CHAPTER 37

MAGNETIC PROPERTIES OF MATTER

(B) If the temperature is increased, the magnetization is increased.
(a) Both A and B are true.
(b) A is true but B is false.
(c) B is true but A is false.
(d) Both A and B are false.

2. A paramagnetic material is kept in a magnetic field. The field is increased till the magnetization becomes constant. If the temperature is now decreased, the magnetization
(a) will increase (b) decrease
(c) remain constant (d) may increase or decrease.

3. A ferromagnetic material is placed in an external magnetic field. The magnetic domains
(a) increase in size (b) decrease in size
(c) may increase or decrease in size
(d) have no relation with the field.

4. A long, straight wire carries a current i. The magnetizing field intensity H is measured at a point P close to the wire. A long, cylindrical iron rod is brought close to the wire so that the point P is at the centre of the rod. The value of H at P will
(a) increase many times (b) decrease many times
(c) remain almost constant (d) become zero.

5. The magnetic susceptibility is negative for
(a) paramagnetic materials only
(b) diamagnetic materials only
(c) ferromagnetic materials only
(d) paramagnetic and ferromagnetic materials.

6. The desirable properties for making permanent magnets are
(a) high retentivity and high coercive force
(b) high retentivity and low coercive force
(c) low retentivity and high coercive force
(d) low retentivity and low coercive force.

7. Electromagnets are made of soft iron because soft iron has
(a) high retentivity and high coercive force
(b) high retentivity and low coercive force
(c) low retentivity and high coercive force
(d) low retentivity and low coercive force.

OBJECTIVE II

1. Pick the correct options.
(a) All electrons have magnetic moment.
(b) All protons have magnetic moment.
(c) All nuclei have magnetic moment.
(d) All atoms have magnetic moment.

2. The permanent magnetic moment of the atoms of a material is not zero. The material
(a) must be paramagnetic (b) must be diamagnetic
(c) must be ferromagnetic (d) may be paramagnetic.

3. The permanent magnetic moment of the atoms of a material is zero. The material
(a) must be paramagnetic (b) must be diamagnetic
(c) must be ferromagnetic (d) may be paramagnetic.

4. Which of the following pairs has quantities of the same dimensions?
(a) Magnetic field B and magnetizing field intensity H
(b) Magnetic field B and intensity of magnetization I
(c) Magnetizing field intensity H and intensity of magnetization I
(d) Longitudinal strain and magnetic susceptibility.

5. When a ferromagnetic material goes through a hysteresis loop, the magnetic susceptibility
(a) has a fixed value (b) may be zero
(c) may be infinity (d) may be negative

6. Mark out the correct options.
(a) Diamagnetism occurs in all materials.
(b) Diamagnetism results from the partial alignment of permanent magnetic moment.
(c) The magnetizing field intensity H is always zero in free space.
(d) The magnetic field of induced magnetic moment is opposite to the applied field.

EXERCISES

1. The magnetic intensity H at the centre of a long solenoid carrying a current of 2·0 A, is found to be 1500 A m^{-1}. Find the number of turns per centimetre of the solenoid.

2. A rod is inserted as the core in the current-carrying solenoid of the previous problem. (a) What is the magnetic intensity H at the centre? (b) If the magnetization I of the core is found to be 0·12 A m^{-1}, find the susceptibility of the material of the rod. (c) Is the material paramagnetic, diamagnetic or ferromagnetic?

3. The magnetic field inside a long solenoid having 50 turns cm^{-1} is increased from 2·5 × 10^{-3} T to 2·5 T when an iron core of cross-sectional area 4 cm^2 is inserted into it. Find (a) the current in the solenoid, (b) the magnetization I of the core and (c) the pole strength developed in the core.

4. A bar magnet of length 1 cm and cross-sectional area 1·0 cm^2 produces a magnetic field of 1·5 × 10^{-4} T at a point in end-on position at a distance 15 cm away from the centre. (a) Find the magnetic moment M of the magnet. (b) Find the magnetization I of the magnet. (c) Find the magnetic field B at the centre of the magnet.

5. The susceptibility of annealed iron at saturation is 5500. Find the permeability of annealed iron at saturation.

6. The magnetic field B and the magnetic intensity H in a material are found to be 1·6 T and 1000 A m^{-1}

respectively. Calculate the relative permeability μ_r and the susceptibility χ of the material.

7. The susceptibility of magnesium at 300 K is $1{\cdot}2 \times 10^{-5}$. At what temperature will the susceptibility increase to $1{\cdot}8 \times 10^{-5}$?

8. Assume that each iron atom has a permanent magnetic moment equal to 2 Bohr magnetons (1 Bohr magneton equals $9{\cdot}27 \times 10^{-24}$ A m^2). The density of atoms in iron is $8{\cdot}52 \times 10^{28}$ atoms m^{-3}. (a) Find the maximum magnetization I in a long cylinder of iron. (b) Find the maximum magnetic field B on the axis inside the cylinder.

9. The coercive force for a certain permanent magnet is $4{\cdot}0 \times 10^5$ A m^{-1}. This magnet is placed inside a long solenoid of 40 turns/cm and a current is passed in the solenoid to demagnetize it completely. Find the current.

□

ANSWERS

OBJECTIVE I

1. (b) 2. (c) 3. (c) 4. (c) 5. (b) 6. (a) 7. (d)

OBJECTIVE II

1. (a), (b) 2. (d) 3. (b) 4. (c), (d) 5. (b), (c), (d) 6. (a), (d)

EXERCISES

1. 7·5

2. (a) 1500 A m^{-1} (b) $8{\cdot}0 \times 10^{-3}$ (c) paramagnetic

3. (a) 0·4 A (b) $2{\cdot}0 \times 10^5$ A m^{-1} (c) 800 A m

4. (a) 2·5 A m^2 (b) $2{\cdot}5 \times 10^4$ A m^{-1} (c) 1·2 T

5. $6{\cdot}9 \times 10^{-5}$

6. $1{\cdot}3 \times 10^3$ each

7. 200 K

8. (a) $1{\cdot}58 \times 10^6$ A m^{-1} (b) 2·0 T

9. 10 A

□