FINAL JEE-MAIN EXAMINATION - JULY, 2022

(Held On Friday 29th July, 2022)

TIME: 9:00 AM to 12:00 NOON

SECTION-A

- 1. Which of the following pair of molecules contain odd electron molecule and an expanded octet molecule?
 - (A) BCl₃ and SF₆
- (B) NO and H₂SO₄
- (C) SF₆ and H₂SO₄
- (D) BCl₃ and NO

Official Ans. by NTA (B)

Ans. (B)

- **Sol.** (A) BCl₃ \rightarrow Even Electron molecule SF₆ \rightarrow Expanded octet molecule
 - (B) NO \rightarrow Odd Electron molecule $H_2SO_4 \rightarrow Expanded$ octet.
 - (C) $SF_6 \rightarrow Even Electron molecule$ $H_2SO_4 \rightarrow Expanded octet.$
 - (D) $BCl_3 \rightarrow Even Electron molecule$ NO \rightarrow Odd Electron molecule

$$...$$
 $...$

 $S \rightarrow 12e^{-}$ in outer orbit.

2. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

20 g 5 g

Consider the above reaction, the limiting reagent of the reaction and number of moles of NH₃ formed respectively are:

- (A) H₂, 1.42 moles
- (B) H₂, 0.71 moles
- (C) N_2 , 1.42 moles
- (D) N_2 , 0.71 moles

Official Ans. by NTA (C)

Ans. (C)

Sol.

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$$W_2 = 20g 3$$

$$n = \frac{20}{28} \frac{5}{2}$$

Stoichiometric Amount:

$$N_2 \rightarrow \frac{20/28}{1} = \frac{20}{28} \quad H_2 \rightarrow \frac{5/2}{3} = \frac{5}{6}$$

- ∴ N₂ is the Limiting Reagent.
- ∴ $n(NH_3) = 2 \times n(N_2) = 2 \times \frac{20}{28}$ = 1.42

- 3. 100 mL of 5% (w/v) solution of NaCl in water was prepared in 250 mL beaker. Albumin from the egg was poured into NaCl solution and stirred well.

 This resulted in a/ an:
 - (A) Lyophilic sol
- (B) Lyophobic sol
- (C) Emulsion
- (D) Precipitate

Official Ans. by NTA (A)

Ans. (A)

- **Sol.** Standard method for the preparation of lyophilic sol. (Discussed in lab Manual)
- 4. The first ionization enthalpy of Na, Mg and Si, respectively, are: 496, 737 and 786 kJ mol⁻¹. The first ionization enthalpy (kJ mol⁻¹) of Al is:
 - (A)487
- (B) 768
- (C) 577
- (D) 856

Official Ans. by NTA (C)

Ans. (C)

Sol. I. E : Na < Al < Mg < Si

$$\therefore$$
 496 < IE (Al) < 737

Option (C), matches the condition.

i.e
$$IE(Al) = 577 \text{ kJmol}^{-1}$$

- 5. In metallurgy the term "gangue" is used for:
 - (A) Contamination of undesired earthy materials.
 - (B) Contamination of metals, other than desired metal
 - (C) Minerals which are naturally occuring in pure form
 - (D) Magnetic impurities in an ore.

Official Ans. by NTA (A)

Ans. (A)

Sol. Earthy and undesired materials present in the ore, other then the desired metal, is known as gangue.

- **6.** The reaction of zinc with excess of aqueous alkali, evolves hydrogen gas and gives :
 - $(A) Zn(OH)_2$
- (B) ZnO
- (C) $[Zn(OH)_4]^{2-}$
- (D) $[ZnO_2]^{2-}$

Official Ans. by NTA (D)

Ans. (C or D)

Sol. Zinc dissolves in excess of aqueous alkali

$$Zn + 2OH^{-} + 2H_{2}O \rightarrow [Zn(OH)_{4}]^{2-} + H_{2} \uparrow$$

Tetrahydroxozincate(II) ion

However, this reaction in NCERT is given as

 $Zn + 2NaOH \rightarrow Na_2ZnO_2 + H_2 \uparrow$

 ZnO_2^{2-} is anhydrous form of $[Zn(OH)_4]^{2-}$

So in aqueous medium best answer of this question is $[Zn(OH)_4]^{2-}$

- 7. Lithium nitrate and sodium nitrate, when heated separately, respectively, give:
 - (A) LiNO₂ and NaNO₂
 - (B) Li₂O and Na₂O
 - (C) Li₂O and NaNO₂
 - (D) LiNO₂ and Na₂O

Official Ans. by NTA (C)

Ans. (C)

Sol. Li₂O, NaNO₂

As per NCERT Lithium nitrate when heated gives lithium oxide, Li₂O, whereas other alkali metal nitrates decompose to give the corresponding nitrite.

$$4\text{LiNO}_3 \longrightarrow 2\text{Li}_2\text{O} + 4\text{NO}_2 + \text{O}_2$$

$$2\text{NaNO}_2 \longrightarrow 2\text{NaNO}_2 + \text{O}_2$$

However, the decomposition product of NaNO₃ are temperature dependent process as shown in the below reaction.

NaNO₃
$$\xrightarrow{\Delta}$$
 NaNO₂ (s) + $\frac{1}{2}$ O₂ (g)
 $\xrightarrow{\Delta}$ 800°C
Na₂O (s) + N₂(g) + O₂ (g)

As temperature is not mentioned, we can go by Ans. (C)

- 8. Number of lone pairs of electrons in the central atom of SCl₂, O₃, ClF₃ and SF₆, respectively, are:
 - (A) 0, 1, 2 and 2
 - (B) 2, 1, 2 and 0
 - (C) 1, 2, 2 and 0
 - (D) 2, 1, 2 and 0

Official Ans. by NTA (B)

Ans. (B)

Sol. (2 \(\ell \).p.)



F | CI - F | (2 \ell .p.)



- 9. In following pairs, the one in which both transition metal ions are colourless is:
 - (A) Sc^{3+} , Zn^{2+}
 - (B) Ti^{4+} , Cu^{2+}
 - (C) V^{2+} , Ti^{3+}
 - (D) Zn^{2+} , Mn^{2+}

Official Ans. by NTA (A)

Ans. (A)

Sol. (A) Sc^{3+} , Zn^{2+} (B) Ti^{4+} , Cu^{2+} $3d^0$ $3d^{10}$ $3d^0$ $3d^9$

 $3d^0 3d^{10}$

(C) V^{2+} , Ti^{3+} (D) Zn^{2+} , Mn^{2+}

 $3d^3$ $3d^1$

 $3d^{10}$ $3d^{5}$

No d-d transitions in ions with d^o & d^{10} configuration. Therefore they are colourless.

- 10. In neutral or faintly alkaline medium, KMnO₄ being a powerful oxidant can oxidize, thiosulphate almost quantitatively, to sulphate. In this reaction overall change in oxidation state of manganese will be:
 - (A)5
- (B) 1
- (C) 0

(D) 3

Official Ans. by NTA (D)

Ans. (D)

Sol. $8 \text{ Mn O}_4^{+7} + 3 \text{ S}_2 \text{ O}_3^{-2} + \text{ H}_2 \text{ O} \rightarrow 8 \text{ Mn O}_2 + 6 \text{ SO}_4^{-2} + 2 \text{ OH}^-$

Change in oxidation state of Mn is from +7 to +4 which is 3.

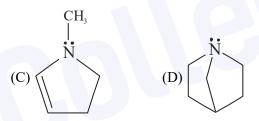


- 11. Which among the following pairs has only herbicides?
 - (A) Aldrin and Dieldrin
 - (B) Sodium chlorate and Aldrin
 - (C) Sodium arsinate and Dieldrin
 - (D) Sodium chlorate and sodium arsinite.

Official Ans. by NTA (D)

Ans. (D)

- **Sol.** Both sodium chlorate and sodium arsenite behave as herbicide.
- **12.** Which among the following is the strongest Bronsted base ?



Official Ans. by NTA (D)

Ans. (D)

Sol. N

It is most basic because there is no amine inversion.

Which among the following pairs of the structures will give different products on ozonolysis? (Consider the double bonds in the structures are rigid and not delocalized.)

Official Ans. by NTA (C)

Ans. (C)

CH₃

CH₃

Ozonolysis

CH₃-C-C-CH₃ + 2 CHO
CHO

CH₃

$$CH_3$$

$$Ozonolysis$$

$$2 CH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$CH_3$$

$$Ozonolysis$$

$$CH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$CH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$COH_3 - C - CHO + CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO$$

$$CHO$$

$$CHO$$

$$CHO$$

$$COH_3 - C - CHO$$

$$CHO$$

$$C$$

Considering the above reactions, the compound 'A' and compound 'B' respectively are:

and compound B respectively are:

$$(A) \qquad \qquad \bigoplus_{N \equiv C} \qquad \bigoplus_{N \equiv C}$$

Sol. CI
$$\frac{\text{NaCN}}{\text{C}_2\text{H}_5\text{OH} - \text{H}_2\text{O}}$$
 $\text{C}\equiv\text{N}$

In NaCN; carbon is more nucleophilic atom.

Whereas in AgCN; Ag – C has covalent bond.

15.
$$\xrightarrow{OH}$$
 $\xrightarrow{Br_2}$ \xrightarrow{A} $\xrightarrow{NH_2OH}$ \xrightarrow{B} $\xrightarrow{P_2O_5}$ $\xrightarrow{\Delta}$ \xrightarrow{C}

Consider the above reaction sequence, the Product

'C' is:

Official Ans. by NTA (D) Ans. (D) Sol. $\xrightarrow{\text{OH}} \xrightarrow{\text{Br}_2} \xrightarrow{\text{Br}_2 \text{Bromination}} \xrightarrow{\text{NH}_2\text{OH}} \xrightarrow{\text{NH}_2\text{OH}}$

ÒН

Consider the above reaction, the compound 'A' is:

(B)
$$H_3C$$
 Cl
 Cl
 Cl
 Cl
 CH_3
 CH_2Cl

Official Ans. by NTA (C) Ans. (C)

Sol.
$$_{CH_3}$$
 $_{CH_3}$ $_{CH_3}$

17.
$$N = NCl^{-}$$
+ 'A' NaOH Product (Orange-red dye)

Which among the following represent reagent 'A'?

Official Ans. by NTA (A)

Ans. (A)

Sol.

$$\begin{array}{c} + \\ N \equiv N \text{ Cl}^{-} \\ + \\ \end{array} \begin{array}{c} \text{Basic} \\ \text{medium} \end{array} \begin{array}{c} N = N - Ph \\ \text{OH} \\ \end{array}$$

18. Consider the following reaction sequence :

$$(i) AlH (i-Bu)_{2} \qquad 'A' \qquad CH_{3}CHO \qquad B \qquad (Major Product)$$

$$CN$$

The product 'B' is:

(A) OHC
$$\sim$$
 N – CH CH₃

(B)
$$H_2N$$
 CH = CH-CHO

(C)
$$H_2N$$
 $CH_2-N = CH-CH_3$

(D)
$$H_2N$$
 $C-N = CH CHO$

Official Ans. by NTA (B)

Ans. (B)

Sol.

NH2
$$\frac{\text{(i) AlH (i-Bu)}_2}{\text{(ii) H}_2\text{O}} \stackrel{\text{NH2}}{\longleftarrow} \frac{\text{CH}_3\text{CHO}}{\text{dil NaOH, } \Delta}$$

Cross aldol condensation

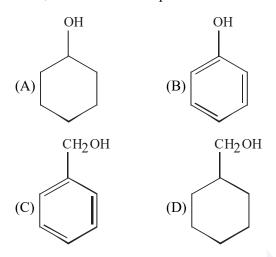
- **19.** Which of the following compounds is an example of hypnotic drug?
 - (A) Seldane
- (B) Amytal
- (C) Aspartame
- (D) Prontosil

Official Ans. by NTA (B)

Ans. (B)

Sol. Amytal is hypnotic drug used to treat sleeping disorder.

20. A compound 'X' is acidic and it is soluble in NaOH solution, but insoluble in NaHCO₃ solution. Compound 'X' also gives violet colour with neutral FeCI₃ solution. The compound 'X' is:



Official Ans. by NTA (B)

Sol. 6 \rightarrow [Fe(C₆H₅O)₆]³-violet colour

SECTION-B

1. Resistance of a conductivity cell (cell constant 129 m⁻¹) filled with 74.5 ppm solution of KCl is 100 Ω (labelled as solution 1). When the same cell is filled with KCl solution of 149 ppm, the resistance is 50 Ω (labelled as solution 2). The ratio of molar conductivity of solution 1 and solution 2 is i.e.

$$\frac{\wedge_1}{\wedge_2}$$
 = x × 10⁻³. The value of x is _____.

(Nearest integer)

Given, molar mass of KCl is 74.5 g mol⁻¹

Official Ans. by NTA (1000)

Ans. (1000)

Sol.
$$\frac{\ell}{A} = 129 \text{m}^{-1}$$

KCl solution 1:

74.5 ppm, $R_1 = 100 \Omega$

KCl solution 2:

149 ppm, $R_2 = 50 \Omega$

149 ppm, $R_2 = 50 Ω$

Here,
$$\frac{ppm_1}{ppm_2} = \frac{M_1}{M_2} \left(= \frac{W_1}{V} \times \frac{V}{W_2/M_0} \right)$$

$$\frac{\wedge_1}{\wedge_2} = \frac{\kappa_1 \times \frac{1000}{M_1}}{\kappa_2 \times \frac{1000}{M_2}}$$

$$= \frac{\kappa_1}{\kappa_2} \times \frac{M_2}{M_1}$$
$$= \frac{50}{100} \times 2$$
$$= \frac{\Lambda_1}{\Lambda_2} = 1,000 \times 10^{-3}$$

Ans. 1,000

2. Ionic radii of cation A⁺ and anion B⁻ are 102 and 181 pm respectively. These ions are allowed to crystallize into an ionic solid. This crystal has cubic close packing for B⁻. A⁺ is present in all octahedral voids. The edge length of the unit cell of the crystal AB is _____ pm. (Nearest Integer)

Official Ans. by NTA (512)

Ans. (566)

Sol.
$$a = 2(r_+ + r_-)$$

 $a = 2(102 + 181)$
 $a = 2(283)$
 $a = 566 \text{ pm}$

3. The minimum uncertainty in the speed of an electron in an one dimensional region of length $2a_0$ (Where a_0 = Bohr radius 52.9 pm) is ____km s⁻¹. (Given : Mass of electron = 9.1×10^{-31} kg, Planck's

Official Ans. by NTA (548)

constant h = $6.63 \times 10^{-34} \text{ Js}$)

Ans. (548)

Sol. Heisenberg's uncertainty principle

$$\Delta \mathbf{x} \times \Delta \mathbf{p}_{\mathbf{x}} \ge \frac{\mathbf{h}}{4\pi}$$

$$\Rightarrow 2a_0 \times m\Delta v_x = \frac{h}{4\pi} (minimum)$$

$$\Rightarrow \Delta v_x = \frac{h}{4\pi} \times \frac{1}{2a_0} \times \frac{1}{m}$$

$$=\frac{6.63\times10^{-34}}{4\times3.14\times2\times52.9\times10^{-12}\times9.1\times10^{-31}}$$

- $= 548273 \text{ ms}^{-1}$
- $= 548.273 \text{ km s}^{-1}$
- = 548 km s⁻¹
- 4. When 600 mL of 0.2 M HNO₃ is mixed with 400 mL of 0.1M NaOH solution in a flask, the rise in temperature of the flask is _____ × 10⁻² °C.

 (Enthalpy of neutralisation = 57 kJ mo1⁻¹ and Specific heat of water = 4.2 JK⁻¹ g⁻¹)

 (Neglect heat capacity of flask)

Official Ans. by NTA (54)

Ans. (54)

Sol. HNO₃ NaOH
$$600 \text{ mL} \times 0.2 \text{ M} \qquad 400 \text{ mL} \times 0.1 \text{ M}$$

$$= 120 \text{ m mol} \qquad = 40 \text{ m mol}$$

$$\text{HNO}_3 + \text{NaOH} \rightarrow \text{NaNO}_3 + \text{H}_2\text{O}$$
Bef. 120 40
Aft. 80 0 40 m mol
$$\Delta_r \text{H} = 40 \text{ m mol} \times (57 \times 10^3) \frac{\text{J}}{\text{mol}}$$

$$= 40 \times 10^{-3} \text{ mol} \times 57 \times 10^3 \frac{\text{J}}{\text{mol}}$$

$$= 2280 \text{ J}$$

$$\text{m S}\Delta \text{T} = 2280$$

$$\Rightarrow 1000 \text{ mL} \times \frac{1\text{gm}}{\text{mL}} \times 4,2 \times \Delta \text{T} = 2280$$

$$\Delta \text{T} = \frac{2280}{4.2} \times 10^{-3}$$

$$= \frac{22800}{42} \times 10^{-3}$$

$$= 542.86 \times 10^{-3}$$

$$\Delta \text{T} = 54.286 \times 10^{-2} \text{ K}$$

$$\Delta \text{T} = 54.286 \times 10^{-20} \text{ C}$$
Ans. $\boxed{54.286}$

Answer mentioned as 54 (Closest integer)

5. If O₂ gas is bubbled through water at 303 K, the number of millimoles of O₂ gas that dissolve in 1 litre of water is _____. (Nearest Integer)

(Given: Henry's Law constant for O₂ at 303 K is 46.82 k bar and partial pressure of O₂ = 0.920 bar)

(Assume solubility of O₂ in water is too small, nearly negligible)

Official Ans. by NTA (1)

Sol. $p = K_H \times x$

$$0.920 = 46.82 \times 10^3 \text{ bar} \times \frac{\text{mol of O}_2}{\text{mol of H}_2\text{O}}$$

$$0.920 = 46.82 \times 10^{3} \times \frac{\text{mol of O}_2}{1000/18}$$

$$0.920 = 46.82 \times n_{o_2}$$

$$p = \frac{0.920}{46.82 \times 18} = n_{0_2}$$

$$\Rightarrow 1.09 \times 10^{-3} = n_{0_2}$$

 \Rightarrow m molof $O_2 = 1$

6. If the solubility product of PbS is 8×10^{-28} , then the solubility of PbS in pure water at 298 K is $x \times 10^{-16}$ mol L⁻¹. The value of x is _____. (Nearest Integer)

[Given
$$\sqrt{2} = 1.41$$
]

Official Ans. by NTA (282)

Ans. (282)

Sol.
$$K_{sp} = S^2$$

$$\mathbf{S} = \sqrt{\mathbf{K}_{sp}} = \sqrt{8 \times 10^{-28}} = 2\sqrt{2} \times 10^{-14}$$
$$= 2.82 \times 10^{-14}$$
$$= 282 \times 10^{-16}$$
$$\mathbf{Ans.} = 282$$

7. The reaction between X and Y is first order with respect to X and zero order with respect to Y.

| Experiment | [X] | [Y] | Initial rate |
|------------|--------------|---------------------------------|-----------------------|
| | $mol L^{-1}$ | $\overline{\text{mol } L^{-1}}$ | $mol L^{-1} min^{-1}$ |
| I. | 0.1 | 0.1 | 2×10^{-3} |
| II. | L | 0.2 | 4×10^{-3} |
| III. | 0.4 | 0.4 | $M \times 10^{-3}$ |
| IV. | 0.1 | 0.2 | 2×10^{-3} |

Examine the data of table and calculate ratio of numerical values of M and L. (Nearest Inetger)

Official Ans. by NTA (40)

Ans. (40)

Sol.
$$r = k [x] [y]^0 = k [x]$$

Using I & II

$$\frac{4 \times 10^{-3}}{2 \times 10^{-3}} = \left(\frac{L}{0.1}\right) \implies L = 0.2$$

Using I & III

$$\frac{M \times 10^{-3}}{2 \times 10^{-3}} = \frac{0.4}{0.1} \implies M = 8$$

$$\frac{M}{L} = \frac{8}{0.2} = 40$$

Ans. 40

8. In a linear tetrapeptide (Constituted with different amino acids), (number of amino acids) - (number of peptide bonds) is

Official Ans. by NTA (1)

Ans. (1)

Sol. In Tetrapeptide,

No. of Amino Acids = 4

No. of Peptide bonds = 3

Hence

Ans. = 1

9. In bromination of Propyne, with Bromine 1, 1, 2, 2-tetrabromopropane is obtained in 27% yield. The amount of 1, 1, 2, 2 tetrabromopropane obtained from 1 g of Bromine in this reaction is _____ × 10⁻¹ g. (Nearest integer)

(Molar Mass : Bromine = 80 g/mol)

Official Ans. by NTA (3)

Ans. (3)

$$= \frac{1}{160} \times \frac{1}{2} \times 360 \times 0.27$$
$$= 0.30375$$
$$= 3.0375 \times 10^{-1}$$

Ans.
$$= 3$$

10. $[Fe(CN)_6]^{3-}$ should be an inner orbital complex. Ignoring the pairing energy, the value of crystal field stabilization energy for this complex is (–) Δ_0 . (Nearest integer)

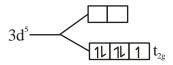
Official Ans. by NTA (2)

Ans. (2)

Sol. $[Fe(CN)_6]^{3-}$

CN- is strong field ligand

$$Fe^{{}^{+}3}\ 3d^5\ (\,t_{2g}^5\ e_g^0\,)$$



CFSE = 5 (
$$-0.4 \Delta_0$$
) = $-2.0 \Delta_0$

Ans. (2)