CHEMISTRY

CLASS XII

COMPETENCY BASED EXAM – OCTOBER 2025

d-Block & f-Block Chemistry MCQs

Q1. The transition metals show variable oxidation states because:
A. They have incomplete s-orbitals
B. They have incomplete d-orbitals
C. They have incomplete p-orbitals
D. They have stable f-orbitals

Answer: B
Reasoning: Variable oxidation states arise due to similar energies of (n–1)d and ns orbitals.

Q2. Which of the following ions is colorless?
A. Ti^{3+}
B. V^{2+}
C. Sc^{3+}
D. Mn^{2+}

Answer: C. Sc^{3+}
Reasoning: Sc^{3+} has $3d^0$ configuration ⟶ no d–d transitions ⟶ colorless.

Q3. Assertion–Reason
Assertion (A): Transition metals form complex compounds.
Reason (R): They have vacant d-orbitals that can accept electron pairs from ligands.

A. Both A and R are true, and R is the correct explanation of A
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, R is false
D. A is false, R is true

Answer: A

Q4. The lanthanide contraction is responsible for:
A. Similar atomic radii of Zr and Hf
B. High density of transition metals
C. Formation of colored ions
D. Magnetic properties of lanthanides

Answer: A
Reasoning: Due to lanthanide contraction, Hf has radius similar to Zr despite being in a different period.

Q5. Which of the following has maximum paramagnetism?
A. Fe^{2+} ($3d^6$)
B. Mn^{2+} ($3d^5$)
C. Co^{2+} ($3d^7$)
D. Ni^{2+} ($3d^8$)

Answer: B. Mn^{2+}
Reasoning: Mn^{2+} has 5 unpaired electrons ⟶ maximum paramagnetism.

Q6. The actinides show greater range of oxidation states than lanthanides because:
A. 5f orbitals penetrate less into the core and participate in bonding
B. 4f orbitals are more shielded
C. Lanthanides have stable f-orbitals
D. Actinides have no shielding

Answer: A
Reasoning: 5f orbitals are less shielded ⟶ more available for bonding ⟶ variable oxidation states.

Q7. Assertion–Reason
Assertion (A): $KMnO_4$ acts as a strong oxidizing agent in acidic medium.
Reason (R): Mn in $KMnO_4$ reduces from +7 oxidation state to +2.

A. Both A and R are true, and R is the correct explanation of A
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, R is false
D. A is false, R is true

Answer: A

Q8. Which of the following elements shows maximum tendency to form complexes?
A. Zn^{2+}

B. Cu^{2+}
C. Fe^{2+}
D. Sc^{3+}

Answer: B. Cu^{2+}
Reasoning: Cu^{2+} has high polarizing power and readily forms stable complexes.

Q9. The magnetic moment of Cr^{3+} ion ($3d^3$) is approximately:
A. 1.73 BM
B. 2.83 BM
C. 3.87 BM
D. 4.90 BM

Answer: C. 3.87 BM
Reasoning: Magnetic moment = (\sqrt{n(n+2)}). For 3 unpaired electrons ⟶ (\sqrt{3(3+2)} = \sqrt{15} ≈ 3.87).

Q10. Assertion–Reason
Assertion (A): Ce^{4+} is a strong oxidizing agent.
Reason (R): Ce^{4+} readily gets reduced to Ce^{3+} due to stability of f^1 configuration.

A. Both A and R are true, and R is the correct explanation of A
B. Both A and R are true, but R is not the correct explanation of A
C. A is true, R is false
D. A is false, R is true

Answer: A