

Magnetochemistry - Multiple Choice Questions

Instructions: Choose the single best answer for each question.

1. The branch of chemistry that deals with the magnetic properties of materials is called:

- a) Electrochemistry
- b) Thermochemistry
- c) Magnetochemistry
- d) Photochemistry

2. The fundamental source of magnetism in materials is due to:

- a) The gravitational force between atoms
- b) The motion of electric charges
- c) The nuclear forces within the atom
- d) The heat energy of the substance

3. The magnetic moment of an electron is primarily due to its:

- a) Mass and charge
- b) Orbital motion and spin
- c) Size and volume
- d) Charge and volume

4. A substance that is weakly repelled by a magnetic field is classified as:

- a) Ferromagnetic
- b) Paramagnetic
- c) Diamagnetic
- d) Antiferromagnetic

5. Paramagnetism is commonly observed in substances that have:

- a) All electrons paired
- b) A permanent dipole moment
- c) Unpaired electrons
- d) A symmetrical electron distribution

6. The magnetic susceptibility (χ) for a diamagnetic substance is:

- a) Positive and large
- b) Positive and small
- c) Negative and small
- d) Negative and large

7. Which of the following ions is expected to be diamagnetic?

- a) Fe^{3+} (Atomic number of Fe = 26)

- b) Cu^{2+} (Atomic number of Cu = 29)
- c) Zn^{2+} (Atomic number of Zn = 30)
- d) Mn^{2+} (Atomic number of Mn = 25)

8. The effective magnetic moment (μ_{eff}) for a transition metal ion is calculated using the formula:

- a) $\mu_{\text{eff}} = \sqrt{n(n+1)}$
- b) $\mu_{\text{eff}} = \sqrt{4S(S+1)}$
- c) $\mu_{\text{eff}} = \sqrt{4S(S+1) + L(L+1)}$
- d) $\mu_{\text{eff}} = g\sqrt{J(J+1)}$

9. For a high-spin d^5 metal ion (e.g., Fe^{3+} or Mn^{2+}), the spin-only magnetic moment in Bohr Magnetons (B.M.) is:

- a) 1.73 B.M.
- b) 2.83 B.M.
- c) 3.87 B.M.
- d) 5.92 B.M.

10. What is the spin-only magnetic moment (in B.M.) for a Ni^{2+} (d^8) ion?

- a) 0.0 B.M.
- b) 1.73 B.M.
- c) 2.83 B.M.
- d) 3.87 B.M.

11. The Gouy balance is used to measure:

- a) Electrical conductivity
- b) Magnetic susceptibility
- c) Viscosity
- d) Refractive index

12. Ferromagnetic materials, like iron, are characterized by:

- a) Random alignment of magnetic moments
- b) No permanent magnetic moment
- c) Alignment of magnetic moments in the same direction
- d) Alignment of magnetic moments in opposite directions, canceling out

13. In an antiferromagnetic material, the magnetic moments of adjacent atoms:

- a) Align parallel to each other
- b) Align antiparallel to each other and are equal in magnitude
- c) Are randomly oriented
- d) Are all zero

14. The constant "g" in the magnetic moment formula is called the:

- a) Gravitational constant
- b) Gyromagnetic ratio or Landé g-factor

- c) Gaussian constant
- d) Ground state constant

15. The Curie Law states that the magnetic susceptibility (χ) of a paramagnetic substance is:

- a) Directly proportional to the absolute temperature (T)
- b) Inversely proportional to the absolute temperature (T)
- c) Independent of temperature
- d) Directly proportional to the square of the temperature (T²)