FINAL JEE–MAIN EXAMINATION – JULY, 2022

(Held On Monday 25th July, 2022) **TIME : 3 : 00 PM to 06 : 00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

1. Match **List I** with **List II** :

List-I (molecule)	List-II (hybridization; shape)
A. XeO_3	I. sp^3d ; linear
B. XeF_2	II. sp^3; pyramidal
C. $XeOF_4$	III. sp^3d^3; distorted octahedral
D. XeF_6	IV. sp^3d^2 ;square pyramidal

Choose the correct answer from the options given below:

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

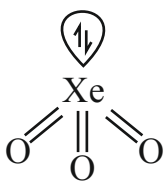
(B) A-II, B-IV, C-III, D-I

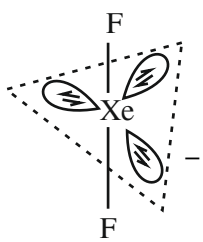
(C) A-IV, B-II, C-III, D-I

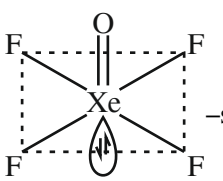
(D) A-IV, B-II, C-I, D-III

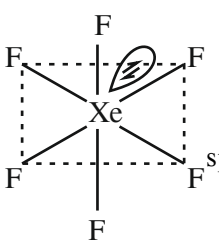
Official Ans. by NTA (A)

Allen Ans. (A)

Sol. (A)  – sp^3 – pyramidal

(B)  – sp^3d – linear

(C)  –sp^3d^2–square pyramidal

(D)  sp^3d^3–distorted octahedral

2. Two solutions A and B are prepared by dissolving 1 g of non-volatile solutes X and Y. respectively in 1 kg of water. The ratio of depression in freezing points for A and B is found to be 1 : 4. The ratio of molar masses of X and Y is :

(A) 1 : 4

(B) 1 : 0.25

(C) 1 : 0.20

(D) 1 : 5

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. $$\frac{\Delta T_{fx}}{\Delta T_{fy}}=\frac{k_f\cdot m_x}{k_f\cdot m_y}=\frac{\frac{1}{M_x}}{\frac{1}{M_y}}$$

$$\Rightarrow \frac{1}{4}=\frac{M_y}{M_x}$$

$$\Rightarrow M_x : M_y = 1 : 0.25$$

3. Ka_1, Ka_2 and Ka_3 are the respective ionization constants for the following reactions (a),(b), and (c).

(a) $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^-$

(b) $HC_2O_4^- \rightleftharpoons H^+ + HC_2O_4^{2-}$

(c) $H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$

The relationship between K_{a_1}, K_{a_2} and K_{a_3} is given as

(A) $K_{a_3}=K_{a_1}+K_{a_2}$ (B) $K_{a_3}=K_{a_1}-K_{a_2}$

(C) $K_{a_3}=K_{a_1}/K_{a_2}$ (D) $K_{a_3}=K_{a_1}\times K_{a_2}$

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. $H_2C_2O_4 \rightleftharpoons H^+ + HC_2O_4^-$ K_{a_1}

$H_2C_2O_4^- \rightleftharpoons H^+ + C_2O_4^{2-}$ K_{a_2}

$H_2C_2O_4 \rightleftharpoons 2H^+ + C_2O_4^{2-}$ $K_{a_3}=K_{a_1}\times K_{a_2}$

4. The molar conductivity of a conductivity cell filled with 10 moles of 20 mL NaCl solution is Λ_{m1} and that of 20 moles another identical cell heaving 80 mL NaCl solution is Λ_{m2}, The conductivities exhibited by these two cells are same.

The relationship between Λ_{m2} and Λ_{m1} is

(A) $\Lambda_{m2} = 2\Lambda_{m1}$ (B) $\Lambda_{m2} = \Lambda_{m1}/2$

(C) $\Lambda_{m2} = \Lambda_{m1}$ (D) $\Lambda_{m2} = 4\Lambda_{m1}$

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. $\Lambda_m = \kappa \times \frac{1000}{M}$

$\Rightarrow \Lambda_m \propto \frac{1}{M}$

$\frac{\Lambda_{m_1}}{\Lambda_{m_2}} = \frac{M_2}{M_1} = \frac{\frac{20}{80}}{\frac{10}{20}} = \frac{1}{4} \times \frac{2}{1} = \frac{1}{2}$

$\Rightarrow \Lambda_{m_2} = 2\Lambda_{m_1}$

5. For micelle formation, which of the following statements are correct?

(A) Micelle formation is an exothermic process.

(B) Micelle formation is an endothermic process.

(C) The entropy change is positive.

(D) The entropy change is negative.

(A) A and D only (B) A and C only

(C) B and C only (D) B and D only

Official Ans. by NTA (B)

Allen Ans. (C)

Sol. For micelle formation, $\Delta S > 0$ (hydrophobic effect) This is possible because, the decrease in entropy due to clustering is offset by increase in entropy due to desolvation of the surfactant, Also $\Delta H > 0$

6. The first ionization enthalpies of Be, B, N and O follow the order

(A) O < N < B < Be (B) Be < B < N < O

(C) B < Be < N < O (D) B < Be < O < N

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. **1st I.E.** $\underset{(2p^3)}{N} > \underset{(2p^4)}{O} > \underset{(2s^2)}{Be} > \underset{(2p^1)}{B}$

7. Given below are two statements.

Statement I : Pig iron is obtained by heating cast iron with scrap iron.

Statement II: Pig iron has a relatively lower carbon content than that of cast iron. In the light of the above statements, choose the correct answer from the options given below.

(A) Both Statement I and Statement II are correct.

(B) Both Statement I and Statement II are not correct.

(C) Statement I is correct but Statement II is not correct

(D) Statement I is not correct but Statement II is correct.

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Statement –I is incorrect because cast iron is obtained by heating pig iron with scrap iron

Statement–II is also incorrect because pig iron has more carbon content (~4%) than cast iron (~3%)

8. High purity (>99.95%) dihydrogen is obtained by

(A) reaction of zinc with aqueous alkali.

(B) electrolysis of acidified water using platinum electrodes.

(C) electrolysis of warm aqueous barium hydroxide solution between nickel electrodes.

(D) reaction of zinc with dilute acid.

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. High purity (>99.95%) dihydrogen is obtained by electrolysis of warm aqueous $Ba(OH)_2$ solution between Ni-electrodes

9. The correct order of density is

(A) Be > Mg > Ca > Sr

(B) Sr > Ca > Mg > Be

(C) Sr > Be > Mg > Ca

(D) Be > Sr > Mg > Ca

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. In II'A' group density decreases down the group till Ca and after that it increases.

Correct order of density is

Sr > Be > Mg > Ca

10. The total number of acidic oxides from the following list is: NO, N_2O, B_2O_3, N_2O_5, CO, SO_3, P_4O_{10}

(A) 3 (B) 4

(C) 5 (D) 6

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Neutral Oxides — N_2O, NO, CO

Acidic Oxides — B_2O_3, N_2O_5, SO_3, P_4O_{10}

11. The correct order of energy of absorption for the following metal complexes is

A: $[Ni(en)_3]^{2+}$, B: $[Ni(NH_3)_6]^{2+}$, C: $[Ni(H_2O)_6]^{2+}$

(A) C < B < A

(B) B < C < A

(C) C < A < B

(D) A < C < B

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Stronger the ligand, larger the splitting & higher the energy of absorption.

$$\underset{(A)}{[Ni(en)_3]^{+2}} > \underset{(B)}{[Ni(NH_3)_6]^{+2}} > \underset{(C)}{[Ni(H_2O)_6]^{+2}}$$

12. **Match List I with List II.**

List–I		List–II	
A.	Sulphate	I.	Pesticide
B.	Fluoride	II.	Bending of bones
C.	Nicotine	III.	Laxative effect
D.	Sodium arsinite	IV.	Herbicide

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

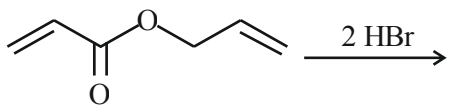
Sol. **A-Sulphate – III (Laxative effect)**

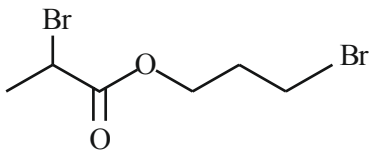
B-Fluoride – II (Bending of bones)

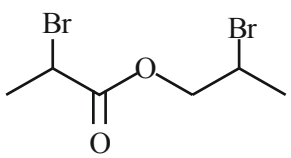
C-Nictoine – I (pesticides)

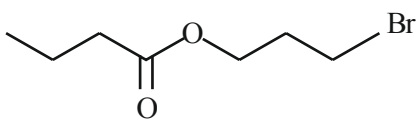
D-Sodium Arsinite – IV (herbicide)

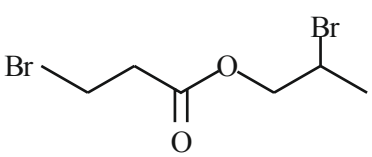
13. Major product of the following reaction is



(A)


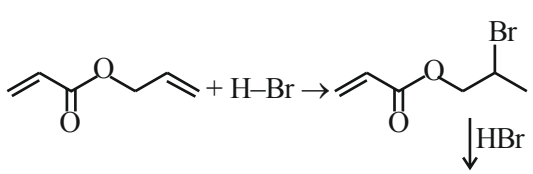
(B)


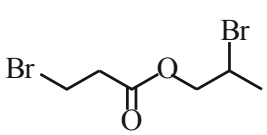
(C)


(D)


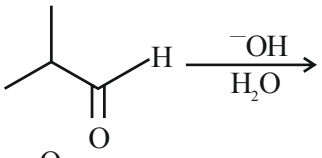
Official Ans. by NTA (D)

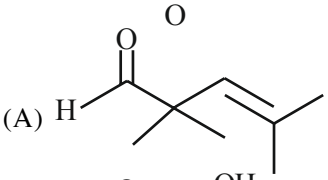
Allen Ans. (D)

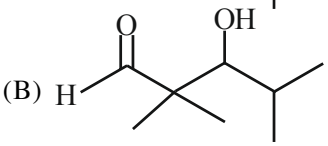
Sol.


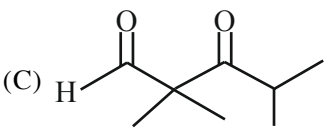


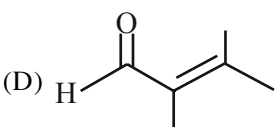
14. What is the major product of the following reaction?



(A) 

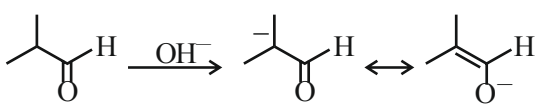
(B) 

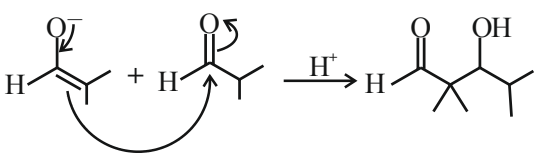
(C) 

(D) 

Official Ans. by NTA (B)

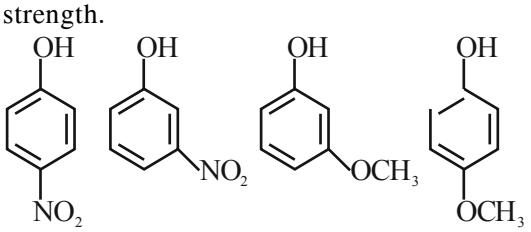
Allen Ans. (B)

Sol. 



Aldol formation takes place.

15. Arrange the following in decreasing acidic strength.



(A) (B) (C) (D)

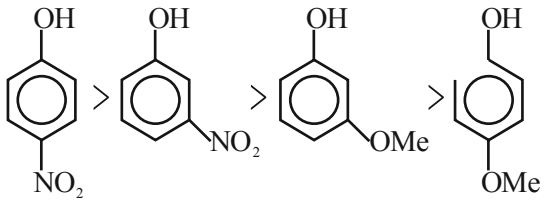
(A) A > B > C > D (B) B > A > C > D

(C) D > C > A > B (D) D > C > B > A

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. The correct order of acid strength is



16. $CH_3-CH_2-CN \xrightarrow[Ether]{CH_3MgBr} A \xrightarrow{H_3O^+} B \xrightarrow[HCl]{Zn-Hg} C$

The correct structure of C is

(A) $CH_3—CH_2—CH_2—CH_3$

(B) $CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3$

(C) $CH_3-CH_2-\overset{\overset{OH}{|}}{CH}-CH_3$

(D) $CH_3—CH_2—CH = CH_2$

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

$$CH_3CH_2-C\equiv N \xrightarrow{CH_3MgBr} CH_3CH_2-\overset{\overset{N\,MgBr}{\|}}{C}-CH_3$$

$$\downarrow H_3O^+$$

$$CH_3CH_2CH_2CH_3 \xleftarrow[HCl]{Zn/Hg} CH_3CH_2-\overset{\overset{O}{\|}}{C}-CH_3$$

(Clemmensen Reduction)

17. **Match List I with List II :**

Choose the correct answer from the options given below:

(A) A–III, B-I, C-IV, D-II

(B) A–III, B-IV, C-I, D-II

(C) A–II, B-I, C-IV, D-III

(D) A–II, B-IV, C-I, D-III

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. **LDPE → Toys**

HDPE → Buckets **(As per NCERT)**

18. Glycosidic linkage between C_1 of α-glucose and C_2 of β-fructose is found in

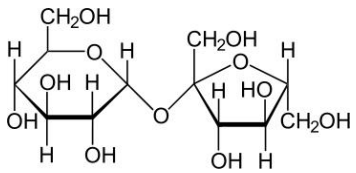
(A) maltose (B) sucrose

(C) lactose (D) amylose

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Theoretical



19. Some drugs bind to a site other than, the active site of an enzyme. This site is known as

(A) non-active site (B) allosteric site

(C) competitive site (D) therapeutic site

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Theoretical

20. In base vs. Acid titration, at the end point methyl orange is present as

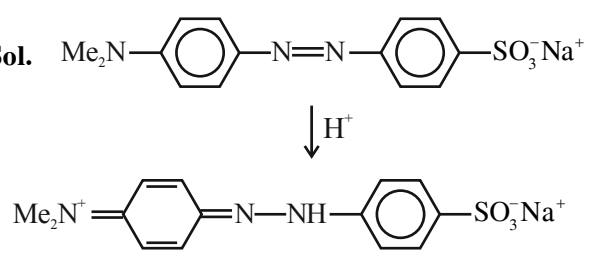
(A) quinonoid form (B) heterocyclic form

(C) phenolic form (D) benzenoid form

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



(QUINONOID FORM)

SECTION-B

1. 56.0 L of nitrogen gas is mixed with excess of hydrogen gas and it is found that 20 L of ammonia gas is produced. The volume of unused nitrogen gas is found to be____ L.

Official Ans. by NTA (46)

Allen Ans. (46)

Sol.

N_2	+	$3H_2$	→	$2NH_3$
56L		excess		O
−10L		−30L		+20L
46L				20L

2. A sealed flask with a capacity of 2 dm^3 contains 11 g of propane gas. The flask is so weak that it will burst if the pressure becomes 2 MPa. The minimum temperature at which the flask will burst is _____ °C. [Nearest integer] (Given: R = 8.3 J K^{-1} mol^{-1}. Atomic masses of C and H are 12u and 1u respectively.) (Assume that propane behaves as an ideal gas.)

Official Ans. by NTA (1655)

Allen Ans. (1655)

Sol. Moles of $C_3H_8 = \frac{11}{44} = 0.25$ moles

$PV = nRT$

$\Rightarrow 2 \times 10^6 \times 2 \times 10^{-3} = 0.25 \times 8.3 \times T$

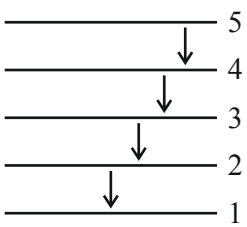
$\Rightarrow T = 1927.710\ K = 1654.56°C$

3. When the excited electron of a H atom from n = 5 drops to the ground state, the maximum number of emission lines observed are _____

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Since only a single H atom is present, maximum number of spectral lines = 4



4. While performing a thermodynamics experiment, a student made the following observations,

$HCl + NaOH \rightarrow NaCl + H_2O\ \Delta H = -57.3$ kJ mol^{-1}

$CH_3COOH + NaOH \rightarrow CH_3COONa + H_2O$

$\Delta H = -55.3$ kJ mol^{-1}.

The enthalpy of ionization of CH_3COOH as calculated by the student is _____ kJ mol^{-1}. (nearest integer)

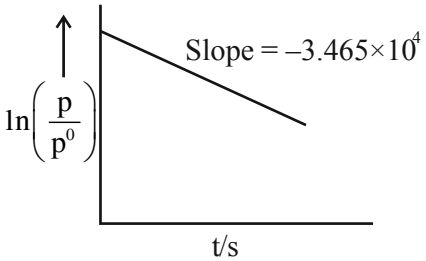
Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $\Delta H_{ionisation}$ of $CH_3COOH = |-57.3 - (-55.3)|$

$= 2$ KJ/mol

5. For the decomposition of azomethane. $CH_3N_2CH_3(g) \rightarrow CH_3CH_3(g)+N_2(g)$ a first order reaction, the variation in partial pressure with time at 600 K is given as



The half life of the reaction is _____ × 10^{-5}s. [Nearest integer]

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. For first order reaction

$$k = \frac{1}{t}\ln\left(\frac{P_0}{P}\right)$$

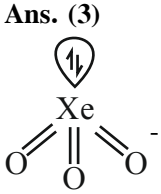
$$\ln\left(\frac{P_0}{P}\right) = kt$$

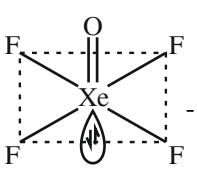
$$t_{1/2} = \frac{\ln 2}{k} = \frac{0.693}{3.465\times10^4} = 2\times10^{-5}$$

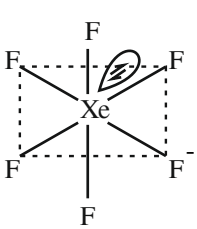
6. The sum of number of lone pairs of electrons present on the central atoms of XeO_3, $XeOF_4$ and XeF_6 is _____

Official Ans. by NTA (3)

Allen Ans. (3)

Sol.  - one lone pair on central atom

 - one lone pair on central atom

 - one lone pair on central atom

7. The spin-only magnetic moment value of M^{3+} ion (in gaseous state) from the pairs Cr^{3+}/Cr^{2+}, Mn^{3+}/Mn^{2}, Fe^{3+}/Fe^{2+} and Co^{3+}/Co^{2+} that has negative standard electrode potential, is B.M.

[Nearest integer]

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $E^0_{Cr^{+3}|Cr^{+2}} = -0.41V$

$[Cr^{+3}] = 4s^0 3d^3$

$\mu = \sqrt{n(n+2)}$ B.M

$= \sqrt{15}$ B.M ~ 4 B.M

8. A sample of 4.5 mg of an unknown monohydric alcohol, R–OH was added to methylmagnesium iodide. A gas is evolved and is collected and its volume measured to be 3.1 mL. The molecular weight of the unknown alcohol is ____ g/mol. [Nearest integer]

Official Ans. by NTA (33)

Allen Ans. (33)

Sol. $ROH + CH_3MgI \rightarrow ROMgI + CH_4(g)$

moles of CH_4 = moles of ROH

$$\Rightarrow \frac{V}{22400} = \frac{m}{M.M} \text{ (Assuming NTP Condition)}$$

$$\Rightarrow \frac{3.1}{22400} = \frac{4.5\times10^{-3}}{M.M}$$

$\Rightarrow$ MM = 32.51

Nearest Integer = 33

9. The separation of two coloured substances was done by paper chromatography. The distances travelled by solvent front, substance A and substance B from the base line are 3.25 cm. 2.08 cm and 1.05 cm. respectively. The ratio of R_f values of A to B is _____

Official Ans. by NTA (2)

Allen Ans. (2)

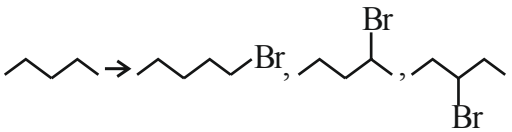
Sol. $$\frac{R_{F_A}}{R_{F_B}} = \frac{\frac{2.08}{3.25}}{\frac{1.05}{3.25}} = \frac{2.08}{1.05} \simeq 2$$

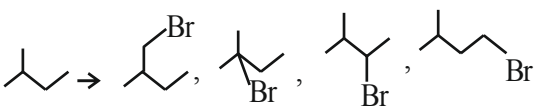
10. The total number of monobromo derivatives formed by the alkanes with molecular formula C_5H_{12} is (excluding stereo isomers)_____

Official Ans. by NTA (8)

Allen Ans. (8)

Sol. The Alkanes and their monobromodervative are

1. 

2. 

3.