Q1 - 2024 (01 Feb Shift 2)

The transition metal having highest 3^{rd} ionisation enthalpy is :

(1) Cr

(2) Mn

(3) V

(4) Fe

Q2 - 2024 (01 Feb Shift 2)

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

Q3 - 2024 (01 Feb Shift 2)

Which of the following compounds show colour due to d-d transition?

(1) $CuSO_4.5H_2O$

(2) $K_2Cr_2O_7$

(3) K_2CrO_4

(4) $KMnO_4$

Q4 - 2024 (27 Jan Shift 1)

Given below are two statements :

Statement (I) : The 4f and 5f - series of elements are placed separately in the Periodic table to preserve the principle of classification.

Statement (II) :S-block elements can be found in pure form in nature. In the light of the above statements, choose the most appropriate answer from the options given below :

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are false

Q5 - 2024 (27 Jan Shift 1)

NaCl reacts with conc. H_2SO_4 and $K_2Cr_2O_7$ to give reddish fumes (B), which react with NaOH to give yellow solution (C). (B) and (C) respectively are ;

(1) CrO_2Cl_2, Na_2CrO_4

(2) Na_2CrO_4, CrO_2Cl_2

(3) $CrO_2Cl_2, KHSO_4$

(4) $CrO_2Cl_2, Na_2Cr_2O_7$

Q6 - 2024 (27 Jan Shift 2)

Given below are two statements:

Statement (I) : In the Lanthanoids, the formation of Ce^{+4} is favoured by its noble gas configuration.

Statement (II) : Ce^{+4} is a strong oxidant reverting to the common +3 state.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Statement I is false but Statement II is true

(2) Both Statement I and Statement II are true

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are false

Q7 - 2024 (27 Jan Shift 2)

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) $^{46}Pd, ^{28}Ni, ^{26}Fe, ^{24}_{2}Cr$

(4) $^{28}Ni, ^{24}Cr, ^{26}Fe, ^{29}Cu$

Q8 - 2024 (29 Jan Shift 1)

In chromyl chloride test for confirmation of Cl^- ion, a yellow solution is obtained. Acidification of the solution and addition of amyl alcohol and 10\% H_2O_2 turns organic layer blue indicating formation of chromium pentoxide. The oxidation state of chromium in that is

(1) +6

(2) +5

(3) +10

(4) +3

Q9 - 2024 (29 Jan Shift 1)

In alkaline medium. MnO_4^- oxidises I^- to

(1) IO_4^-

(2) IO^-

(3) I_2

(4) IO_3^-

Q10 - 2024 (29 Jan Shift 2)

Which of the following acts as a strong reducing agent? (Atomic number : $Ce = 58, Eu = 63, Gd = 64, Lu = 71$)

(1) Lu^{3+}

(2) Gd^{3+}

(3) Eu^{2+}

(4) Ce^{4+}

Q11 - 2024 (29 Jan Shift 2)

Which of the following statements are correct about Zn, Cd and Hg ?

A. They exhibit high enthalpy of atomization as the d-subshell is full.

B. Zn and Cd do not show variable oxidation state while Hg shows +I and + II.

C. Compounds of Zn, Cd and Hg are paramagnetic in nature.

D. Zn, Cd and Hg are called soft metals.

Choose the most appropriate from the options given below:

(1) B, D only

(2) B, C only

(3) A, D only

(4) C, D only

Q12 - 2024 (30 Jan Shift 1)

Diamagnetic Lanthanoid ions are:

(1) Nd^{3+} and Eu^{3+}

(2) La^{3+} and Ce^{4+}

(3) Nd^{3+} and Ce^{4+}

(4) Lu^{3+} and Eu^{3+}

Q13 - 2024 (30 Jan Shift 1)

Match List-I with List-II

List-I Species	List-II Electronic distribution
(A) Cr^{+2}	(I) $3d^8$
(B) Mn^{+}	(II) $3d^3 4s^1$
(C) Ni^{+2}	(III) $3d^4$
(D) V^{+}	(IV) $3d^5 4s^1$

Choose the correct answer from the options given below:

(1) (A)-I, (B)-II, (C)-III, (D)-IV

(2) (A)-III, (B) - IV, (C) - I, (D)-II

(3) (A)-IV, (B)-III, (C)-I, (D)-II

(4) (A)-II, (B)-I, (C)-IV, (D)-III

Q14 - 2024 (30 Jan Shift 2)

The orange colour of $K_2Cr_2O_7$ and purple colour of $KMnO_4$ is due to

(1) Charge transfer transition in both.

(2) d $\rightarrow$ d transition in $KMnO_4$ and charge transfer transitions in $K_2Cr_2O_7$.

(3) d $\rightarrow$ d transition in $K_2Cr_2O_7$ and charge transfer transitions in $KMnO_4$.

(4) $d \rightarrow d$ transition in both.

Q15 - 2024 (30 Jan Shift 2)

Alkaline oxidative fusion of MnO_2 gives "A" which on electrolytic oxidation in alkaline solution produces B. A and B respectively are:

(1) Mn_2O_7 and MnO_4^-

(2) MnO_4^{2-} and MnO_4^-

(3) Mn_2O_3 and MnO_4^{2-}

(4) MnO_4^{2-} and Mn_2O_7

Q16 - 2024 (30 Jan Shift 2)

A and B formed in the following reactions are:

$$CrO_2Cl_2 + 4NaOH \rightarrow A + 2NaCl + 2H_2O$$
$$A + 2HCl + 2H_2O_2 \rightarrow B + 3H_2O$$

(1) $A = Na_2CrO_4,\ B = CrO_5$

(2) $A = Na_2Cr_2O_4,\ B = CrO_4$

(3) $A = Na_2Cr_2O_7,\ B = CrO_3$

(4) $A = Na_2Cr_2O_7,\ B = CrO_5$

Q17 - 2024 (31 Jan Shift 1)

Identify correct statements from below:

A. The chromate ion is square planar.

B. Dichromates are generally prepared from chromates.

C. The green manganate ion is diamagnetic.

D. Dark green coloured K_2MnO_4 disproportionates in a neutral or acidic medium to give permanganate.

E. With increasing oxidation number of transition metal, ionic character of the oxides decreases.

Choose the correct answer from the options given below:

(1) B, C, D only

(2) A, D, E only

(3) A, B, C only

(4) B, D, E only

Q18 - 2024 (31 Jan Shift 1)

The 'Spin only' Magnetic moment for $\left[Ni(NH_3)_6\right]^{2+}$ is _____ $\times 10^{-1}$BM.

(given = Atomic number of Ni : 28)

Q19 - 2024 (31 Jan Shift 2)

Choose the correct statements from the following

A. Mn_2O_7 is an oil at room temperature

B. V_2O_4 reacts with acid to give VO_2^{2+}

C. CrO is a basic oxide

D. V_2O_5 does not react with acid

Choose the correct answer from the options given below :

(1) A, B and D only

(2) A and C only

(3) A, B and C only

(4) B and C only

Q20 - 2024 (31 Jan Shift 2)

Number of moles of H^+ ions required by 1 mole of MnO_4^- to oxidise oxalate ion to CO_2 is _____.

Q21 - 2024 (31 Jan Shift 2)

In the reaction of potassium dichromate, potassium chloride and sulfuric acid (conc.), the oxidation state of the chromium in the product is $(+)$

Answer Key

Q1 (2)	**Q2** (1)	**Q3** (1)	**Q4** (3)
Q5 (1)	**Q6** (2)	**Q7** (2)	**Q8** (1)
Q9 (4)	**Q10** (3)	**Q11** (1)	**Q12** (2)
Q13 (2)	**Q14** (1)	**Q15** (2)	**Q16** (1)
Q17 (4)	**Q18** (28)	**Q19** (2)	**Q20** (8)
Q21 (6)			

Q1

3rd Ionisation energy : [NCERT Data]

V : 2833KJ/mol

Cr : 2990KJ/mol

Mn : 3260KJ/mol

Fe : 2962KJ/mol

alternative

Mn : $3\,d^5 4\,s^2$

Fe : $3\,d^6 4\,s^2$

Cr : $3\,d^5 4\,s^1$

V : $3\,d^3 4\,s^2$

So Mn has highest 3rd IE among all the given elements due to d^5 configuration.

Q2

Cr^{2+} is reducing as it configuration changes from d^4 to d^3 due to formation of Cr^{3+}, which has half filled t_{2g} level, on other hand, the change Mn^{3+} to Mn^{2+} result half filled d^5 configuration which has extra stability.

Q3

$CuSO_4 \cdot 5H_2O$

Cu^{2+} : $3\,d^9 4\,s^0$

unpaired electron present so it show colour due to d-d transition.

Q4

s-block elements are highly reactive and found in combined state.

Q5

$NaCl + \text{conc. } H_2SO_4 + K_2Cr_2O_7$

$\rightarrow CrO_2Cl_2 + KHSO_4 + NaHSO_4 + H_2O$

(B)

Reddish brown

$$CrO_2Cl_2 + NaOH \rightarrow Na_2CrO_4 + NaCl + H_2O$$

(C)

Yellow colour

Q6

Statement (1) is true, Ce^{+4} has noble gas electronic configuration.

Statement (2) is also true due to high reduction potential for $Ce^{4+}/Ce^{3+}(+1.74\ V)$, and stability of Ce^{3+}, Ce^{4+} acts as strong oxidizing agent.

Q7

$[Cr] = [Ar]4\,s^1 3\,d^5$

$[Cd] = [Kr]5\,s^2 4\,d^{10}$

$[Cu] = [Ar]4\,s^1 3\,d^{10}$

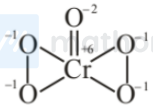
$[Ag] = [Kr]5\,s^1 4\,d^{10}$

$[Zn] = [Ar]4\,s^2 3\,d^{10}$

Q8

$$Cl^- + K_2Cr_2O_7 + H_2SO_4 \rightarrow CrO_2Cl_2 \xrightarrow{\text{Basic medium}} \underset{\text{yellow solution}}{CrO_4^{2-}} + Cl^-$$

$$\underset{\text{yellow solution}}{CrO_4^{2-}} \xrightarrow[3.\,10\%\ H_2O_2]{1.\,\text{Acidification}\ 2.\,\text{Amyl alcohol}} \underset{\text{blue compound}}{CrO_5}$$



Q9

$$2MnO_4^- + H_2O + I^- \xrightarrow{\text{alkaline medium}} 2MnO_2 + 2OH^- + IO_3^-$$

Q10

Eu^{+2}

$[Xe]4f^7 6\,s^0 \quad Eu^{+3} + 1e^-$

$[Xe]4f^6 6\,s^0$

Q11

(A) Zn, Cd, Hg exhibit lowest enthalpy of atomization in respective transition series.

(C) Compounds of Zn, Cd and Hg are diamagnetic in nature.

Q12

$Ce : [Xe]4f^{1}5\ d^{1}6\ s^{2}; Ce^{4+}$ diamagnetic

$La : [Xe]4f^{0}5\ d^{1}6\ s^{2}; La^{3+}$ diamagnetic

Q13

$_{24}Cr \rightarrow [Ar]3\ d^{5}4\ s^{1}; Cr^{2+} \rightarrow [Ar]3\ d^{4}$

$_{25}Mn \rightarrow [Ar]3\ d^{5}4\ s^{2}; Mn^{+} \rightarrow [Ar]3\ d^{5}4\ s^{1}$

$_{28}Ni \rightarrow [\ Ar\ ]3\ d^{8}4\ s^{2}; Ni^{2+} \rightarrow [\ Ar\ ]3\ d^{8}$

$_{23}\ V \rightarrow [Ar]3\ d^{3}4\ s^{2}; V^{+} \rightarrow [Ar]3\ d^{3}4\ s^{1}$

Q14

$$\left.\begin{array}{l} K_2Cr_2O_7 \rightarrow Cr^{+6} \rightarrow \text{ No d - d transition} \\ KMnO_4 \rightarrow Mn^{7+} \rightarrow \text{ No d-d transition} \end{array}\right\} \text{Charge transfer}$$

Q15

Alkaline oxidative fusion of MnO_2 :

$$2MnO_2 + 4OH^- + O_2 \rightarrow 2MnO_4^{2-} + 2H_2O$$

Electrolytic oxidation of $MnO_4{}^{2-}$ in alkaline medium.

$$MnO_4^{2-} \rightarrow MnO_4^- + e^-$$

Q16

$$CrO_2Cl_2 + 4NaOH \rightarrow \underset{(A)}{Na_2CrO_4} + 2NaCl + 2H_2O$$

$$Na_2CrO_4 + 2H_2O_2 + 2HCl \rightarrow \underset{(B)}{CrO_5} + \underset{\text{Missingfrom balanced eqaution}}{2NaCl} + 3H_2O$$

Q17

A. CrO_4^{2-} is tetrahedral

B. $2Na_2CrO_4 + 2H^+ \rightarrow Na_2Cr_2O_7 + 2Na^+ + H_2O$

C. As per NCERT, green manganate is paramagnetic with 1 unpaired electron.

D. Statement is correct

E. Statement is correct

Q18

NH_3 act as WFL with Ni^{2+}

$Ni^{2+} = 3\ d^8$

No. of unpaired electron $= 2$

$$\mu = \sqrt{n(n+2)} = \sqrt{8} = 2.82BM$$
$$= 28.2 \times 10^{-1}BM$$
$$x = 28$$

Q19

(A) Mn_2O_7 is green oil at room temperature.

(B) V_2O_4 dissolve in acids to give VO^{2+} salts.

(C) CrO is basic oxide

(D) V_2O_5 is amphoteric it reacts with acid as well as base.

Q20

$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \longrightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

$\therefore$ Number of moles of H^+ ions required by 1 mole of MnO_4^- to oxidise oxalate ion to CO_2 is 8

Q21

$K_2Cr_2O_7(s) + 4KCl(s) + 6H_2SO_4$ (conc.)

$\rightarrow 2CrO_2Cl_2(g) + 6KHSO_4 + 3H_2O$

This reaction is called chromyl chloride test.

Here oxidation state of Cr is +6.