

COMPLETE d-BLOCK

- The electronic configuration of Cu(II) is $3d^9$ whereas that of Cu(I) is $3d^{10}$. Which of the following is correct ?
 - Cu(II) is less stable
 - Stability of Cu(I) and Cu(II) depends on nature of copper salts
 - Cu(II) is more stable
 - Cu(I) and Cu(II) are equally stable
- Consider the following reaction
 $MnO_2 + KOH + O_2 \rightarrow A + H_2O$
 Product 'A' in neutral or acidic medium disproportionate to give products 'B' and 'C' along with water. The sum of spin-only magnetic moment values of B and C is _____ BM. (nearest integer)
 (Given atomic number of Mn is 25)
- The element which shows only one oxidation state other than its elemental form is :
 - Cobalt
 - Scandium
 - Titanium
 - Nickel
- A transition metal 'M' among Sc, Ti, V, Cr, Mn and Fe has the highest second ionisation enthalpy. The spin only magnetic moment value of M^+ ion is _____ BM (Near integer)
 (Given atomic number Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26)
- Given below are two statements :
Statement I: The higher oxidation states are more stable down the group among transition elements unlike p-block elements.
Statement II: Copper can not liberate hydrogen from weak acids.
 In the light of the above statements, choose the correct answer from the options given below :
 - Both Statement I and Statement II are false
 - Statement I is false but Statement II is true
 - Both Statement I and Statement II are true
 - Statement I is true but Statement II is false
- Iron (III) catalyses the reaction between iodide and persulphate ions, in which
 - Fe^{3+} oxidises the iodide ion
 - Fe^{3+} oxidises the persulphate ion
 - Fe^{2+} reduces the iodide ion
 - Fe^{2+} reduces the persulphate ion
 Choose the **most appropriate** answer from the options given below:
 - B and C only
 - B only
 - A only
 - A and D only
- The 'spin only' magnetic moment value of MO_4^{2-} is _____ BM. (Where M is a metal having least metallic radii. among Sc, Ti, V, Cr, Mn and Zn).
 (Given atomic number : Sc = 21, Ti = 22, V = 23, Cr = 24, Mn = 25 and Zn = 30)
- The equilibrium $Cr_2O_7^{2-} \rightleftharpoons 2CrO_4^{2-}$ is shifted to the right in :
 - an acidic medium
 - a basic medium
 - a weakly acidic medium
 - a neutral medium
- Given below are two statements :
Statement (I) : Fusion of MnO_2 with KOH and an oxidising agent gives dark green K_2MnO_4 .
Statement (II) : Manganate ion on electrolytic oxidation in alkaline medium gives permanganate ion.
 In the light of the above statements, choose the **correct** answer from the options given below.
 - Both **Statement I** and **Statement II** is true
 - Both **Statement I** and **Statement II** is false
 - Statement I** is true but **Statement II** is false
 - Statement I** is false but **Statement II** is true

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- 10.** The difference in the 'spin-only' magnetic moment values of KMnO_4 and the manganese product formed during titration of KMnO_4 against oxalic acid in acidic medium is _____ BM. (nearest integer)
- 11.** Among VO_2^+ , MnO_4^- and $\text{Cr}_2\text{O}_7^{2-}$, the spin-only magnetic moment value of the species with least oxidising ability is BM (Nearest integer).
(Given atomic member V = 23, Mn = 25, Cr = 24)
- 12.** Arrange the following elements in the increasing order of number of unpaired electrons in it.
(A) Sc (B) Cr
(C) V (D) Ti
(E) Mn
Choose the correct answer from the options given below:
(1) (C) < (E) < (B) < (A) < (D)
(2) (B) < (C) < (D) < (E) < (A)
(3) (A) < (D) < (C) < (B) < (E)
(4) (A) < (D) < (C) < (E) < (B)
- 13.** The metal that shows highest and maximum number of oxidation state is:
(1) Fe (2) Mn
(3) Ti (4) Co
- 14.** The spin only magnetic moment value of the ion among Ti^{2+} , V^{2+} , Co^{3+} and Cr^{2+} , that acts as strong oxidising agent in aqueous solution is BM (Near integer).
(Given atomic numbers : Ti : 22, V : 23, Cr : 24, Co : 27)
- 15.** The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is _____. Ti^{2+} , Cr^{2+} and V^{2+}
(1) 0 (2) 2
(3) 3 (4) 1
- 16.** The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of CO_2 . The sum of spin-only magnetic moment values of A and B is ____ B.M. (Nearest integer)
(Given atomic number: C : 6, Na : 11, O : 8, Fe : 26, Cr : 24]
- 17.** A first row transition metal in its +2 oxidation state has a spin-only magnetic moment value of 3.86 BM. The atomic number of the metal is
(1) 25 (2) 26
(3) 22 (4) 23
- 18.** A first row transition metal with highest enthalpy of atomisation, upon reaction with oxygen at high temperature forms oxides of formula M_2O_n (where n = 3,4,5). The 'spin-only' magnetic moment value of the amphoteric oxide from the above oxides is ____ BM (near integer)
(Given atomic number : Sc : 21, Ti : 22, V : 23, Cr : 24, Mn : 25, Fe : 26, Co : 27, Ni : 28, Cu : 29, Zn : 30)
- 19.** Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.
Assertion (A) : In aqueous solutions Cr^{2+} is reducing while Mn^{3+} is oxidising in nature.
Reason (R) : Extra stability to half filled electronic configuration is observed than incompletely filled electronic configuration.
In the light of the above statement, choose the most appropriate answer from the options given below:
(1) Both (A) and (R) are true and (R) is the correct explanation of (A)
(2) Both (A) and (R) are true but (R) is not the correct explanation of (A)
(3) (A) is false but (R) is true
(4) (A) is true but (R) is false

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- 28.** Choose the correct option having all the elements with d^{10} electronic configuration from the following:
- (1) ^{27}Co , ^{28}Ni , ^{26}Fe , ^{24}Cr
 - (2) ^{29}Cu , ^{30}Zn , ^{48}Cd , ^{47}Ag
 - (3) ^{46}Pd , ^{28}Ni , ^{26}Fe , ^{24}Cr
 - (4) ^{28}Ni , ^{24}Cr , ^{26}Fe , ^{29}Cu
- 29.** Identify the incorrect pair from the following:
- (1) Photography - AgBr
 - (2) Polythene preparation – TiCl_4 , $\text{Al}(\text{CH}_3)_3$
 - (3) Haber process - Iron
 - (4) Wacker process – Pt Cl_2

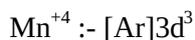
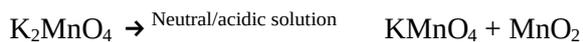
SOLUTIONS
1. Ans. (3)

Sol. Cu(II) is more stable than Cu(I) because hydration energy of Cu^{+2} ion compensate IE_2 of Cu.

2. Ans. (4)

Sol. $\text{MnO}_2 + \text{KOH} + \text{O}_2 \rightarrow \text{K}_2\text{MnO}_4 + \text{H}_2\text{O}$

(A)



$$n = 3, \infty = \sqrt{3(3+2)} = 3.87 \text{ B.M.}$$

Nearest integer is (4)

3. Ans. (2)

Sol. Co, Ti, Ni can show +2, +3 and +4 oxidation state, But 'Sc' only shows +3 stable oxidation state.

4. Ans. (6)

Sol. Among given metals, Cr has maximum IE_2 because Second electron is removed from stable configuration $3d^5$


 \therefore No of unpaired e^- in Cr^+ is 5, $n = 5$

$$\text{So, Magnetic moment} = \sqrt{n(n+2)} \text{ B.M}$$

$$= \sqrt{5(5+2)} = 5.92 \text{ BM} \approx 6$$

5. Ans. (3)

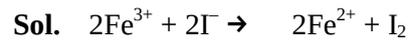
Sol. On moving down the group in transition elements, stability of higher oxidation state increases, due to increase in effective nuclear charge.

$$\Rightarrow E^\circ_{\text{Cu}^{+2}/\text{Cu}} = 0.34 \text{ V}$$

$$\Rightarrow E^\circ_{\text{H}^+/\text{H}_2} = 0$$



Cu can't liberate hydrogen gas from weak acid.

6. Ans. (4)


Fe^{+3} oxidises I^- to I_2 and convert itself into Fe^{+2} . This Fe^{+2} reduces $\text{S}_2\text{O}_8^{2-}$ to SO_4^{2-} and converts itself into Fe^{+3} .

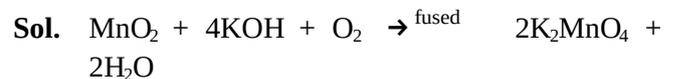
7. Ans. (0)

Sol. Metal having least metallic radii among Sc, Ti, V, Cr, Mn & Zn is Cr.

 Spin only magnetic moment of CrO_4^{2-} .

 Here Cr^{+6} is in d^0 configuration (diamagnetic).

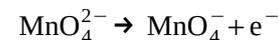
8. Ans. (2)

9. Ans. (1)


Dark green

Electrolytic oxidation in alkaline medium :

At anode :


10. Ans. (6)

Sol. Spin only magnetic moment of Mn in $\text{KMnO}_4 = 0$

Spin only value of manganese product formed during titration of KMnO_4 against oxalic acid in acidic medium is = 6

11. Ans. (0)

Sol. For 3d transition series;

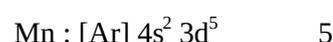
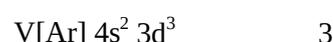
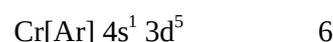
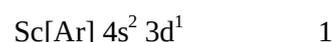
 Oxidising power : $\text{V}^{+5} < \text{Cr}^{+6} < \text{Mn}^{+7}$


Number of unpaired electron = 0

$$\boxed{\infty = 0}$$

12. Ans. (4)

Sol. Unpaired Electron



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- 13. Ans. (2)**
Sol. Mn shows highest oxidation state (Mn⁺⁷) in 3d series metals.
- 14. Ans. (5)**
Sol. Strong oxidising agent = Co⁺³
 No. of unpaired e⁻ in Co⁺³[3d⁶] = 4
 Hence $\propto \sqrt{n(n+2)} = \sqrt{24}$ BM
 Nearest integer = 5
- 15. Ans. (3)**
Sol. The ions Ti⁺², V⁺² Cr⁺² are strong reducing agents and will liberate hydrogen from a dilute acid, eg.

$$2\text{Cr}_{(\text{aq.})}^{+2} + 2\text{H}_{(\text{aq.})}^{+} \rightarrow 2\text{Cr}_{(\text{aq.})}^{+3} + \text{H}_{2(\text{g})}$$
- 16. Ans. (6)**
Sol. $4\text{FeCr}_2\text{O}_4 + 8\text{Na}_2\text{CO}_3 + 7\text{O}_2 \rightarrow$

$$\text{A} \qquad \qquad \qquad \text{B}$$

$$8\text{Na}_2\text{CrO}_4 + 2\text{Fe}_2\text{O}_3 + 8\text{CO}_2$$

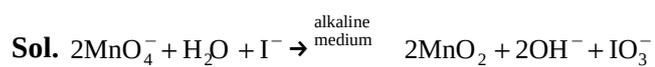
 Spin only magnetic moment
 For Na₂CrO₄ $\mu_B = 0$
 For Fe₂O₃ $\mu_B = 5.9$
 sum = 5.9
- 17. Ans.(4)**
Sol. ${}_{22}\text{Ti}^{+2} \Rightarrow [\text{Ar}]3d^2$
 ${}_{23}\text{V}^{+2} \Rightarrow [\text{Ar}]3d^3$
 ${}_{25}\text{Mn}^{+2} \Rightarrow [\text{Ar}]3d^5$
 ${}_{26}\text{Fe}^{+2} \Rightarrow [\text{Ar}]3d^6$
- 18. Ans.(0)**
Sol. 'V' has highest enthalpy of atomisation (515 kJ/mol) among first row transition elements.
 V₂O₅
 Here 'V' is in +5 oxidation state
 $\text{V}^{+5} \Rightarrow 1s^2 2s^2 2p^6 3s^2 3p^6$ (no unpaired electrons)
- 19. Ans. (1)**
Sol. Cr²⁺ is reducing as its configuration changes from d⁴ to d³ due to formation of Cr³⁺, which has half filled t_{2g} level, on other hand, the change Mn³⁺ to Mn²⁺ result half filled d⁵ configuration which has extra stability.
- 20. Ans. (2)**
Sol. 3rd Ionisation energy : [NCERT Data]
 V : 2833 KJ/mol
 Cr : 2990 KJ/mol
 Mn : 3260 KJ/mol
 Fe : 2962 KJ/mol
 alternative
 Mn : 3d⁵ 4s²
 Fe : 3d⁶ 4s²
 Cr : 3d⁵ 4s¹
 V : 3d³ 4s²
 So Mn has highest 3rd IE among all the given elements due to d⁵ configuration.
- 21. Ans. (4)**
Sol. A. CrO₄²⁻ is tetrahedral
 B. $2\text{Na}_2\text{CrO}_4 + 2\text{H}^{+} \rightarrow \text{Na}_2\text{Cr}_2\text{O}_7 + 2\text{Na}^{+} + \text{H}_2\text{O}$
 C. As per NCERT, green manganate is paramagnetic with 1 unpaired electron.
 D. Statement is correct
 E. Statement is correct
- 22. Ans. (1)**
Sol. Mn, Ni and Cd metals used in battery industries.
- 23. Ans. (2)**
Sol. (A) Mn₂O₇ is green oil at room temperature.
 (B) V₂O₄ dissolve in acids to give VO²⁺ salts.
 (C) CrO is basic oxide
 (D) V₂O₅ is amphoteric it reacts with acid as well as base.
- 24. Ans. (2)**
Sol. Alkaline oxidative fusion of MnO₂:

$$2\text{MnO}_2 + 4\text{OH}^{-} + \text{O}_2 \rightarrow 2\text{MnO}_4^{2-} + 2\text{H}_2\text{O}$$

 Electrolytic oxidation of MnO₄²⁻ in alkaline medium.

$$\text{MnO}_4^{2-} \rightarrow \text{MnO}_4^{-} + \text{e}^{-}$$

25. **Ans. (4)**



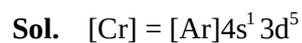
26. **Ans. (4)**



27. **Ans. (1)**

Sol. (A) Zn, Cd, Hg exhibit lowest enthalpy of atomization in respective transition series.
(C) Compounds of Zn, Cd and Hg are diamagnetic in nature.

28. **Ans. (2)**



29. **Ans. (4)**

Sol. The catalyst used in Wacker's process is PdCl_2