PHYSICS

BOOKS - JEEVITH PUBLICATIONS PHYSICS (KANNADA ENGLISH)

MOVING CHARGES AND MAGNETISM

One Mark Questions With Answers

1. Name the physicist who in his experiment concluded that moving charges or currents

produce magnetic fields in the surrounding space.

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2. What is the source of magnetic field?

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3. Write the expression for magnetic field at the centre of a current carrying circular coil.

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4. At which point around a current carrying circular conductor, the magnetic flux density remains maximum?

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5. Write the expression for magnetic flux at one end of a long solenoid carrying current.

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6. Give the expression for magnetic flux density at a point due to an infinitely long conductor perpendicular to it.

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7. Give the expression for magnetic flux density at a point at one end of an infinitely long conductor.

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8. Write the expression for the magnetic field at a point due to a current element.

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9. Give Biot - Savart formula in vector form.

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10. Write the expression for magnetic field at the centre of a current carrying circular coil.

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11. Give the expression for magnetic flux density, at a point on the axis, due to a current carrying circular conductor.

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12. What is magnetic flux density?

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13. State Maxwell's right handed cork screw rule to find the direction of magnetic field around a current carrying conductor.

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14. Define SI unit of magnetic flux density.

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15. What is the action of a magnetic field on a current carrying conductor?

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16. Write the expression for the force on a current carrying conductor placed in a magnetic field.

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17. When is the force on a current carrying conductor (a) maximum (b) minimum?

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18. Which rule is used to determine the force on a current carrying conductor placed in a magnetic field?

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19. State Fleming's left hand rule or motor rule.

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20. Write the equation for the force between the two parallel straight wires and give the meaning of the symbols used.

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21. Define ampere.

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22. What is the nature of force between two parallel wires carrying current in opposite directions?

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23. What is the nature of force between two parallel wires carrying current in same direction?

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24. What is the principle of an electric motor?

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25. Name any one use of a moving coil galvanometer.

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26. Which instrument can be used for the measurement of current of the order of 10^{-6} A?

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27. What is the torsional couple due to?

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28. Define current sensitivity of a moving coil galvanometer.

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29. How is galvanometer converted into an ammeter?

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30. What is the resistance of an ideal ammeter?

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31. Why is an ammeter always connected in series?

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32. Why is a voltmeter always connected in parallel?

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33. What is the resistance of an ideal voltmeter?

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34. What is a shunt?

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35. How is a galvanometer converted into a voltmeter?

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36. State the priniciple of superposition of magnetic field.

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37. Mention the order of magnetic flux density on the surface of a neutron star.

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38. Represent graphically the directions of $\vec{v}$, $\vec{B}$ and $\vec{F}$ on a moving charge q.

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39. Give the expression for the electric force on a moving charge in an uniform electric

field.

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40. Give the expression for the magnetic force on a moving charge in an uniform magnetic field. What will be the maximum magnetic force on the moving charge?

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41. An electron is accelerated in the direction of the electric filed. What will happen to its acceleration over a period of time?

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42. Give the expression for the centripetal force experienced by a moving charge entering into a uniform magnetic field.

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43. Mention the direction of velocity of a charged particle with respect to the magnetic force experienced by it.

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44. If the magnitude of electric force and magnetic force are equal and if v of a charged particle is perpendicular to both $\vec{E}$ and $\vec{B}$, then find the net force on the charge.

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45. What is meant by velocity selector?

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46. What is a cyclotron?

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47. Who invented the cyclotron?

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48. Give the expression for cyclotron frequency.

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49. Give the expression for velocity of a charged particle in a cyclotron.

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50. Write any one application of the cyclotron.

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51. Name any one magnetic system.

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52. What is a toroid?

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53. Give the expression for magnetic field due to a toroid.

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54. What is the value of magnetic field at any point in the open space inside a toroid?

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55. Define the term gyromagnetic ratio.

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56. Define the term gyromagnetic ratio.

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57. Give the expression for Bohr magneton.

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58. Write the value of the magnetic moment of an electron related to orbital motion of an electron and spin motion of an electron .

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59. Does an electron spin about an axis of rotation?

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60. What is meant by spin magnetic moment?

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61. Define current sensitivity of a moving coil galvanometer.

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62. How does current sensitivity of a MCG depend on couple per unit twist of the wire?

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63. How is current sensitivity of a MCG related to the magnetic flux density surrounding the coil?

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64. IF the current sensitvity gets doubled then what happens to the voltage sensitivity of the MCG?

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65. Define voltage sensitivity of a MCG.

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66. Write the expression for nuclear magnetic moment.

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67. Give the expression for figure of merit or current sensitiveness of a galvanometer.

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68. Give the expression voltage sensitiveness of a galvanometer.

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Two Marks Questions With Answers

1. State the Right-hand clasp rule.

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2. What is meant by 'magnetic dipole moment' of current loop? Write its SI unit.

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3. Compare the ratio of magnetic field produced at the centre of a circular conductor

and a point on the axis of a conductor.

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4. Explain the mechanical effect produced by an electric current.

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5. Give any two differences between an ammeter and a voltmeter.

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6. What is the nature of force between two parallel wires carrying current in same direction?

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7. Why should the effective resistance of an ideal ammeter be zero and that of a voltmeter, be infinity?

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8. Write the expression for the torque on a current loop placed in a uniform magnetic field and explain the terms used.

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9. Write the expression for the magnetic field at a point on the axis of a long solenoid carrying current and give the meaning of the symbols used.

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10. Give the expression for Lorentz force acting on a moving electric charge in a combined electric and magnetic field.

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11. An electron in an electric field is made static and prevented from falling under gravity. Write the equation satisfying the above condition.

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12. What is the cause for the helical motion of a charged particle in a magnetic field?

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13. What is meant by the pitch of a charged particle describe a helical path?

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14. Give the direction of current passing through an open surface.

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15. State Ampere's circuital law and represent it mathematically.

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16. Write the equation for the force between the two parallel straight wires and give the

meaning of the symbols used.

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17. Give the direction of the magnetic field due to a current carrying circular conductor.

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18. Can a current carrying circular loop act as a magnetic dipole? Give the expression for the

magnetic field at a point, due to a current carrying circular loop.

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19. Give an analogy for the torques experienced by an electric dipole and a magnetic dipole.

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20. Write the expression for the magnetic moment due to an electron circulating around the nucleus of an atom.

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21. Represent the magnetic moment vector in terms of angular momentum vector of electrons revolving around the nucleus.

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Three Marks Questions With Answers

1. If 'P' is the middle point on the axis of a solenoid then derive the expression for magnetic field at that point.

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2. What are the factors which determine the force on a current carrying condcuctor in a magnetic field?

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3. A galvanometer has a resistance G and requires a current I_g for full scale deflection. How do you convert it into (i) an ammeter? (ii) a voltmeter?

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4. Describe an experiment conducted by Oersted to demonstrate that magnetic field is produced by electric current.

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Five Marks Questions With Answers

1. Obtain an expression for the magnetic force on a current carrying conductor.

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2. Obtain expression for the radius of the circular path and its frequency, of a charged

particle entering into an uniform magnetic field.

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3. Describe the motion of a charged particle in a combined electric and magnetic field.

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4. Obtain an expression for the magnetic dipole moment of a revolving electron in a

hydrogen atom, and hence find the value of Bohr magneton.

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5. Obtain an expression for magnetic field in terms of magnetic dipole moment associated with circular current loop.

(or)

Show that circular current loop can be associated with a magnetic dipole.

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6. Obtain an expression for the magnetic field at a point due to an infinitely long thin conductor or wire by applying Ampere's circuital law.

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7. Obtain an expression for Magnetic field inside a solenoid by using Ampere's Circuital Law.

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8. Obtain an expression for magnetic field inside the toroid.

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9. Obtain an expression for the force between two straight parallel conductor carrying current. Hence define ampere.

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10. Obtain an expression for torque acting on a rectangular current loop.

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11. With the help of a neat labelled diagram expain MCG and obtain an expression for current sensitivity of MCG.

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12. How is galvanometer converted into an ammeter?

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13. How is a galvanometer converted into a voltmeter?

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14. Give any two differences between an ammeter and a voltmeter.

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Numericals With Solutions

1. Two circular coils of mean radii 0.1 m and 0.5 m consisting of 5 turns and 10 turns respectively are arranged concentric to one another with their planes at right angles to

each other. If a current of 2A is passed through each of them, calculate the magnitude of the resultant magnetic field at their common centre.

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2. Find the magnitude of magnetic induction at a point 0.06m from the centre and along the axis of a circular coil carrying a current of 2 A. Also calculate the magnitude of magnetic induction at the centre of the coil.

Given: Number of turns in the coil = 20

Mean radius of the coil = 0.05 m.

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3. A current of 5 mA through a coil of 10 turns produces a magnetic field of 6.28×10^{28} T at the centre of the coil. Calculate the radius of the coil.

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4. The magnetic flux at two points on the axis of a circular coil at distances 5 cm and 20 cm from the centre are in the ratio 8:1. Find the diameter of the coil.

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5. A circular coil of 10 turns and mean radius of 0.1 m is kept with its plane in the magnetic meridian. If a current of 2 A passes through it,

calculate the resultant magnetic field at its centre. $\left(B_H = 4 \times 10^{-5} T\right)$

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6. The plane of a circular coil is at right angles to the magnetic meridian. If the number of turns in the coil equals 2, radius of the coil equals 0.078 m and current 2.8 A, then calculate the net magnetic field at the centre for clockwise and anticlockwise currents.

Given : $B_u = 4 \times 10^{-5} T$.

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7. Two identical circular coils are separated by a distance twice the radius of either of the coil. If n = 2, r = 0.08 m, i = 3A, then calculate the resultant magnetic field at the mid point of the line joining their centres, for currents in the same sense and opposite sense in the two circular coils.

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8. A straight horizontal rod of mass 30 grams and length 0.3m is placed in a uniform horizontal magnetic field of strength 0.2 T perpendicular to the rod. Calculate the current through the rod, if the force on it just balances its weight. $g = 9.8ms^{-2}$.

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9. Calculate the separation between two long, straight parallel wires, carrying currents of 100

A and 50 A, if they repel each other with a force of 1 Nm^{-1}.

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10. A conductor of length 10 cm carrying 2.5 A current is placed in a magnetic field of 0.5 T. Calculate the maximum and minimum forces on the conductor. What is the force on the conductor when it is placed at 45° to the direction of field?

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11. Calculate the force experienced by the wire (iii) from the figure.

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12. 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 the coil is 5.0 A, what is the (a) total torque on the coil, (b) total force on the coil, (c)

average force on each electron in the coil due to the magnetic field? (The coil is made of copper wire of cross-sectional area $10^{-5}m^2$, and the free electron density in copper is given to be about $10^{29}m^{-3}$.)

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13. A solenoid 60 cm long and of radius 4.0 cm has 3 layers of windings of 300 turns each. A 2.0 cm long wire of mass 2.5 g lies inside the solenoid (near its centre) normal to its axis,

both the wire and the axis of the solenoid are in the horizontal plane. The wire is connected through two leads parallel to the axis of the solenoid to an external battery which supplies a current of 6.0 A in the wire. What value of current (with appropriate sense of circulation) in the windings of the solenoid can support the weight of the wire?

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14. A galvanometer coil has a resistance of 12 Ω and the meter shows FSD for a current of 3 mA. How will you convert the meter into a voltmeter of range 0 - 18V.

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15. A galvanometer coil has a resistance of 15Ω and the meter shows FSD for a current of 4mA. How will you convert the meter into an ammeter of range 0 to 6A.

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16. A toroid has a non ferromagnetic core of inner radius 25 cm and outer radius 26 cm around which 3500 turns of wire are wound. If the current in the wire is 11A, what is the magnetic field (a) outside the toroid? (b) inside the core of the toroid? (c) in the empty space surrounded by the toroid?

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17. A straight horizontal conducting rod of length 0.45 m and mass 60 g is suspended by two vertical wires at its ends. A current of 5.0 A is set up in the rod through the wires. (a) What magnetic field should be set up normal to the conductor in order that the tension in the wires is zero? (b) What will be the total tension in the wires if the direction of current is reversed, keeping the magnetic field same as before?

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18. In a chamber, a uniform magnetic field of 8.0 G is maintained. An electron with speed of $4.0 \times 10^6 ms^{-1}$ enters the chamber in a direction normal to the field.

(a) Describe the path of the electron.

(b) What is the frequency of revolution of the electron?

(c) What happens to the path of electron if it progessively loses its energy due to collisions with the atoms or molecules of the environment?

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19. A square coil of side 10 cm consists of 20 turns and carries a current of 12A. The coil is suspended vertically and normal to the plane of the coil, makes an angle of 30° with the direction of a uniform horizontal magnetic field of magnitude 0.80T. What is the magnitude of torque experienced by the coil?

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20. Two concentric circular coils X and Y of radii 16 cm and 10 cm respectively, lie in the same vertical plane containing the north to south direction. Coil X has 20 turns and carries a current of 16A, coil Y has 25 turns and carries a current of 18A. The direction of the current in X is anticlockwise and is clockwise in Y, for an observer looking at the coils facing west. Give the magnitude and direction of the net magnetic field due to the coils at their centre.

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21. An electron emitted by a heated cathode and accelerated through a p.d. of 2.0 kV enters a region with uniform magnetic field of 0.15T. Determine the trajectory of the electron if the field (a) is transverse to its initial velocity (b) makes an angle of 30° with the initial velocity.

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22. An $\alpha -$ particle of mass $6.65 \times 10^{-27} kg$ is travelling at right angles to a magnetic field

with a speed of $6 \times 10^5 ms^{-1}$. The strength of the magnetic field is 0.2 T. Calculate the force on the $\alpha -$ particle and its acceleration.

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23. A beam of protons moving with a velocity of $4 \times 10^5 ms^{-1}$, enters a uniform field of 0.3T at an angle of 60° to the direction of the magnetic field. Find (i) the radius of the helical path of the proton beam and (ii) pitch of the

helix. (Mass of proton =$1.67 \times 10^{-27} kg$, charge on proton $= 1.6 \times 10^{-19} C$).

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