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Class: 12
Subject: Physics
Topic: Moving charges and magnetism
No. of Questions: 30

1. A circular coil of wire consisting of 100 turns, each of radius 8.0 cm carries a current of 0.40 A. What is the magnitude of the magnetic field B at the centre of the coil?

2. A long straight wire in the horizontal plane carries a current of 50 A in north to south direction. Give the magnitude and direction of B at a point 2.5 m east of the wire.

3. A closely wound solenoid 80 cm long has 5 layers of windings of 400 turns each. The diameter of the solenoid is 1.8 cm. If the current carried is 8.0 A, estimate the magnitude of B inside the solenoid near its centre.

4. In a chamber, a uniform magnetic field of 6.5 G ($1\ G = 10^{-4} T$) is maintained. An electron is short into the field with a speed of 4.8×10^6 m s^{-1} normal to the field. Explain why the path of the electron is a circle. Determine the radius of the circular orbits. ($e = 1.6 \times 10^{-19}$ C, $m_e = 9.1 \times 10^{-31}$ kg)

5. Answer the following questions:
   A magnetic field that varies in magnitude from point to point but has a constant direction (east to west) is set up in a chamber. A charged particle enters the chamber and travels un-deflected along a straight path with constant speed. What can you say about the initial velocity of the particle?
   A charged particle enters an environment of a strong and non-uniform magnetic field varying from point to point both in magnitude and direction, and comes out of it following a complicated trajectory. Would its final speed equal the initial speed if it suffered no collisions with the environment?

6. An electron travelling west to east enters a chamber having a uniform electrostatic field in north to south direction. Specify the direction in which a uniform magnetic field should be set up to prevent the electron from deflecting from its straight line path.

7. An electron emitted by a heated cathode and accelerated through a potential difference of 2.0 k V, enters a region with uniform magnetic field of 0.15 T. Determine trajectory of the electron if the field (a) is transverse to its initial velocity, (b) makes an angle of 30^o with the initial velocity.

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8. 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 total torque on the coil, total force on the coil and 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}.)

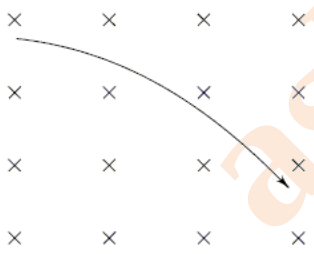
9. A galvanometer coil has a resistance of 12 Ω and the metre shows full scale deflection for a current of 3 mA. How will you convert the metre into a voltmeter of range 0 to 18 V?

10. A galvanometer coil has a resistance of 15 Ω and the metre shows full scale deflection for a current of 4 mA. How will you convert the metre into an ammeter of range 0 to 6 A?

11. The direction of the force experienced by a charged particle moving with a velocity v in a uniform magnetic field B is

A. parallel to v and perpendicular to B
B. parallel to B and perpendicular to v
C. parallel to both v and B
D. perpendicular to both v and B

12. A particle is projected into a uniform magnetic field acting perpendicular to the plane of the paper. The field points into the paper, indicated by x which represents the tail of the field vector. The trajectory shown could be that of



A. neutron
B. proton
C. alpha particle
D. electron

13. In the region around a charge at rest, there is

A. electric field only
B. magnetic field only
C. neither electric nor magnetic field
D. electric as well as magnetic field

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14. A magnetic needle is kept in a non-uniform magnetic field. It experiences

A. a force as well as a torque
B. a force but no torque
C. a torque but no force
D. neither a force nor a torque

15. A proton (mass = 1.7×10^{-27} kg) moves with a speed of 5×10^{5} m/s in a direction perpendicular to a magnetic field of 0.17 T. The acceleration of the proton is

A. zero
B. 2×10^{12} ms^{-2}
C. 4×10^{12} ms^{-2}
D. 8×10^{12} ms^{-2}

16. The vertical component of the earth's magnetic field is zero at the

A. magnetic poles
B. magnetic equator
C. geographic poles
D. 45° latitude

17. The angle of dip is 90° at the

magnetic poles
magnetic equator
geographic poles
90° latitude

18. The relative permeability of iron is of the order of

A. zero
B. 1
C. 10^{-4}
D. 10^{3}

19. A bar magnet of magnetic moment 2.0 JT^{-1} lies aligned with the direction of a uniform magnetic field of 0.25 T. What is the work done to turn the magnet so as to align its magnetic moment opposite to the field direction?

A. 0.25 J
B. 0.5 J
C. 0.75 J
D. J

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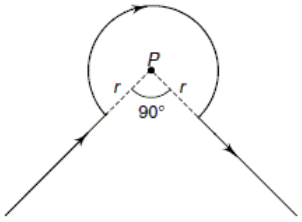
20. A toroidal solenoid has 3000 turns and a mean radius of 10 cm. It has a soft iron core of relative permeability 2000. What is the magnitude of the magnetic field in the core when a current of 1 A is passed through the solenoid?

A. 0.012 T
B. 0.12 T
C. 1.2 T
D. 12 T

21. A small piece of a material is repelled by a strong magnet. The material is

A. paramagnetic
B. ferromagnetic
C. diamagnetic
D. non-magnetic

22. The wire shown in figure carries a current of 32 A. If r = 3.14 cm, the magnetic field at point P will be



A. 1.6×10^{-4} T
B. 3.2×10^{-4} T
C. 4.8×10^{-4} T
D. 6.4×10^{-4} T

23. A proton of mass 1.67×10^{-27} kg and charge 1.6×10^{-19} C is projected with a speed of 2×10^{6} ms^{-1} at an angle of 60^{o} to the x -axis. If a uniform magnetic field of 0.014 T is applied along the y -axis, the path of the proton is

A. a circle of radius 0.1 m and time period $2\pi \times 10^{-7}$ s
B. a circle of radius 0.2 m and time period $\pi \times 10^{-7}$ s
C. a helix of radius 0.1 m and time period $2\pi \times 10^{-7}$ s
D. a helix of radius 0.2 m and time period $4\pi \times 10^{-7}$ s

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24. A loosely wound helix made of stiff wire is mounted vertically with the lower end just touching a dish of mercury. When a current from the battery is started in the coil through the mercury, then

A. the wire oscillates
B. the wire continues making contact
C. the wire breaks contact just when the current is passed
D. the mercury will expand by heating due to passage of current

25. A coil having N turns is wound tightly in the form of a spiral with inner and outer radii a and b respectively. When a current I passes through the coil, the magnetic field at the centre is

A. $\frac{\mu_0 NI}{b}$
B. $\frac{2\mu_0 NI}{a}$
C. $\frac{\mu_0 NI}{2(b-a)}\ln\frac{b}{a}$
D. $\frac{\mu_0 NI}{2(b-a)}\ln\frac{a}{b}$

26. Two poles of the same strength attract each other with a force of magnitude F when placed at two corners of an equilateral triangle. If a north pole of the same strength is placed at the third vertex, it experiences a force of magnitude

A. $\sqrt{3}$ F
B. F
C. $\sqrt{2}$ F
D. 2 F

27. An electron moves with a speed of 2×10^5 ms^{-1} along the positive x-direction in a magnetic field B = $(\hat{i} - 4\hat{j} - 3\hat{k})$ tesla. The magnitude of the force (in Newton) experienced by the electron is (the charge on electron = 1.6×10^{-19} C)

A. 1.18×10^{-13}
B. 1.28×10^{-13}
C. 1.6×10^{-13}
D. 1.72×10^{-13}

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28. Two short bar magnets of magnetic moments 'M' each are arranged at the opposite corners of a square of side 'd', such that their centres coincide with the corners and their axes are parallel. If the like poles are in the same direction, the magnetic field at any of the other corners of the square is

A. $\frac{\mu_0}{4\pi}\cdot\frac{M}{d^3}$
B. $\frac{\mu_0}{4\pi}\cdot\frac{2M}{d^3}$
C. $\frac{\mu_0}{4\pi}\cdot\frac{M\sqrt{5}}{d^3}$
D. $\frac{\mu_0}{4\pi}\cdot\frac{3M}{d^3}$

29. A straight section PQ of a circuit lies along the x–axis from x = $-\frac{a}{2}$ to x = $\frac{a}{2}$ and carries a current I.
The magnetic field due to the section PQ at point x = + a will be

A. proportional to a
B. proportional to a^2
C. proportional to $\frac{1}{a}$
D. equal to zero

30. A bar magnet of magnetic moment 2.0 JT^{-1} lies aligned with the direction of a uniform magnetic field of 0.25 T. What is the amount of work required to turn the magnet, so as to align its magnetic moment perpendicular to the field direction?

A. 0.125 J
B. 0.25 J
C. 0.5 J
D. J