PHYSICS

BOOKS - BINA LIBRARY PHYSICS (ASSAMESE ENGLISH)

ELECTROMAGNETISM

Example

1. An electron circulates round the nucleus in a path of radius $(5.1x10^{-11})$ m at a frequency of $(6.8x10^{15})$ Hz. Calculate the magnetic field at the centre of the path.

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2. Calculate the magnetic field due to a circular coil of 100 turns, radius 30 cm, carrying a current of 10 A, (i) at the centre and (ii) at a point 40 cm

away from the centre on its axis.

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3. What will be the magnetic field at a point on the axis of a long solenoid containing 10 turns per cm length, when a current of 1 ampere flows through it ?

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4. A charged particle of mass m and charge q moving with velocity $[v = 3i + 4j - 2k]entersamag \neq ticfield[B = 2i - 5j + 3k]atright\angle s \rightarrow$ bar(B)`. Find the expression of the force experienced by the particle.

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5. A proton enters a uniform magnetic field of intensity 1.5 T in a direction perpendicular to the field. If the K.E. of the proton is $\left(8.5x10^{-25}J\right)$, find

the force acting on it.

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6. A $\left[He^{2+}\right]$ ion travels a velocity of 10^5 m/s at right angles to a magnetic field of 0.80 T. What is the magnitude of the magnetic force on the ion ?

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7. A long straight wire carries a current of 10 ampere. An electron travels with a velocity of 5.0x10 ms parallel to the wire at 0.1 m from it and in a direction opposite to the current. What force is exerted on the electron ?.

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8. An electron enters a magnetic field of 1G with a speed $\left[2x10^{6}ms^{-1}\right]$ in a perpendicular direction. Calculate its (i) radius of path and (ii) frequency

of revolution.

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9. An electron having mass (9.1 x 10 ^−31 kg) and charge (1.6 x 10 ^−19 C) moves in a circular path of radius 0.5 m with a velocity 10 6 m/s in a magnetic fied. Strength of magnetic filed is

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10. Two particles-one of mass m1, and the other of mass m2, carry equal charges. After being accelerated through the same potential difference they enter a region of uniform magnetic field and describe circular paths of radius (r_1), and (r_2), respectively. Find the ratio of their masses.

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11. A charged particle enters a magnetic field with a velocity v in a direction perpendicular to the field. Find an expression for the radius of the circular path of the particle.

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12. What prevents us from slipping every time we take a step forward?

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13. A proton moving with velocity $\left(10^7\right)$ m/s to enters a magnetic field of 1.5 T making an angle 30^o with the direction of the field. Find the radius of the helical path and its frequency of rotational motion

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14. In a cyclotron, magnetic field of 1.4Wb/m^2 is used. To accelerate protons, how rapidly should the electric field between the Dees be reversed?

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15. Two straight parallel wires, each 20 cm long are separated by 10 cm. They carry 20 amp and 30 amp of current respectively. Calculate the force between them.

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16. Two straight wires A and B of lengths 10 m cach carrying currents of 4.0 A and 6.0 A in opposite directions lic parallel to each other at a distance of 2 cm. Estimate the force on a 10 cm section of the wire B near its centre.

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17. Two straight parallel wires A and B, cach 20 cm long are separated by 10 cm. They carry 20 A and 30 A current respectively in opposite directions. Calculate the magnetic field (i) the mid point

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18. Two straight parallel wires A and B, cach 20 cm long are separated by 10 cm. They carry 20 A and 30 A current respectively in opposite directions. Calculate the magnetic field at (ii) the point 5 cm from A and 15 cm from B on the line joining them.

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19. A galvanometer having a resistance of 50Ω gives a full scale deflection for a current of 0.05 A. The length in meter of a resistance wire of area of cross section 3×10^−3 cm^2 that can be used to convert the galvanometer into an ammeter which can read a maximum of 5A current is [specific resistance of the wire =5×10^−7 Ωm]

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20. A galvanometer gives full scale deflection with 0.2 mA. The resistance of its coil is 1000 ohms. How much shunt resistance is required to converted into an ammeter to measure currents upto a 2 amperers?

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21. A galvanometer has an internal resistance of 1.0 ohm. It gives maximum deflection for current of 50 mA. Show how it can be converted into (i) a voltmeter with a maximum reading a of 2.5 volts, (ii) an ammeter with a maximum reading of 2.5 A.

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22. What is the cause of friction?

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23. How will you convert galvanometer which needs 50 mA for full scale deflection into a voltmeter reading upto 2.5 volts ? The resistance of the galvanometer is 10 ohms.

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24. A circular coil of 300 turns and diameter 14 cm carries a current of 15A. What is the magnetic moment of the loop?

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25. A short bar magnet of magnetic moment 0.4JT^-1 is placed in a uniform magnetic field of 0.16 T. The magnet is in stable equilibrium when the potential energy is

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26. Calculate the work done in rotating a magnet of pole strength $\left[10^{-2}\right]$ Ampere-m and magnetic length 10 cm through an angle of 60° from its position along the magnetic, meridian. (B = 200T)

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27. The dip at a place is $\left(30^{0}\right)$ and If the vertical component of earth's magnetic field at that point is 7.5×10^−5 T. then what will be the total magnetic field of earth at that point.

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28. Horizontal component of earth's magnetic field at a place is √ 3 times the vertical component. What is the value of inclination at that place?

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Exercise

1. What is the direction of force of friction acting on a moving object?

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2. When does static friction come into play ?

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3. What is meant by air resistance ?

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4. Define SI unit of magnetic flux density.

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5. What are dimensions of tesla?

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6. Write down the Biot-Savart's Law in vector form.

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7. State Ampere's circuital law.

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8. What is one ampere current?

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9. Write the expresion for Lorentz force acting on a charged particle.

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10. Why is it possible to write on rough blackboard with chalk ?

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11. Why is it difficult to walk on ice ?

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12. Define the term magnetic moment.

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13. What is magnetic moment of a current loop?

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14. A magnetic dipole is placed in a uniform magnetic fields, B, when the potential energy is minimum

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15. Define dip at a place.

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16. What is magnetic susceptibility?

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17. What is Curie's law?

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18. What is Curie temperature of a ferromagnetic material? Give one example of a ferromagnetic material.

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19. Name one ferromagnetic substance,

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20. What are dimensions of μ_0

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21. Name one paramagnetic substance.

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22. What is magnetic hysteresis?

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23. State two factors on which the sensitivity of a moving coil galvanometer depends.

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24. What is voltage sensitivity of a galvanometer?

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25. Can we have surfaces with zero friction ?

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26. Find an expression for the magnetic field at a point on the axis of a circular current loop.

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27. A ball is set rolling on the ground. Will it stop by itself ? Why ?

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28. A charged particle enters a magnetic field with a velocity v in a direction perpendicular to the field. Find an expression for the radius of the circular path of the particle.

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29. Find an expression for the magnetic field at a point on the axis of a circular current loop.

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30. Give three factors on which the frictional force in fluids depends.

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31. Give three harmful effects of friction.

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32. Why is friction essential ?

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33. Why is a voltmeter connected in parallel with a circuit?

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34. Why an ammeter should have as low resistance as possible?

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35. Why should a voltmeter have as large resistance as possible?

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36. Find the following expression for the magnetic moment of an electron moving in a circular path

$\mu_c = \frac{c}{2m_c}1$

Wherel is the angular momentum of the electron about the nucleus, e and m_c are its charge and mass.

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37. What is voltmeter? How galvanometer converted to a voltmeter?

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38. A rectangular coil carrying current is placed in a uniform magnetic field in such a way that normal to the coil makes an angle θ with the direction of magnetic flux density. Find the magnitude of torque acting on the coil Define magnetic moment of a current loop.

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39. Find an expression for the magnetic field at a point on the axis of a circular current loop.

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40. Friction opposes the _____ between the surfaces in contact with each other.

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41. Friction depends on the _____ of surfaces.

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42. Find the magnetic field due to a short bar magnet at any point on axial line.

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43. Friction produces _____

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44. A magnetic dipole is placed in a uniform magnetic fields, B, when the potential energy is minimum

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45. Name three elements required to specify the earth's magnetic field at a given place.

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46. The sprinkling of powder on the carrom board _____ friction

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47. Sliding friction is _____ than the static friction

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48. What is meant by hysteresis loop? What type of magnetic material is used in making permanent magnets?

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49. How can a magnetic field be produced without using a magnet?

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50. Is the source of magnetic field analogue to the source of electric field ?

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51. How does a current carrying wire differ from a wire without carrying current?

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52. Explain why sportsmen use shoes with spikes.

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53. Write three disadvantages of friction.

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54. How does the magnetic field at the centre of a current carrying circular coil change, when current is doubled and its radius is halved?

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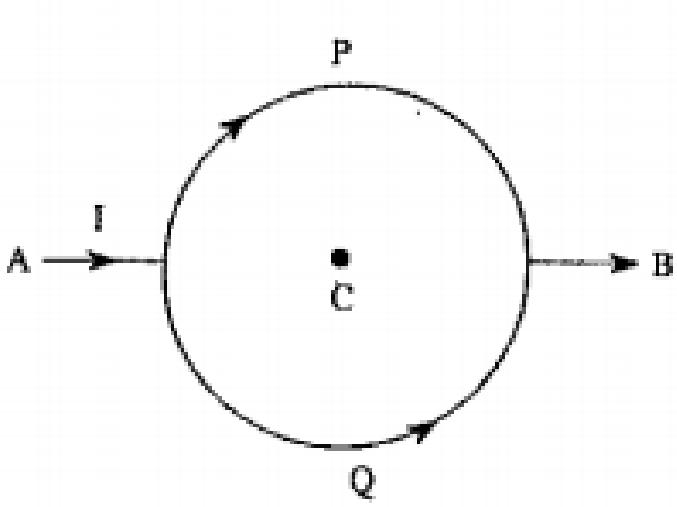
55. What is the magnetic field at the centre C of the circular loop shown in Fig.?



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56. Does a magnetic field exert a force on a static charge?

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57. When a charged particle moves in a magnetci field does the kinetic energy always remains constant?

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58. Explain why earth's magnetic field does not affect the working of a moving coil galvano meter.

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59. Explain why two parallel wires carrying currents in opposite directions repel each other.

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60. If two parallel conducting wires carry current in the same direction, then they

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61. Why an ammeter has low resistance while a voltmeter has high resistance?

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62. Why is a voltmeter connected in parallel with a circuit?

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63. Can a magnetic field increase the K.E. of a charged particle moving through it?

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64. By mistake, a voltmeter is connected in series and an ammeter In parallel with a resistance in a circuit, What will happen to the instrument?

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65. Under what condition does an electron moving through a magnetic field experience maximum force?

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66. A magnetic needle is placed on a cork floating on a lake in the northern hemisphere. Does this needle together with the cork move

towards the north of the lake?

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67. A diamagnetic substance is placed in the middle between two magnetic poles. If allowed to rotate, explain why the specimen comes to rest with its axis perpendicular to the field.

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68. A small magnet is pivoted to move freely in the magnetic meridian. At what place on the carth will the magnet be vertical?

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69. If a bar magnet is cut into two equal parts along the magnetic axis, then the magnetic moment becomes ?

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70. Explain why an unmagnetised piece of iron is attracted by a bar magnet.

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71. Why should the material used for making permanent magnet have high coercivity?

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72. "A soft iron core in solenoid acts as an electromagnet". Explain.

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73. An infinitely long straight current carrying wire produces a magnetic field B at a point at a distance 'a' from it. What must be the radius of the

circular loop, so that for the same current through it the magnetic field at (i) its dentre equals B/2

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74. An infinitely long straight current carrying wire produces a magnetic field B at a point at a distance 'a' from it. What must be the radius of the circular loop, so that for the same current through it the magnetic field at (II) an axial point, distant equal to the radius of the loop equals B?

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75. Find the force between two straight parallel wires, each of length one metre and cach carrying a current of 100 amperes when separated by a distance of one metre $\left(given\mu_0 = 4\pi x10^{-7}\frac{N}{m}\right)$.

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76. In a chamber , a uniform magnetic field of 6.5G(1G=10^−4T) is maintained. An electron is shot into the field with a speed of 4.8×10^6m/s normal to the field. Determine the radius of the circular orbit.

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77. A proton enters a uniform magnetic field of intensity 1.5 T in a direction perpendicular to the field. If the K.E. of the proton is $\left(8.5x10^{-25}J\right)$, find the force acting on it.

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78. A proton enters a magnetic field of flux density 1.5Wb/m^2 with a speed of 2×10^7 m/s at angle of 30^o with the field. Find the force on the proton .

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79. A coil of 200 turns has a cross-sectional area 900 mm It carries a current of 2 ampere. The plane of the coil is perpendicular to the uniform magnetic field of 0.5T. Calculate : magnetic moment

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80. A coil of 200 turns has a cross-sectional area 900 mm It carries a current of 2 ampere. The plane of the coil is perpendicular to the uniform magnetic field of 0.5T. Calculate : torque acting on the coil

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81. A galvanometer having a coil resistance 120Ω shows full scale deflection for a current of 2.5 mA. How would you convert it into an ammeter of range 0 to 75A?

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82. A dipole of magnetic moment $\left(2.5Am^2\right)$ is deflected through 30^o from magnetic meridian. If the earth's horizontal field is $\left(0.4x10^{-4}\right)$ I calculate the deflection moment.

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83. A freely suspended magnet of moment $\left(0.98Am^2\right)$ is deflected through '60^0' by a couple. Calculate the magnitude of the couple if the earth's horizontal field is 0.4x10^(-4) T.

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84. Find the value of the vertical component and resultant intensity of the earth's magnetic field at a place where H is 0.2 G and angle of dip is 60^o.

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85. An electron is revolving along a circular path of radius 1 À with a frequency $\left(10^{15}\right)$ Hz. What is the associated magnetic moment?

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86. A moving coil galvanometer has resistance 50Ω. The maximum bearable current is 100mA. How will you convert it into (i) a voltmeter to record 100V p.d.? and (ii) an ammeter to measure 5A current?

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87. A proton enters a magnetic field of flux density 1.5Wb/m^2 with a speed of 2×10^7 m/s at angle of 30^o with the field. Find the force on the proton .

A. $\left[2.4 \cdot 10^{-12}\right]$ N

B. $\left[0.24 \cdot 10^{-12}\right]$ N

C. $\left[0.24 \cdot 10^{-12}\right]$ N

D. $\left[24 \cdot 10^{-12}\right]$ N

Answer: A

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88. An electron and a proton enter a magnetic field perpendicularly. Both have same K.E. Which of the following is true?

A. Both move on straight path

B. Both trajectories are equally curved

C. The trajectory of the electron is less curved

D. The trajectory of the proton is less curved.

Answer: D

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89. The earth's magnetic induction at a certain point is $\left[7x10^{-5}Wbm^{-2}\right]$. This is to be annulled by the magnetic induction at the centre of a circular conducting loop of radius 15 cm. The required current in the loop is

A. 0.56 A

B. 5.6 A

C. 0.28A

D. 2.8A

Answer: B

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90. Two concentric circular coils of 10 turns cach are situated in the same plane. Their radii are 20 cm and 40 cm and they carry respectively 0.2A and 0.3A current in oponite direction. The magnetic field io tesla at the centre is

A. $\left[\left(\frac{35}{4}\right)\mu_0\right]$

B. $\left(\frac{\mu_0}{80}\right)$

C. $\left[\left(\frac{7}{80}\right)\mu_0\right]$

D. $\left[\left(\frac{5}{4}\right)\mu_0\right]$

Answer: D

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91. A long copper tube of inner radius R carries a current I. The magnetie field B inside the tube is

A. $\left[\left(\frac{\mu_0}{2}\pi R\right)I\right]$

B. $\left[\left(\frac{\mu_0}{4}\pi R\right)I\right]$

C. $\left[\left(\frac{\mu_0}{2}R\right)I\right]$

D. zero

Answer: D

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92. Two long parallel wires carry equal current I in the same direction. The length of each wire is I and the distance between them is a. Force acting on cach wire is

A. $\left[\mu_0 \frac{l}{2\pi a} I^2\right]$

B. $\left[\mu_0 l \frac{L}{2\pi a^2}\right]$

C. $\left[\mu_0 l^2 \frac{I^3}{4\pi a^2}\right]$

D. $\left[\mu_0 I \frac{L^2}{4} \pi a^2\right]$

Answer: A

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93. In order to increase the sensitivity of a moving coil galvanometer one should decrease

A. strength of the magnet

B. torsional constant of suspension

C. the number of tums of coil

D. area of the coil.

Answer: B

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94. A galvanometer has a resistance of 25Ω and a maximum of 0.01A current can be passed through it. In order to change it, into an ammeter of range 10A, the shunt resistance required is

A. $5/999\ \Omega$

B. $10/999\ \Omega$

C. $15/999\ \Omega$

D. $25/999\ \Omega$

Answer: D

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95. A voltmeter of resistance $\left(2x10^4\Omega\right)$ reads 5V. To make it read 20V, the extra resistance required is

A. $\left[4x10^4\Omega\right]$ in parallel

B. $\left[6x10^4\Omega\right]$ in parallel

C. $\left[4x10^4\Omega\right]$ in series

D. $\left[6x10^4\Omega\right]$ in series

Answer: A

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96. A galvanometer of resistance 20Ω is to be converted into an ammeter of range 1A . If a current of 1 mA produces full scale deflection, the shunt

required for this purpose is

A. 0.01 (Ω)

B. 0.05 (Ω)

C. 0.02 (Ω)

D. 0.04 (Ω)

Answer: C

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97. Two long parallel wires carry equal current I in the same direction. The length of each wire is I and the distance between them is a. Force acting on cach wire is

A. attract one another

B. repel one another

C. get rotated, to be perpendicular to each other

D. do not exert any forces on one another.

Answer: A

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98. An electric charge moves with a constant velocity v parallel to the lines of force of a uniform magnetic field H, the force experienced by the charge is

A. evH

B. e/Hv

C. ev/H

D. zero.

Answer: D

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99. When a magnetic field is applied on an electron moving with uniform velocity it is deflected in a direction

A. at right angles to the field

B. at 45° to the field

C. at right angles to both v and B.

D. none of the above

Answer: C

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100. A stationary electron placed in a magnetic field experiences a mechanical push equal to

A. cvB

B. zero

C. IvB

D. none of these

Answer: B

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101. The force acting on an electron at rest in a uniform magnetic field B will

A. compel the electron to move in the direction of B

B. compel the electron to move in a direction perpendicular to B

C. make the electron move in a circular path

D. be zero.

Answer: D

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102. A conducting circular loop of radius r carries a current I. It is placed in a uniform magnetle field B such that B is perpendicular to the plane of the loop, The magnetic force acting on the loop is given by

A. IrB

B. $[2\pi IrB]$

C. 0

D. $[\pi IrB]$

Answer: C

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103. Earth's magnetic field always has a horizontal component except at

A. the equator

B. a magnetic pole

C. a latitude of 60°N

D. a longitude of 60^{o} E

Answer: B

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104. Distinguish among paramagnetic , ferromagnetic and diamagnetic materials qualitatively.

A. diamagnetic substances are repelled by magnets

B. diamagnetic substances are feebly attracted by a magnet

C. they settle with long axis normal to the magnetic field

D. both (a) and (c) above.

Answer: D

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105. Demagnetisation of magnets is effected by

A. rough handling

B. heating

C. magnetising in the opposite direction

D. all the above.

Answer: D

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