

# **FINAL JEE-MAIN EXAMINATION - JULY, 2022**

(Held On Monday 25th July, 2022)

# TIME: 9:00 AM to 12:00 NOON

### **CHEMISTRY**

### **SECTION-A**

1. SO<sub>2</sub>Cl<sub>2</sub> on reaction with excess of water results into acidic mixture

$$SO_2Cl_2 + 2H_2O \rightarrow H_2SO_4 + 2HCl$$

16 moles of NaOH is required for the complete neutralisation of the resultant acidic mixture. The number of moles of SO<sub>2</sub>Cl<sub>2</sub> used is:

- (A) 16
- (B) 8

(C)4

(D) 2

Official Ans. by NTA (C)

Ans. (C)

**Sol.** Let  $n(SO_2Cl_2) = x$  moles

$$\therefore$$
 n(H<sub>2</sub>SO<sub>4</sub>) = x, n(HCl) = 2x

$$\Rightarrow$$
 n(H+) = 4x

### For Neutralisation

$$\Rightarrow$$
 n(H<sup>+</sup>) = n(OH<sup>-</sup>)

- $\Rightarrow$  4x = 16
- $\Rightarrow x = 4$
- **2.** Which of the following sets of quantum numbers is not allowed?

(A) 
$$n = 3$$
,  $l = 2$ ,  $m_l = 0$ ,  $s = +\frac{1}{2}$ 

(B) 
$$n = 3$$
,  $l = 2$ ,  $m_l = -2$ ,  $s = +\frac{1}{2}$ 

(C) 
$$n = 3$$
,  $l = 3$ ,  $m_l = -3$ ,  $s = -\frac{1}{2}$ 

(D) 
$$n = 3$$
,  $l = 0$ ,  $m_l = 0$ ,  $s = -\frac{1}{2}$ 

# Official Ans. by NTA (C)

Ans. (C)

- **Sol.**  $1 = 0, 1, 2, \dots, (n-1)$ 
  - $\therefore$  for n = 3

$$1 = 0, 1, 2$$

 $\Rightarrow 1=3$ 

not possible for n = 3

### **TEST PAPER WITH SOLUTION**

- 3. The depression in freezing point observed for a formic acid solution of concentration  $0.5 \text{ mL L}^{-1}$  is  $0.0405^{\circ}\text{C}$ . Density of formic acid is  $1.05 \text{ g mL}^{-1}$ . The Van't Hoff factor of the formic acid solution is nearly: (Given for water  $k_f = 1.86 \text{ K kg mol}^{-1}$ )
  - (A) 0.8
- (B) 1.1
- (C) 1.9
- (D) 2.4

Official Ans. by NTA (C)

Ans. (C)

- **Sol.** [HCOOH] =  $0.5 \text{ ml l}^{-1}$ 
  - $\Rightarrow$  (0.5 ml  $\times$  1.05 g ml<sup>-1</sup>) HCOOH in 1L
  - ⇒ 0.525 g HCOOH in 1L

$$m = \frac{(0.525/46)}{1 \text{kg}} \text{mol}$$
 [Assuming dilute solution]

$$\therefore \Delta T_f = iK_f m \Rightarrow i = \frac{\Delta T_f}{k_c m} = \frac{0.0405 \times 46}{1.86 \times 0.525} = 1.9$$

4. 20 mL of 0.1 M NH<sub>4</sub>OH is mixed with 40 mL of 0.05 M HCl. The pH of the mixture is nearest to:

(Given: 
$$K_b(NH_4OH) = 1 \times 10^{-5}$$
,  $\log 2 = 0.30$ ,

$$\log 3 = 0.48$$
,  $\log 5 = 0.69$ ,  $\log 7 = 0.84$ ,

log 11 = 1.04)

- (A) 3.2
- (B) 4.2
- (C) 5.2
- (D) 6.2

Official Ans. by NTA (C)

Ans. (C)

**Sol.**  $NH_4OH + HCl \rightarrow NH_4Cl + H_2O$ 

mmole 2

- 2 mmole

$$\left[NH_4^+\right] = \frac{2\text{mmole}}{60 \text{ ml}} = \frac{1}{30} \text{ M}$$

$$pH = \frac{pK_{w} - pK_{b} - \log C}{2} = \frac{14 - 5 + 1.48}{2} = 5.24$$



5.

Match List - I with List - II

List - I

List - II

- (A)  $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$
- (I) Cu
- (A)  $N_2(g) + 3N_2(g) \rightarrow 2NN_3(g)$ (B)  $CO(g) + 3H_2(g) \rightarrow CH_4(g) + H_2O(g)$
- (II)  $Cu/ZnO Cr_2O_3$
- (C)  $CO(g) + H_2(g) \rightarrow HCHO(g)$
- (III)  $\operatorname{Fe}_{x}O_{y} + \operatorname{K}_{2}O + \operatorname{Al}_{2}O_{3}$
- (D)  $CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$
- (IV) Ni

Choose the correct answer from the options given below:

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

## Official Ans. by NTA (C)

Ans. (C)

#### Sol. Factual

- 6. The IUPAC nomenclature of an element with electronic configuration  $[Rn]5f^{14}6d^{1}7s^{2}$  is:
  - (A) Unnilbium
- (B) Unnilunium
- (C) Unnilquadium
- (D) Unniltrium

# Official Ans. by NTA (D)

Ans. (D)

#### Sol. Atomic Number 103

- 7. The compound(s) that is(are) removed as slag during the extraction of copper is:
  - (1) CaO
- (2) FeO
- (3) Al<sub>2</sub>O<sub>3</sub>
- (4) ZnO
- (5) NiO

Choose the correct answer from the options given below:

- (A)(3)(4) Only
- (B) (1), (2), (5) Only
- (C)(1),(2) Only
- (D) (2) Only

## Official Ans. by NTA (D)

Ans. (D)

- **Sol.**  $FeO + SiO_2 \rightarrow FeSiO_3$
- 8. The reaction of  $H_2O_2$  with potassium permanganate in acidic medium leads to the formation of mainly:
  - (A)  $Mn^{2+}$
- (B) Mn<sup>4+</sup>
- (C)  $Mn^{3+}$
- (D)  $Mn^{6+}$

### Official Ans. by NTA (A)

Ans. (A)

**Sol.**  $H_2O_2 + MnO_4^- \rightarrow Mn^{2+} + O_2$  (unbalanced)

- **9.** Choose the correct order of density of the alkali metals:
  - (A) Li < K < Na < Rb < Cs
  - (B)  $Li \le Na \le K \le Rb \le Cs$
  - (C) Cs < Rb < K < Na < Li
  - (D) Li < Na < K < Cs < Rb

### Official Ans. by NTA (A)

Ans. (A)

Sol. Factual

10. The geometry around boron in the product 'B' formed from the following reaction is

$$BF_3 + NaH \xrightarrow{450K} A + NaF$$

 $A + NMe_3 \rightarrow B$ 

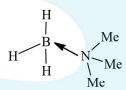
- (A) trigonal planar
- (B) tetrahedral
- (C) pyramidal
- (D) square planar

Official Ans. by NTA (B)

Ans. (B)

Sol. 
$$BF_3 + NaH \xrightarrow{450K} B_2H_6 + NaF$$

$$B_2H_6 + NMe_3 \longrightarrow 2[BH_3 \leftarrow NMe_3]$$



- 11. The interhalogen compound formed from the reaction of bromine with excess of fluorine is a:
  - (A) hypohalite
- (B) halate
- (C) perhalate
- (D) halite

Official Ans. by NTA (B)

Ans. (B)

- **Sol.**  $Br_2 + 5 F_2 \longrightarrow 2BrF_5 \xrightarrow{H_2O} HBrO_3$  (Forms bromate)
- **12.** The photochemical smog does not generally contain:
  - (A) NO
- (B) NO<sub>2</sub>
- (C) SO<sub>2</sub>
- (D) HCHO

Official Ans. by NTA (C)

Ans. (C)

Sol. Factual



13. A compound 'A' on reaction with 'X' and 'Y produces the same major product but different by product 'a' and 'b'. Oxidation of 'a' gives a substance produced by ants.

'X' and 'Y' respectively are:

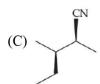
- (A) KMnO<sub>4</sub>/H<sup>+</sup> and dil. KMnO<sub>4</sub>, 273 K
- (B) KMnO<sub>4</sub>,(dilute), 273 K and KMnO<sub>4</sub>/H<sup>+</sup>
- (C) KMnO<sub>4</sub>/H<sup>+</sup> and O<sub>3</sub>, H<sub>2</sub>O/Zn
- (D) O<sub>3</sub>, H<sub>2</sub>O/Zn and KMnO<sub>4</sub>/H<sup>+</sup>

Official Ans. by NTA (D)
Ans. (D)

Sol.

14. Most stable product of the following reaction is:







Official Ans. by NTA (B)
Ans. (B)

Sol.

15. Which one of the following reactions does not represent correct combination of substrate and product under the given conditions?

(A) 
$$H_2$$
  $H_2$   $H_3$   $H_4$ 

(C) 
$$\xrightarrow{\text{CO}_2\text{C}_2\text{H}_5} \xrightarrow{\text{(i) AlH(iso Bu)}_2} \text{H}$$

Official Ans. by NTA (D)

Ans. (D)

16. An organic compound 'A' on reaction with NH<sub>3</sub> followed by heating gives compound B. Which on further strong heating gives compound C (C<sub>8</sub>H<sub>5</sub>NO<sub>2</sub>). Compound C on sequential reaction with ethanolic KOH, alkyl chloride and hydrolysis with alkali gives a primary amine. The compound A is:

Official Ans. by NTA (C)

Ans. (C)



Sol. Gabriel Pthalimide reaction

COOH 
$$\frac{NH_3}{1}$$
  $\frac{CONH_2}{CONH_2}$ 

(A) (B)  $\frac{CONH_2}{CONH_2}$ 

Strong heating  $\frac{CONH_2}{CONH_2}$ 
 $\frac{KOH}{EtOH}$ 

NH

O

(C)

 $\frac{N+K+KOH}{EtOH}$ 

NH

O

 $\frac{N+K+KOH}{EtOH}$ 

NH

O

 $\frac{N+K+KOH}{EtOH}$ 

RNH

O

 $\frac{N+K+KOH}{H_2O}$ 

**17.** Melamine polymer is formed by the condensation of :

(A) 
$$H_2N$$
  $NH_2$   $+$  HCHO

(B)  $H_2N$   $NH_2$   $+$  HCHO

(C)  $H_2N$   $NH_2$   $+$  HCHO

(D)  $NH_2$   $+$  HCHO

Official Ans. by NTA (A) Ans. (A)

Formaldehyde HCHO

NH<sub>2</sub>

Sol.

Melamine formaldehyde Resin is melamine polymer

- **18.** During the denaturation of proteins, which of these structures will remain intact?
  - (A) Primary
  - (B) Secondary
  - (C) Tertiary
  - (D) Quaternary

# Official Ans. by NTA (A)

Ans. (A)

- Sol. Primary structure remains intact during denaturation of proteins
- 19. Drugs used to bind to receptors, inhibiting its natural function and blocking a message are called:
  - (A) Agonists
  - (B) Antagonists
  - (C) Allosterists
  - (D) Anti histaminists

### Official Ans. by NTA (B)

Ans. (B)

Sol. Factual

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

**Statement I :** On heating with KHSO<sub>4</sub>, glycerol is dehydrated and acrolein is formed.

**Statement II:** Acrolein has fruity odour and can be used to test glycerol's presence.

Choose the correct option.

- (A) Both Statement I and Statement II are correct.
- (B) Both Statement I and Statement II are incorrect
- (C) Statement I is correct but Statement II is incorrect.
- (D) Statement I is incorrect but Statement II is correct.

Official Ans. by NTA (B)

Ans. (C)

**Sol.** Acrolein has a pungent, suffocating odour.

Acrolein is used to detect presence of glycerol



### **SECTION-B**

1. Among the following species

$$N_2, N_2^+, N_2^-, N_2^{2-}, O_2, O_2^+, O_2^-, O_2^{2-}$$

the number of species showing diamagnetism is

Official Ans. by NTA (2)

Ans. (2)

**Sol.** Diamagnetic species are:  $N_2$ ,  $O_2^{2-}$ 

2. The enthalpy of combustion of propane, graphite and dihydrogen at 298 K are: -2220.0 kJ mol<sup>-1</sup>, -393.5 kJ mol<sup>-1</sup> and -285.8 kJ mol<sup>-1</sup> respectively. The magnitude enthalpy of formation of propane (C<sub>3</sub>H<sub>8</sub>) is......kJ mol<sup>-1</sup>. (Nearest integer)

Official Ans. by NTA (104)

Ans. (104)

**Sol.** 
$$3C_{(gr)} + 4H_{2(g)} \rightarrow C_3H_{8(g)}$$
  
=  $-103.7 \text{ kJ mol}^{-1}$ 

3. The pressure of a moist gas at 27°C is 4 atm. The volume of the container is doubled at the same temperature. The new pressure of the moist gas is  $.... \times 10^{-1}$  atm. (Nearest integer)

(Given: The vapour pressure of water at 27°C is 0.4 atm)

Official Ans. by NTA (22)

Ans. (22)

**Sol.** 
$$\left[P_{gas}\right]_0 + V.P. = 4$$

$$[P_{gas}]_0 = 4 - 0.4 = 3.6$$

As volume is doubled,  $\left[P_{gas}\right]_{new} = 1.8$  atm

New Total Pressure = 1.8 + 0.4 = 2.2 atm

4. The cell potential for Zn|Zn<sup>2+</sup> (aq)||Sn<sup>x+</sup>|Sn is 0.801 V at 298 K. The reaction quotient for the above reaction is 10<sup>-2</sup>. The number of electrons involved in the given electrochemical cell reaction is......

(Given 
$$E_{Zn^{2+}|Zn}^0 = -0.763V$$
,  $E_{Sn^{x+}|Sn}^0 = +0.008V$ 

and 
$$\frac{2.303RT}{F} = 0.06V$$
)

Official Ans. by NTA (4)

Ans. (2)

**Sol.** 
$$E = E^0 - \frac{2.303 \,\text{RT}}{\text{nF}} \log Q$$

Here, E = +0.801V,  $E^0 = 0.008 - (-0.763)$ = +0.771 V

$$\therefore 0.801 = +0.771 - \frac{0.06}{n} \log 10^{-2}$$

 $\Rightarrow$  n = 4

5. The half life for the decomposition of gaseous compound A is 240 s when the gaseous pressure was 500 Torr initially. When the pressure was 250 Torr, the half life was found to be 4.0 min. The order of the reaction is...... (Nearest integer)

Official Ans. by NTA (1)

Ans. (1)

**Sol.**  $(t_{1/2})_{500 \text{ torr}} = 240 \text{ sec} = 4 \text{ min.}$ 

 $(t_{1/2})_{250 \text{ torr}} = 4 \text{ min.}$ 

 $t_{1/2} \propto a^{1-n}$ 

As  $t_{1/2}$  is independent of initial pressure. Hence, order is 1st order.

**6.** Consider the following metal complexes:

 $\left[\text{Co(NH}_3)\right]^{3+}$ 

 $\left[\text{CoCl}(\text{NH}_3)_5\right]^{2+}$ 

 $[Co(CN)_{6}]^{3-}$ 

 $[Co(NH_3)_5(H_2O)]^{3+}$ 

The spin-only magnetic moment value of the complex that absorbs light with shortest wavelength is B.M. (Nearest integer)

Official Ans. by NTA (0)

Ans. (0)

**Sol.**  $\Delta_0 \propto \frac{1}{\lambda}$ 

Here,  $CN^-$  being SFL will have maximum CFSE So,  $[Co(CN)_6]^{3-}$  will be  $d^2sp^3$ ,  $\mu=0$ 

7. Among Co<sup>3+</sup>, Ti<sup>2+</sup>, V<sup>2+</sup> and Cr<sup>2+</sup>ions, one if used as a reagent cannot liberate H<sub>2</sub> from dilute mineral acid solution, its spin-only magnetic moment in gaseous state is .....B.M. (Nearest integer)

Official Ans. by NTA (5)

\_\_\_ Ans. (5)

**Sol.**  $Co^{3+}$  can't liberate  $H_2$ .

It has d<sup>6</sup> configuration,

Number of unpaired electrons = 4

$$\mu = \sqrt{4 \times 6} = 4.92$$
 B.M.



8. While estimating the nitrogen present in an organic compound by Kjeldahl's method, the ammonia evolved from 0.25 g of the compound neutralized 2.5 mL of 2 M H<sub>2</sub>SO<sub>4</sub>. The percentage of nitrogen present in organic compound is .......

Official Ans. by NTA (56)

Ans. (56)

Sol. 
$$\%N = \frac{1.4(N_1V_1)}{\text{mass of organic compound}}$$

$$\%N = \frac{1.4(2.5 \times 2 \times 2)}{0.25} = 56$$

9. The number of sp<sup>3</sup> hybridised carbons in an acyclic neutral compound with molecular formula C<sub>4</sub>H<sub>5</sub>N is:

Official Ans. by NTA (1)

Ans. (0 or 1)

**Sol.** DU = 
$$4+1-\left(\frac{5-1}{2}\right)=3$$

$$H_3C-CH=CH-C\equiv N$$
 $sp^3$ 

or

$$CH_2 = C = CH = CH = NH$$
Zero sp<sup>3</sup> carbon

10. In the given reaction

$$\begin{array}{c|c} H_3C & O \\ \parallel & C-O \, Et \\ \hline & C-O \, Et \\ \hline & CH_2-C-CH_3 \\ \hline & O \end{array} \qquad A$$

(Where Et is  $-C_2H_5$ )

The number of chiral carbon/s in product A is

Official Ans. by NTA (2)

Ans. (2)

Sol.

2 chiral carbons