1. The magnetic field at the center of a circular loop of radius 0.05 m carrying current 3 A is:

(a) 12×10^{-5} T
(b) 6×10^{-5} T
(c) 3.77×10^{-5} T
(d) 7.54×10^{-5} T

Answer: (d) 7.54×10^{-5} T
Explanation:
Magnetic field at center of loop:
B = (mu naught × I) / (2 × R)
= $(4 \times \text{pi} \times 10^{-7} \times 3) / (2 \times 0.05)$
= 7.54×10^{-5} T

2. The SI unit of magnetic field is:

(a) Ampere
(b) Weber
(c) Tesla
(d) Gauss

Answer: (c) Tesla
Explanation:
1 Tesla = 1 Newton / (Ampere × meter).
It is the SI unit of magnetic field.

3. According to Biot–Savart law, magnetic field B is directly proportional to:

(a) Square of distance
(b) Current
(c) Area of loop
(d) Voltage

Answer: (b) Current
Explanation:
B is directly proportional to current I and inversely proportional to square of distance from wire.

4. The magnetic field at a distance r from a long straight current-carrying wire is:

(a) mu naught × I / (2 × r)
(b) mu naught × I / (4 × pi × r)
(c) mu naught × I × r
(d) mu naught × I × r squared

Answer: (a) mu naught × I / (2 × r)
Explanation:
This is derived from the Biot–Savart law.

5. Magnetic field inside a long solenoid is:

(a) Constant
(b) Zero
(c) Inversely proportional to current
(d) Non-uniform

Answer: (a) Constant
Explanation:
Inside a long ideal solenoid, the magnetic field is uniform and directed along the axis.

6. The magnetic field due to a current-carrying circular loop at its center is:

(a) Directly proportional to radius
(b) Inversely proportional to radius
(c) Inversely proportional to square of radius
(d) Independent of radius

Answer: (b) Inversely proportional to radius
Explanation:
B = (mu naught × I) / (2 × R)

7. Right-hand thumb rule is used to determine:

(a) Direction of electric field
(b) Direction of force
(c) Direction of magnetic field
(d) Direction of motion

Answer: (c) Direction of magnetic field
Explanation:
Thumb shows current direction, curled fingers show magnetic field around conductor.

8. Magnetic field inside a toroid is:

(a) Zero
(b) Constant
(c) Directly proportional to distance from center
(d) Inversely proportional to distance

Answer: (b) Constant
Explanation:
Inside a toroid, magnetic field is constant and confined within the core.

9. Force experienced by a charge q moving with velocity v in magnetic field B is:

(a) q × v
(b) q × E
(c) q × B
(d) q × (v cross B)

Answer: (d) q × (v cross B)
Explanation:
This gives magnitude and direction of magnetic force on a moving charge.

10. A current-carrying conductor experiences maximum force in a magnetic field when:

(a) It is parallel to magnetic field
(b) It is perpendicular to magnetic field
(c) It is at 45 degrees to field
(d) No current flows

Answer: (b) It is perpendicular to magnetic field
Explanation:
Force is maximum when angle between current and magnetic field is 90 degrees.

11. Magnetic field at the axis of a circular loop is:

(a) Zero
(b) Maximum at center
(c) Same throughout axis
(d) Inversely proportional to square of distance from center

Answer: (d) Inversely proportional to square of distance from center
Explanation:
B decreases with distance along the axis of the loop.

12. Ampere's circuital law states that:

(a) Magnetic field forms closed loops
(b) Current produces voltage
(c) Line integral of magnetic field equals mu naught times net current enclosed
(d) None of these

Answer: (c) Line integral of magnetic field equals mu naught times net current enclosed
Explanation:
Ampere's law: $\oint B \cdot dl$ = mu naught × I enclosed

13. Magnetic field due to a solenoid increases with:

(a) Decrease in current
(b) Decrease in number of turns
(c) Increase in number of turns per unit length
(d) Increase in radius

Answer: (c) Increase in number of turns per unit length
Explanation:
B = mu naught × n × I, where n = number of turns per unit length

14. Force between two long straight parallel conductors carrying current in same direction is:

(a) Repulsive
(b) Attractive

(c) Zero
(d) Alternating

Answer: (b) Attractive
Explanation:
Parallel currents attract; anti-parallel currents repel.

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15. A wire of length L carrying current I is placed perpendicular to uniform magnetic field B. Force on wire is:

(a) I × B
(b) I × L × B
(c) I × B divided by L
(d) Zero

Answer: (b) I × L × B
Explanation:
F = I × L × B × sin(theta); for perpendicular, sin(90) = 1 → F = I × L × B

16. A square loop of side 0.2 m carrying current 5 A is placed in a uniform magnetic field of 0.3 T perpendicular to its plane. The torque on the loop is:

(a) 0.06 Nm
(b) 0 Nm
(c) 0.1 Nm
(d) 0.03 Nm

Answer: (b) 0 Nm
Explanation:
Torque, $\tau = n \times I \times A \times B \times \sin(\theta)$
Here, $\theta = 0°$ (perpendicular to the plane, so normal is parallel to B)
$\Rightarrow \sin(0°) = 0 \rightarrow \tau = 0$

17. Magnetic moment of a current loop is given by:

(a) I × A
(b) B × A

(c) q × r
(d) m × v

Answer: (a) I × A
Explanation:
Magnetic moment (M) = Current (I) × Area vector (A)

18. Two long parallel wires carry currents 10 A and 5 A in opposite directions. The distance between them is 0.2 m. The force per unit length between them is:

(a) 5×10^{-5} N/m (attractive)
(b) 5×10^{-5} N/m (repulsive)
(c) 10^{-5} N/m (repulsive)
(d) Zero

Answer: (b) 5×10^{-5} N/m (repulsive)
Explanation:
F/L = (mu naught / 2π) × ($I_1 \times I_2$) / d
= $(2 \times 10^{-7}) \times (10 \times 5) / 0.2 = 5 \times 10^{-5}$ N/m
Since currents are in opposite directions, force is repulsive.

19. A proton moving perpendicular to a magnetic field of 0.1 T with velocity 2×10^{6} m/s experiences a force of:

(a) 3.2×10^{-14} N
(b) 2×10^{-13} N
(c) 1.6×10^{-13} N
(d) 4×10^{-14} N

Answer: (c) 1.6×10^{-13} N
Explanation:
F = q × v × B
= $(1.6 \times 10^{-19}) \times (2 \times 10^{6}) \times 0.1 = 3.2 \times 10^{-14}$ N

20. The direction of force on a moving charge in a magnetic field is given by:

(a) Fleming's Left-Hand Rule
(b) Fleming's Right-Hand Rule
(c) Lenz's Law

(d) Ampere's Rule

Answer: (a) Fleming's Left-Hand Rule
Explanation:
Fleming's Left-Hand Rule gives direction of force on a current or charge in a magnetic field.

21. A wire of length 0.5 m carrying current 4 A is placed in magnetic field 0.2 T. The maximum force on wire is:

(a) 0.2 N
(b) 0.4 N
(c) 0.1 N
(d) 0.05 N

Answer: (b) 0.4 N
Explanation:
$F = I \times L \times B \times \sin(\theta) = 4 \times 0.5 \times 0.2 \times 1 = 0.4$ N (maximum when $\sin(90°) = 1$)

22. Magnetic field inside a long ideal solenoid does not depend on:

(a) Current
(b) Number of turns per unit length
(c) Length of solenoid
(d) Permeability of medium

Answer: (c) Length of solenoid
Explanation:
B = mu naught × n × I → independent of total length, depends only on turns per unit length.

23. Which one of the following can produce a magnetic field?

(a) A stationary charged particle
(b) A bar magnet
(c) A neutral metal ball
(d) A stationary neutron

Answer: (b) A bar magnet
Explanation:

Only moving charges or magnetic materials produce magnetic fields. Bar magnets have atomic magnetic moments aligned.

24. A current loop behaves like:

(a) A point charge
(b) A magnetic dipole
(c) An electric dipole
(d) A neutral particle

Answer: (b) A magnetic dipole
Explanation:
A current loop produces a magnetic dipole moment and has two poles like a bar magnet.

25. The unit of magnetic moment is:

(a) $A \times m^2$
(b) $A \times s$
(c) $A \times m$
(d) $N \times m$

Answer: (a) $A \times m^2$
Explanation:
Magnetic moment = $I \times A$; so unit is Ampere × meter^2

26. Magnetic field at the center of a semicircular arc of radius R carrying current I is:

(a) mu naught × I / (2 × R)
(b) mu naught × I / (4 × R)
(c) mu naught × I / R
(d) mu naught × I × R

Answer: (b) mu naught × I / (4 × R)
Explanation:
Use Biot–Savart law: B = mu naught × I / (4 × R) for a semicircular wire.

27. Force on a charged particle moving parallel to a magnetic field is:

(a) Maximum
(b) Minimum
(c) Zero
(d) Infinite

Answer: (c) Zero
Explanation:
$F = q \times v \times B \times \sin(\theta)$ → If velocity is parallel to B, then $\theta = 0$, $\sin(0) = 0$ → $F = 0$

28. Cyclotron is used to:

(a) Measure magnetic field
(b) Accelerate neutral particles
(c) Accelerate charged particles
(d) Produce electric field

Answer: (c) Accelerate charged particles
Explanation:
Cyclotron uses magnetic and electric fields to accelerate charged particles in a spiral path.

29. A beam of electrons enters a uniform magnetic field at right angle. Its path will be:

(a) Straight
(b) Parabolic
(c) Circular
(d) Elliptical

Answer: (c) Circular
Explanation:
$F = q \times v \times B$ acts as centripetal force → electrons move in circular path.

30. A current of 2 A is flowing through a circular loop of radius 0.1 m. Magnetic field at the center is:

(a) 4×10^{-5} T
(b) 8×10^{-6} T
(c) 1.26×10^{-5} T
(d) 1.26×10^{-4} T

Answer: (d) 1.26×10^{-4} T
Explanation:
B = mu naught × I / (2 × R)
= (4 × pi × 10^{-7} × 2) / (2 × 0.1)
= 1.26×10^{-4} T

31. A circular loop of radius 0.1 m carries a current of 3 A. What is the magnetic moment of the loop?

(a) 0.094 $A \cdot m^2$
(b) 0.047 $A \cdot m^2$
(c) 0.0094 $A \cdot m^2$
(d) 0.0047 $A \cdot m^2$

Answer: (b) 0.047 $A \cdot m^2$
Explanation:
Magnetic moment, $M = I \times A = I \times \pi r^2 = 3 \times \pi \times (0.1)^2 = 0.047$ $A \cdot m^2$

32. A rectangular current loop of area 0.05 m^2 is placed in a magnetic field of 0.2 T. If the plane of the loop is parallel to the field, what is the torque on the loop?

(a) 0.01 Nm
(b) 0 Nm
(c) 0.005 Nm
(d) 0.002 Nm

Answer: (b) 0 Nm
Explanation:
Torque, $\tau = M \times B \times \sin(\theta)$; if loop is parallel to field, $\theta = 0° \Rightarrow \sin(0) = 0 \Rightarrow \tau = 0$

33. A magnetic dipole placed in a uniform magnetic field experiences:

(a) Only torque
(b) Only force
(c) Both force and torque
(d) Neither force nor torque

Answer: (a) Only torque

Explanation:
In uniform magnetic field, net force is zero, but torque tends to align the dipole.

34. A galvanometer has resistance 40 Ω and gives full-scale deflection at 2 mA. The value of shunt resistance needed to convert it to an ammeter of range 2 A is:

(a) 0.04 Ω
(b) 0.02 Ω
(c) 0.05 Ω
(d) 0.08 Ω

Answer: (a) 0.04 Ω
Explanation:
$S = (Ig \times G) / (I - Ig) = (2\times10^{-3} \times 40) / (2 - 0.002) = 0.08 / 1.998 \approx 0.04\ \Omega$

35. A galvanometer is converted to voltmeter of range 10 V using resistance 4980 Ω. If G = 20 Ω, the current for full-scale deflection is:

(a) 2 mA
(b) 1 mA
(c) 0.5 mA
(d) 5 mA

Answer: (b) 1 mA
Explanation:
$V = Ig \times (R + G) \Rightarrow 10 = Ig \times (4980 + 20) \Rightarrow Ig = 10 / 5000 = 0.002\ A = 2\ mA$

36. Magnetic field at the center of a circular loop of radius R carrying current I is proportional to:

(a) R
(b) 1/R
(c) R^2
(d) $1/R^2$

Answer: (b) 1/R
Explanation:
$B = (\mu_0 I)/(2R) \Rightarrow B \propto 1/R$

37. Magnetic field inside a very long straight solenoid carrying current is:

(a) Directly proportional to its radius
(b) Inversely proportional to its radius
(c) Constant throughout the cross-section
(d) Zero at center

Answer: (c) Constant throughout the cross-section
Explanation:
Field inside ideal solenoid is uniform and independent of radius.

38. A particle with charge +q enters a magnetic field at angle 90°. The radius of circular path is proportional to:

(a) q
(b) 1/q
(c) v
(d) mv/qB

Answer: (d) mv/qB
Explanation:
r = (mv)/(qB)

39. In cyclotron, particle gains energy due to:

(a) Magnetic field
(b) Electric field
(c) Gravity
(d) Friction

Answer: (b) Electric field
Explanation:
The electric field between dees accelerates the particle; magnetic field bends the path.

40. A long straight wire produces magnetic field of 4×10^{-5} T at a distance of 2 cm. The current in wire is:

(a) 4 A
(b) 2 A

(c) 6 A
(d) 8 A

Answer: (a) 4 A
Explanation:
$B = (\mu_0 I)/(2\pi r) \Rightarrow I = B \times 2\pi r / \mu_0$
$= (4 \times 10^{-5} \times 2\pi \times 0.02) / (4\pi \times 10^{-7}) = 4$ A

41. Magnetic force on a charged particle is maximum when the angle between velocity and magnetic field is:

(a) 0°
(b) 45°
(c) 90°
(d) 180°

Answer: (c) 90°
Explanation:
$F = qvB\sin\theta \Rightarrow$ maximum when $\sin\theta = 1 \Rightarrow \theta = 90°$

42. Magnetic field due to current in a straight wire is:

(a) Along the wire
(b) Perpendicular to wire and field
(c) In concentric circles around wire
(d) Radial

Answer: (c) In concentric circles around wire
Explanation:
Use Right-Hand Thumb Rule – magnetic lines are circular around current.

43. A current loop behaves like a magnetic dipole because:

(a) Current produces electric field
(b) It stores charge
(c) It has poles
(d) It produces uniform magnetic field like a bar magnet

Answer: (d) It produces uniform magnetic field like a bar magnet

Explanation:
A loop creates magnetic field pattern similar to that of a dipole/bar magnet.

44. Magnetic force on a wire is independent of:

(a) Current
(b) Length of wire
(c) Magnetic field
(d) Mass of wire

Answer: (d) Mass of wire
Explanation:
$F = I \times L \times B \times \sin\theta$ → no dependence on mass

45. The torque acting on a rectangular coil in a uniform magnetic field is maximum when the plane of coil is:

(a) Parallel to field
(b) Perpendicular to field
(c) At 45°
(d) Along field direction

Answer: (a) Parallel to field
Explanation:
Maximum torque $\tau = nIAB$ when $\theta = 90°$ ⇒ coil plane || B ⇒ normal ⊥ B