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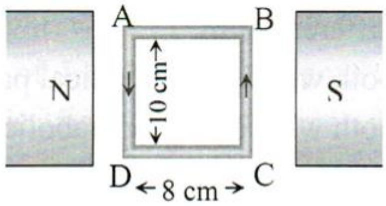
Marks : 200

10.MAGNETIC FIELD DUE TO ELECTRIC CURRENT,5.MAGNETIC EFFECT OF ELECTRIC CURRENT

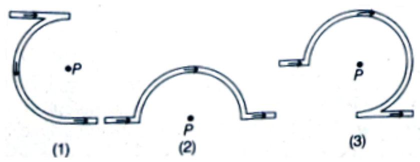
Single Correct Answer Type

1. The torsional rigidity of the suspension fibre (in Nm/degree) is
   a) 2×10^{-3} b) 2.0×10^{-5}
   c) 2.0×10^{-6} d) 0.02
2. An electric current is always accompanied by a magnetic field', was discovered by
   a) Ampere b) Oersted c) Kelvin d) Fleming
3. When a current is passed in a moving coil galvanometer the coil gets deflected because
   a) The current deflects any thing
   b) Current in the coil produces a magnetic field
   c) Current in the coil produces an electric field
   d) A couple acts on the coil
4. Which of the following is the unit of magnetic induction?
   a) T b) Wb/m^2
   c) N/Am d) All of these
5. Which of the following instrument is used for measurement of current?
   a) Ammeter
   b) Moving coil galvanometer
   c) Tangent galvanometer
   d) All of these
6. In which of the following instrument, accuracy can be increased with loss in sensitivity?
   a) Tangent galvanometer
   b) Ammeter
   c) Moving coil galvanometers
   d) Voltmeter
7. An alpha particle of positive charge +2e is compelled to rotate along a circular path of radius r in a cyclotron with linear speed v. The magnetic moment of the closed loop is
   a) Zero b) (1/2) evr c) evr d) 2 evr
8. The magnetic field at a point due to a current carrying conductor is directly proportional to
   a) Resistance of the conductor
   b) Thickness of the conductor
   c) Distance from the conductor
   d) Current flowing through the conductor
9. A length L of a wire carries a steady current I. It is bent first to form circular plane coil of one turn. The same length is now bent more sharply to give a double loop of small radius the magnetic field at the centre , caused by the same current is:
   a) A quarter of its first value
   b) Four times of its first value
   c) A half of its first value unaltered
   d) None of these
10. When range of an ammeter is increased, its sensitivity
    a) Increases b) Decreases
    c) Remain same d) Can't say
11. A 100 turns coil shown in figure carries a current of 2 ampere in a magnetic field $B = 0.2$ Wb/m^2. The torque acting on the coil

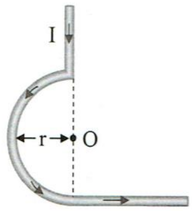


    a) 0.32 Nm tending to rotate the side AD out of the page
    b) 0.32 Nm tending to rotate the side AD into the page
    c) 0.0032 Nm tending to rotate the side AD out of the page
    d) 0.0032 Nm tending to rotate the side AD into the page
12. The circular scale is used for the measurement of current in a:
    a) Suspended type of moving coil galvanometer
    b) Moving magnet galvanometer
    c) Both (a) or (b)
    d) Neither (a) or (b)
13. The magnitude of the magnetic field inside a long solenoid is increased by
    a) decreasing its radius b) decreasing the current through it
    c) increasing its area of cross-section d) introducing a medium of higher permeability

14. The function of shunt resistance in ammeter is
    a) It lowers resistance of galvanometer
    b) It protects galvanometer
    c) It decides range of ammeter
    d) All of these
15. A galvanometer of resistance 90 Ω is shunted by a resistance of 10 Ω. What fraction of main current passes through the shunt?
    a) 1/10 b) 9/100 c) 1/100 d) 9/10
16. Resistance of galvanometer is 500 Ω. Effective resistance of ammeter with shunt is 25 Ω. What is the value of shunt?
    a) $\frac{500}{19}\Omega$ b) $\frac{250}{19}\Omega$ c) $\frac{1000}{19}\Omega$ d) $\frac{125}{19}\Omega$
17. Figure here shows three cases, in all cases, the circular path has radius r and straight ones are infinitely long. For same current, the magnetic field at the centre P in cases 1,2 and 3 have the ratio



    a) $\left(-\frac{\pi}{2}\right):\left(\frac{\pi}{2}\right):\left(\frac{3\pi}{4}-\frac{1}{2}\right)$
    b) $\left(-\frac{\pi}{2}+1\right):\left(\frac{\pi}{2}+1\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$
    c) $-\frac{\pi}{2}:\frac{\pi}{2}:3\frac{\pi}{4}$
    d) $\left(-\frac{\pi}{2}-1\right):\left(\frac{\pi}{2}-\frac{1}{4}\right):\left(\frac{3\pi}{4}+\frac{1}{2}\right)$
18. In the figure, what is the magnetic field at the point O?



    a) $\frac{\mu_0 I}{4\pi r}$ b) $\frac{\mu_0 I}{4\pi r}+\frac{\mu_0 I}{2\pi r}$
    c) $\frac{\mu_0 I}{4r}+\frac{\mu_0 I}{4\pi r}$ d) $\frac{\mu_0 I}{4r}-\frac{\mu_0 I}{4\pi r}$
19. The tangent galvanometer has maximum accuracy, when the deflection of the needle is
    a) 30° b) 45° c) 60° d) 90°
20. The strength of the magnetic field at a point distant r near a long straight current carrying wire is B. The field at a distance $\frac{r}{2}$ will be
    a) $\frac{B}{2}$ b) 2B c) $\frac{B}{4}$ d) 4B
21. A rectangular coil of a moving coil galvanometer containing 100 turns and 5 cm long and 3 cm broad is suspended in a radial magnetic field of induction 0.025 Wb/m^2 by a fibre of torque constant 1.5×10^{-19} Nm per degree. The current for which coil will deflect through an angle of 10° is
    a) 4 μA b) 3 μA c) 5 μA d) 6 μA
22. A coil of radius 200 mm is to produce a field of 0.4 G in its centre with a current of 0.25 A. How many turns must be there in the coil?
    a) 61 b) 51 c) 41 d) 63
23. The sensitivity of galvanometer is 50 div/A. When shunt is used its sensitivity becomes 10 div/A. If the resistance of galvanometer is 20 Ω, then the value of shunt is
    a) 2 Ω b) 4 Ω c) 5 Ω d) 8 Ω
24. Before passing current through T.G. its magnetic needle is under the influence of
    a) Horizontal component of earths field
    b) Vertical component of earths field
    c) Earths, magnetic field
    d) All of these
25. SI unit of current sensitivity of M.C.G. is given by:
    a) Ohm / deg. b) Rad / a
    c) Amp / deg d) Volt / deg
26. T.G. does not work at the magnetic poles of earth because
    a) $B_V = 0$ at poles
    b) Temperature is very small at poles
    c) $B_H = 0$ at poles
    d) $B_H = \infty$ at poles
27. A solenoid of length 50 cm and a radius of cross-section 1 cm has 1000 turns of wire wound over it. If the current carried is 5 A, the magnetic field on its axis, near the centre of the solenoid is approximately (Take, permeability of free space, $\mu_0 = 4\pi \times 10^{-7}$ T − mA^{-1})
    a) 0.63×10^{-2} T b) 1.26×10^{-2} T
    c) 2.51×10^{-2} T d) 6.3 T
28. The pointer of a dead beat galvanometer gives a steady deflection because
    a) Eddy currents are produced in the conducting frame over which the coil is wound
    b) Its magnet is very strong
    c) Its pointer is very light
    d) Its frame is made of ebonite
29. In a moving coil galvanometer, we use a radial magnetic field so that the galvanometer scale is

a) Linear b) Algebraic
c) Logarithmic d) Exponential

30. To make the field radial in a moving coil galvanometer,
a) The number of turns in the coil is increased
b) Magnet is taken in the form of horse shoe type
c) Poles are cylindrically cut
d) Coil is wound on an aluminium frame

31. A circular coil 'A' has a radius 'R' and the current flowing through it is I. Another circular coil 'B' has radius 2R and current flowing through it is 2I. The magnetic field at the centre of the circular coil is in the ratio of (i.e. B_A to B_B)
a) 4 : 1 b) 2 : 1 c) 6 : 1 d) 1 : 1

32. In an ammeter, 10% of the main current is passing through galvanometer, if the galvanometer is shunted with a 10 Ω resistance. What is the resistance of the galvanometer?
a) 20 Ω b) 50 Ω c) 90 Ω d) 100 Ω

33. A galvanometer may be converted into an ammeter or a voltmeter. In which of the following cases the resistance of the device so obtained is least ?
a) Ammeter of range 1 A
b) Ammeter of range 10 A
c) Voltmeter of range 1 V
d) Voltmeter of range 10 V

34. The magnetic force on a charged particle moving in the field does no work, because
a) kinetic energy of the charged particle does not change
b) the charge of the particle remains same
c) the magnetic force is parallel to velocity of the particle
d) the magnetic force is parallel to magnetic field

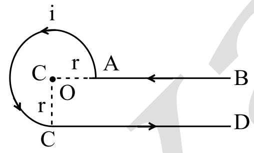
35. In moving coil galvanometer
a) Magnet is stationery
b) Coil is stationery
c) Magnet and coil are moving
d) Magnet and coil are stationery

36. A long wire carrying a steady current is bent into a single coil such that magnetic induction at centre is B. then same wire is bent to form a coil of smaller radius of n turns when magnetic induction at centre is B'. Then
a) $B' = B$ b) $B' = nB$ c) $B' = n^2B$ d) $B = n^2B'$

37. In cyclotron , the applied magnetic field :
a) Increases the speed of particle only
b) Change the direction of particle only
c) Change the direction and increases the speed of particle
d) Neither changes the direction and increases the speed of particle

38. The line integral of magnetic field $\vec{B}$ around any closed path through which current I is flowing is given by $\oint_c \vec{B}\,\vec{d}l =$
a) $\mu_0 I^2$ b) $\frac{\mu_0}{I}$ c) $\mu_0 I$ d) $\frac{I}{\mu_0}$

39. The magnetic induction at point C, if the current carrying wire is in the shape shown in the figure is



a) $\frac{\mu_0 i}{4\pi r}\left[\frac{3}{2}\pi + 1\right]$ b) $\frac{\mu_0 i}{2\pi r}\left[\frac{3}{2}\pi + 1\right]$
c) $\frac{\mu_0 i}{\pi r}\left[\frac{3}{2}\right]$ d) $\frac{\mu_0 i}{2\pi r}\left[1 - \frac{3}{2}\pi\right]$

40. Which one of the following particles cannot be accelerated by a cyclotron?
a) Proton b) Positron
c) Neutron d) α-particles

41. A voltmeter of resistance G ohm has range V volt. To increase its range upto (nV), one must connect
a) A shunt of $\left(\frac{G}{n}\right)$ across it
b) A shunt of $\left(\frac{G}{n-1}\right)$ across it
c) A series of resistance $(n-1)G$
d) A series of resistance (nG)

42. A cyclotron is used to accelerate protons, deuterons, α-particles, etc. If the energy attained, after acceleration, by the protons is E, the energy attained by α-particles shall be
a) 4E b) 2E c) E d) E/4

43. In two parallel wires A and B, 10 A and 2 A current respectively, is flowing in opposite directions. The distance between the wires is 10 cm. If the wire A is of infinite length and wire B is of 2 m length, then the force acting on the wire B will be
a) 8×10^{-5} N b) 4×10^{-5} N
c) 4×10^{-7} N d) 8×10^{-7} N

44. In order to adjust plane of coil of TG. In magnetic meridian:
a) The $a\ell$ - pointer should be parallel to the coil
b) The $a\ell$- pointer should be perpendicular to

the coil

c) The magnetic needle should be perpendicular to the coil

d) The magnetic needle should be inclined at 45° with the coil

45. A galvanometer of resistance 50 Ω is connected to a battery of 3 V along with a resistance of 2950 Ω in series. A full scale deflection of 30 divisions is obtained in the galvanometer. In order to reduce this deflection to 20 divisions, the resistance in series should be

a) 4450 Ω b) 5050 Ω c) 5550 Ω d) 6050 Ω

46. If k is reduction factor of T.G. and is deflection then the sensitivity of TG. Is given by

a) $S = \frac{\cos^2\theta}{k}$ b) $S = \frac{\sin^2\theta}{k}$

c) $S = \frac{\tan^2\theta}{k}$ d) None of these

47. A charged particle of charge q moving with a velocity v, enters along the axis of a solenoid Carrying a current. If B is the magnetic induction along the axis of the solenoid then the force acting on the charged particle will be

a) q v B b) Less than q v B

c) Zero d) More than q v B

48. A galvanometer has a current sensitivity of 5 divisions per milliampere and voltage sensitivity of 1 division per millivolt. The galvanometer has 30 divisions and it is to be used as an ammeter to read 6 A. This requires a shunt of value

a) $\frac{5}{999}$ Ω b) $\frac{1}{333}$ Ω c) $\frac{1}{111}$ Ω d) $\frac{7}{999}$ Ω

49. A current carrying conductor placed in a uniform magnetic field, experience

a) A weak force

b) A strong force

c) A mechanical push on it

d) An electrostatic imbalance

50. An electron is travelling along the x-direction. It encounters a magnetic field in the y-direction. Its subsequent motion will be

a) straight line along the x-direction b) a circle in the XZ-plane

c) a circle in the YZ-plane d) a circle in the XY-plane

51. An ammeter gives full deflection when a current of 2 A flows through it. The resistance of ammeter is 12 ohm. If the same ammeter is to be used for measuring a maximum current of 5 A, then the ammeter must be connected with a resistance of

a) 8 Ω in series b) 18 Ω in series

c) 8 Ω in parallel d) 18 Ω in parallel

52. The M.C.G. has resistance G and I_g be the minimum current for it full scale deflection. To Convert M.C.G. into ammeter of range la, the required shunt is

a) $S = \left(\frac{I_g}{I - I_g}\right)$ b) $S = \left(\frac{I_g - G}{I - I_g}\right)$

c) $S = \left(\frac{I_g}{G(I - I_g)}\right)$ d) None of these

53. The coil of a suspended coil galvanometer has a very high resistance when a momentary current is passed through the coil. It

a) Shows steady deflection

b) Gets deflected and comes to rest slowly

c) Oscillates with the decreasing amplitude

d) Oscillates with the same amplitude

54. What is relation between voltage sensitivity sv and the current sensitivity s_1 of a moving coil galvanometer of resistance G?

a) $S_v = GS_1$ b) $S_v = \frac{S_1}{G}$

c) $S_v S_1 = G$ d) $G = S_v S_1^2$

55. A straight wire of length 0.5 metre and carrying a current of 1.2 ampere placed in a uniform magnetic field of induction 2 tesla. The magnetic field is perpendicular to the length of the wire. The force on the wire is

a) 2.4 N b) 1.2 N c) 3.0 N d) 2.0 N

56. R- in a moving coil galvanometer, the deflection of the coil θ is related to the electric current I by the relation

a) $I \propto \tan\theta$ b) $I \propto \theta$ c) $I \propto \theta^2$ d) $I \propto \sqrt{\theta}$

57. Which of the following instrument is more sensitive?

a) Tangent galvanometer

b) Moving coil galvanometer

c) Both' a' and 'b'

d) Neither 'a' nor 'b'

58. The accuracy of M.C.G. can be increased by

a) Taking large deflection

b) Decreasing number of turns

c) Decreasing area of the coil

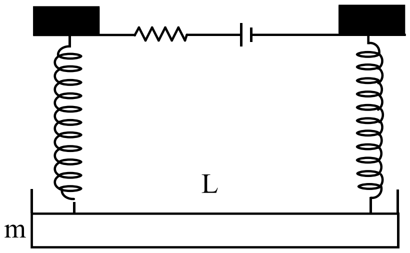
d) All of these

59. A rectangular coil has 100 turns each of area 50 cm^2. It is capable of rotation about an axis joining the mid points of two opposite sides. When a current of 5 A is passed through it

while its plane at right angles to a uniform magnetic field, it experiences a torque of 5 Nm. The magnetic field will be

a) T b) 2 T c) 0.5 T d) 1.5 T

60. A straight rod of mass m and length L is suspended from the identical springs as shown in figure. The spring is stretched a distance x_0 due to the weight of the wire.



The circuit has total resistance R. When the magnetic field perpendicular to the plane of paper is switched ON, then springs are observed to extend further by the same distance. The magnetic field strength is

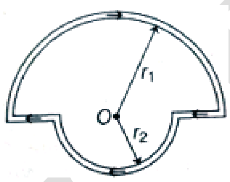
a) $\frac{2mgA}{LE}$ b) $\frac{mgR}{LE}$

c) $\frac{mgR}{2LE}$ d) $\frac{mgR}{E}$

61. A Voltmeter has a range o- V with a series resistance R. With a series resistance 2 R its range is o- V'. The correct relation between V and V' is

a) V' < 2 V b) V' > 2 V c) V' = 2 V d) V' = V

62. In the figure shown below, there are two semi-circles of radii r_1 and r_2 in which a current i is flowing. The magnetic induction at the centre O will be



a) $\frac{\mu_0 j}{4}(r_1 + r_2)$ b) $\frac{\mu_0}{4}(r_1 - r_2)$

c) $\frac{\mu_0 j}{4}\left(\frac{r_1 + r_2}{r_1 r_2}\right)$ d) $\frac{\mu_0 j}{4}\left(\frac{r_2 - r_1}{r_1 r_2}\right)$

63. Three moving coil galvanometer A, B and C made of coil of three different material having torsional constant 1.8×10^{-8}, 2.8×10^{-8} and 3.8×10^{-8} respectively. If three galvanometers are identical in all other respects, then in which of above cases, sensitivity is maximum?

a) A b) B

c) C d) Constant in each case

64. The magnetic field at the centre of a circular coil of radius r carrying current I is B_1. The field at the centre of another coil of radius 2 r carrying same current I is B_2. The ratio $\frac{B_1}{B_2}$ is

a) $\frac{1}{2}$ b) 1 c) 2 d) 4

65. A particle carrying a charge equal to 100 times the charge on an electron is rotating one rotation per second in a circular path of radius 0.8 m. The value of the magnetic field produced at the centre will be (μ_0 = permeability for vacuum)

a) $\frac{10^{-7}}{\mu_0}$ b) $10^{-17}\mu_0$

c) $10^{-6}\mu_0$ d) $10^{-7}\mu_0$

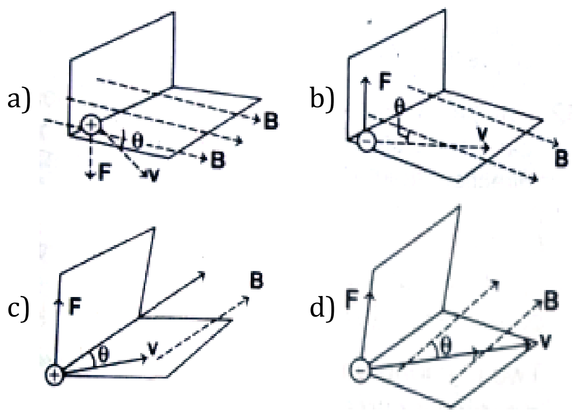
66. An ammeter is a

a) Low resistance galvanometer and is always, connected in parallel with a circuit
b) Low resistance galvanometer and it is always connected in series with the circuit
c) High resistance galvanometer and is always connected in series with the circuit
d) High resistance galvanometer and is always connected in parallel with the circuit

67. An electron and a proton have equal kinetic energies. They enter a magnetic field perpendicularly, then

a) Both will follow a circular path with different radii
b) Both will follow a helical path
c) Both will follow a parabolic path
d) All the statements are false

68. Which of the following figure is correct for the direction of magnetic force on a charge moving in a uniform magnetic field?

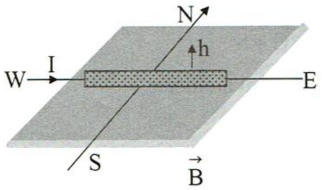


69. If a long hollow copper pipe carries a direct current, the magnetic field associated with the current will be

a) Only inside the pipe
b) Only outside the pipe
c) Neither inside nor outside the pipe

d) Both inside and outside the pipe

70. A conductor of length l is placed in E – W direction on a plane. Earth's horizontal magnetic field is B. The amount of charge passed through it when it is found to jump to a height h is



a) $\frac{2}{3}\frac{m\sqrt{2gh}}{Bl}$ b) $\frac{m\sqrt{2gh}}{2Bl}$

c) $\frac{m\sqrt{2gh}}{Bl}$ d) $\frac{m\sqrt{3gh}}{Bl}$

71. The tangent galvanometer has 'n' number of turns. The radius of coil of T.G. is' a' and θ be the deflection of magnetic needle and B_H be the horizontal component of earth's magnetic field then the current through T.G. is given by

a) $I = \frac{2aB_H}{\mu_0 n}\text{Tan}\,\theta$ b) $I = \frac{\mu_0 n}{2aB_H}\text{Tan}\,\theta$

c) $I = \tan\theta$ d) $I = \frac{2aB_H}{\mu_0 n \tan\theta}$

72. The parallel combination of galvanometer and shunt is called

a) Voltmeter b) Ohmmeter

c) Ammeter d) Speedometer

73. In cyclotron, for a given magnet, radius of the semicircle traced by positive ion is directly proportional to
(v = velocity of positive ion)

a) v^{-2} b) v^{-1} c) v d) v^2

74. A circular coil of radius r carries a current I. The magnetic field at its centre is B. At what distance from the centre, on the axis of the coil the magnetic field will be B/27?

a) 3 r b) 2 r c) $\sqrt{3}$ r d) $2\sqrt{2}$ r

75. Gauss is unit of which quantity?

a) H b) B c) ϕ d) I

76. A proton beam enters a magnetic field of 10^{-4}Wb m^{-2} normally. If the specific charge of proton is 10^{11} C kg^{-1} and its velocity is 10^9 ms^{-1}, then the radius of the circle described will be

a) 100 m b) 0.1 m c) 1 m d) 10 m

77. The magnetic field at a distance r from a long wire carrying current I is 0.4 tesla. The magnetic field at a distance 2r is

a) 0.2 tesla b) 0.8 tesla c) 0.1 tesla d) 1.6 tesla

78. If the magnetic induction normal to the plane of a coil of n turns and radius r carrying a current I is measured on the axis of the coil at a small distance 'a' from centre of coil, then fractional decrease in induction is

a) $\frac{3}{2}\frac{a^2}{r^2}$ b) $\frac{2}{3}\frac{a^2}{r^2}$ c) $\frac{3}{2}\frac{a}{r}$ d) $\sqrt{\frac{3}{2}\frac{a^2}{r^2}}$

79. A voltmeter can be converted into ammeter by connecting

a) A low resistance in series
b) A low resistance in parallel
c) A high resistance in series
d) A high resistance in parallel

80. To convert a moving coil galvanometer into an ammeter, one needs to connect a

a) Small resistance in series
b) Small resistance in parallel
c) Large resistance in series
d) Large resistance in parallel

81. A long, straight wire of radius a carries a steady current i. The current is uniformly distributed across its cross-section. The ratio of the magnetic field at a/2 and 2a is

a) $\frac{1}{4}$ b) 4

c) 1 d) $\frac{1}{2}$

82. The current in a wire is directed towards east and the wire is placed in magnetic field directed towards north. The force on the wire is

a) Due east
b) Due. South
c) Vertically upwards
d) Vertically downwards

83. In M.C.G., the coil of M.C.G. will be in equilibrium position if

a) Deflecting torque = restoring torque
b) Deflecting torque> restoring torque
c) Deflecting torque < restoring torque
d) None of these

84. A proton of mass m and charge q is accelerated by a potential difference V in a perpendicular magnetic field B occupying space t. The value of sin θ where θ is deviation of proton from initial direction is

a) $Bt\sqrt{\frac{q}{3Vm}}$ b) $Bt\sqrt{\frac{q}{2Vm}}$

c) $Bt\sqrt{\frac{2q}{Vm}}$ d) $Bt\sqrt{\frac{q}{Vm}}$

85. The magnitude of the magnetic induction at a point on the axis at a large distance r from the centre of a circular coil of n turns and area A carrying current i is given by

a) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{nA}{ir^3}$ b) $B_{ais} = \frac{\mu_0}{4\pi} \cdot \frac{2niA}{r^3}$

c) $B_{axis} = \frac{\mu_0}{4\pi} \cdot \frac{2ni}{Ar^3}$ d) $B_{avis} = \frac{\mu_0}{4\pi} \cdot \frac{niA}{r^3}$

86. A square coil of edge L having n turns carries a current i. It is kept on a smooth horizontal plate. A uniform magnetic field B exists in a direction parallel to an edge. The total mass of the coil is M. What should be the minimum value of B for which the coil will start tipping over?

a) $\frac{Mg}{niL}$ b) $\frac{Mg}{2niL}$

c) $\frac{Mg}{4niL}$ d) $\frac{2Mg}{niL}$

87. The value of galvanometer constant is

a) $G = \frac{\mu_0 n}{2a}$ b) $G = \frac{\mu_0 a}{2n}$

c) $G = \frac{2a}{\mu_0 n}$ d) None of these

88. A cyclotron is a device which is generally used to

a) Accelerate -ve ions

b) Accelerate +ve ions

c) Accelerate both positive and negative ions

d) Keep the charged particle along a circular path of constant radius

89. When a galvanometer of resistance G is converted into an ammeter of range ia, then current passing through shunt (s) is :

a) $I_S = \frac{G}{G+S} \times I$ b) $I_S = \frac{S}{S+G} \times I$

c) $I_S = \frac{SI+G}{G}$ d) $I_S = \frac{S+GI}{S}$

90. A magnetic field is measured by

a) Ammeter b) Pyrometer

c) Flux meter d) Thermopile

91. Two identical coils carrying equal current have a common centre and their planes are at right angles to each other. What is the ratio of magnitudes of the resultant magnetic field and the field due to one coil along its axis?

a) $2 : 1$ b) $1 : 1$ c) $1 : \sqrt{2}$ d) $\sqrt{2} : 1$

92. A galvanometer whose resistance is 120 Ω gives full scale deflection with a current of 0.05 A so that it can read a maximum current of 10 A. A shunt resistance is added in parallel with it. The resistance of the ammeter so formed is

a) 0.06 Ω b) 0.006 Ω c) 0.6 Ω d) 6 Ω

93. Cyclotron is a device which is used to produce

a) High magnetic field b) High electric field

c) High speed electron d) High speed ions.

94. When a conductor of length l carrying a current I is placed in a magnetic field of induction B at an angle θ with respect to $\vec{B}$, the force experienced by it is

a) $F = IBl$ b) $F = IBl\sin\theta$

c) $F = IBl\cos\theta$ d) $F = IBl\tan\theta$

95. The magnetic field intensity due to a long solenoid at its end is

a) $\mu_0 nI$ b) $2\mu_0 nI$ c) $\mu_0 nI/2$ d) $\sqrt{\mu_0 nI}$

96. The sensitivity of a M.C.G. will increase if

a) A weak magnet is used

b) Number of turns in the coil is decreased

c) Radius of the coil is decreased

d) Strong magnet with more number of turns and greater radius is used

97. The energy resides in a current carrying conductor in the form of

a) Magnetic field b) Mechanical work

c) Electrostatic field d) Gravitational field

98. A circular coil of radius R carries a constant current i. It is placed in a uniform magnetic field $\vec{B}$ such that $\vec{B}$ is perpendicular to the plane of the coil. The magnetic force acting on the coil is

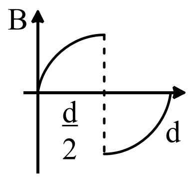
a) $\pi r^2 iB$ b) $2\pi riB$ c) πriB d) Zero

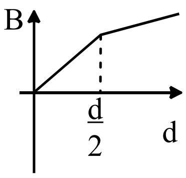
99. A tangent galvanometer is used at three places A,B, C where the earth's horizontal components are in the ratio 10 : 12: 15. It is most sensitive at

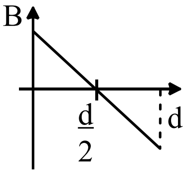
a) A b) B

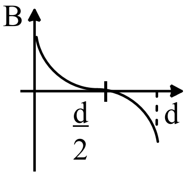
c) C d) None of these

100. A uniform beam of positively charged particles is moving with a constant velocity parallel to another beam of negatively charged particles moving with the same velocity in opposite direction separated by a distance d. The variation of magnetic field B along a perpendicular line draw between the two beams is best represented by

a) 

b) 

c) 

d) 

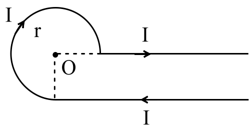
101. If n is number of turns, B magnetic field strength A area of coil and K torsional constant of Suspension wire, then sensitivity is given by

a) $\frac{nAB}{K}$ b) $\frac{K}{nAB}$
c) $nABK$ d) $\frac{nAB\sin\theta}{K}$

102. A wider conductor strip of width x is bent into a slender tubing of radius r with its two ends forming two plane extensions. A current I flowing through it gives magnetic field in tubular portion given by

a) $\frac{\mu_0 I}{2\pi r}$ b) $\frac{\mu_0 I}{2x}$ c) $\frac{\mu_0 I}{\pi x}$ d) $\frac{\mu_0 I}{x}$

103. Current 'I' is flowing in a conductor shaped as shown in the figure. The radius of the curved part is r and the length of straight portion is very large. The value of the magnetic field at the centre O will be



a) $\frac{\mu_0 I}{4\pi r}\left(\frac{\pi}{2}+1\right)$ b) $\frac{\mu_0 I}{4\pi r}\left(\frac{\pi}{2}-1\right)$
c) $\frac{\mu_0 I}{4\pi r}\left(\frac{3\pi}{2}+1\right)$ d) $\frac{\mu_0 I}{4\pi r}\left(\frac{3\pi}{2}-1\right)$

104. Which of the following has NO effect on the sensitivity of moving coil galvanometer?

a) Number of turns
b) Area of coil
c) Magnetic field of magnet
d) The current it measures

105. Stray magnetic field does not affect the deflection. Of a coil of M.C.G. because

a) Magnetic field of M.C.G. is strong
b) Magnetic field of M.C.G. is weak
c) M.C.G. is portable
d) None of these

106. Proton and α particle of equal momenta , enter a uniform magnetic field normally , the radii of their orbits will have the ratio

a) 1:1 b) 2:1 c) 1:2 d) 4:1

107. The force between two long parallel wires A and B carrying current is $0.004 Nm^{-1}$. The conductors are 0.01 m apart. If the current in conductor A is twice that of conductor B, then the current in the conductor B would be

a) 5 A b) 50 A
c) 10 A d) 100 A

108. In equilibrium position, under the action of the two crossed fields b and B_H the deflection of magnetic needle of T.G. is given by tangent law, which is,

a) $B = B_H \tan\theta$ b) $B_H = b\tan\theta$
c) $B = B_H \sin\theta$ d) $B = B_H \cos\theta$

109. There are 50 turns of a wire in every cm length of a long solenoid. If 4 A current is flowing in the solenoid. The approximate value of magnetic field along its axis at an internal point and at end point will be respectively

a) $12.6 \times 10^{-7} Wbm^{-2}$, $6.3 \times 10^{-3} Wbm^{-2}$
b) $12.6 \times 10^{-3} Wbm^{-2}$, $25.2 \times m^{-2} 10^{-3} Wbm^{-2}$
c) $25.1 \times 10^{-3} Wbm^{-2}$, $12.6 \times 10^{-3} Wbm^{-2}$
d) $25.1 \times 10^{-5} Wbm^{-2}$, $6.3 \times 10^{-3} Wbm^{-2}$

110. In a cyclotron, the charged particle cannot be accelerated to energies of the order of billion electron volt because if the speed of the particle is increased

a) The frequency of revolution is increased
b) The frequency of revolution is decreased
c) The frequency of a.c. Source is decreased
d) The frequency of a.c. Source is increased

111. The magnetic field at the centre of the M.C.G. is 0.25 T. The coil has an area of $0.2 m^2$ and has 28 turns. If the sensitivity of the M.C.G. is to be increased by 25%, the number of turns of the coil should be ____. Assume all other things remaining constant

a) 30 b) 32 c) 35 d) 38

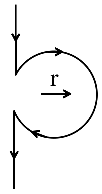
112. A galvanometer of resistance G, is shunted by a resistance S ohm. To keep the main current in the circuit unchanged, the resistance to be put in series with the galvanometer is

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

113. A circular coil of 20 turns and radius 10 cm is placed in a uniform magnetic field of 0.10 T normal to the plane of the coil. If the current in coil is 5 A, then the torque acting on the coil will be

a) 31.4 N − m b) 3.14 N − m
c) 0.314 N − m d) zero

114. Magnetic field induction at the centre of a circular coil shown in the figure is



a) $\frac{\mu_0 I(\pi - 1)}{\pi r}$ b) $\frac{(\mu_0 I)(\pi - 1)}{2\pi r}$

c) $\frac{\mu_0 I}{\pi r}$ d) $\frac{\mu_0 I}{2r}\left(\frac{\pi + 1}{\pi}\right)$

115. A coil of area A and number of turns n, carrying a current i is free to move in uniform magnetic induction B. If θ is the angle between the plane ofthe coil and magnetic induction, torque acting on the coil is :

a) IBA sin θ b) IBA cos θ

c) IBA tan θ d) IBA cot θ

116. A horizontal overhead power line carries a current of 90 A in East to West direction. What are the magnitude and direction of the magnetic field due to the current 1.5 m below the line?

a) 1.2×10^{-5} T, perpendicularly outward to the plane of paper

b) 1.9×10^{-5} T, perpendicularly outward to the plane of paper

c) 2.6×10^{-5} T, perpendicularly inward to the plane of paper

d) 2.6×10^{-5} T, perpendicularly inward to the plane of paper

117. The relation between the current (i) deflection θ and reduction factor (k) is given by

a) $I = \frac{\tan\theta}{K}$ b) $I = \frac{K}{\tan\theta}$

c) $I = k \tan\theta$ d) None of these

118. If a current is passed in a spring, it

a) gets compressed b) gets expanded

c) oscillates d) remains unchanged

119. A long horizontally fixed wire carries a current of 100 A. Directly above and parallel to it is a fine wire that carries a current of 20 A and weights 0.04 N/m. The distance between the two wires for which the upper wire is just supported by magnetic repulsion is

a) 10^{-2} mm b) 10^{-2} cm

c) 10^{-2} m d) 10^{-2} km

120. Field inside a toroid is

a) Directly proportional to its length

b) Directly proportional to current

c) Inversely proportional to the number of currents

d) Inversely proportional to current

121. The deflection produced per unit voltage in m:c.g. is called

a) Charge sensitivity b) Current sensitivity

c) Voltage sensitivity d) All of these

122. The deflection in a moving coil galvanometer falls from 50 divisions to 10 divisions, when a shunt of 12 Ω is connected across it. The resistance of the galvanometer is

a) 24 Ω b) 36 Ω c) 60 Ω d) 48 Ω

123. Two long straight wires are set parallel to each other at separation r and each carries a current i in the same direction. The strength of the magnetic field at any point mid-way between the two wires is

a) $\frac{\mu_0 j}{\pi r}$ b) $\frac{2\mu_0 i}{\pi r}$

c) $\frac{\mu_0 i}{2\pi r}$ d) zero

124. Six very long insulated copper wires are bound together to form a cable. The currents carried by the wires are $i_1 = +10$ A, $i_2 = -13$ A, $i_3 = +10$ A, $i_4 = +7$ A, $i_5 = -12$ A and $i_6 = +18$ A. The magnetic induction at a perpendicular distance of 10 cm from the cable is (Take, $\mu_0 = 4\pi \times 10^{-7}$ Wb/A − m)

a) 40μT b) 37.5μT

c) 30μT d) 35μT

125. Which of the following has largest resistance?

a) Ammeter b) Milliammeter

c) Micro ammeter d) All of these

126. A long straight wire carries a current of π ampere. The magnetic field due to it will be 5×10^{-5} weber/m^2 at what distance from the wire [μ_0 = permeability of air]?

a) $10^4 \mu_0$ metre b) $\frac{10^4}{\mu_0}$ metre

c) $10^6 \mu_0$ metre d) $\frac{10^6}{\mu_0}$ metre

127. An ammeter is obtained by shunting a 30 Ω galvanometer with 30 Ω resistance. What additional shunt be connected across it to double its range?

a) 10 Ω b) 15 Ω c) 30 Ω d) 50 Ω

128. To make the field radial in a moving coil galvanometer

a) The number of turns in the coil is increased

b) Magnet is taken in the form of horse shoe type

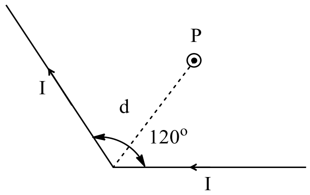
c) Poles are cylindrically cut

d) Coil is wound on aluminium frame

129. A soft iron core is placed at the centre at

rectangular coil in m.c.c. because
a) It increases magnetic field
b) It decreases magnetic field
c) More current to pass through the coil
d) All of these

130. A long conducting wire carrying a current I is bent at 120° (see figure). The magnetic field B at a point P on the right bisector of bending angle at a distance d from the bend is (μ_0 is the permeability of free space)



a) $\frac{3\mu_0 I}{2\pi d}$ b) $\frac{\mu_0 I}{2\pi d}$ c) $\frac{\mu_0 I}{\sqrt{3}\pi d}$ d) $\frac{\sqrt{3}\mu_0 I}{2\pi d}$

131. Two toroids 1 and 2 have total number of turns 200 and 100 respectively with average radii 40 cm and 20 cm, respectively. If they carry same current i, the ratio of the magnetic fields along the two loops is
a) 1: 1 b) 4: 1
c) 2: 1 d) 1: 2

132. A moving coil galvanometer of resistance 40 Ω gives full scale deflection when a current of 0.25 mA is passed it. To convert it to voltmeter of range 10 V, the resistance required to be placed in series is
a) 2000 Ω b) 20000 Ω c) 3996 Ω d) 39960 Ω

133. A straight wire of length 0.5 m carrying a current of 1.6 ampere is placed in a uniform magnetic field of induction 2 T. If the magnetic field is perpendicular to the length of the wire, then force on the wire is
a) 2.4 N b) 1.2 N c) 1.6 N d) 3.2 N

134. A closely wound flat circular coil of 25 turns of wire has diameter of 10 cm and carries a current of 4 ampere. Determine the flux density at the centre of a coil
a) 1.679×10^{-5} tesla b) 2.028×10^{-4} tesla
c) 1.256×10^{-3} tesla d) 1.512×10^{-6} tesla

135. The accuracy of M.C.G.
a) Does not depend on deflection
b) Increases with deflection
c) Decreases with deflection
d) Always fluctuates

136. In tangent galvanometer
a) Coil is fixed and magnet is free to deflect
b) Magnet is fixed and coil is free to deflect
c) Both coil and magnet are fixed
d) Both coil and magnet are free to deflect

137. The coil of a suspended coil galvanometer has a very high resistance, when a momentary current is passed through the coil, it
a) Shows steady deflection
b) Gets deflected and comes to rest slowly
c) Oscillates with the decreasing amplitude
d) Oscillates with the same amplitude

138. A charged particle of mass m and charge q describes circular motion of radius r in a uniform' magnetic field of strength B. The frequency of revolution is
a) $\frac{Bq}{2\pi m}$ b) $\frac{Bq}{2\pi r m}$ c) $\frac{2\pi m}{Bq}$ d) $\frac{Bq}{2\pi q}$

139. Three tangent galvanometer A, B and C give deflections of 30°, 35° and 40° when a current of 100 mA is passed through each of them the sensitivity of
a) A is maximum and C is minimum
b) C is maximum and B is minimum
c) B is maximum and C is minimum
d) C is maximum and A is minimum

140. There are 50 turns of a wire in every cm length of a long solenoid. If 4 ampere current is flowing in the solenoid, the approximate value of magnetic field along its axis at an internal point and at one end will be respectively
a) $12.6 \times 10^{-3} Wb/m^2, 6.3 \times 10^{-3} Wb/m^2$
b) $12.6 \times 10^{-3} Wb/m^2, 25.1 \times 10^{-3} Wb/m^2$
c) $25.1 \times 10^{-3} Wb/m^2, 12.6 \times 10^{-3} Wb/m^2$
d) $25.1 \times 10^{-5} Wb/m^2, 12.6 \times 10^{-5} Wb/m^2$

141. A proton and an alpha particle enter in a uniform magnetic field with the same velocity. The period of rotation of the alpha particle will be
a) Four times that of the proton
b) Two times that of the proton
c) Three times that of the proton
d) Same as that of the proton

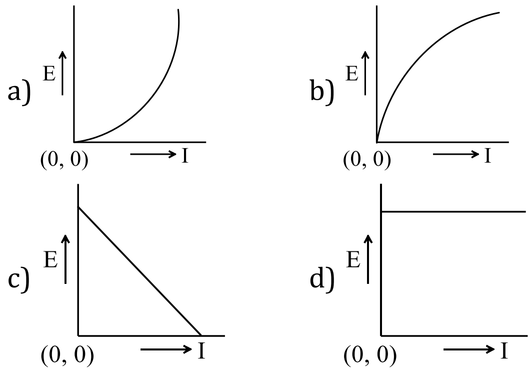
142. The magnetic field produced by a current passing through the coil of T.G. is in direction:
a) East-west b) North-south
c) Vertical (Bv) d) Inclined ' $45^0$with Bv

143. The magnetic induction at a point P which is distant 4 cm from a long current carrying wire is 10^{-8} tesla. The field of induction at a distance 12 cm from the same current would be

a) 3.33×10^{-9} tesla b) 1.11×10^{-4} tesla
c) 3×10^{-3} tesla d) 9×10^{-2} tesla

144. A charged particle is moving in a uniform magnetic field in a circular path. Radius of circular path is R. When energy of particle is doubled, then new radius will be
a) $R\sqrt{2}$ b) $R\sqrt{3}$ c) 2 R d) 3 R

145. A long solenoid carries current I. Curve between energy density (at mid-point of solenoid) E and I is given by



146. Two identical coils carrying equal current have a common centre and their planes are at right angle to each other. What is the ratio of magnitude of the resultant magnetic field and the field due to one coil along its axis
a) 2: 1 b) 1: 1 c) $1: \sqrt{2}$ d) $\sqrt{2}: 1$

147. A galvanometer gives full scale deflection when the current passed through it is 3 mA. Its resistance is 100 Ω without connecting additional resistance in series, then it can be used as voltmeter of range
a) 3.0 V b) 0.3 V c) 0.020 V d) 0.003 V

148. A coil of T.G. having diameter 16 cm is set up in magnetic meridian when a current of 0.8 A is passed through the coil. The magnetic needle is deflected through 45°. The length of the wire in the coil is ($B_H = 2 \times 10^{-5}$ T)
a) 1.6 mm b) 1.6 cm c) 1.6 m d) 1.1 m

149. A galvanometer of resistance g Ω and series resistance R is used to convert it into voltmeter reading of v volt. The current passing through voltmeter is:
a) $I_g = \frac{V}{R+G}$ b) $I_g = \frac{R+G}{V}$
c) $I_g = \frac{V+G}{R}$ d) $I_g = \frac{V+R}{G}$

150. Which one of the following particles cannot be accelerated by a cyclotron?
a) Proton b) Electron
c) Deuteron d) α particle

151. The resistance of a galvanometer is 90 ohms. If only 10 percent of the main current may flow through the galvanometer, in which way and of what value, a resistor is to be used?
a) 10 ohm in series b) 10 ohm in parallel
c) 810 ohm in series d) 810 ohm in parallel

152. The sensitivity of a tangent galvanometer can be increased by
a) Decreasing the radius of the coil
b) Decreasing the value of B_H
c) Increasing the number of turns of the coil
d) All of these

153. Toroid is a solenoid of
a) Infinite length
b) Infinite length of non-uniform radius
c) Infinite length bent into a circle
d) Conical shape

154. A wire of length L carrying a current I is bend into a circle. The magnitude of the magnetic Field at the centre of the circle is
a) $\frac{\pi\mu_0 I}{L}$ b) $\frac{\mu_0 I}{2L}$ c) $\frac{2\pi\mu_0 I}{L}$ d) $\frac{\mu_0 I}{2\pi L}$

155. The maximum kinetic energy of protons in a cyclotron of radius 0.4 m in a magnetic field of 0.5 T is (mass of proton $= 1.67 \times 10^{-27}$ kg, charge of proton $= 1.6 \times 10^{-19}$C)
a) 3 MeV b) 1.9 MeV c) 5 MeV d) 4 MeV

156. A proton of mass m and charge q is moving in a plane with kinetic energy E. If there exists a uniform magnetic field B, perpendicular to the plane of the motion, the proton will move in a circular path of radius
a) $\frac{2Em}{qB}$ b) $\frac{\sqrt{2Em}}{qB}$ c) $\frac{\sqrt{Em}}{2qB}$ d) $\sqrt{\frac{2Eq}{mB}}$

157. A galvanometer has a resistance of 3663 ohm. A shunt S is connected across it such that (1/34) of the total current passes through the galvanometer. Then the value of the shunt is
a) 3663 ohm b) 111 ohm
c) 107.7 ohm d) 3555.3 ohm

158. A charge q is moving with a velocity $v_1 = 1\hat{i}$ m/s at a point in a magnetic field and experiences a force $F = q(-\hat{i} + \hat{k})$N. If the charge is moving with a velocity $v_2 = 2\hat{j}$m/s at the same point, then it experiences a force $F_2 = q(\hat{i} - \hat{k})$N. The magnetic induction B at that point is
a) $(\hat{i} + \hat{j} + \hat{k})$Wb/m^2 b) $(\hat{i} - \hat{j} + \hat{k})$W/m^2
c) $(-\hat{i} + \hat{j} - \hat{k})$Wb/m^2 d) $(\hat{i} + \hat{j} - \hat{k})$Wb/m^2

159. A galvanometer (G = 1000 Ω) gives full scale deflection when a current 10 μA flows through

it. It is required to measure a current whose maximum value does not exceed 1 A. To do so we need to connect a resistance of

a) 0.01 Ω in series b) 100 Ω in parallel
c) 0.01 Ω in parallel d) 1000 Ω in series

160. A voltmeter of range 3 V and resistance 200 Ω cannot be converted to an ammeter of range
a) 10 mA b) 100 mA c) 1 A d) 10 A

161. In a cyclotron, the charged particles cannot be accelerated upto
a) Kev b) Be v c) Me v d) 500 ev

162. After passing current through the coil of an adjusted tangent galvanometer, the magnetic needle at its centre is under the influence of
a) Only B_H
b) Only B_v
c) Magnetic induction B due to current through the coil
d) Magnetic induction B due to current through the coil and B_H

163. The range of ammeter can be increased by
a) Decreasing shunt b) Increasing shunt
c) Changing scale d) None of these

164. A current of 10 ampere is flowing in a wire of length 1.5 m. A force of 15 N acts on it when it is placed in a uniform magnetic field of 2 tesla. The angle between the magnetic field and the direction of the current is
a) 30° b) 45° c) 60° d) 90°

165. A galvanometer with a scale divided into 150 equal divisions has a current sensitivity of 10 div/mA and voltage sensitivity of 2 div/mV. The shunt resistance to be connected to the galvanometer so that it can read a current of 6 A will be
a) 0.125 Ω b) 0.0125 Ω c) 1.25 Ω d) 2.5 Ω

166. An electron moving in a circular orbit of radius r makes n rotations per second. The magnetic field produced at the centre has magnitude
a) $\frac{\mu_0 ne}{2\pi r}$ b) Zero c) $\frac{\mu_0 n^2 e}{r}$ d) $\frac{\mu_0 ne}{2r}$

167. A galvanometer of resistance 95 Ω shunted by a resistance of 5 Ω gives deflection of 50 divisions when joined in series with resistance of 20 kΩ and 2.0 V accumulator. The current sensitivity of the galvanometer in division per μA is
a) 1/2 b) 1 c) 5 d) 10

168. A particle carrying a charge equal to 100 times the charge on an electron is rotating per second in a circular path of radius 0.8 metre. The value of the magnetic field produced at the centre will be (μ_0= permeability for vacuum)
a) $\frac{10^{-7}}{\mu_0}$ b) $10^{-17}\ \mu_0$ c) $10^{-6}\ \mu_0$ d) $10^{-7}\ \mu_0$

169. In suspended coil type M.C.G. the coil is suspended in radial magnetic field by thin fibre at phosphor bronze because
a) It has high torsional constant
b) It has law torsional constant
c) Negative torsional constant
d) None of these

170. A moving coil galvanometer has 28 turns and area of coil is $4 \times 10^{-2} m^2$. If the magnetic field is 0.2 T, then to increase the current sensitivity by 25% without changing area and field, the number of turns should be changed to
a) 24 b) 35 c) 60 d) 54

171. The voltage sensitivity of M.C.G. is given by
a) $S = \frac{nAB}{K}$ b) $S = \frac{nAB}{KG}$
c) S= n ABKG d) $S = \frac{KG}{nAB}$

172. The Lorentz force on a charged particle of charge q moving with velocity v in presence of both the electric field E(r) and the magnetic field B(r) is given by
a) $q\left[E(r) + \frac{1}{2}v \times B(r)\right]$ b) $q[E(r) + v \times B(r)]$
c) $q[E(r) - v \times B(r)]$ d) $q[v \times B(r) - E(r)]$

173. An ammeter should have very low resistance, so that it may
a) Not burn out
b) Shows large deflection
c) Have better stability
d) Not change the value of the current

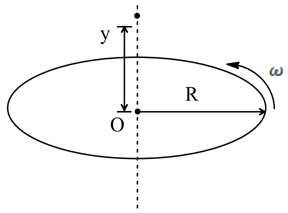
174. A long straight wire carries an electric current of 2 A. The magnetic induction at a perpendicular distance of 5 m from the wire is
a) 4×10^{-8}T b) 8×10^{-8}T
c) 12×10^{-8}T d) 16×10^{-8}T

175. A current of 0.1 A circulates around a coil of 100 turns and having a radius equal to 5 cm. The magnetic field set up at the centre of the coil is (Take, $\mu_0 = 4\pi \times 10^{-7}$ Wb/A − m)
a) $5\pi \times 10^{-5}$ T b) $8\pi \times 10^{-5}$ T
c) $4\pi \times 10^{-5}$ T d) $2\pi \times 10^{-5}$ T

176. An electric charge e moves with a constant speed v parallel to the lines of force of a uniform magnetic field b, the force experienced by the charge is

a) $\frac{ev}{B}$ b) $\frac{e}{Bv}$ c) eBv d) Zero

177. A disc of radius r spins with angular velocity ω as shown. The disc has a uniform surface charge density σ. Magnetic field at distance y from centre on axis is



a) $\frac{\mu_0\sigma\omega}{2}\left(\frac{R^2+y^2}{\sqrt{R^2+y^2}}\right)$

b) $\frac{\mu_0\sigma\omega}{2}\left(\frac{R^2+y^2}{\sqrt{R^2+y^2}}-2y\right)$

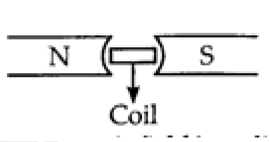
c) $\frac{2\mu_0\sigma\omega}{3}\left(\frac{R^2+y^2}{\sqrt{R^2+y^2}}-2y\right)$

d) $\frac{\mu_0\sigma\omega}{3}\left(\frac{R^2-2y^2}{\sqrt{R^2-y^2}}+2y\right)$

178. Ampere's law is analogous to
a) Kirchhoff's law in current electricity
b) Faraday's law in e. m. f
c) Lenz's law
d) Gauss theorem in electrostatics

179. If T.G. is carried from equatorial region to N-pole of earth then its reduction factor will :
a) Increase b) Decrease
c) Remain unchanged d) Become zero

180. Figure shows the north and south poles of a permanent magnet in which n turn coil of area of Cross section A is resting such that for a current i passed through the coil, the plane of the coil makes an angle θ with respect to direction of magnetic field B. If the plane of magnetic field and the coil are horizontal and vortical respectively, the torque on the coil will be



a) nIAB cos θ
b) nIAB sin θ
c) nIAB
d) None of the above since the magnetic field is radial

181. A charge q moves with velocity v through electric field E as well as magnetic field B. Then, the force acting on it is
a) $q(E \times v)$ b) $q(B \times v)$
c) $qE + q(v \times B)$ d) $q(v \times B)$

182. When a current carrying coil is placed in a uniform magnetic field of induction B, then a torque τ acts on it. If I is the current, n is the number of turns and a is the face area of the coil and the normal to the coil makes on angle θ with h, then
a) $\tau = nIAB$ b) $\tau = nIAB\cos\theta$
c) $\tau = nIAB\sin\theta$ d) $\tau = nIAB\tan\theta$

183. Sensitivity of a moving coil galvanometer can be increased by
a) Decreasing the number of turns of coil
b) Increasing the number of turns of coil
c) Decreasing the area of a coil
d) By using a weak magnet

184. Two voltmeters have resistances 500 Ω & 3000 Ω which one will read voltage more accurately:
a) Both will read equally accurate
b) 500 Ω resistance voltmeter will read more accurately
c) 3000 Ω resistance will read more accurately
d) Resistance of voltmeter has no effect on accuracy and sensitivity

185. Two circular coils 1 and 2 are made from the same wire but the radius of the 1st coil is twice that of the 2nd coil. What is the ratio of potential difference applied across them, so that the magnetic field at their centres is the same?
a) 3 b) 4
c) 6 d) 2

186. The accuracy of mcg is
a) Not dependent on deflection
b) Increases with deflection
c) Decreases with deflection
d) None of these

187. Si unit of reduction factor of T.G is
a) A b) A-m c) A-m^2 d) Nm^2/c^2

188. The phenomenon in which magnetic field is produced in the space near a conductor carrying current is called
a) Thermionic effect
b) Photoelectric effect
c) Heating effect
d) Magnetic effect of electric current

189. Which of the following is riot the unit of magnetic induction?
a) Maxwell b) Gauss
c) Oersted d) Weber / meter²

190. A current I flows along the length of an

infinitely long, straight and thin-walled pipe. Then

a) The magnetic field at all points inside the pipe is the same but non zero
b) The magnetic field at any point inside the pipe is zero
c) The magnetic is zero only on the axis of the pipe
d) The magnetic field is different at different points inside the pipe

191. Before passing current through T.G its magnetic is under the influence of
a) Horizontal component of earths field
b) Vertical component of earths field
c) Earth's magnetic field
d) External magnetic field

192. The equation for the sensitivity of T.G. is:
a) $\frac{2rB_H}{\mu_0 n} x\, cos^2\theta$ b) $\frac{2rB_H}{\mu_0 n} x\, sec^2\theta$
c) $\frac{\mu_0 n}{2rB_H} x\, cos^2\theta$ d) $\frac{2\mu_0 n}{4}$

193. If a current flowing in a circular coil is in anticlockwise direction, then direction of magnetic field will be
a) Towards you b) Away from you
c) At an angle of 45° d) In parallel of the coil

194. The magnetic field inside a solenoid is
a) Directly proportional to its length
b) Inversely proportional to the total number of turns
c) Inversely proportional to the current
d) Directly proportional to the current

195. An ammeter of low range can be converted into an ammeter of higher range by connecting
a) A high resistance in series
b) A high resistance in parallel
c) Low resistance in series
d) A low resistance in parallel

196. When a galvanometer of resistance G is converted into an ammeter of range IA then the current passing through shunt (s) is
a) $I_s = \left(\frac{G}{G+S}\right) I$ b) $I_s = \left(\frac{S}{S+G}\right) I$
c) $I_s = \left(\frac{SI+G}{S}\right) I$ d) $I_s = \left(\frac{SI+G}{G}\right) I$

197. A magnetic field $4 \times 10^{-3}\hat{k}$T exerts a force $(4\hat{i} + 3\hat{j}) \times 10^{-10}$ N on a particle having a charge 10^{-9}C and going on the XY-plane. The velocity of the particle is
a) $-75\hat{i} + 100\hat{j}$ b) $-100\hat{i} + 75\hat{j}$
c) $25\hat{i} + 2\hat{j}$ d) $2\hat{i} + 25\hat{i}$

198. A voltmeter of resistance g ohm has range v volt. To increase its range upto (n v) one must connect
a) A shunt of $\left(\frac{G}{n}\right)$ across it
b) A shunt of $\left(\frac{G}{n-1}\right)$Across it 11-1
c) A series of resistance (n-l) G
d) A series of resistance (nG)

199. A proton is projected with velocity $v = 2\hat{i}$ in a region, where magnetic field $B = (\hat{i} + 3\hat{j} + 4\hat{k})\mu T$ and electric field $E = 10\hat{i}\mu V/m$, then find out the net force on proton.
a) 22.6×10^{-25} N b) 14.14×10^{-25} N
c) 1.6×10^{-25} N d) 10.5×10^{-25} N

200. In radial magnetic field, the torque acting on the current carrying freely suspended coil is
a) Zero b) Maximum
c) Less than zero d) None of these

N.B.Navale

Date : 28.03.2025 **TEST ID: 56**
Time : 03:00:00 **PHYSICS**
Marks : 200

10.MAGNETIC FIELD DUE TO ELECTRIC CURRENT,5.MAGNETIC EFFECT OF ELECTRIC CURRENT

: ANSWER KEY :

1)	**c**	**2)**	**b**	**3)**	**d**	**4)**	**d**	**105)**	**a**	**106)**	**b**	**107)**	**c**	**108)**	**a**
5)	**d**	**6)**	**a**	**7)**	**c**	**8)**	**d**	**109)**	**c**	**110)**	**b**	**111)**	**c**	**112)**	**a**
9)	**b**	**10)**	**b**	**11)**	**a**	**12)**	**b**	**113)**	**d**	**114)**	**b**	**115)**	**b**	**116)**	**a**
13)	**d**	**14)**	**d**	**15)**	**d**	**16)**	**a**	**117)**	**c**	**118)**	**a**	**119)**	**c**	**120)**	**b**
17)	**a**	**18)**	**c**	**19)**	**b**	**20)**	**b**	**121)**	**c**	**122)**	**d**	**123)**	**d**	**124)**	**a**
21)	**a**	**22)**	**b**	**23)**	**c**	**24)**	**a**	**125)**	**c**	**126)**	**a**	**127)**	**b**	**128)**	**c**
25)	**b**	**26)**	**c**	**27)**	**b**	**28)**	**a**	**129)**	**a**	**130)**	**d**	**131)**	**a**	**132)**	**d**
29)	**a**	**30)**	**c**	**31)**	**d**	**32)**	**c**	**133)**	**c**	**134)**	**c**	**135)**	**b**	**136)**	**a**
33)	**b**	**34)**	**a**	**35)**	**a**	**36)**	**c**	**137)**	**c**	**138)**	**a**	**139)**	**a**	**140)**	**c**
37)	**b**	**38)**	**c**	**39)**	**a**	**40)**	**c**	**141)**	**b**	**142)**	**a**	**143)**	**a**	**144)**	**a**
41)	**c**	**42)**	**c**	**43)**	**a**	**44)**	**b**	**145)**	**a**	**146)**	**d**	**147)**	**b**	**148)**	**c**
45)	**a**	**46)**	**a**	**47)**	**c**	**48)**	**a**	**149)**	**a**	**150)**	**b**	**151)**	**b**	**152)**	**d**
49)	**c**	**50)**	**d**	**51)**	**c**	**52)**	**a**	**153)**	**c**	**154)**	**a**	**155)**	**b**	**156)**	**b**
53)	**c**	**54)**	**b**	**55)**	**b**	**56)**	**b**	**157)**	**b**	**158)**	**a**	**159)**	**c**	**160)**	**a**
57)	**b**	**58)**	**d**	**59)**	**b**	**60)**	**b**	**161)**	**b**	**162)**	**d**	**163)**	**a**	**164)**	**a**
61)	**a**	**62)**	**c**	**63)**	**a**	**64)**	**c**	**165)**	**b**	**166)**	**d**	**167)**	**a**	**168)**	**b**
65)	**b**	**66)**	**b**	**67)**	**a**	**68)**	**c**	**169)**	**b**	**170)**	**b**	**171)**	**b**	**172)**	**b**
69)	**b**	**70)**	**c**	**71)**	**a**	**72)**	**c**	**173)**	**d**	**174)**	**b**	**175)**	**c**	**176)**	**d**
73)	**c**	**74)**	**d**	**75)**	**b**	**76)**	**a**	**177)**	**b**	**178)**	**d**	**179)**	**b**	**180)**	**c**
77)	**a**	**78)**	**a**	**79)**	**b**	**80)**	**b**	**181)**	**c**	**182)**	**c**	**183)**	**b**	**184)**	**c**
81)	**c**	**82)**	**c**	**83)**	**a**	**84)**	**b**	**185)**	**b**	**186)**	**b**	**187)**	**a**	**188)**	**d**
85)	**b**	**86)**	**b**	**87)**	**a**	**88)**	**b**	**189)**	**a**	**190)**	**b**	**191)**	**a**	**192)**	**c**
89)	**a**	**90)**	**c**	**91)**	**d**	**92)**	**c**	**193)**	**a**	**194)**	**d**	**195)**	**d**	**196)**	**a**
93)	**d**	**94)**	**b**	**95)**	**c**	**96)**	**d**	**197)**	**a**	**198)**	**b**	**199)**	**a**	**200)**	**b**
97)	**a**	**98)**	**d**	**99)**	**a**	**100)**	**d**								
101)	**a**	**102)**	**d**	**103)**	**c**	**104)**	**d**								

N.B.Navale

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10.MAGNETIC FIELD DUE TO ELECTRIC CURRENT,5.MAGNETIC EFFECT OF ELECTRIC CURRENT

: HINTS AND SOLUTIONS :

Single Correct Answer Type

1 **(c)**

$C = \frac{IAB}{\theta} = \frac{2 \times 10^{-5}}{10} = 2 \times 10^{-6}$ Nm/deg

7 **(c)**

Current due to motion of α particle $= \frac{2e}{T}$

$\therefore$ Magnetic moment $= I \times A = \frac{2e}{T} \times \pi r^2$

$= \frac{e(2\pi r)r}{T} = evr$

10 **(b)**

$S = \frac{d\theta}{di.}$ If i increases , s decreases

11 **(a)**

$\tau = NBIA = 100 \times 0.2 \times 2 \times (0.08 \times 0.1)$

$= 0.32 N\ m$

Direction is given by Fleming's left hand rule

13 **(d)**

By field along the axis of a solenoid, $B = \mu_0 ni$

The magnitude of the magnetic field inside a long solenoid is increased by introducing a medium of higher permeability.

15 **(d)**

Fraction of current passing through the galvanometer is $\frac{I_g}{I}$

$= \frac{S}{S+G} = \frac{10}{10+90} = \frac{10}{100} = \frac{1}{10}$

Fraction of current passing through shunt is

$\frac{I_s}{I} = 1 - \frac{I_g}{I} = 1 - \frac{1}{10} = \frac{9}{10}$

16 **(a)**

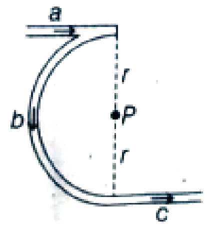
$R_{eff.} = \frac{SG}{S+G} \Rightarrow 25 = \frac{S \times 500}{S + 500}$

$\therefore 500\, S = 25\, S + 12500 \Rightarrow S = \frac{500}{19} \Omega$

17 **(a)**

For first figure, magnetic field at P due to straight part (a),

$B_a = \frac{\mu_0}{4\pi} \cdot \frac{i}{r}$ (inward)



Magnetic field at P due to circular part (b),

$B_b = \frac{\mu_0}{4\pi} \frac{\pi i}{r}$ (outward)

Magnetic field at P due to straight part (c),

$B_c = \frac{\mu_0}{4\pi} \frac{i}{r}$ (outward)

So, net magnetic field at the centre of first figure,

$B_1 = B_b + B_c - B_a$ ....(i)

$= \frac{\mu_0}{4\pi} \frac{\pi i}{r}$ (outward)

For second figure, magnetic field at P due to two straight and one circular part,

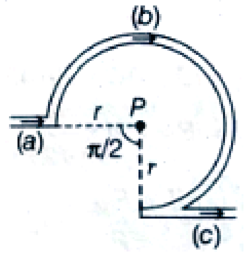
$B_2 = \frac{\mu_0}{4\pi} \frac{\pi i}{r}$ (inward) ....(ii)

For third figure, magnetic field at P due to straight part (a),

$B_a = 0$

Magnetic field at P due to circular part (b),

$B_b = \frac{\mu_0}{4\pi} \frac{\left(2\pi - \frac{\pi}{2}\right) i}{r}$ (inward)



Magnetic field at P due to straight part (c),

$B_c = \frac{\mu_0}{4\pi}\frac{i}{r}$ (outward)

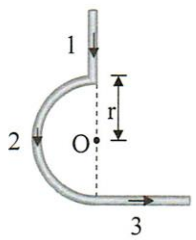
So, net magnetic field at centre of third figure,

$B_3 = \frac{\mu_0}{4\pi} \cdot \frac{i}{r}\left(\frac{3\pi}{2} - 1\right)$ (inward) ....(iii)

From Eqs. (i), (ii) and (iii), we get

$B_1 : B_2 : B_3 = -\pi : \pi : \left(\frac{3\pi}{2} - 1\right) = -\frac{\pi}{2} : \frac{\pi}{2} : \left(\frac{3\pi}{4} - \frac{1}{2}\right)$

18 **(c)**



Magnetic fields due to different portions 1, 2 and 3 are respectively,

$B_1 = 0,$

$B_2 = \frac{\mu_0}{4\pi}.\frac{\pi I}{r}$ (directed outside the paper)

$B_3 = \frac{\mu_0}{4\pi}.\frac{I}{r}$ (directed outside the paper)

$\therefore B_{net} = B_2 + B_3 = \frac{\mu_0 I}{4r} + \frac{\mu_0 I}{4\pi r}$

20 **(b)**

$B = \frac{\mu_0}{4\pi}\frac{2I}{r}$

New distance $= \frac{r}{2}$

$\therefore$ New magnetic field $= \frac{\mu_0}{4\pi}\frac{2I}{\left(\frac{r}{2}\right)} = 2B$

21 **(a)**

$C\theta = nIAB$

$\therefore I = \frac{C\theta}{nAB} = \frac{1.5 \times 10^{-9} \times 10}{100 \times 15 \times 10^{-4} \times 0.025}$

$= 4 \times 10^{-6} A = 4\ \mu A$

22 **(b)**

$B = 0.4 \times 10^{-4} T = 4 \times 10^{-5}\ T$

Using $B = \frac{\mu_0 n I}{2r}$ we get,

$n = \frac{2Br}{\mu_0 I} = \frac{2 \times 4 \times 10^{-5} \times 200 \times 10^{-3}}{4 \times 3.14 \times 10^{-7} \times 0.25}$

$\therefore n = 50.9 \approx 51$

23 **(c)**

$\frac{I_g}{I} = \frac{1}{5}$

$\therefore \frac{S}{S + G} = \frac{I_g}{I} = \frac{1}{5}$

$\therefore 5\ S = S + G$

$\therefore 4\ S = 20 \Rightarrow S = 5\ \Omega$

27 **(b)**

The magnetic field is given by $B = \mu_0 ni$

where, $\mu_0 = 4\pi \times 10^{-7}\ T - mA^{-1}$,

$n = \frac{1000}{50 \times 10^{-2}}, i = 5\ A$

$\therefore$ Magnetic field, $B = 4\pi \times 10^{-7} \times \frac{1000}{50 \times 10^{-2}} \times 5$

$= 1.26 \times 10^{-2}\ T$

31 **(d)**

$B_A = \frac{\mu_0}{4\pi} \times \frac{2\pi I}{R}$

$\therefore B_B = \frac{\mu_0}{4\pi} \times \frac{2\pi(2I)}{2R} = \frac{\mu_0}{4\pi} \times \frac{2\pi I}{R}$

$\therefore \frac{B_A}{B_B} = \frac{1}{1}$

32 **(c)**

$I_g = \frac{I \times 10}{100} = \frac{I}{10}$

$\therefore S = \frac{I_g G}{I - I_g}$

$\therefore G = \frac{S(I - I_g)}{I_g} = \frac{S\left(I - \frac{1}{10}I\right)}{\left(\frac{I}{10}\right)} = \frac{S \times \frac{9}{10}I}{\left(\frac{I}{10}\right)}$

$\therefore G = 9\ S = 9 \times 10 = 90\ \Omega$

34 **(a)**

Magnetic force on a charged particle in magnetic field is always perpendicular to the direction of magnetic field. Therefore, work done by the magnetic force on charged particle will be zero. i.e

$W = 0$

According to work-energy theorem, $K_2 - K_1 = W$

$\Rightarrow K_2 - K_1 = 0 \Rightarrow K_1 = K_2$

Hence, kinetic energy of the charged particle does not change.

38 **(c)**

From Ampere's circuital law, $\oint_c \vec{B}.\vec{dl} = \mu_0 I$ where I is the current in the closed path

42 **(c)**

Kinetic energy,

$\frac{1}{2}mv^2 = \frac{q^2B^2R^2}{2m}$

For an α-particle, the charge is two times that of the proton but mass is 4 times that of the proton. Hence compared to kinetic energy of a proton, for the same conditions in the cyclotron, energy of alpha particle is E

43 **(a)**

According to question, force,

$$F = \frac{\mu_0}{4\pi}\cdot\frac{2i_1i_2}{d} = \frac{10^{-7}\times 2\times 10\times 2\times 2}{0.1}$$
$$= 8\times 10^{-5}\ \text{N}$$

45 **(a)**

The current through the galvanometer

$= \frac{3}{2950+50} = 10^{-3}$ A

∴ To reduce the deflection from 30 divisions to 20 divisions, the current required

$= \frac{20}{30}\times 10^{-3} = \frac{2}{3}\times 10^{-3}$ A

∴ The required resistance, $R = \frac{3}{R+50} = \frac{2}{3}\times 10^{-3}$

$\therefore R + 50 = \frac{3\times 3}{2}\times 10^3$

$\therefore R + 50 = 4.5\times 10^3$

$\therefore R = 4500 - 50 = 4450\ \Omega$

48 **(a)**

5 div = 1 mA

∴ 30 div = 6 mA = 6×10^{-3} A,

1 div = 1 mV

∴ 30 div = 30 mV = 30×10^{-3} V

Now, $G = \frac{V}{I_g} = \frac{30\times 10^{-3}}{6\times 10^{-3}} = 5\ \Omega$

Also, since $\frac{S}{S+G} = \frac{I_g}{I}$

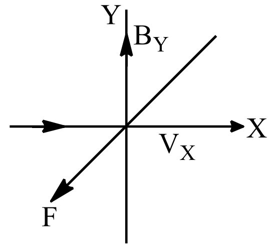
$\therefore \frac{S}{S+5} = \frac{6\times 10^{-3}}{6} = 10^{-3}$

$\therefore S = \frac{5\times 10^{-3}}{1-10^{-3}} = \frac{5\times 10^{-3}}{\left(\frac{1000-1}{1000}\right)} = \frac{5\times 10^{-3}\times 10^3}{999}$

$\therefore S = \frac{5}{999}\Omega$

50 **(d)**

If a particle carrying charge q and moving with velocity v through a point in magnetic field experiences a deflecting force F, then magnetic field B is given by



$F = qv\times B$

Here, $v = v_x\hat{i}$ and $B = B_y\hat{j}$

$\therefore F = ev_xB_y(\hat{i}\times\hat{j}) = ev_xB_y\hat{k}$

Hence, subsequent motion of the charged particle will be a circle in the XY-plane.

51 **(c)**

$I_g = \frac{S}{S+G}.I$

$\therefore 2 = \frac{S}{S+12}\times 5$

$\therefore S = 8\ \Omega$ in parallel

53 **(c)**

It oscillates with the decreasing amplitude as current is passed. Coil oscillates but current is momentary (it is for small time) and current decreases and becomes zero. So, oscillation of the coil is of decreasing amplitude

55 **(b)**

$F = BIl = 2\times 1.2\times 0.5 = 1.2$ N

59 **(b)**

$B = \frac{\tau}{InA} = \frac{5}{5\times 100\times 50\times 10^{-4}} = 2$ T

60 **(b)**

As, $2kx_0 = mg = iLB = \left(\frac{E}{R}\right) - LB$

∴ The magnetic field, $B = \frac{mgR}{EL}$

61 **(a)**

$I_g = \frac{V}{R+G} = \frac{V}{2R+G}$

$\frac{V}{V} = \frac{2R+G}{R+G} = \frac{2(R+G)-G}{R+G}$

$= 2 - \frac{G}{R+a} < 2$

$\Rightarrow V < 2V$

62 **(c)**

The direction of magnetic field produced due to both semi-circular parts will be perpendicular to the paper and inwards.

Also, $B = B_1 + B_2 = \frac{\mu_0 j}{4r_1} + \frac{\mu_0 j}{4r_2} = \frac{\mu_0 j}{4}\left(\frac{r_1+r_2}{r_1r_2}\right)$

63 **(a)**

$$S_i = \frac{d\theta}{dI} = \frac{nAB}{C}$$

$\therefore S_i \propto \frac{1}{C} \Rightarrow$ A has maximum sensitivity

64 **(c)**

$$B \propto \frac{1}{r}$$

$$\therefore \frac{B_1}{B_2} = \frac{r_2}{r_1} = \frac{2r}{r} = 2$$

65 **(b)**

Current produced due to rotation of charged particle is given as

$$i = \frac{q}{t} = \frac{100 \times \theta}{1}$$

$$i = 100e$$

Magnetic field at the centre of circular path

$$= \frac{\mu_0 j}{2r} = \frac{\mu_0 \times 100\theta}{2 \times 0.8}$$

$$= \frac{\mu_0 \times 100 \times 1.6 \times 10^{-19}}{2 \times 0.8} = 10^{-17}\mu_0$$

67 **(a)**

Particles are entering perpendicularly. Hence, they will describe circular path. Since their masses are different, they describe paths of different radii

68 **(c)**

Direction of force on a moving charge in a uniform magnetic field can be found by right hand rule. As we know, the direction of F is the direction of cross product of velocity v and magnetic field B, which is perpendicular to the plane containing v and B.

So, for positive charge, it acts upward and for negative charge, it acts downward, hence figure (c) is correct.

69 **(b)**

Because inside the pipe, $I = 0$

$$\therefore B = \frac{\mu_0 I}{2\pi r} = 0$$

73 **(c)**

$$r = \frac{mv}{Bq} \Rightarrow r \propto v$$

75 **(b)**

B represents the magnetic field

76 **(a)**

$$r = \frac{mv}{qB} \Rightarrow r = \frac{v}{\left(\frac{q}{m}\right)B}$$

$$r = \frac{10^9}{(10^{11})10^{-4}} = 10^2 \text{m}$$

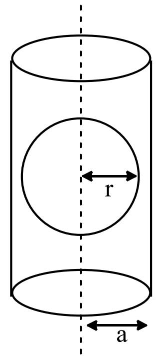
77 **(a)**

$$B = \frac{\mu_0 I}{2\pi r} \Rightarrow B \propto \frac{1}{r}$$

$\therefore$ When r is doubled, B is halved

81 **(c)**

Current density, $J = \frac{i}{\pi a^2}$



From Ampere's circuital law,

$$\oint B \cdot di = \mu \cdot i_{enclosed}$$

For $r < a$,

$$\Rightarrow \text{At } B \times 2\pi r = \mu_0 \times J \times \pi r^2$$

$$B = \frac{\mu_0 i}{\pi a^2} \times \frac{r}{2}$$

$r = a/2$,

$$B_1 = \frac{\mu_0 i}{4\pi a}$$

For

$r > a_1$

$$B \times 2\pi r = \mu_0 j \Rightarrow B = \frac{\mu_0 j}{2\pi r}$$

At $r = 2a$

$$B_2 = \frac{\mu_0^j}{4\pi a}$$

So,

$$\frac{B_1}{B_2} = 1$$

85 **(b)**

As we know that, the magnetic field on the axis of a circular current carrying loop,

$B = \frac{\mu_0 n a^2}{2(r^2+a^2)^{\frac{3}{2}}}$ ....(i)

where, i = current through the coil, a = radius of a circular loop, r = distance of point from the centre along the axis and n = number of turns in the coil.
Area of the coil, $A = \pi a^2$

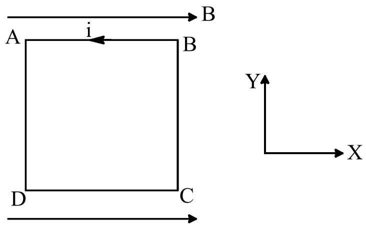
$\Rightarrow a^2 = \frac{A}{\pi}$ ....(ii)

and if r >> a, then $(r^2 + a^2)^{3/2} = r^3$ ....(iii)
From Eqs. (i), (ii) and (iii), we get

$$B = \left(\frac{\mu_0 ni}{2r^3}\right)\frac{A}{\pi} \times \frac{2}{2}$$

$$B = \frac{2\mu_0 niA}{4\pi r^3}$$

86 **(b)**



Deflecting torque due to current.

$\tau_1 = (niA)B = \sin 90° = niL^2B$

Restoring torque, $\tau_2 = Mg\frac{L}{2} \Rightarrow \tau_1 \geq \tau_2$

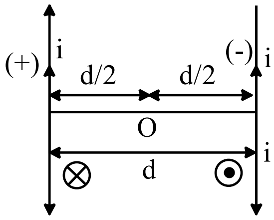
$niL^2B \geq Mg\frac{L}{2} \Rightarrow B \geq \frac{Mg}{2niL}$

$B_{min} = \frac{Mg}{2niL}$

91 **(d)**
The coils are placed perpendicular to each other. The magnetic field due to current through each at the centre is B.
The resultant magnetic field due to current through both the coils will be
$= \sqrt{B^2 + B^2} = \sqrt{2}\,B$
$\therefore$ The ratio $= \frac{\sqrt{2}B}{B} = \frac{\sqrt{2}}{1}$

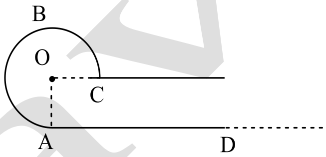
92 **(c)**
Resistance of shunted ammeter $= \frac{GS}{G+S}$
Also, $\frac{I}{I_g} = 1 + \frac{G}{S}$
$\therefore \frac{GS}{G+S} = \frac{I_g.G}{I} = \frac{0.05 \times 120}{10} = 0.6\ \Omega$

100 **(d)**
A charged particle beam is equivalent to a current carrying wire as shown below



Magnetic fields produced by both beam are in opposite direction.
At centre, B = 0
Hence, option (d) represents correct variation of B with d.

103 **(c)**
The angle subtended by the circular part ABC at the centre is $3\pi/2$



Field due to ABC,
$B_1 = \frac{\mu_0}{4\pi}\frac{I}{r}\left(\frac{3\pi}{2}\right)$
Field due to AD at O,
$B_2 = \frac{\mu_0}{2\pi r} \times \frac{1}{2} = \frac{\mu_0 I}{4\pi r}$
... [$\because$ A is at the end of the wire]
$\therefore$ Total induction $= \frac{\mu_0 I}{4\pi r}\left(\frac{3\pi}{2} + 1\right)$

107 **(c)**
Force per unit length, $\frac{F}{l} = \frac{\mu_0}{2\pi}\frac{i_A i_B}{r}$

Given,

$\therefore (0.004) = \frac{2 \times 10^{-7}}{0.01}\left(2i_B^2\right)$

$\therefore i_B = 10$ A

109 **(c)**
The magnetic field in the solenoid along its axis
(i) At an internal point $B_{in} = \mu_0$ ni

$= 4\pi \times 10^{-7} \times 5000 \times 4$

(here, $n = 50$ turn $cm^{-1} = 5000$ turns m^{-2}) =
$25.1 \times 10^{-3} Wbm^{-2}$

(ii) At the end,

$$B_{end} = \frac{1}{2}B_{in} = \frac{\mu_0 ni}{2} = \frac{25.1 \times 10^{-3}}{2}$$

$$= 12.6 \times 10^{-3} Wbm^{-2}$$

111 **(c)**

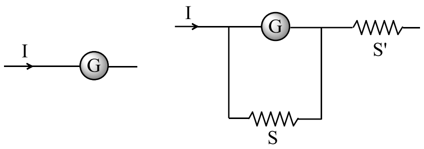
$$S_i = \frac{nAB}{C}$$

Here, $S_i \propto n \Rightarrow \frac{S_1}{S_2} = \frac{n_1}{n_2}$

$$\therefore \frac{S_1}{\left(\frac{125\, S_1}{100}\right)} = \frac{28}{n_2} \Rightarrow \frac{4}{5} = \frac{28}{n_2}$$

$$\therefore n_2 = 35$$

112 **(a)**



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

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

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

113 **(d)**

Torque acting on the coil is given by

$$\tau = NiBA\sin\theta$$

As, magnetic field is normal to plane of coil.

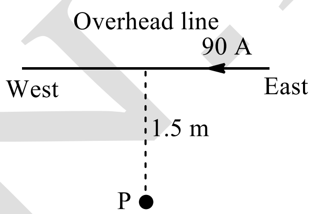
So, $\theta = 0°$

$$\therefore \tau = 0$$

116 **(a)**

Given, $i = 90$ A and $r = 1.5$ m

Here, point P is below the power line, where we have to find the magnetic field and its direction.



The magnitude of magnetic field,

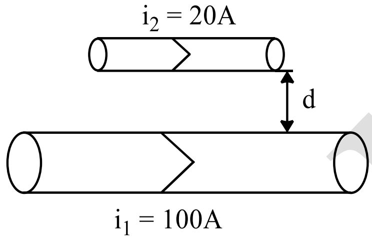
$$B = \frac{\mu_0}{4\pi} \cdot \frac{2i}{r} = \frac{10^{-7} \times 2 \times 90}{1.5} = 1.2 \times 10^{-5}\ T$$

The direction of magnetic field is given by Maxwell's right hand rule. So, the direction of magnetic field at point P due to the flowing current is perpendicularly outward to the plane of paper.

118 **(a)**

In adjoining loops of spring, the current being in the same direction, there will be attraction. Due to which, the spring gets compressed.

119 **(c)**



As we know that, force/length between the two current carrying wire is given by

$$\frac{dF}{dl} = \frac{\mu_0}{2\pi}\frac{i_1 i_2}{d}$$

So, according to question, $\frac{dF}{dl} = 0.04$

So,

$$\Rightarrow 0.04 = \frac{\mu_0}{2\pi}\frac{100 \times 20}{d}$$

$$d = \frac{\mu_0}{2\pi}\frac{100 \times 20}{0.04}$$

So,

$$d = \frac{2 \times 10^{-7} \times 100 \times 20}{0.04}$$

$$= 10^{-2}\ m$$

122 **(d)**

$$S = 12\ \Omega = \frac{G}{n-1}, n = \frac{50}{10} = 5$$

$$\therefore S = \frac{G}{n-1} = \frac{G}{5-1} = \frac{G}{4}$$

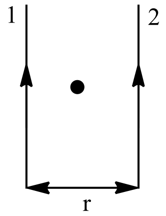
$$\therefore G = 4\,S = 4 \times 12 = 48\ \Omega$$

123 **(d)**

According to the question, $B_1 = \frac{\mu_0 i}{2\pi\left(\frac{r}{2}\right)}$

and $B_2 = \frac{\mu_0 j}{2\pi\left(\frac{r}{2}\right)}$

Since, B_1 and B_2 are equal in magnitude and opposite in direction, hence they cancel to each other.



So, the strength of the magnetic field at any point mid-way between the two wires,

$B_{net} = 0.$

124 **(a)**
Net current due to all wires,

$i_{net} = i_4 + i_2 + i_3 + i_4 + i_5 + i_6$

$i_{net} = 10 - 13 + 10 + 7 - 12 + 18 = 20\ A$

We know that, magnetic field due to an infinitely long straight conductor at a perpendicular distance r from it is given by

$B = \frac{\mu_0 i}{2\pi r} = \frac{\mu_0 i_{net}}{2\pi r}$

where, i = current in wire

and r = perpendicular distance.

$= \frac{4\pi \times 10^{-7} \times 20}{2\pi \times 10 \times 10^{-2}}$

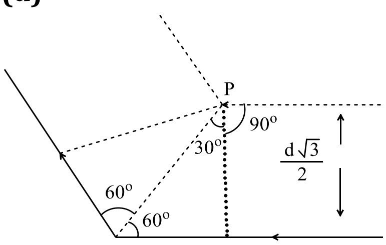
$= 4 \times 10^{-5}$

$B = 40\mu T$

126 **(a)**
$B = \frac{\mu_0}{2\pi}\frac{I}{r}$
$\therefore 5 \times 10^{-5} = \frac{\mu_0}{2\pi} \times \frac{\pi}{r}$
$\therefore r = \frac{\mu_0 \times \pi}{5 \times 10^{-5} \times 2\pi}$
$\therefore r = 10^4 \mu_0$ metre

127 **(b)**
$(R_{eff} = 30||30 = 15\ \Omega = G)$
$\therefore S = \frac{I_g G}{I - I_g} = \frac{I_g(15)}{2I_g - I_g} = 15\ \Omega$ ... $[\because I = 2I_g]$

130 **(d)**



$$B_{net} = 2\left[\frac{\mu_0}{4\pi} \times \frac{I}{\left(\frac{d\sqrt{3}}{2}\right)} \times [1 + \sin 30°]\right]$$

$$= 2\left[\frac{\mu_0}{4\pi} \times \frac{2I}{d\sqrt{3}} \times \frac{3}{2}\right] = \frac{\sqrt{3}\mu_0 I}{2\pi d}$$

131 **(a)**
The magnetic field within the turns of toroid,

$B = \frac{\mu_0 Ni}{2\pi r}$

where, N = number of turns, i = current in loops and r = radius of each turn.

Given, $N_1 = 200, N_2 = 100, r_1 = 40$ cm, $r_2 =$ 20 cm
and current i is same, then

$\frac{B_1}{B_2} = \frac{\mu_0 N_1 i}{2\pi r_1} \times \frac{2\pi r_2}{\mu_0 N_2 i}$

Substituting the given values in the above relation, we get

$\frac{B_1}{B_2} = \left(\frac{N_1}{N_2}\right)\left(\frac{r_2}{r_1}\right)$

$= \left(\frac{200}{100}\right)\left(\frac{20}{40}\right)$

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

$B_1 : B_2 = 1 : 1$

The ratio of their magnetic fields along the two loops is 1: 1.

132 **(d)**
$R_S = \frac{V}{I_g} - G = \frac{10}{0.25 \times 10^{-3}} - 40 = 39960\ \Omega$

133 **(c)**
$\vec{F} = I\vec{l} \times \vec{B}$
$\therefore F = IlB\sin\theta$
$\therefore F = 1.6 \times 0.5 \times 2 \times \sin(90°) = 1.6$ N

134 **(c)**
Using, $B = \frac{\mu_0}{4\pi}.\frac{2\pi nI}{r}$,
$B = 10^{-7} \times \frac{2\pi nI}{r} = 10^{-7} \times \frac{2 \times \pi \times 25 \times 4}{5 \times 10^{-2}}$
$\therefore B = 1.256 \times 10^{-3}$T

140 **(c)**
The magnetic field in the solenoid along its axis (i) at an internal point $= \mu_0 nI$
$= 4\pi \times 10^{-7} \times 5000 \times 4 = 25.1 \times 10^{-3}$ Wb/m^2

(Here, n = 50 turns/cm = 5000 turns/m)

(ii) at one end

$B_{end} = \frac{1}{2}B_{in} = \frac{\mu_0 nI}{2} = \frac{25.1 \times 10^{-3}}{2}$

$= 12.6 \times 10^{-3} Wb/m^2$

143 **(a)**

$B = \frac{\mu_0}{4\pi}\frac{2I}{r} \Rightarrow B \propto \frac{1}{r}$

$\therefore \frac{B_1}{B_2} = \frac{r_2}{r_1} \Rightarrow \frac{10^{-8}}{B_2} = \frac{12}{4} \Rightarrow B_2 = 3.33 \times 10^{-9}$ tesla

144 **(a)**

$r = \frac{\sqrt{2mK}}{qB} \Rightarrow r \propto \sqrt{K}$

$\therefore \frac{R}{R_2} = \sqrt{\frac{K}{2K}} \Rightarrow R_2 = R\sqrt{2}$

147 **(b)**

$R = \frac{V}{I_g} - G$

$\therefore 0 = \frac{V}{3 \times 10^{-3}} - 100$

$\therefore V = 100 \times 3 \times 10^{-3} = 0.3$ V

148 **(c)**

$I = \frac{2aB_H}{\mu_0 n}\tan\theta$

$\therefore n = \frac{2 \times 8 \times 10^{-2} \times 2 \times 10^{-5} \times 1}{4 \times 3.14 \times 10^{-7} \times 0.8} = 3.185$

$\therefore L = 2\pi a\, n = 2 \times 3.14 \times 8 \times 10^{-2} \times 3 \approx 1.6$m

149 **(a)**

$R = \frac{V}{I_g} - G, \frac{V}{I_g} = R + G, I_g = \frac{V}{R+G}$

151 **(b)**

$I_g = 10\%$ of $I = \frac{I}{10}$

$\therefore S = \frac{G}{(n-1)} = \frac{90}{(10-1)} = 10\ \Omega$ in parallel

154 **(a)**

Magnetic field at the centreof coil b $= \frac{\mu_0 i}{2\pi}$

N=1 and $2\pi R$ L⇒$R = \frac{l}{2\pi}$

$B = \frac{\mu_0 I 2\pi}{2L} = \frac{\Pi\mu_0 I}{L}$

155 **(b)**

$K.E = \frac{q^2B^2R^2}{2m}$

$= \frac{(1.6 \times 10^{-19})^2 \times (0.5)^2 \times (4 \times 10^{-1})^2}{2 \times 1.67 \times 10^{-27}}$

$= \frac{(1.6)^2 \times 10^{-38} \times 25 \times 10^{-2} \times 16 \times 10^{-2}}{2 \times 1.67 \times 10^{-27}}$

$= \frac{1024 \times 10^{-42}}{3.34 \times 10^{-27}} = 306.58 \times 10^{-15}$

$= 3.06 \times 10^{-13} J = \frac{3.06 \times 10^{-13}}{1.6 \times 10^{-19}}$ eV

$= 1.9 \times 10^6$ eV

= 1.9 MeV

156 **(b)**

$r = \frac{mv}{qB} = \frac{\sqrt{2Em}}{qB}$

157 **(b)**

$\frac{I_g}{I} = \frac{1}{34} = \frac{S}{S + 3663}$

$\therefore S = \frac{3663}{33} = 111\ \Omega$

158 **(a)**

Let the magnetic field, $B = B_1\hat{i} + B_2\hat{j} + B_3\hat{k}$

Applying $F_m = q(v \times B)$ two times, we have

$q(-\hat{j} + \hat{k}) = q[(\hat{i}) \times (B_1\hat{i} + B_2\hat{j} + B_3\hat{k})]$

$= q[B_2\hat{k} - B_3\hat{j}]$

On comparing two sides, we get

$B_2 = 1$ and $B_3 = 1$

Further, $q(\hat{i} - \hat{k}) = q[(\hat{j}) \times (B_1\hat{i} + B_2\hat{j} + B_3\hat{k})] = q(-B_1\hat{k} + B_3\hat{i})$

Again comparing, we get

$B_1 = 1$ and $B_3 = 1$

$B = (\hat{i} + \hat{j} + \hat{k}) Wb/m^2$

159 **(c)**

$I_g = 10 \times 10^{-6}$A

Using, $S = \frac{I_g}{I - I_g}G = \frac{10 \times 10^{-6} \times 1000}{1 - 10 \times 10^{-6}} \approx 10^{-2}\Omega$

$= 0.01\ \Omega$

$\therefore S = 0.01\ \Omega$ is parallel

160 **(a)**

$I_g = \frac{V}{R} = \frac{3}{200} = 15$ mA

In (A), 10 mA < 15 mA ⇒ $I < I_g$

$\therefore I \neq 10$ mA

164 **(a)**

$F = BIl\sin\theta$

$\therefore \sin\theta = \frac{F}{BIl} = \frac{15}{2 \times 10 \times 1.5} = \frac{1}{2}$

$\therefore \theta = 30°$

165 **(b)**

10 div = 1 mA and 2 div = 1 mV

∴ 150 div = 15 mA and 150 div = 75 mV

$\therefore R_o = G = \frac{V}{I} = \frac{75}{15} = 5\ \Omega$

$\therefore \frac{S}{S+G} = \frac{I_g}{I}$

$\therefore \frac{S}{S+5} = \frac{15 \times 10^{-3}}{6} = \frac{5 \times 10^{-3}}{2}$

$\therefore 2S = 5 \times 10^{-3}S + 25 \times 10^{-3}$

$\therefore S = 0.0125\ \Omega$

166 **(d)**

$B = \frac{\mu_0 I}{2r}$

$I = \frac{q}{t} = e \times n$

$B = \frac{\mu_0 e \times n}{2r}$

167 **(a)**

$I = \frac{V}{R} = \frac{2}{20\ k\Omega} = 0.1\ mA = 100\ \mu A$

$\therefore$ Sensitivity, $S = \frac{d\theta}{dI} = \frac{50}{100} = \frac{1}{2}$ div/μA

168 **(b)**

$I = \frac{q}{t} = 100 \times e$

$B_{centre} = \frac{\mu_0}{4\pi}\frac{2\pi I}{r} = \frac{\mu_0}{4\pi}\frac{2\pi \times 100e}{r}$

$= \frac{\mu_0 \times 200 \times 1.6 \times 10^{-19}}{4 \times 0.8} = 10^{-17}\mu_0$

170 **(b)**

Current sensitivity (S)

$= \frac{d\theta}{dI} = \frac{1}{K} = \frac{nAB}{C}$

$\therefore S \propto n$

$\therefore \frac{S'}{S} = \frac{n'}{n}$

$\therefore n' = \frac{125}{100} \times 28 = 35$

172 **(b)**

When a point charge q is moving with velocity v and located at r at a given time t in presence of both the electric field E(r) and the magnetic field B(r), then it experiences a force called Lorentz force and given by

$F = F_{electric} + F_{magnetic}$

$F = q[E(r) + v \times B(r)]$

174 **(b)**

Using, $B = \frac{\mu_0}{4\pi}\frac{2I}{r}$,

$B = 10^{-7} \times \frac{2I}{r} = 10^{-7} \times \frac{2 \times 2}{5} = 8 \times 10^{-8}T$

175 **(c)**

Magnetic field at the centre of circular coil of N turns is given by

$B = \frac{\mu_0 Ni}{2r} = \frac{4\pi \times 10^{-7} \times 100 \times 0.1}{2 \times 5 \times 10^{-2}}$

$= 4\pi \times 10^{-5}$ T

179 **(b)**

$K = \frac{2rB_H}{\mu_0 n}$

as t.g move from equator to pole BH goes on decreasing so k will decrease.

180 **(c)**

If the plane of magnetic field and the coil are horizontal and vertical respectively then θ= 0. Thus, the torque on the coil is given by, τ_n = nIAB cos θ = nIAB cos 0 = nIAB

181 **(c)**

The force on a charge q due to electric field,

$F_E = qE$

and due to magnetic field,

$F_B = q(v \times B)$

When charge particle moves in combined field, then resultant force, $F = F_E + F_B = qE + q(v \times B)$

183 **(b)**

$S = \frac{nBA}{C}$

$S \propto n$

185 **(b)**

At the centre of coil-1,

$B_1 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_1}{r_1}$ ....(i)

At the centre of coil-2,

$B_2 = \frac{\mu_0}{4\pi} \times \frac{2\pi i_2}{r_2}$ ....(ii)

But

$\frac{\mu_0}{4\pi}\frac{2\pi i_1}{r_1} = \frac{\mu_0}{4\pi}\frac{2\pi i_2}{r_2}$ or $\frac{i_1}{r_1} = \frac{i_2}{r_2}$

We know that, V = iR

where, R = resistance.

Also, R ∝ 1

∴ V ∝ il

Here, I = 2πr

∴ V ∝ ir

Now, ratio of potential differences,

$$\frac{V_2}{V_1} = \frac{i_2 \times r_2}{i_1 \times r_1} = \frac{i_2 \times r_2}{2i_2 \times 2r_2} = \frac{1}{4}$$

$$\Rightarrow \frac{V_1}{V_2} = \frac{4}{1}$$

190 **(b)**

Applying Ampere's law, $\oint B.dl = \mu_0 i$, to any closed path inside the pipe, we find no current is enclosed. Hence, $B = 0$

197 **(a)**

From Lorentz force,

$$F = q(v \times B)$$

Given, $F = (4\hat{j} + 3\hat{j}) \times 10^{-10}$ N,

$$q = 10^{-9}C$$

and $B = 4 \times 10^{-3}\hat{k}T$

$$\therefore (4\hat{i} + 3\hat{j}) \times 10^{-10} = 10^{-9}(a\hat{i} + b\hat{j}) \times (4 \times 10^{-3}\hat{k})$$

Solving, we get

$$\Rightarrow a = -75, b = 100$$

$$v = -75\hat{i} + 100\hat{j}$$

199 **(a)**

Given, velocity of proton, $v = 2\hat{i}$

Magnetic field, $B = (\hat{i} + 3\hat{j} + 4\hat{k})\mu T$

Electric field, $E = 10\hat{i}\mu V/m$

Charge on proton, $q = 16 \times 10^{-19}C$

Applied Lorentz force on the proton,

$$F = qE + q(v \times B) = q[E + (v \times B)]$$

$$= 16 \times 10^{-19}\left[10 \times 10^{-6}\hat{i} + 2\hat{i} \times (\hat{i} + 3\hat{j} + 4\hat{k}) \times 10^{-6}\right]$$

$$= 1.6 \times 10^{-19} \times 10^{-6}\left[10\hat{i} + 6\hat{k} - 8\hat{j}\right]$$

$$F = 1.6 \times 10^{-25}\left[10\hat{i} - 8\hat{j} + 6\hat{k}\right]N$$

$$|F| = 1.6 \times 10^{-25} \times \sqrt{(10)^2 + (-8)^2 + (6)^2}$$

$$= 1.6 \times 10^{-25} \times 14.14 = 22.6 \times 10^{-25} \text{ N}$$

200 **(b)**

In radial magnetic field, plane of the coil is always parallel to magnetic induction.

$\therefore \theta = 0$

Thus $\tau_n = nIAB \cos\theta = nIAB \cos 0$

$= nIAB(\text{maximum})$