieces of a permanent magnet such that $\vec{B}$ is in the plane of the coil. If due to a current i in the triangle a torque τ acts on it, the side ℓ of the triangle is –

(A) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B.i}\right)^{1/2}$ (B) $2\left(\frac{\tau}{\sqrt{3}\,B.i}\right)^{1/2}$

(C) $\frac{2}{\sqrt{3}}\left(\frac{\tau}{B.i}\right)$ (D) $\frac{1}{\sqrt{3}}\left(\frac{\tau}{B.i}\right)$

Q.44 If the magnetic dipole moment of an atom of diagmagnetic material paramagnetic material and ferromagnetic material are denoted by μ_d, μ_p and μ_f respectively, then –
(A) $\mu_d = 0$ and $\mu_p \neq 0$ (B) $\mu_d \neq 0$ and $\mu_p = 0$
(C) $\mu_p = 0$ and $\mu_f \neq 0$ (D) $\mu_d \neq 0$ and $\mu_f \neq 0$

Q.45 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 $\vec{v}$ and $\vec{B}$ can have any value other than 90°
(B) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°
(C) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°
(D) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°