

Magnetism and Matter — Assignment 1

Class 12 Physics · Topic-wise question bank covering every concept of the chapter · Narayan Gurukul Academy

Instructions: (1) Attempt all questions. This worksheet walks through every concept of the chapter, topic by topic.
 (2) The interactive MCQ version of these questions (with instant answer reveal) is available on the notes page.
 (3) Universal values: $g = 10 \text{ m/s}^2$ unless stated. Give answers with correct SI units.

Bar Magnet and Magnetic Dipole

MCQ Questions (choose the correct option)

- The magnetic moment of a bar magnet of pole strength m and magnetic length $2l$ is
 - $m \times 2l$
 - $m + 2l$
 - $m/2l$
 - $2l/m$
- The magnetic field on the axial line of a short bar magnet at distance r from its centre is
 - $\mu_0 2M/4\pi r^3$
 - $\mu_0 M/4\pi r^3$
 - $\mu_0 M/4\pi r^2$
 - $\mu_0 2M/4\pi r^2$
- The magnetic field on the equatorial line of a short bar magnet at distance r is
 - $\mu_0 M/4\pi r^3$
 - $\mu_0 2M/4\pi r^3$
 - $\mu_0 M/4\pi r^2$
 - $\mu_0 2M/4\pi r^2$
- The SI unit of magnetic moment is
 - $\text{A} \cdot \text{m}^2$
 - A/m
 - $\text{A} \cdot \text{m}$
 - $\text{T} \cdot \text{m}^2$

1 Mark Questions

- Define magnetic dipole moment.
- Write the expression for the magnetic field on the axial line of a short bar magnet.
- Write the expression for the magnetic field on the equatorial line of a short bar magnet.

2 Mark Questions

- Define magnetic dipole moment and give its SI unit.
- Compare the magnetic fields on the axial and equatorial lines of a short bar magnet at the same distance.

3 Mark Questions

- Derive the expression for the magnetic field on the axial line of a bar magnet.
- Derive the expression for the magnetic field on the equatorial line of a bar magnet.

Torque and Work on a Magnetic Dipole

MCQ Questions (choose the correct option)

1. The torque on a magnetic dipole in a uniform magnetic field B is
 - (A) $M \times B$
 - (B) $M \cdot B$
 - (C) B/M
 - (D) MB^2
2. The potential energy of a magnetic dipole in a magnetic field is
 - (A) $-M \cdot B$
 - (B) $+M \cdot B$
 - (C) $M \times B$
 - (D) MB^2
3. The torque on a magnetic dipole is maximum when the dipole is
 - (A) perpendicular to B
 - (B) parallel to B
 - (C) antiparallel to B
 - (D) at 45° to B
4. A magnetic dipole is in stable equilibrium when
 - (A) M is parallel to B
 - (B) M is perpendicular to B
 - (C) M is antiparallel to B
 - (D) M is at 45° to B

1 Mark Questions

1. Write the expression for the torque on a magnetic dipole in a uniform magnetic field.
2. Write the expression for the potential energy of a magnetic dipole in a magnetic field.
3. When is the torque on a magnetic dipole maximum?

2 Mark Questions

1. Write the expressions for the torque and the potential energy of a magnetic dipole in a field, and state the conditions for stable and unstable equilibrium.
2. A bar magnet of magnetic moment $2 \text{ A}\cdot\text{m}^2$ is placed at 30° to a field of 0.5 T . Find the torque on it. (Ans: $0.5 \text{ N}\cdot\text{m}$)

3 Mark Questions

1. Derive the expression for the torque on a magnetic dipole in a uniform magnetic field.
2. Derive the expression for the potential energy of a magnetic dipole and show that the energy is minimum when it is aligned with the field.

Earth's Magnetism**MCQ Questions (choose the correct option)**

1. The angle between the magnetic meridian and the geographic meridian is called the
 - (A) angle of declination
 - (B) angle of dip
 - (C) magnetic moment
 - (D) magnetic susceptibility

2. The angle between the earth's total magnetic field and the horizontal is called the
 - (A) angle of dip (inclination)
 - (B) angle of declination
 - (C) magnetic latitude
 - (D) magnetic azimuth
3. At the magnetic poles, the angle of dip is
 - (A) 90°
 - (B) 0°
 - (C) 45°
 - (D) 60°
4. If B is the total field, its horizontal and vertical components are
 - (A) $B_H = B \cos\delta$, $B_V = B \sin\delta$
 - (B) $B_H = B \sin\delta$, $B_V = B \cos\delta$
 - (C) $B_H = B \tan\delta$, $B_V = B \cot\delta$
 - (D) $B_H = B$, $B_V = 0$

1 Mark Questions

1. Define angle of declination.
2. Define angle of dip.
3. What is the angle of dip at the magnetic equator?

2 Mark Questions

1. Define magnetic declination and the angle of dip.
2. At a place the horizontal component of the earth's field is 0.4 G and the angle of dip is 30° . Find the total field. (Ans: ≈ 0.46 G)

3 Mark Questions

1. Define the elements of the earth's magnetism and derive the relation between the total field, its horizontal and vertical components, and the angle of dip.
2. Explain the three magnetic elements of the earth and derive $\tan \delta = B_V/B_H$.

Magnetic Properties of Materials

MCQ Questions (choose the correct option)

1. A material with a small positive susceptibility is
 - (A) paramagnetic
 - (B) diamagnetic
 - (C) ferromagnetic
 - (D) non-magnetic
2. Diamagnetic materials have a
 - (A) small negative susceptibility
 - (B) large positive susceptibility
 - (C) zero susceptibility
 - (D) large negative susceptibility
3. Ferromagnetic materials are strongly attracted and have a

- (A) large positive susceptibility
 - (B) small negative susceptibility
 - (C) zero susceptibility
 - (D) small positive susceptibility
4. The relative permeability of a diamagnetic material is
- (A) slightly less than 1
 - (B) much greater than 1
 - (C) exactly 1
 - (D) slightly more than 1

1 Mark Questions

1. Define magnetic susceptibility.
2. Give one example each of a diamagnetic, a paramagnetic and a ferromagnetic material.
3. What is the sign of the susceptibility of a diamagnetic substance?

2 Mark Questions

1. Distinguish between paramagnetic, diamagnetic and ferromagnetic materials.
2. Define susceptibility and permeability and give the relation between them. (Ans: $\mu_r = 1 + \chi$)

3 Mark Questions

1. Explain the classification of magnetic materials on the basis of susceptibility, with examples, and compare their behaviour in a non-uniform magnetic field.
2. Define magnetic susceptibility and permeability. Explain the difference between hard and soft ferromagnetic materials.

Hysteresis

MCQ Questions (choose the correct option)

1. Hysteresis is the lag of
 - (A) magnetisation behind the magnetising field
 - (B) current behind voltage
 - (C) charge behind potential
 - (D) flux behind current
2. The area of a hysteresis loop measures the
 - (A) energy loss per unit volume per cycle
 - (B) magnetic moment
 - (C) susceptibility
 - (D) permeability
3. Soft iron has a
 - (A) narrow hysteresis loop
 - (B) wide hysteresis loop
 - (C) zero loop area
 - (D) square loop
4. For a permanent magnet, the material should have
 - (A) a wide hysteresis loop and high retentivity

- (B) a narrow hysteresis loop
- (C) low coercivity
- (D) zero retentivity

1 Mark Questions

1. Define hysteresis.
2. What does the area of a hysteresis loop represent?
3. Name a material suitable for making a permanent magnet.

2 Mark Questions

1. Define hysteresis and draw the hysteresis loop for a ferromagnetic material.
2. Distinguish between soft and hard magnetic materials on the basis of their hysteresis loops.

3 Mark Questions

1. Explain hysteresis with the help of a B-H curve, and explain the terms retentivity and coercivity.
2. Explain hysteresis, define retentivity and coercivity, and state which type of material is used for (i) a transformer core and (ii) a permanent magnet.