1. A bar magnet is placed in a uniform magnetic field at an angle θ. What is the torque acting on it?

A) MB
B) MB sinθ
C) MB cosθ
D) M/B

Answer: B) MB sinθ
Explanation: The torque (τ) acting on a magnetic dipole in a magnetic field is $\tau = MB \sin\theta$, where M is magnetic moment and B is magnetic field.

2. The magnetic moment of a bar magnet is M. If it is cut into two equal halves perpendicular to its length, the magnetic moment of each piece will be:

A) M
B) M/2
C) M/4
D) 2M

Answer: B) M/2
Explanation: Cutting a bar magnet perpendicular to its length halves the magnetic moment because magnetic moment $\propto$ length.

3. If a magnetic needle is placed at the magnetic north pole of Earth, it will:

A) Point vertically upward
B) Point vertically downward
C) Align horizontally
D) Become stationary in any direction

Answer: B) Point vertically downward
Explanation: At the magnetic north pole, Earth's magnetic field is completely vertical and directed downward.

4. Magnetic field at the center of a circular current loop of radius r and current I is:

A) $\mu_o I / 2\pi r$
B) $\mu_o I / 2r$
C) $\mu_o Ir / 2$

D) $\mu_o I / 4\pi r$

Answer: B) $\mu_o I / 2r$
Explanation: Magnetic field at the center of a current-carrying loop is given by $B = \mu_o I / 2r$.

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

A) A force and a torque
B) Only a force
C) Only a torque
D) Neither force nor torque

Answer: C) Only a torque
Explanation: A magnetic dipole in a uniform magnetic field experiences torque but no net force.

6. Magnetic susceptibility (χ) of a diamagnetic substance is:

A) Small and positive
B) Small and negative
C) Large and positive
D) Zero

Answer: B) Small and negative
Explanation: Diamagnetic substances slightly repel magnetic fields, hence they have small negative susceptibility ($\chi < 0$).

7. A magnetic needle oscillates 10 times per minute in a magnetic field B. When the field is increased to 4B, the frequency becomes:

A) 10
B) 20
C) 40
D) 100

Answer: C) 40
Explanation: Frequency $\propto \sqrt{B}$. So if $B \rightarrow 4B$, then $f \rightarrow 2f$. New frequency = $10 \times 2 = 20$ oscillations per 30 seconds = 40 per minute.

8. Which of the following materials can be permanently magnetized?

A) Paramagnetic
B) Diamagnetic
C) Ferromagnetic
D) Non-magnetic

Answer: C) Ferromagnetic
Explanation: Only ferromagnetic materials like iron, cobalt, and nickel can be permanently magnetized due to strong domain alignment.

9. The Earth's magnetic field is due to:

A) Magnetic materials in the Earth’s crust
B) Electric currents in Earth’s core
C) Gravitational pull
D) Solar winds

Answer: B) Electric currents in Earth’s core
Explanation: The geodynamo effect — electric currents in the liquid outer core — is responsible for Earth’s magnetic field.

10. The angle between the geographic meridian and magnetic meridian is called:

A) Dip
B) Declination
C) Latitude
D) Magnetic inclination

Answer: B) Declination
Explanation: Magnetic declination is the angle between true north (geographic) and magnetic north.

11. If the horizontal component of Earth’s magnetic field is 0.35 G and the angle of dip is 60°, what is the vertical component?

A) 0.20 G
B) 0.30 G

C) 0.60 G
D) 0.35 G

Answer: C) 0.60 G
Explanation: Vertical component = H × tan(δ) = 0.35 × tan(60°) = 0.35 × √3 ≈ 0.60 G.

12. The magnetic field lines due to a bar magnet:

A) Are discontinuous
B) Intersect each other
C) Form closed loops
D) Start from south and end at north

Answer: C) Form closed loops
Explanation: Magnetic field lines are always closed loops from N to S outside the magnet and S to N inside.

13. Which of the following is used to detect the Earth's magnetic field?

A) Voltmeter
B) Tangent galvanometer
C) Magnetic needle
D) Ammeter

Answer: C) Magnetic needle
Explanation: A magnetic compass needle aligns with Earth’s magnetic field, making it a basic detector.

14. A bar magnet has magnetic moment 0.5 A·m². What is the torque in a magnetic field of 0.2 T, when it is placed at 90° to the field?

A) 0.1 N·m
B) 0.05 N·m
C) 0.2 N·m
D) 0.01 N·m

Answer: A) 0.1 N·m
Explanation: $\tau = MB \sin\theta = 0.5 \times 0.2 \times \sin(90°) = 0.1$ N·m.

15. The horizontal component of Earth's magnetic field is zero at:

A) Equator
B) Poles
C) 45° latitude
D) Tropic of Cancer

Answer: B) Poles
Explanation: At the magnetic poles, the field is vertical, so the horizontal component is zero.

16. At a place, the angle of dip is 45° and the horizontal component of Earth's magnetic field is 0.3 G. The vertical component is:

A) 0.3 G
B) 0.424 G
C) 0.212 G
D) 0.6 G

Answer: B) 0.424 G
Explanation:
Vertical component = $H \times \tan(\theta) = 0.3 \times \tan(45°) = 0.3 \times 1 = 0.3$ G
Total magnetic field = $\sqrt{(H^2 + V^2)} = \sqrt{(0.3^2 + 0.3^2)} = 0.424$ G

17. Susceptibility of a paramagnetic material:

A) Increases with temperature
B) Is independent of temperature
C) Decreases with temperature
D) First increases then decreases

Answer: C) Decreases with temperature
Explanation:
According to Curie's law, $\chi \propto 1/T$, so susceptibility decreases as temperature increases.

18. Which of the following statements is true for ferromagnetic substances?

A) They are weakly magnetized
B) They do not retain magnetism

C) They have domains aligned permanently
D) Their susceptibility is negative

Answer: C) They have domains aligned permanently
Explanation:
In ferromagnetic materials, atomic dipoles are aligned in domains even without external fields.

19. A neutral point in a magnetic field is a point where:

A) Only electric field exists
B) Magnetic field is maximum
C) Magnetic field is zero
D) Only gravitational field exists

Answer: C) Magnetic field is zero
Explanation:
At a neutral point, fields from different sources cancel each other, resulting in net zero magnetic field.

20. The SI unit of magnetic susceptibility is:

A) Tesla
B) Weber
C) No unit
D) $A \cdot m^2$

Answer: C) No unit
Explanation:
It is a ratio of two magnetic quantities and hence dimensionless.

21. The magnetic moment of a bar magnet is 1.2 $A \cdot m^2$. The magnet is placed in a uniform field of 0.5 T. The maximum torque acting on it is:

A) 0.6 N·m
B) 1.7 N·m
C) 0.24 N·m
D) 2.4 N·m

Answer: A) 0.6 N·m

Explanation:
$\tau = MB \sin\theta \rightarrow$ for maximum torque, $\sin\theta = 1 \rightarrow \tau = 1.2 \times 0.5 = 0.6$ N·m

22. In diamagnetic materials, magnetic dipole moments:

A) Align in the direction of field
B) Strengthen the external field
C) Oppose the magnetic field
D) Are zero in the absence of a field

Answer: C) Oppose the magnetic field
Explanation:
Diamagnetic materials develop an induced magnetic moment opposite to the applied field.

23. Magnetic meridian is:

A) A vertical plane containing magnetic axis of Earth
B) A vertical plane perpendicular to geographic meridian
C) A horizontal plane passing through a magnet
D) A vertical plane parallel to equator

Answer: A) A vertical plane containing magnetic axis of Earth
Explanation:
The magnetic meridian is the vertical plane in which a magnetic needle aligns itself.

24. The bar magnet is cut into two equal pieces. The magnetic moment of each piece is:

A) Same as original
B) Twice the original
C) Half the original
D) One-fourth the original

Answer: C) Half the original
Explanation:
Magnetic moment $M = m \times 2l$; halving the length gives $M = m \times l \rightarrow$ half of original.

25. A bar magnet has a magnetic moment of 2 A·m². If it is placed at an angle of 60° in a magnetic field of 0.3 T, torque experienced is:

A) 0.6 N·m
B) 0.519 N·m
C) 0.45 N·m
D) 0.3 N·m

Answer: B) 0.519 N·m
Explanation:
$\tau = MB \sin\theta = 2 \times 0.3 \times \sin(60°) = 0.6 \times \sqrt{3}/2 \approx 0.519$ N·m

26. A freely suspended magnet aligns itself in which direction?

A) East–West
B) North–South
C) Random
D) Vertical

Answer: B) North–South
Explanation:
It aligns with Earth's magnetic field which approximately points from magnetic south to magnetic north.

27. Magnetic dipole moment of a solenoid is given by:

A) m = B × A
B) m = NIA
C) $m = NI/\mu_o$
D) $m = \mu_o NI$

Answer: B) m = NIA
Explanation:
Magnetic dipole moment = Number of turns × Current × Area.

28. If a diamagnetic substance is placed in a non-uniform magnetic field, it will move:

A) Toward the stronger field
B) Toward the weaker field

C) Will remain stationary
D) Randomly

Answer: B) Toward the weaker field
Explanation:
Diamagnetic materials are repelled by magnetic fields and hence move to weaker regions.

29. For a magnetic dipole in a magnetic field, the condition for stable equilibrium is when angle between m and B is:

A) 0°
B) 45°
C) 90°
D) 180°

Answer: A) 0°
Explanation:
Stable equilibrium occurs when the dipole aligns with the field.

30. The angle of dip at magnetic equator is:

A) 0°
B) 45°
C) 60°
D) 90°

Answer: A) 0°
Explanation:
At the magnetic equator, the field is purely horizontal → dip angle = 0°.

31. If the horizontal component of Earth's magnetic field is 0.36 G and the angle of dip is 60°, then the vertical component is:

A) 0.62 G
B) 0.31 G
C) 0.18 G
D) 0.623 G

Answer: A) 0.62 G
Explanation:
Vertical component = H × tan(dip) = 0.36 × tan(60°) = 0.36 × 1.732 ≈ 0.62 G

32. Magnetic inclination is defined as the angle between:

A) Magnetic meridian and geographic meridian
B) Magnetic axis and equator
C) Magnetic field vector and horizontal
D) Magnetic field and vertical

Answer: C) Magnetic field vector and horizontal
Explanation:
Inclination (dip) is the angle made by Earth's total magnetic field with the horizontal.

33. The magnetic field due to a short bar magnet at an axial point is inversely proportional to:

A) r
B) r^2
C) r^3
D) r^4

Answer: C) r^3
Explanation:
On axial line, $B \propto 1/r^3$. So, magnetic field decreases rapidly with distance.

34. A current-carrying conductor is placed in a magnetic field. The force on the conductor will be maximum when:

A) Angle between the conductor and magnetic field is 0°
B) Angle between the conductor and magnetic field is 90°
C) Angle between the conductor and magnetic field is 45°
D) The conductor is parallel to the magnetic field

Answer: B
Explanation: The force is given by $F = I \times L \times B \times \sin\theta$. It is maximum when $\sin\theta = 1$, i.e., $\theta = 90°$.

35. The magnetic field due to a long straight current-carrying wire is:

A) Inversely proportional to distance from the wire
B) Directly proportional to the square of the distance
C) Independent of the current
D) Zero at any point outside the wire

Answer: A
Explanation: $B = (\mu_o I) / (2\pi r)$, so it decreases with distance r.

36. A solenoid has 1000 turns per meter and carries a current of 2 A. What is the magnetic field inside it? ($\mu_o = 4\pi \times 10^{-7}$ Tm/A)

A) 4×10^{-3} T
B) 8×10^{-3} T
C) 2×10^{-3} T
D) 6×10^{-3} T

Answer: A
Explanation: $B = \mu_o \times n \times I = (4\pi \times 10^{-7}) \times 1000 \times 2 = 8\pi \times 10^{-4} \approx 4 \times 10^{-3}$ T.

37. The magnetic field at the center of a circular loop of radius r carrying current I is:

A) $\mu_o I / (2r)$
B) $\mu_o I / (4\pi r)$
C) $\mu_o I / (2\pi r)$
D) $\mu_o I / r$

Answer: A
Explanation: Magnetic field at center of a circular loop is $B = \mu_o I / (2r)$.

38. A 1 m long wire carries a current of 5 A and is placed in a uniform magnetic field of 2 T perpendicular to it. What is the magnetic force?

A) 10 N
B) 5 N
C) 15 N
D) 20 N

Answer: A
Explanation: $F = I \times L \times B \times \sin\theta = 5 \times 1 \times 2 \times 1 = 10$ N (since $\theta = 90°$).

39. The direction of the magnetic field due to a current-carrying wire is determined using:

A) Fleming's left-hand rule
B) Right-hand thumb rule
C) Ampere's circuital law
D) Coulomb's law

Answer: B
Explanation: Right-hand thumb rule gives the direction of the magnetic field in circular loops around the wire.

40. Two long parallel wires carrying equal current in the same direction will:

A) Repel each other
B) Attract each other
C) Remain unaffected
D) Rotate

Answer: B
Explanation: Parallel currents in the same direction attract each other.

41. A charged particle enters a magnetic field perpendicular to its velocity. The path followed will be:

A) Straight line
B) Circular
C) Parabola
D) Ellipse

Answer: B
Explanation: Force acts as centripetal force, making the particle move in a circular path.

42. Magnetic moment of a current loop is:

A) Proportional to the current and area

B) Proportional to the square of the area
C) Inversely proportional to current
D) Independent of area

Answer: A
Explanation: Magnetic moment M = I × A (current × area of the loop).

43. Magnetic field inside a long solenoid is:

A) Zero
B) Non-uniform
C) Uniform and parallel to axis
D) Circular

Answer: C
Explanation: The magnetic field inside an ideal solenoid is uniform and parallel to its axis.

44. Magnetic force on a moving charge in a magnetic field is given by:

A) qvB
B) qB
C) qv
D) qvB sinθ

Answer: D
Explanation: Magnetic force F = qvB sinθ, where θ is the angle between v and B.

45. The SI unit of magnetic field is:

A) Gauss
B) Tesla
C) Newton
D) Weber

Answer: B
Explanation: Tesla (T) is the SI unit of magnetic field.