

ANSWERS

I. Multiple Choice Questions (Type-I)

1. (ii) 2. (i) 3. (iv) 4. (ii) 5. (i) 6. (ii)
7. (ii) 8. (i) 9. (iv) 10. (iii) 11. (i) 12. (i)
13. (i) 14. (iv) 15. (ii) 16. (iii) 17. (i) 18. (iii)
19. (iv) 20. (iii) 21. (ii)

II. Multiple Choice Questions (Type-II)

22. (i), (ii) 23. (i), (iv) 24. (ii), (iii) 25. (ii), (iv)
26. (i), (ii) 27. (ii), (iii) 28. (ii), (iii) 29. (i), (ii)
30. (ii), (iii) 31. (ii), (iii)


III. Short Answer Type

32. Cu shows positive E^\ominus value.
33. **Hint :** Negative E^\ominus values for Mn^{2+} and Zn^{2+} are related to stabilities of half filled and fully filled configuration respectively. But for Ni^{2+} , E^\ominus value is related to the highest negative enthalpy of hydration.
34. Ionisation enthalpy of Cr is lower due to stability of d^5 and the value for Zn is higher because its electron comes out from 4s orbital.
35. The high melting points of transition metals are attributed to the involvement of greater number of electrons in the interatomic metallic bonding from (n-1) d-orbitals in addition to ns electrons
36. **Hint :** Cu^{2+} gets reduced to Cu^+
$$2Cu^{2+} + 4I^- \longrightarrow Cu_2I_2 + I_2$$

(white precipitate)
37. **Hint :** $CuCl_2$ is more stable than Cu_2Cl_2 . The stability of Cu^{2+} (aq.) rather than Cu^+ (aq.) is due to the much more negative $\Delta_{hyd}H^\ominus$ of Cu^{2+} (aq.) than Cu^+ (aq.).
38. A = MnO_2 B = Cl_2 C = NCl_3
$$MnO_2 + 4HCl \longrightarrow MnCl_2 + Cl_2 + 2H_2O$$

(A) (B)
$$NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$$

(excess) (C)
39. **Hint :** It is due to the ability of oxygen to form multiple bonds to metals.
40. **Hint :** Due to symmetrical electronic configuration there is no orbital contribution in Cr^{3+} ion. However appreciable orbital contribution takes place in Co^{2+} ion.

41. **Hint :** It is because in the beginning, when $5f$ orbitals begin to be occupied, they will penetrate less into the inner core of electrons. The $5f$ electrons will therefore, be more effectively shielded from the nuclear charge than $4f$ electrons of the corresponding lanthanoids. Therefore outer electrons are less firmly held and they are available for bonding in the actinoids.
42. **Hint :** Due to lanthanoid contraction, they have almost same size (Zr, 160 pm) and (Hf, 159 pm).
43. It is because after losing one more electron Ce acquires stable $4f^0$ electronic configuration.
44. KMnO_4 acts as oxidising agent. It oxidises oxalic acid to CO_2 and itself changes to Mn^{2+} ion which is colourless.
- $$5\text{C}_2\text{O}_4^{2-} + 2\text{MnO}_4^- + 16\text{H}^+ \longrightarrow 2\text{Mn}^{2+} + 8\text{H}_2\text{O} + 10\text{CO}_2$$
- (Coloured) (Colourless)
45. $\text{Cr}_2\text{O}_7^{2-}$  CrO_4^{2-}
Dichromate (Orange) Chromate (Yellow)
46. Oxidising behaviour of KMnO_4 depends on pH of the solution.
- In acidic medium ($\text{pH} < 7$)
- $$\text{MnO}_4^- + 8\text{H}^+ + 5\text{e}^- \longrightarrow \text{Mn}^{2+} + 4\text{H}_2\text{O}$$
- (Colourless)
- In alkaline medium ($\text{pH} > 7$)
- $$\text{MnO}_4^- + \text{e}^- \longrightarrow \text{MnO}_4^{2-}$$
- (Green)
- In neutral medium ($\text{pH} = 7$)
- $$\text{MnO}_4^- + 2\text{H}_2\text{O} + 3\text{e}^- \longrightarrow \text{MnO}_2 + 4\text{OH}^-$$
- (Brown precipitate)
47. Due to lanthanoid contraction, the atomic radii of the second and third row transition elements is almost same. So they resemble each other much more as compared to first row elements.
48. **Hint :** High ionisation enthalpy to transform $\text{Cu}(\text{s})$ to $\text{Cu}^{2+}(\text{aq})$ is not balanced by its hydration enthalpy. However, in case of Zn after removal of electrons from $4s$ -orbital, stable $3d^{10}$ configuration is acquired.
49. As the oxidation state increases, size of the ion of transition element decreases. As per Fajan's rule, as the size of metal ion decreases, covalent character of the bond formed increases.
50. $n + 1$ rule : For $3d = n + 1 = 5$
 $4s = n + 1 = 4$
So electron will enter in $4s$ orbital.
Ionisation enthalpy is responsible for the ionisation of atom. $4s$ electrons are loosely held by the nucleus. So electrons are removed from $4s$ orbital prior to $3d$.
51. **Hint :** It is due to regular increase in ionisation enthalpy.

IV. Matching Type

52. (i) → (c) (ii) → (d) (iii) → (b) (iv) → (e) (v) → (a)
53. (i) → (b) (ii) → (a) (iii) → (d) (iv) → (e) (v) → (c)
54. (i) → (c) (ii) → (a) (iii) → (b)
55. (i) → (c) (ii) → (a) (iii) → (e) (iv) → (b)
56. (i) → (d) (ii) → (a) (iii) → (b) (iv) → (e) (v) → (f)
57. (i) → (b) (ii) → (d) (iii) → (a) (iv) → (e) (v) → (c)
58. (i) → (c) (ii) → (d) (iii) → (b) (iv) → (a)

V. Assertion and Reason Type

59. (i) 60. (ii) 61. (iii) 62. (i) 63. (ii)

VI. Long Answer Type

64. A = Cu B = Cu(NO₃)₂ C = [Cu(NH₃)₄] D = CO₂
E = CaCO₃ F = Cu₂[Fe(CN)₆] G = Ca (HCO₃)₂
CuCO₃ → CuO + CO₂
CuO + CuS → Cu + SO₂
(A)
Cu + 4HNO₃ (Conc) → Cu (NO₃)₂ + 2NO + 2H₂O
(B)
Cu²⁺ + NH₃ → [Cu(NH₃)₄]
(B) (C)
Ca(OH)₂ + CO₂ → CaCO₃ + H₂O
(D) (E)
CaCO₃ + H₂O + CO₂ → Ca (HCO₃)₂
65. A = FeCr₂O₄ B = Na₂CrO₄ C = Na₂Cr₂O₇·2H₂O D = K₂Cr₂O₇
4FeCr₂O₄ + 8Na₂CO₃ + 7O₂ → 8Na₂CrO₄ + 2Fe₂O₃ + 8CO₂
(A) (B)
2NaCrO₄ + 2H⁺ → Na₂Cr₂O₇ + 2Na⁺ + H₂O
Na₂Cr₂O₇ + 2KCl → K₂Cr₂O₇ + 2NaCl
(C) (D)
66. A = MnO₂ (B) K₂MnO₄ (C) KMnO₄ (D) KIO₃
2 MnO₂ + 4KOH + O₂ → 2K₂MnO₄ + 2H₂O
(A) (B)
3MnO₄²⁻ + 4H⁺ → 2MnO₄⁻ + MnO₂ + 2H₂O
(C)
2MnO₄⁻ + H₂O + KI → 2MnO₂ + 2OH⁻ + KIO₃
(A) (D)

67. **Hint :** (i) As the size decreases covalent character increases. Therefore La_2O_3 is more ionic and Lu_2O_3 is more covalent.
(ii) As the size decreases from La to Lu, stability of oxosalts also decreases.
(iii) Stability of complexes increases as the size of lanthanoids decreases.
(iv) Radii of $4d$ and $5d$ block elements will be almost same.
(v) Acidic character of oxides increases from La to Lu.
68. (a) (i) Cu, because the electronic configuration of Cu is $3d^{10}4s^1$. So second electron needs to be removed from completely filled d -orbital.
(ii) Zn [**Hint :** As above]
(iii) Zn [**Hint :** No unpaired electron for metallic bonding]
- (b) (i) $\text{Fe}(\text{CO})_5$ [**Hint :** EAN rule]
(ii) MnO_3F [**Hint :** Mn shows +7 oxidation state; d -electrons are not involved in bonding.]
69. Interstitial compounds.
Characteristic properties :
(i) High melting points, higher than those of pure metals.
(ii) Very hard.
(iii) Retain metallic conductivity.
(iv) Chemically inert.
70. (a) Reaction between iodide and persulphate ions is :

$$2\text{I}^- + \text{S}_2\text{O}_8^{2-} \xrightarrow{\text{Fe(III)}} \text{I}_2 + 2\text{SO}_4^{2-}$$
Role of Fe (III) ions :

$$2\text{Fe}^{3+} + 2\text{I}^- \longrightarrow 2\text{Fe}^{2+} + \text{I}_2$$

$$2\text{Fe}^{2+} + \text{S}_2\text{O}_8^{2-} \longrightarrow 2\text{Fe}^{3+} + 2\text{SO}_4^{2-}$$
- (b) (i) Vanadium (V) oxide in contact process for oxidation of SO_2 to SO_3 .
(ii) Finely divided iron in Haber's process in conversion of N_2 and H_2 to NH_3 .
(iii) MnO_2 in preparation of oxygen from KClO_3 .
71. A = KMnO_4 B = K_2MnO_4 C = MnO_2 D = MnCl_2
- $$\text{KMnO}_4 \xrightarrow{\Delta} \text{K}_2\text{MnO}_4 + \text{MnO}_2 + \text{O}_2$$
- (A) (B) (C)
- $$\text{MnO}_2 + \text{KOH} + \text{O}_2 \longrightarrow 2\text{K}_2\text{MnO}_4 + 2\text{H}_2\text{O}$$
- $$\text{MnO}_2 + 4\text{NaCl} + 4\text{H}_2\text{SO}_4 \longrightarrow \text{MnCl}_2 + 2\text{NaHSO}_4 + 2\text{H}_2\text{O} + \text{Cl}_2$$
- (D)