Magnetic field due to electric current

LEVEL-1

Questions based on Biot-Savart law

Q.1 Along the direction of current carrying wire, the value of magnetic field is ?
(A) zero
(B) infinity
(C) depends on the length of the wire
(D) uncertain

Q.2 A linear small part of a circuit PQ is situated on X-axis from x = –a/2 to x = +a/2 and a current I is flowing through it. The magnetic field produced due to part PQ at point x = +a will be-
(A) proportional to a
(B) proportional to a^2
(C) proportional to (1/a)
(D) equal to zero

Q.3 Value of Tesla in gauss is -
(A) 10^3 (B) 10^6 (C) 10^4 (D) 10^2

Q.4 The vector form of Biot-Savart law is -
(A) $d\vec{B} = \frac{kid\vec{\ell} \times \vec{r}}{r^2}$ (B) $d\vec{B} = \frac{kid\vec{\ell} \times \vec{r}}{r^3}$
(C) $d\vec{B} = \frac{kid\vec{\ell} \times \vec{r}}{r}$ (D) $d\vec{B} = \frac{kid\vec{\ell} \times \hat{r}}{r}$

Q.5 To obtain maximum intensity of magnetic field at a point the angle between position vector of point and small elements of length of the conductor is -
(A) 0 (B) $\pi/4$ (C) $\pi/2$ (D) π

Q.6 The value of intensity of magnetic field at a point due to a current carrying conductor is obtained from-
(A) Gauss's law (B) Faraday's law
(C) Coulomb's law (D) Biot Savart's law

Q.7 The value of intensity of magnetic field at a point due to a current carrying conductor depends -
(A) Only on the value of current
(B) Only on a small part of length of conductor
(C) On angle between the line joining the given point to the mid point of small length and the distance between the small length of the point
(D) On all and the above

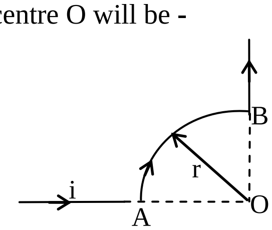
Questions based on Magnetic field due to different current carrying system

Q.8 The radii of two concentric coils having same number of turns are 10 cm and 20 cm respectively. Equal currents are passed through them first in same direction and then in opposite direction. In these two conditions the ratio of resultant magnetic fields at the centre will be -
(A) 3 : 1 (B) 2 : 1
(C) 3 : 2 (D) 1 : 1

Q.9 Which of the following statements is false for Helmholtz coils ?
(A) In Helmholtz coils, both coils are coaxial
(B) The planes of Helmholtz coils are perpendicular to each other
(C) The distance between the coils is equal to the radius of the coil
(D) The magnetic field produced in the middle region between the coils is uniform

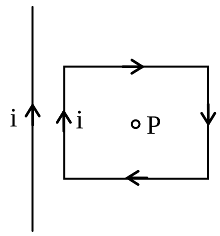
Q.10 The diameter of a circular coil is 0.16m and it has 100 turns. If a current of 5 ampere is passed through the coil, then the intensity of magnetic field at a point on the axis at a distance 0.06 m from its centre will be -
(A) 2×10^{-3} Wb/m^2 (B) 2×10^{-2} Wb/m^2
(C) 2×10^{3} Wb/m^2 (D) 2×10^{2} Wb/m^2

Q.11 The section AB in the following figure is a quarter of a circle of radius r. The magnitude and direction of magnetic induction at the centre O will be -



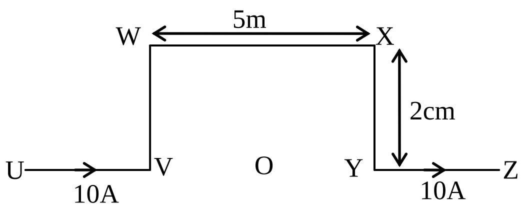
(A) $\frac{\mu_0 i}{2r}$ ⊙ (B) $\frac{\mu_0 i}{4r}$ ⊗
(C) $\frac{\mu_0 i}{8r}$ ⊙ (D) $\frac{\mu_0 i}{8r}$ ⊗

Q.12 A wire is kept parallel to a square coil. Both carry current of same amount. If the magnetic field due to the wire at any point P with in the coil is B_1, then the total magnetic induction B at P will be -



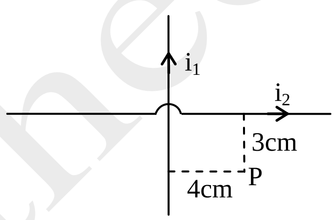
(A) B = 0 (B) $B > B_1$
(C) $B < B_1$ (D) $B = B_1$

Q.13 The resulting magnetic field at the point O due to the current carrying wire shown in the figure-



(A) points vertically upwards
(B) points vertically downwards
(C) is zero
(D) is the same as due to the segment WX alone

Q.14 Two insulated wires of infinite length are lying mutually at right angles to each other as shown in the figure. Current of 2A and 1.5A respectively are flowing in them. The value of magnetic induction at point P will be -



(A) 2×10^{-3} N/A-m (B) 2×10^{-5} N/A-m
(C) 0 (D) 2×10^{-4} N/A-m

Q.15 A current of 10 A is flowing through a circular coil of diameter 1 cm. What is the magnetic induction at its centre ?
(A) $4\pi \times 10^{-4}$ Tesla (B) $2\pi \times 10^{-4}$ Tesla
(C) $4\pi \times 10^{-8}$ Tesla (D) $4\pi \times 10^{-6}$ Tesla

Q.16 The ratio of magnetic field on the axis of current carrying coil of radius a to the magnetic field at its centre will be -

(A) $\dfrac{1}{\left(1+\dfrac{x^2}{a^2}\right)^{3/2}}$ (B) $\dfrac{1}{\left(1+\dfrac{a^2}{x^2}\right)^{1/2}}$

(C) $\dfrac{1}{\left(1+\dfrac{a^2}{x^2}\right)^{2}}$ (D) $\dfrac{1}{\left(1+\dfrac{a^2}{x^2}\right)^{3}}$

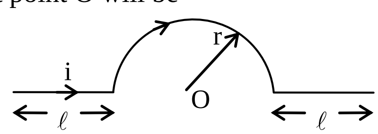
Q.17 An electric current i is flowing in a circular coil of radius a. At what distant from the centre of the axis of the coil will the magnetic field be $\frac{1}{8}$ th of its value at the centre ?

(A) 3a (B) $\sqrt{3}$ a (C) $\dfrac{a}{3}$ (D) $\dfrac{a}{\sqrt{3}}$

Q.18 The ratio of magnetic inductions at the centre of a circular coil of radius a and on its axis at a distance equal to its radius, will be -

(A) $\dfrac{1}{\sqrt{2}}$ (B) $\dfrac{\sqrt{2}}{1}$ (C) $\dfrac{1}{2\sqrt{2}}$ (D) $\dfrac{2\sqrt{2}}{1}$

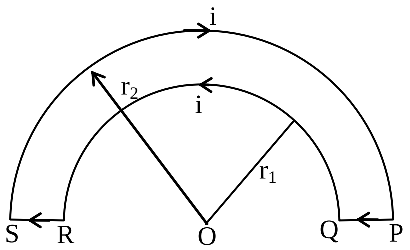
Q.19 A current i is flowing in a conductor as shown in the figure. The magnetic induction at point O will be –



(A) 0 (B) $\dfrac{\mu_0 i}{r}$

(C) $\dfrac{2\mu_0 i}{r}$ (D) $\dfrac{\mu_0 i}{4r}$

Q.20 A wire loop PQRSP is constructed by joining two semicircular coils of radii r_1 and r_2 respectively as shown in the figure. Current is flowing in the loop. The magnetic induction at point O will be -



(A) $\frac{\mu_0 i}{4}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

(B) $\frac{\mu_0 i}{4}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$

(C) $\frac{\mu_0 i}{2}\left[\frac{1}{r_1}-\frac{1}{r_2}\right]$

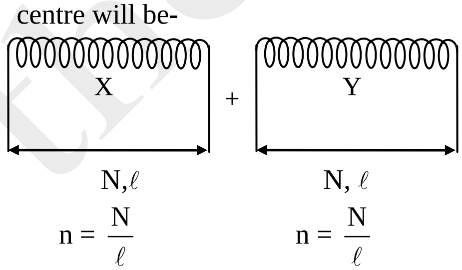
(D) $\frac{\mu_0 i}{2}\left[\frac{1}{r_1}+\frac{1}{r_2}\right]$

Q.21 The magnetic flux density at a point distant d from a long straight current carrying conductor is B. Then its value of at distance $\frac{d}{2}$ will be -

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

Questions based on Ampere's law and solenoid

Q.22 In the given figure x and y are two coils whose length and number of turns are same and each carry current I. The flux density at the centre, inside the coil is B and that at the end is B/2, when two coils are joined to make a coil of double the length and current I is passed through it then flux density at the centre will be-

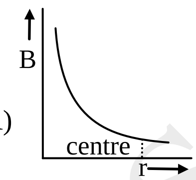


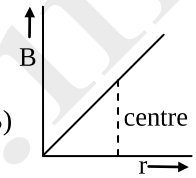
(A) zero (B) B/2
(C) B (D) 2B

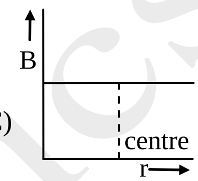
Q.23 At the centre of a straight solenoid the magnetic induction is B. If the length is reduced to half but to keep the number of turns same, these are wound in two layers, then the magnetic induction at the centre will be -

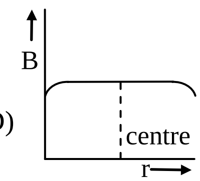
(A) B/2 (B) B
(C) 2B (D) 4B

Q.24 In a solenoid the magnetic induction produced due to current (B) is a function of distance x from one end -

(A)


(B)


(C)


(D)


Q.25 The number of turns per unit length of a solenoid is 10. If its average radius is 5 cm and it carries a current of 10A, 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.26 A solenoid of length 0.5 m and diameter 0.6 cm consists of 1000 turns of fine wire carrying a current of 5.0×10^{-3} ampere. The magnetic field in Weber/m^2 at the ends of the solenoid will be -

(A) 8.71×10^{-6} (B) 6.28×10^{-6}
(C) 3.14×10^{-6} (D) 6.28×10^{-5}

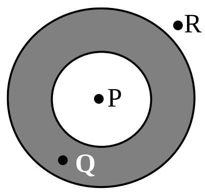
Q.27 The average radius of a toroid made out of a nonmagnetic material is 0.1m and it has 500 turns. If it carries 0.5 ampere current, then the intensity of magnetic field along its circular axis in Tesla will be

(A) 5×10^{-4} (B) 5×10^{-3}
(C) 5×10^{-2} (D) 2×10^{-3}

Q.28 A hollow tube is carrying an electric current along the length distributed uniformly over its surface. The magnetic field -

(A) increases linearly from the axis to the surface
(B) is non-zero inside the tube
(C) inside the tube is zero
(D) is zero just outside the tube

Q.29 Current is flowing through a conducting hollow pipe whose area of cross-section is shown as. The value of magnetic induction will be zero at-



(A) points P, Q and R
(B) Point R but not at P and Q
(C) Q but not at P and R
(D) P but not at Q and R

Q.30 At any internal point of a solenoid the value of magnetic field produced depends -
(A) only on current flowing in the solenoid
(B) only on length of the solenoid
(C) on number of the turns.
(D) on all of the above

Q.31 The magnetic field generated along the axis of a solenoid is proportional to -
(A) its length
(B) square of current flowing in its
(C) number of turns per unit length in it
(D) reciprocal of its radius

Q.32 When the number of turns in a toroidal coil is doubled, the value of magnetic flux density will become-
(A) four times (B) eight times
(C) half (D) double

Q.33 Total number of turns in a toroid is N and radius is R. If current i is passed through it, then the magnetic field inside the toroid will be -
(A) $\frac{\mu_0 Ni}{2R}$ (B) $\mu_0 Ni$
(C) $\frac{\mu_0 Ni}{2\pi R}$ (D) $\frac{\mu_0 Ni}{R}$

Q.34 An air core toroid with 10 turns/cm carries a current of 1 milliampere. The intensity of magnetic field inside it, in Weber/m^2 will be-
(A) $4\pi \times 10^{-6}$ (B) $4\pi \times 10^{-7}$
(C) $4\pi \times 10^{-8}$ (D) $4\pi \times 10^{-9}$

Questions based on Magnetic force on charge particles

Q.35 A particle of mass 0.5 gm and charge 2.5×10^{-8} coulomb is moving with velocity 6×10^4 m/s, horizontally what should be the value of magnetic field acting on it, so that the particle is able to move in a straight line – ($g = 10$ m/s^2)
(A) 0.327 Weber/m^2
(B) 3.27 Weber/ m^2
(C) 32.7 Weber/m^2
(D) this is not possible

Q.36 On a moving electron, electric field E and the magnetic flux density B are so applied that the resultant force on the electron is zero. Then the velocity of electron will be :
(A) B/E (B) E/B
(C) E.e/B (D) E/e.B

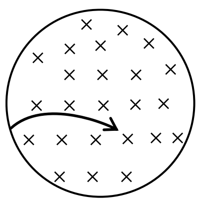
Q.37 Choose the wrong statement -
(A) The radius of path of a charged particle moving in a uniform magnetic field is proportional to the momentum of the particle
(B) An electron beam is moving towards east, on which a perpendicular magnetic field is acting upwards. The beam will be deflected towards the north direction
(C) A positive charge is going straight away from the observer. The magnetic line of force produced due to it are in clockwise direction.
(D) While passing through a given place, the path of electron remains straight line. It can be definitely said that the magnetic field is not present at that place

Q.38 An electric field of 1500 volt/m and a magnetic field of 0.4 Tesla are so applied on a moving electron that the resultant force on it is zero. The speed of the electron is -

(A) 1500 m/s (B) 2800 m/s
(C) 3750 m/s (D) 600 m/s

Q.39 A proton beam enters a uniform magnetic field of 0.3 Tesla making an angle of 60º to its direction with a velocity of 4×10^5 m/s. The radius of the helical path of the proton beam will be -
(A) 4 mm (B) 6 mm
(C) 8 mm (D) 12 mm

Q.40 There is a magnetic field acting in a plane downward perpendicular to sheet of paper. Particles in vacuum move in the plane of paper from left to right. The path indicated by an arrow could be travelled by -



(A) Proton (B) Neutron
(C) Electron (D) α-particle

Q.41 A charged particle is moved along a magnetic field line. The magnetic force on the particle is -
(A) along its velocity
(B) opposite to its velocity
(C) perpendicular to its velocity
(D) zero

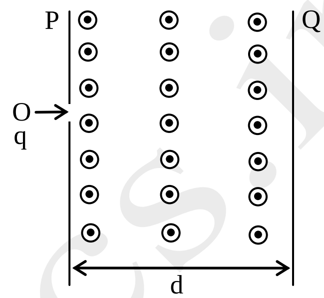
Q.42 Electron and proton of equal momentum enter a uniform field normal to the lines of force. If the radii of curvature of circular paths be r_e and r_p respectively, then -

(A) $\frac{r_e}{r_p} = \frac{1}{1}$ (B) $\frac{r_e}{r_p} = \frac{m_p}{m_e}$

(C) $\frac{r_e}{r_p} = \sqrt{\frac{m_p}{m_e}}$ (D) $\frac{r_e}{r_p} = \sqrt{\frac{m_e}{m_p}}$

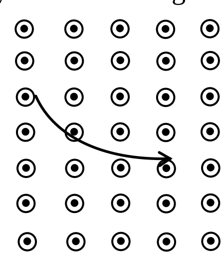
Q.43 A proton charge (+e coulomb) enters in a magnetic field of strength B (Tesla) perpendicular to the magnetic lines of force, with speed v. The force on the proton is -
(A) evB (B) 0
(C) ∞ (D) evB/2

Q.44 A charged particle having kinetic energy K enters into the region of a uniform magnetic filed between two plates P and Q as shown in fig. The charged particle just misses hitting the plate Q. The magnetic field in the region between the two plates -



(A) mK/qd (B) 2mK/qd
(C) $\sqrt{(mK)/qd}$ (D) $\sqrt{(2mk)}$ /qd

Q.45 In a region of space a uniform magnetic filed perpendicular to the plane of the page and directed towards reader exists. A particle has a trajectory as shown in fig. The particle is-



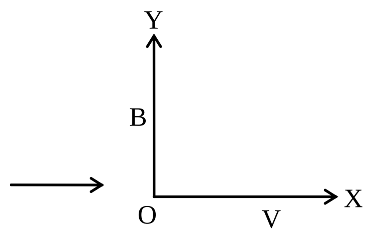
(A) proton (B) neutron
(C) electron (D) α-particle

Q.46 If a particle moves in a circular path in anti-clockwise direction after entering into a downward vertical magnetic field. The charge on the particle is -
(A) positive
(B) negative
(C) neutral
(D) nothing can be said

Q.47 In a room a uniform magnetic field is acting vertically downward. When an electron moves in the horizontal plane its speed in a circular path is constant. Its path is -
(A) Clockwise in horizontal plane
(B) Clockwise in vertical plane
(C) Anti-clockwise in horizontal plane
(D) Anti-clockwise in vertical plane

Q.48 When an electron beam is moving in a magnetic field, then the work done is equal to the -
(A) charge of electron
(B) magnetic field
(C) product of electronic charge and the magnetic field
(D) 0

Q.49 If a positively charged particle is moving as shown in the figure, then it will get deflected out to magnetic field towards -



(A) +x–direction (B) +y-direction
(C) –x-direction (D) +z-direction

Q.50 An electron enters a magnetic field along perpendicular direction. Following quantity will remain constant -
(A) momentum (B) kinetic energy
(C) velocity (D) acceleration

Q.51 Which of the following rays are not deflected by a magnetic field -
(A) α-rays (B) β-rays
(C) γ-rays (D) positive rays

Q.52 An electron, a proton and a deuteron move in a magnetic field with same momentum perpendicularly. The ratio of the radii of their circular paths will be -
(A) 1 : 1 : 1 (B) 1 : 1 : 2
(C) 1 : 2 : 4 (D) 2 : 1 : 1

Q.53 If an electron moves in a circular path with velocity v in a magnetic field B, then during a semicircular journey, its gain in energy will be-
(A) $\frac{1}{2}$ MB^2 (B) 0
(C) $\frac{1}{4}$ MB^2 (D) BevR

Q.54 The ratio of magnetic force (F_m) and electric force (F_c) acting on two parallel moving charges (v - velocity of moving charge, c - velocity of light) -
(A) $\left(\frac{v}{c}\right)^2$ (B) $\left(\frac{c}{v}\right)^2$
(C) $\frac{v}{c}$ (D) $\frac{c}{v}$

Q.55 Two parallel beams of electrons moving in the same direction will-
(A) repel each other
(B) attract each other
(C) not interact with each other
(D) annihilate each other

Q.56 When an electron beam is moving in a magnetic field, then the work done is equal to the -
(A) charge of electron
(B) magnetic field
(C) product of electronic charge and the magnetic field
(D) 0

Questions based on Magnetic force on current carrying wire

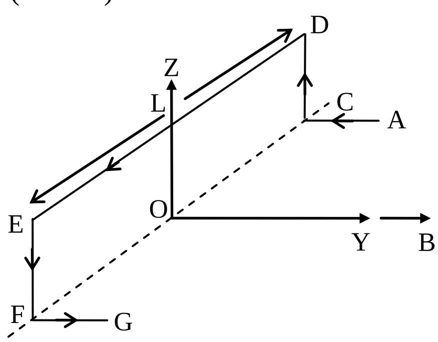
Q.57 Two long parallel conductors A and B are at a distance 0.01m from each other. The current in conductor A is double of that in B and force between then is 0.004 Newton/m. The current flowing through B in ampere will be -
(A) 0.1 (B) 1.0
(C) 10 (D) 100

Q.58 A current of 1 ampere is passed through a wire of a length 0.5 meter. If it is placed normally in a field of 4 Weber/m^2, then the force acting on the wire in Newton will be -
(A) 2 (B) 5 (C) 4 (D) zero

Q.59 A linear conductor of length 40 cm is carrying a current of 3 ampere and is placed in a magnetic field of intensity 500 gauss. If a conductor is making an angle 30º with the field, then the force acting on it will be -
(A) 3×10^4 N (B) 3×10^2 N

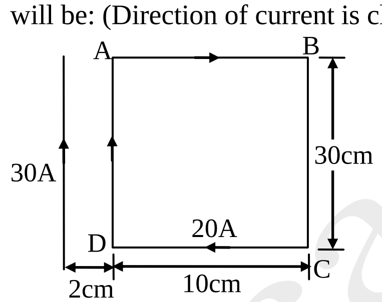
(C) 3×10^{-2} N (D) 3×10^{-4} N

Q.60 A wire ACDEFG having each part of length L and carrying a current of i ampere, is turned according to the diagram shown. A uniform magnetic field B is placed parallel to positive Y-axis. The force acting on wire will be (ED = L) -



(A) iBL in the negative Z-direction
(B) iBL in the positive Z-direction.
(C) iB/L in the negative X-direction
(D) iB/L in positive X-direction

Q.61 The resultant force due to a current carrying long wire on a current loop ABCD in Newton will be: (Direction of current is clockwise)

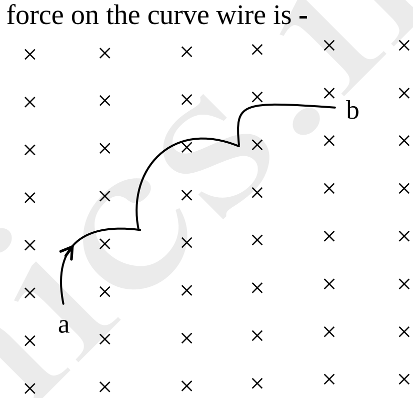


(A) 1.8×10^{-3} (B) 0.36×10^{-3}
(C) 1.5×10^{-3} (D) zero

Q.62 Out of two identical straight conducting wires of length 20 cm and mass 1.2 gm each, one wire is horizontally clamped below the other wire and in series with both the wires a current source is connected. The second wire can be in equilibrium in air at a height of 0.75 cm from first wire if the current flowing in the wires is-
(A) 47 A (B) 4.7 A
(C) 0.47 A (D) 0.047 A

Q.63 Current I is flowing through a circular coil of radius r. It is placed in a magnetic field B_0 in such a way that the plane of the circular coil is perpendicular to B_0. The force acting in it will be -
(A) πIrB_0 (B) IrB_0
(C) zero (D) $2\pi IrB_0$

Q.64 Fig shows a wire of arbitrary shape carrying a current i between points a and b. The length of the wire is L and the distance between points
a and b is d. The wire lies in a plane at right angles to z uniform magnetic field B. The force on the curve wire is -



(A) iLB (B) idB
(C) i(L – d) B (D) None of these

Q.65 A direct current is sent through a helical spring. The spring -
(A) tends to get shorter
(B) tends to get longer
(C) tends to rotate about the axis
(D) tends to move northward

Q.66 Two long, thin wires distant a apart exert a force F on one another when current through each wire is i. The distance between the wires is doubled and the current is decreased to i/3. The force they exert on one another now-
(A) F/6 (B) F/9 (C) 2F/3 (D) F/18

Q.67 The distance between two thin long straight parallel conducting wires is b. On passing the same current in them, the force per unit length between them will be-
(A) $\frac{\mu_0 i}{2\pi b}$ (B) $\frac{\mu_0 i^2}{2\pi}$ (C) $\frac{\mu_0 i^2}{2\pi b}$ (D) 0

Q.68 A stream of electrons is projected horizontally from right. A straight conductor carrying a current is supported parallel to electron stream and above it. If the current in the conductor is from left to right them what will be the effect on electron stream ?

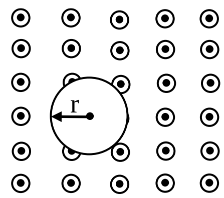
(A) The electron stream will be speeded up towards the right

(B) The electron stream will be retarded

(C) The electron stream will be pulled upward

(D) The electron stream will be pulled downward.

Q.69 A circular loop carrying current i is placed in a uniform magnetic induction field B as shown in fig. The force on circular loop is -



(A) $2\pi rBi$ (B) πrBi (C) 0 (D) Bir

Questions based on Magnetic behaviour of current carrying coil

Q.70 A current of 2 ampere is flowing through a coil of radius 0.1 m and having 10 turns. The magnetic moment of the coil will be :

(A) 20 A-m^2 (B) 2A-m^2

(C) 0.314 A-m^2 (D) 0.628 A-m^2

Q.71 The radius of a circular ring of wire is R and it carries a current of I ampere. At its centre a smaller ring of radius r with current i and N turns is placed. Assuming that the planes of two rings are perpendicular to each other and the magnetic induction produced at the centre of bigger ring is constant, then the torque acting on smaller ring will be -

(A) $Ni\pi r^2 \times \left\{\frac{\mu_0 I}{2R}\right\}$ (B) zero

(C) $Nir^2 \times \left\{\frac{\mu_0 I}{2R}\right\}$ (D) $Nir^2 \left\{\frac{I^2}{2R}\right\}$

Q.72 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 is rotating the coil from angle $\theta = 0^\circ$ to $\theta = 180^\circ$ in an external magnetic field B will be -

(A) πNiR^2B (B) $2\pi NiR^2B$

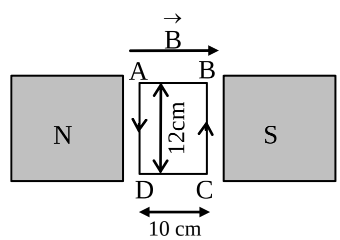
(C) $(2NiB)/(\pi R^2)$ (D) $4\pi NiR^2B$

Q.73 A current carrying wire of length ℓ is bent to from a circular coil. If this coil is placed in any other magnetic field, then for the maximum torque on the coil, the number of turns will be

(A) 1 (B) 2

(C) 4 (D) 8

Q.74 A coil of 50 turns is situated in a magnetic field B = 0.25 Weber/m^2 as shown in figure. A current of 2 ampere is flowing in the coil. Torque acting on the coil will be :



(A) 0.15 N (B) 0.3 N

(C) 0.45 N (D) 0.6 N

Q.75 A current carrying loop lying in a magnetic field behaves like a -

(A) magnetic dipole

(B) magnetic pole

(C) magnetic material

(D) non-magnetic material