CHEMISTRY

SECTION-A

1. Water sample is called cleanest on the basis of which one of the BOD values given below

(1) 11 ppm   (2) 15 ppm

(3) 3 ppm   (4) 21 ppm

Official Ans. by NTA (3)

Sol. Clean water could have BOD value of less than 5 ppm whereas highly polluted water could have a BOD value of 17 ppm or more.

2. Calamine and Malachite, respectively, are the ores of :
(1) Nickel and Aluminium
(2) Zinc and Copper
(3) Copper and Iron
(4) Aluminium and Zinc

Official Ans. by NTA (2)

Sol. Calamine $\Rightarrow ZnCO_3$

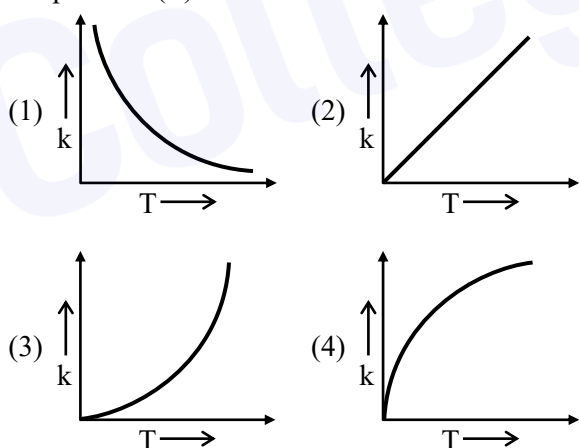Malachite $\Rightarrow Cu(OH)_2 \cdot CuCO_3$

3. Experimentally reducing a functional group **cannot** be done by which one of the following reagents ?
(1) Pt-C/H$_2$ (2) Na/H$_2$
(3) Pd-C/H$_2$ (4) Zn/H$_2$O

Official Ans. by NTA (2)

Sol. Solution NaH$_2$ is not reducing agent

4. Which one of the following given graphs represents the variation of rate constant (k) with temperature (T) for an endothermic reaction ?
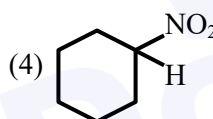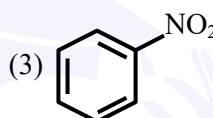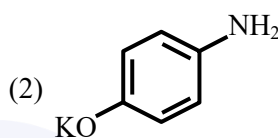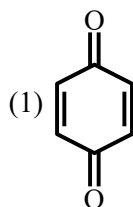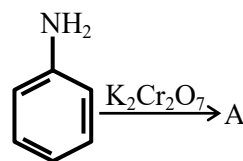

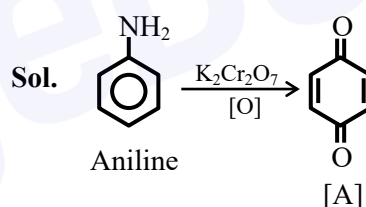**Official Ans. by NTA (3)**

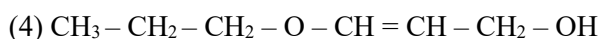**Sol.** By observation we get this plot during measurable temperatures

Ans. 3rd Option.

5. Identify A in the following reaction.

Official Ans. by NTA (1)

Sol.

Aniline   [A]

6. In the following sequence of reactions a compound **A**, (molecular formula $C_6H_{12}O_2$) with a straight chain structure gives a C_4 carboxylic acid. **A** is :

$$\mathbf{A} \xrightarrow[H_3O^+]{LiAlH_4} \mathbf{B} \xrightarrow{Oxidation} C_4 - \text{carboxylic acid}$$

(1) $CH_3 - CH_2 - COO - CH_2 - CH_2 - CH_3$

(2) $CH_3-CH_2-\overset{\overset{\displaystyle OH}{|}}{CH}-CH_2-O-CH=CH_2$

(3) $CH_3 - CH_2 - CH_2 - COO - CH_2 - CH_3$

(4) $CH_3 - CH_2 - CH_2 - O - CH = CH - CH_2 - OH$

Official Ans. by NTA (3)

Sol.

$$CH_3-CH_2-CH_2-\overset{\underset{\|}{O}}{C}-O-CH_2-CH_3 \quad \text{(A) } [C_6H_{12}O_2]$$

$$\downarrow \begin{array}{l}(1)\ LiAlH_4 \\ (2)\ H_3O^+\end{array}$$

$$CH_3-CH_2-CH_2-CH_2-OH + CH_3-CH_2-$$

(B)

$$\downarrow [O]$$

$$CH_3-CH_2-CH_2-\overset{\underset{\|}{O}}{C}-OH \quad [C_4 \text{ carboxylic acid}]$$
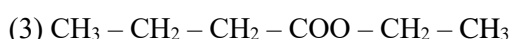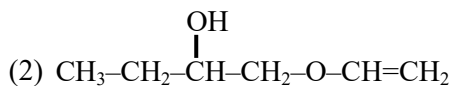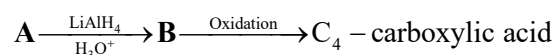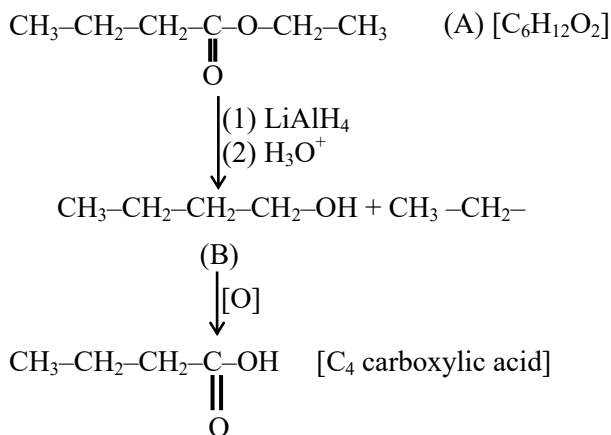
7. Match **List – I** with **List - II**.

List -I (Colloid Preparation Method)		List -II (Chemical Reaction)	
(a)	Hydrolysis	(i)	$2AuCl_3 + 3HCHO + 3H_2O \rightarrow$ $2Au(sol) + 3HCOOH + 6HCl$
(b)	Reduction	(ii)	$As_2O_3 + 3H_2S \rightarrow As_2S_3(sol) + 3H_2O$
(c)	Oxidation	(iii)	$SO_2 + 2H_2S \rightarrow 3S(sol) + 2H_2O$
(d)	Double Decomposition	(iv)	$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3(sol) + 3HCl$

Choose the most appropriate answer from the options given below.

(1) (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

(2) (a)-(iv), (b)-(i), (c)-(iii), (d)-(ii)

(3) (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

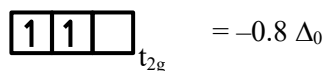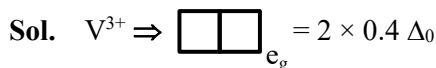(4) (a)-(i), (b)-(ii), (c)-(iv), (d)-(iii)

Official Ans. by NTA (2)

Sol. According to type of reactions for preparation, colloids have been classified

8. The Crystal Field Stabilization Energy (CFSE) and magnetic moment (spin-only) of an octahedral aqua complex of a metal ion (M^{z+}) are $-0.8\ \Delta_0$ and 3.87 BM, respectively. Identify (M^{z+}) :
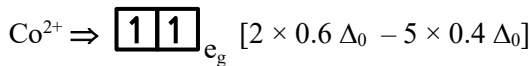
(1) V^{3+} (2) Cr^{3+}

(3) Mn^{4+} (4) Co^{2+}

Official Ans. by NTA (4)

Sol. $V^{3+} \Rightarrow \boxed{\ \ |\ \ }_{e_g} = 2 \times 0.4\ \Delta_0$

$\boxed{1|1|\ }_{t_{2g}} = -0.8\ \Delta_0$

$= 2$ unpaired e^-

$\mu = 2.89$ Bm

$Co^{2+} \Rightarrow \boxed{1|1}_{e_g} \ [2 \times 0.6\ \Delta_0 - 5 \times 0.4\ \Delta_0]$

$= -0.8\ \Delta_0$

$\boxed{1\downarrow|1\downarrow|1}_{t_{2g}}$ 3 unpaired $e^- \Rightarrow \mu = 3.87$ BM
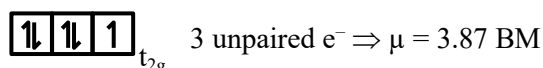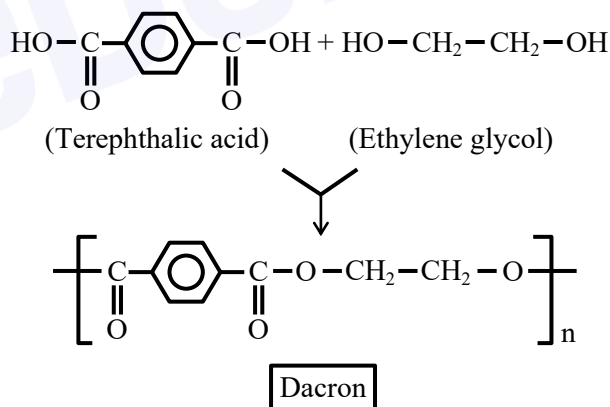
hence d^7 configuration is of Co^{2+} Ans.

9. Monomer units of Dacron polymer are :

(1) ethylene glycol and phthalic acid

(2) ethylene glycol and terephthalic acid

(3) glycerol and terephthalic acid

(4) glycerol and phthalic acid

Official Ans. by NTA (2)

Sol.

$$HO-\overset{\underset{\|}{O}}{C}-\bigcirc-\overset{\underset{\|}{O}}{C}-OH + HO-CH_2-CH_2-OH$$

(Terephthalic acid)   (Ethylene glycol)

$$\downarrow$$

$$\left[\overset{\underset{\|}{O}}{C}-\bigcirc-\overset{\underset{\|}{O}}{C}-O-CH_2-CH_2-O\right]_n$$

Dacron

10. Which one of the following compounds is aromatic in nature ?

(1)   (2)

(3)   (4)
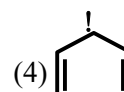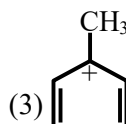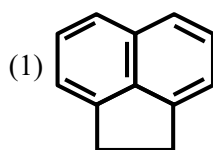
Official Ans. by NTA (4)

Sol. (1) (Acenaphthene)

 → 10 πe^- in cyclic conjugation

→ ⟨Aromatic⟩

(2) → $4\pi e^-$ in ring conjugation ⟹ Anti Aromatic

(3) $-CH_3$ ⟹ $4\pi e^-$ in ring conjugation ⟹ Antiaromatic

(4)

 ⟹ $6\pi e^-$ in ring conjugation ⟹ ⟨Aromatic⟩
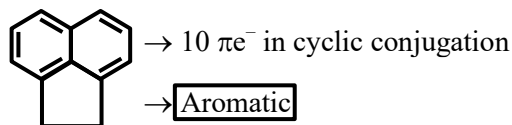
└— Cyclopentadienyl anion

11. In the given chemical reaction, colors of the Fe^{2+} and Fe^{3+} ions, are respectively :

$5Fe^{2+} + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O + 5Fe^{3+}$
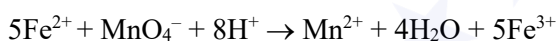
(1) Yellow, Orange   (2) Yellow, Green

(3) Green, Orange   (4) Green, Yellow
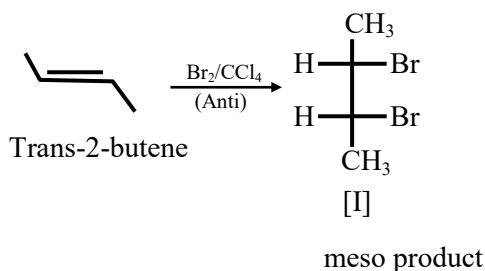
Official Ans. by NTA (4)

Sol. Colour of Fe^{2+} is observed green and Fe^{3+} is yellow

12. The stereoisomers that are formed by electrophilic addition of bromine to trans-but-2-ene is/are :

(1) 2 enantiomers and 2 mesomers

(2) 2 identical mesomers

(3) 2 enantiomers

(4) 1 racemic and 2 enantiomers

Official Ans. by NTA (2)

Sol.

Trans-2-butene $\xrightarrow[\text{(Anti)}]{Br_2/CCl_4}$

[I]

meso product

13. Hydrogen peroxide reacts with iodine in basic medium to give :

(1) IO_4^- (2) IO^- (3) I^- (4) IO_3^-

Official Ans. by NTA (3)

Sol. $I_2 + H_2O_2 + 2OH^- \longrightarrow 2I^- + 2H_2O + O_2$

14. In the following sequence of reactions,

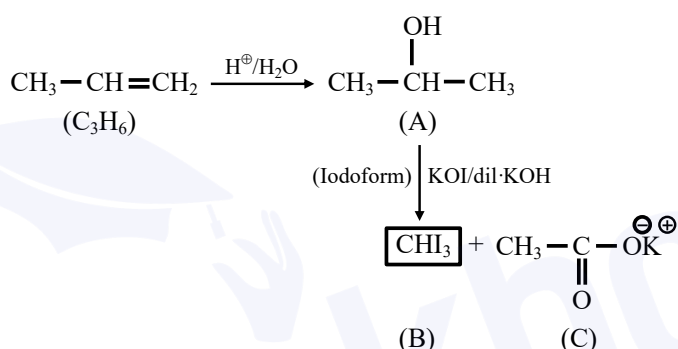$C_3H_6 \xrightarrow{H^+/H_2O} A \xrightarrow[\text{dil KOH}]{KIO} B + C$

The compounds **B** and **C** respectively are :

(1) CI_3COOK, $HCOOH$ (2) CI_3COOK, CH_3I

(3) CH_3I, $HCOOK$ (4) CHI_3, CH_3COOK

Official Ans. by NTA (4)

Sol.

$$CH_3-CH=CH_2 \xrightarrow{H^\oplus/H_2O} CH_3-\underset{OH}{CH}-CH_3$$
(C₃H₆)   (A)

(Iodoform) KOI/dil·KOH

⟨CHI₃⟩ + $CH_3-\underset{\underset{O}{\|}}{C}-\overset{\oplus}{O}\overset{\ominus}{K}$

(B)   (C)

15. Given below are **two** statements :

Statement I : The nucleophilic addition of sodium hydrogen sulphite to an aldehyde or a ketone involves proton transfer to form a stable ion.
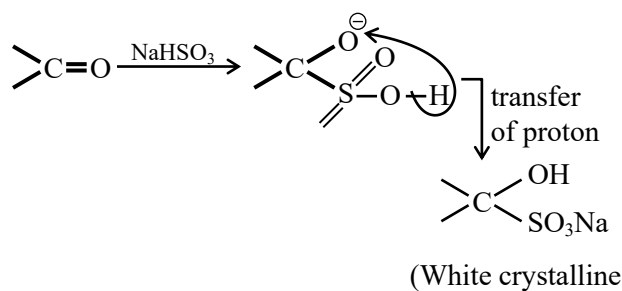
Statement II : The nucleophilic addition of hydrogen cyanide to an aldehyde or a ketone yields amine as final product.

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

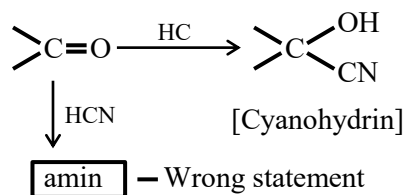(1) Both **Statement I** and **Statement II** are true.

(2) **Statement I** is true but **Statement II** is false.

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

(4) Both **Statement I** and **Statement II** are false.

Official Ans. by NTA (2)

Sol. **Statement I :** Correct
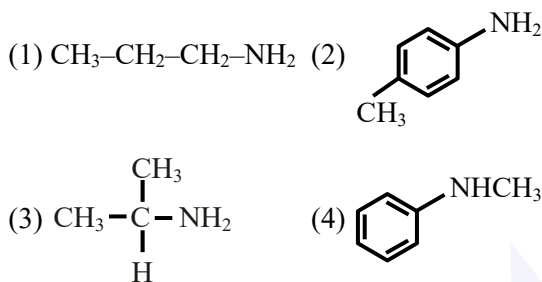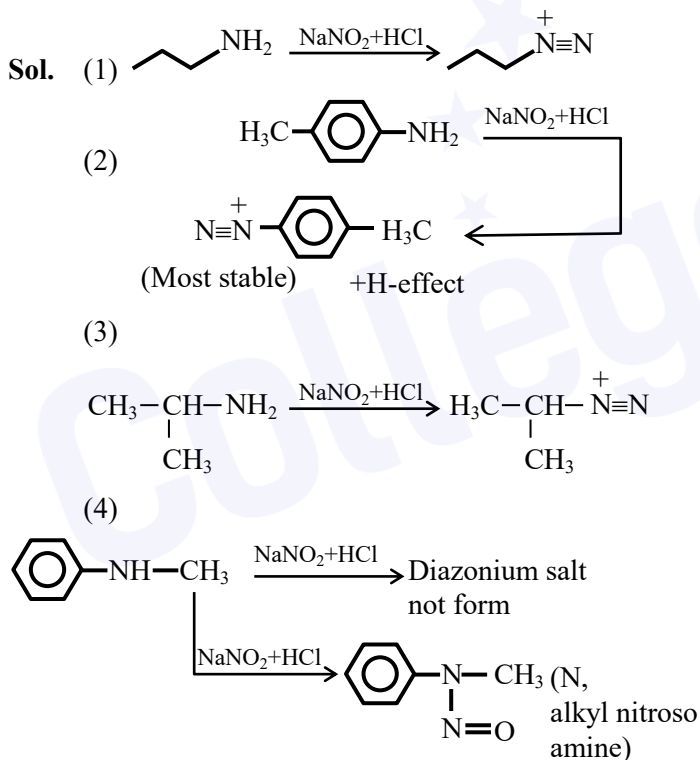

$$>C=O \xrightarrow{NaHSO_3}$$

transfer of proton

$$>C<\overset{OH}{\underset{SO_3Na}{}}$$

(White crystalline

Statement II :

[Cyanohydrin]

amin — Wrong statement

(Amine not formed)

16. Which one of the following gives the most stable Diazonium salt ?

(1) $CH_3–CH_2–CH_2–NH_2$

(2)

(3)

(4)

Official Ans. by NTA (2)

Sol. (1)

(2)

(Most stable) +H-effect
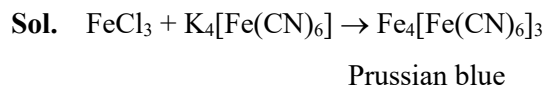
(3)

(4)

17. The potassium ferrocyanide solution gives a Prussian blue colour, when added to :
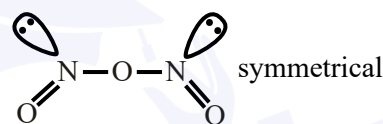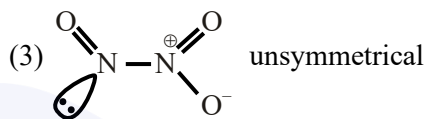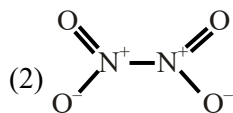
(1) $CoCl_3$

(2) $FeCl_2$

(3) $CoCl_2$

(4) $FeCl_3$

Official Ans. by NTA (4)

Sol. $FeCl_3 + K_4[Fe(CN)_6] \rightarrow Fe_4[Fe(CN)_6]_3$

Prussian blue

18. The oxide **without** nitrogen-nitrogen bond is :

(1) N_2O

(2) N_2O_4

(3) N_2O_3

(4) N_2O_5

Official Ans. by NTA (4)

Sol. (1) $N\equiv N^+—O^-$

(2)

(3) unsymmetrical

 symmetrical

(4)

19. Number of paramagnetic oxides among the following given oxides is _____.

Li_2O, CaO, Na_2O_2, KO_2, MgO and K_2O

(1) 1

(2) 2

(3) 3

(4) 0

Official Ans. by NTA (1)

Sol. $Li_2O \Rightarrow 2Li^+ \quad O^{2-}$ \qquad $MgO \Rightarrow Mg^{2+} \quad O^{2-}$

$CaO \Rightarrow Ca^{2+} \quad O^{2-}$ \qquad $K_2O \Rightarrow 2K^+ \quad O^{2-}$

$Na_2O_2 \Rightarrow 2Na^+ \quad O_2^{2-}$

$KO_2 \Rightarrow K^+ \quad O_2^-$

$O_2^- \Rightarrow$ Complete octet, diamagnetic

$O^{2-} \Rightarrow \sigma_{1s}^2 \ \sigma_{1s}^{*2} \ \sigma_{2s}^2 \ \sigma_{2s}^{*2} \ \sigma_{2px}^2 \ \pi_{2py}^2 \simeq \pi_{2pz}^2 \ \pi_{2py}^{*2} \simeq \pi_{2pz}^{*2}$ (dia)

$O_2^- \Rightarrow \sigma_{1s}^2 \ \sigma_{1s}^{*2} \ \sigma_{2s}^2 \ \sigma_{2s}^{*2} \ \sigma_{2px}^2 \ \pi_{2py}^2 \simeq \pi_{2pz}^2 \ \pi_{2py}^{*2} \simeq \pi_{2pz}^{*1}$ ra)
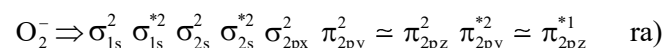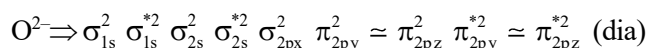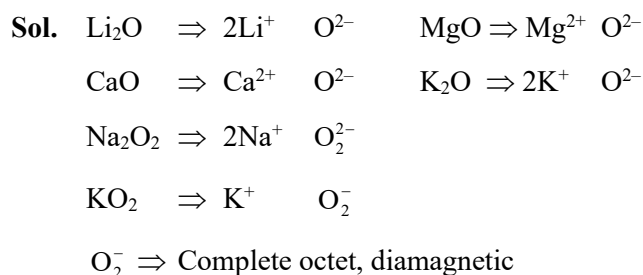
20. Identify the element for which electronic configuration in +3 oxidation state is $[Ar]3d^5$:

(1) Ru (2) Mn (3) Co (4) Fe

Official Ans. by NTA (4)

Sol. Fe^{3+} $[Ar]$ $3d^5$

SECTION-B

1. An empty LPG cylinder weighs 14.8 kg. When full, it weighs 29.0 kg and shows a pressure of 3.47 atm. In the course of use at ambient temperature, the mass of the cylinder is reduced to 23.0 kg. The final pressure inside of the cylinder is _____atm. (Nearest integer)

(Assume LPG of be an ideal gas)

Official Ans. by NTA (2)

Sol. Initial mass of gas = 29 –14.8 = 14.2 Kg

mass of gas used = 29 –23 = 6 Kg

gas left = 14.2 – 6 = 8.2 Kg

(1) $3.47 \times V = \left(\dfrac{14.2 \times 10^3}{M}\right) \times R \times T$

(2) $p \times V = \left(\dfrac{8.2 \times 10^3}{M}\right) \times R \times T$

Divide :

$\dfrac{(1)}{(2)} \Rightarrow \dfrac{3.47}{P} = \dfrac{14.2}{8.2}$

$P = 2.003$

2. The molar solubility of $Zn(OH)_2$ in 0.1 M NaOH solution is $x \times 10^{-18}$ M. The value of x is _____(Nearest integer)

(Given : The solubility product of $Zn(OH)_2$ is 2×10^{-20})

Official Ans. by NTA (2)

Sol. $Zn(OH)_2$ (s) $\rightleftharpoons$ Zn^{+2} (aq) + $2OH^-$ (aq)

　　　　　　　　S　　　　(0.1 + 2s) $\simeq$ 0.1

$K_{sp} = S(0.1)^2$

$2 \times 10^{-20} = s \times 10^{-2} \Rightarrow s = 2 \times 10^{-18}$

　　　　　　　　$= x \times 10^{-18}$

$x = 2$

3. For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when $\Delta S = -176.0$ JK^{-1} and $\Delta H = -57.8$ kJ mol^{-1}, the magnitude of ΔG at 298 K for the reaction is_____ kJ mol^{-1}. (Nearest integer)

Official Ans. by NTA (5)

Sol. $\Delta G = \Delta H - T\Delta S$

$\Delta G = 57.8 - \dfrac{298(-176)}{1000}$

$\Delta G = -5.352$ kJ/mole

|Nearest integer value| = 5

4. The sum of oxidation states of two silver ions in $[Ag(NH_3)_2] [Ag(CN)_2]$ complex is _____.

Official Ans. by NTA (2)

Sol. $[Ag(NH_3)_2]^+ [Ag(CN)_2]^-$

　+1 ↙　　　　　　　↘ +1

5. The number of atoms in 8 g of sodium is $x \times 10^{23}$. The value of x is_____.(Nearest integer)

[Given : $N_A = 6.02 \times 10^{23}$ mol^{-1}

Atomic mass of Na = 23.0 u]

Official Ans. by NTA (2)

Sol. No. of atoms = $\dfrac{8}{23} \times 6.02 \times 10^{23} = 2.09 \times 10^{23}$

　　　　　　　　　　$\simeq 2 \times 10^{23}$

　　　　　　　　　　$= x \times 10^{23}$

$x = 2$

6. If 80 g of copper sulphate $CuSO_4 \cdot 5H_2O$ is dissolved in deionised water to make 5 L of solution. The concentration of the copper sulphate solution is $x \times 10^{-3}$ mol L^{-1}. The value of x is _____.

[Atomic masses Cu : 63.54 u, S : 32 u, O : 16 u, H : 1 u]

Official Ans. by NTA (64)

Sol. Moles of $CuSO_4 \cdot 5H_2O = \dfrac{80}{249.54}$

Molarity = $\dfrac{\frac{80}{249.54}}{5} = 64.117 \times 10^{-3}$

Nearest integer, x = 64

7. A 50 watt bulb emits monochromatic red light of wavelength of 795 nm. The number of photons emitted per second by the bulb is $x \times 10^{20}$. The value of x is _____.

[Given : h = 6.63 × 10⁻³⁴ Js and c = 3.0 × 10⁸ ms⁻¹]

Official Ans. by NTA (2)

Sol. Total energy per sec. = 50 J

$$50 = \frac{n \times 6.63 \times 10^{-34} \times 3 \times 10^{8}}{795 \times 10^{-9}}$$

n = 1998.49 × 10¹⁷ [n = no. of photons per second]

= 1.998 × 10²⁰

≃ 2 × 10²⁰

= x × 10²⁰

x = 2

8. The spin-only magnetic moment value of B_2^+ species is _____ ×10⁻² BM. (Nearest integer)

[Given : $\sqrt{3} = 1.73$]

Official Ans. by NTA (173)

Sol. $B_2^+ \Rightarrow \sigma_{1s}^2\ \sigma_{1s}^{*2}\ \sigma_{2s}^2\ \sigma_{2s}^{*2}\ \pi_{2py}^1 \simeq \pi_{2pz}^0$

$\Rightarrow 9e^-$

$\mu = \sqrt{1(1+2)} = \sqrt{3}$ BM

= 1.73 BM

= 1.73 × 10⁻² BM

9. If the conductivity of mercury at 0°C is 1.07 × 10⁶ S m⁻¹ and the resistance of a cell containing mercury is 0.243 Ω, then the cell constant of the cell is $x \times 10^4$ m⁻¹. The value of x is _____.(Nearest integer)

Official Ans. by NTA (26)

Sol. k = 1.07 × 10⁶ Sm⁻¹, R = 0.243 Ω

$$G = \frac{1}{R} = \frac{1}{0.243}\Omega^{-1}$$

k = G × G*

$$G^* = \frac{k}{G} = \frac{1.07 \times 10^6}{\frac{1}{0.243}} \simeq 26 \times 10^4\ \text{m}^{-1}$$
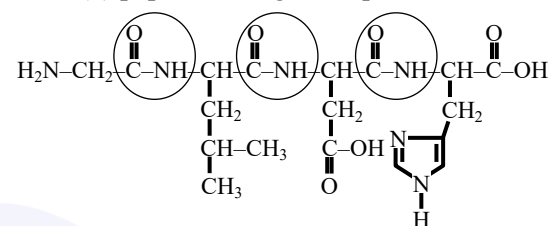
10. A peptide synthesized by the reactions of one molecule each of Glycine, Leucine, Aspartic acid and Histidine will have _____ peptide linkages.

Official Ans. by NTA (3)

Sol.

Total (3) peptide linkages are present

3 peptide linkage

Ans. (3)