

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

 (Held On Thursday 28<sup>th</sup> July, 2022)

TIME : 3 : 00 PM to 6 : 00 PM

**CHEMISTRY**
**TEST PAPER WITH SOLUTION**
**SECTION-A**

1. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**
- Assertion A** : Zero orbital overlap is an out of phase overlap.

**Reason R** : It results due to different orientation/direction of approach of orbitals.

In the light of the above statements. Choose the **correct** answer from the options given below

(A) Both A and R are true and R is the correct explanation of A

(B) Both A and R are true but R is NOT the correct explanation of A

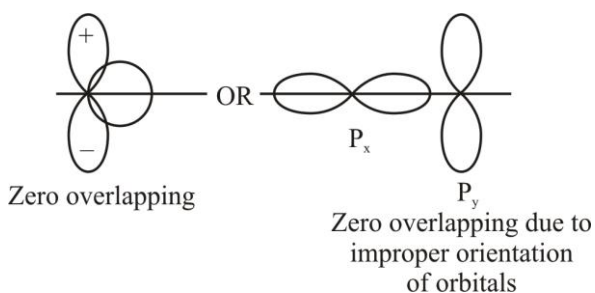
(C) A is true but R is false

(D) A is false but R is true

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

**Allen Ans. (A)**

**Sol.**



2. The correct decreasing order for metallic character is

(A)  $\text{Na} > \text{Mg} > \text{Be} > \text{Si} > \text{P}$

(B)  $\text{P} > \text{Si} > \text{Be} > \text{Mg} > \text{Na}$

(C)  $\text{Si} > \text{P} > \text{Be} > \text{Na} > \text{Mg}$

(D)  $\text{Be} > \text{Na} > \text{Mg} > \text{Si} > \text{P}$

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

**Allen Ans. (A)**

**Sol.** Across a period metallic character decreases

3. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**
- Assertion A** : The reduction of a metal oxide is easier if the metal formed is in liquid state than solid state.

**Reason R** : The value of  $\Delta G^\ominus$  becomes more on negative side as entropy is higher in liquid state than solid state.

In the light of the above statements. Choose the most appropriate answer from the options given below

(A) Both A and R are correct and R is the correct explanation of A

(B) Both A and R are correct but R is NOT the correct explanation of A

(C) A is correct but R is not correct

(D) A is not correct but R is correct

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

**Allen Ans. (A)**

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

$\therefore$  Entropy of liquid is more than solid

$\therefore$  on melting the entropy increases and  $\Delta G$  becomes more negative and hence it becomes easier to reduce metal

4. The products obtained during treatment of hard water using Clark's method are:

(A)  $\text{CaCO}_3$  and  $\text{MgCO}_3$

(B)  $\text{Ca(OH)}_2$  and  $\text{Mg(OH)}_2$

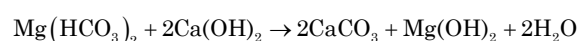
(C)  $\text{CaCO}_3$  and  $\text{Mg(OH)}_2$

(D)  $\text{Ca(OH)}_2$  and  $\text{MgCO}_3$

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

**Allen Ans. (C)**

**Sol.** In Clark's method lime water is used



5. **Statement I:** An alloy of lithium and magnesium is used to make aircraft plates.

**Statement II :** The magnesium ions are important for cell-membrane integrity.

In the light the above statements, choose the *correct* answer from the options given below

- (A) Both Statement I and Statement II are true  
 (B) Both Statement I and Statement II are false  
 (C) Statement I is true but Statement II is false  
 (D) Statement I is false but Statement II is true

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

**Allen Ans. (B)**

**Sol.** Alloy of Li and Mg is used to make armour plates and not aircraft plates.

Calcium plays important roles in neuromuscular function, interneuronal transmission and cell membrane integrity

6. White phosphorus reacts with thionyl chloride to give

- (A)  $\text{PCl}_5$ ,  $\text{SO}_2$  and  $\text{S}_2\text{Cl}_2$  (B)  $\text{PCl}_3$ ,  $\text{SO}_2$  and  $\text{S}_2\text{Cl}_2$   
 (C)  $\text{PCl}_3$ ,  $\text{SO}_2$  and  $\text{Cl}_2$  (D)  $\text{PCl}_5$ ,  $\text{SO}_2$  and  $\text{Cl}_2$

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

**Allen Ans. (B)**

**Sol.**  $\text{P}_4 + 8\text{SOCl}_2 \rightarrow 4\text{PCl}_3 + 4\text{SO}_2 + 2\text{S}_2\text{Cl}_2$

7. Concentrated  $\text{HNO}_3$  reacts with Iodine to give  
 (A)  $\text{HI}$ ,  $\text{NO}_2$  and  $\text{H}_2\text{O}$  (B)  $\text{HIO}_2$ ,  $\text{N}_2\text{O}$  and  $\text{H}_2\text{O}$   
 (C)  $\text{HIO}_3$ ,  $\text{NO}_2$  and  $\text{H}_2\text{O}$  (D)  $\text{HIO}_4$ ,  $\text{N}_2\text{O}$  and  $\text{H}_2\text{O}$

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

**Allen Ans. (C)**

**Sol.**  $\text{I}_2 + 10\text{HNO}_{3(\text{conc})} \Rightarrow 2\text{HIO}_3 + 10\text{NO}_2 + 4\text{H}_2\text{O}$

8. Which of the following pair is not isoelectronic species?

(At. no. Sm, 62; Er, 68; Yb, 70; Lu, 71; Eu, 63; Tb, 65; Tm, 69)

- (A)  $\text{Sm}^{2+}$  and  $\text{Er}^{3+}$  (B)  $\text{Yb}^{2+}$  and  $\text{Lu}^{3+}$   
 (C)  $\text{Eu}^{2+}$  and  $\text{Tb}^{4+}$  (D)  $\text{Tb}^{2+}$  and  $\text{Tm}^{4+}$

**Official Ans. by NTA (A or D)**

**Allen Ans. (A & D)**

**Sol.**  $\text{Sm}^{2+} \rightarrow$  electron = 60  
 $\text{Er}^{3+} \rightarrow$  electron = 65  
 $\text{Tb}^{2+} \rightarrow$  electron = 63  
 $\text{Tm}^{4+} \rightarrow$  electron = 65 } (not isoelectronic)

9. Given below are two statements : One is labelled as **Assertion A** and the other is labelled as **Reason R**

**Assertion A :** Permanganate titrations are not performed in presence of hydrochloric acid.

**Reason R :** Chlorine is formed as a consequence of oxidation of hydrochloric acid.

In the light of the above statements, choose the *correct* answer from the options given below

- (A) Both A and R are true and R is the correct explanation of A  
 (B) Both A and R are true but R is NOT the correct explanation of A  
 (C) A is true but R is false  
 (D) A is false but R is true

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

**Allen Ans. (A)**

**Sol.**  $2\text{KMnO}_4 + 16\text{HCl} \rightarrow 2\text{MnCl}_2 + 2\text{KCl} + 8\text{H}_2\text{O} + \text{Cl}_2$

HCl gets oxidised by  $\text{KMnO}_4$  into  $\text{Cl}_2$

10. Match List I with List II

	List I (Complex)		List II (Hybridization)
A	$\text{Ni}(\text{CO})_4$	I	$\text{sp}^3$
B	$[\text{Ni}(\text{CN})_4]^{2-}$	II	$\text{sp}^3\text{d}^2$
C	$[\text{Co}(\text{CN})_6]^{3-}$	III	$\text{d}^2\text{sp}^3$
D	$[\text{CoF}_6]^{3-}$	IV	$\text{dsp}^2$

Choose the correct answer from the options given below:

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

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

**Allen Ans. (B)**

Sol.  $\text{Ni}(\text{CO})_4$  Hybridisation  $sp^3$

$[\text{Ni}(\text{CN})_4]^{2-}$  Hybridisation  $dsp^2$

$[\text{Co}(\text{CN})_6]^{3-}$  Hybridisation  $d^2sp^3$

$[\text{Co}(\text{F})_6]^{3-}$  Hybridisation  $sp^3d^2$

11. Dinitrogen and dioxygen, the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because

- (A)  $\text{N}_2$  is unreactive in the condition of atmosphere.
- (B) Oxides of nitrogen are unstable.
- (C) Reaction between them can occur in the presence of a catalyst.
- (D) The reaction is endothermic and require very high temperature.

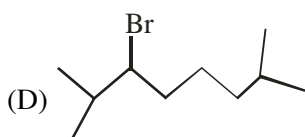
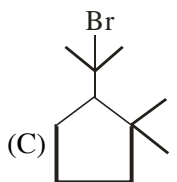
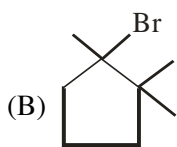
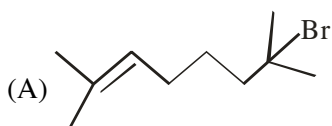
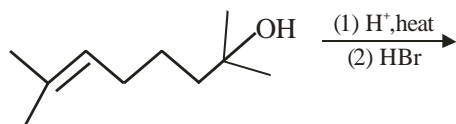
Official Ans. by NTA (D)

Allen Ans. (D)

Sol.  $\text{N}_2 + \text{O}_2 \xrightleftharpoons{(1483-2000 \text{ K})} 2\text{NO}$

(Endothermic and feasible at high temperature)

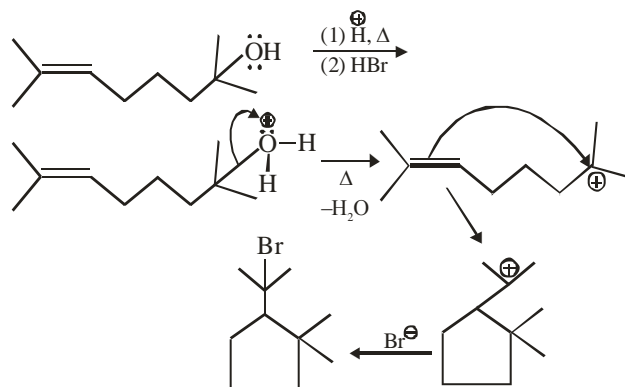
12. The major product in the given reaction is



Official Ans. by NTA (C)

Allen Ans. (C)

Sol.



13. Arrange the following in increasing order of reactivity towards nitration

- A. p-xylene
- B. bromobenzene
- C. mesitylene
- D, nitrobenzene
- E. benzene

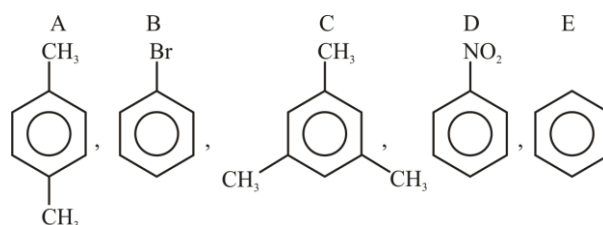
Choose the correct answer from the options given below

- (A)  $C < D < E < A < B$
- (B)  $D < B < E < A < C$
- (C)  $D < C < E < A < B$
- (D)  $C < D < E < B < A$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol.



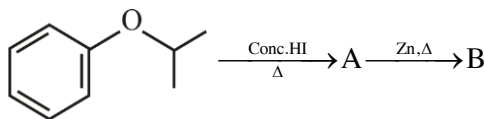
$-\text{NO}_2$  is strongly deactivating



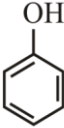

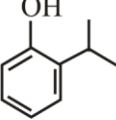
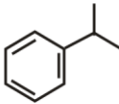
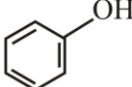

$-\text{Br}$  – deactivating

$-\text{CH}_3$ –activating group

$D < B < E < A < C$

14. Compound I is heated with Conc. HI to give a hydroxy compound A which is further heated with Zn dust to give compound B. Identify A and B.

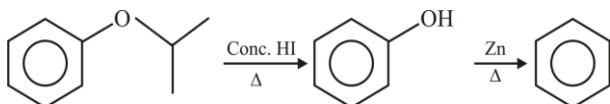


- (A) A = , B = 
- (B) A = , B = 
- (C) A = , B = 
- (D) A = , B = 

Official Ans. by NTA (D)

Allen Ans. (D)

Sol.



15. Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**

**Assertion A** : Aniline on nitration yields ortho, meta & para nitro derivatives of aniline.

**Reason R**: Nitrating mixture is a strong acidic mixture.

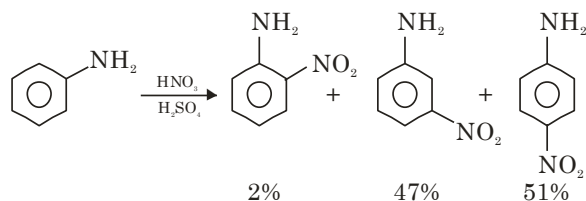
In the light of the above statements, choose the **correct** answer from the options given below

- (A) Both A and R are true and R is the correct explanation of A
- (B) Both A and R are true but R is NOT the correct explanation of A
- (C) A is true but R is false
- (D) A is false but R is true

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



Due to formation of anilinium ion in acidic medium meta product is also obtained in significant amount

16. Match List I with List II

List (Polymer)	List II(Nature)
A. $\left[ \text{CH}_2 - \underset{\text{Cl}}{\text{C}} = \text{CH} - \text{CH}_2 \right]_n$	I. Thermosetting polymer
B. $\left[ \text{N} \left( \text{CH}_2 \right)_6 \text{N} \left( \text{C} \left( \text{CH}_2 \right)_4 \text{C} \right) \right]_n$	II. Fibers
C. $\left[ \text{CH}_2 - \underset{\text{Cl}}{\text{CH}} \right]_n$	III. Elastomer
D. $\left[ \text{C}_6\text{H}_4 \text{CH}_2 \text{C}_6\text{H}_4 \text{CH}_2 \right]_n$	IV. Thermoplastic polymer

Choose the correct answer from the options given below:

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

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Neoprene is elastomer

Nylon-6, 6 is fiber

PVC is thermoplastic

Novolac is thermosetting



**SECTION-B**

1. 2L of 0.2 M  $\text{H}_2\text{SO}_4$  is reacted with 2L of 0.1 M NaOH solution, the molarity of the resulting product  $\text{Na}_2\text{SO}_4$  in the solution is \_\_\_\_ millimolar. (Nearest integer).

**Official Ans. by NTA (25)**

**Allen Ans. (25)**



0.4 mol    0.2 mol    -

0.3 mol    -    0.1 mol

Molarity of  $\text{Na}_2\text{SO}_4$  is  $\frac{0.1}{4} = 0.025\text{M}$

= 25 mM.

2. Metal M crystallizes into a FCC lattice with the edge length of  $4.0 \times 10^{-8}$  cm. The atomic mass of the metal is \_\_\_\_ g/mol. (Nearest integer).  
 (Use :  $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$ , density of metal,  $M = 9.03 \text{ g cm}^{-3}$ )

**Official Ans. by NTA (87)**

**Allen Ans. (87)**

**Sol.**  $a = 4 \times 10^{-8} \text{ cm}$

$d = 9.03 \text{ g/ml}$

$d = \frac{ZM}{N_A a^3}$

$M = \frac{9.03 \times 6.02 \times 10^{23} \times 64 \times 10^{-24}}{4} = 86.97$

3. If the wavelength for an electron emitted from H-atom is  $3.3 \times 10^{-10} \text{ m}$ , then energy absorbed by the electron in its ground state compared to minimum energy required for its escape from the atom, is \_\_\_\_ times. (Nearest integer).

[Given :  $h = 6.626 \times 10^{-34} \text{ Js}$ ,

Mass of electron =  $9.1 \times 10^{-31}$ ]

**Official Ans. by NTA (2)**

**Allen Ans. (2)**

**Sol.**  $\lambda = \frac{h}{\sqrt{2mK}}$

$K = \frac{h^2}{2m\lambda^2}$

$K = \frac{h^2}{2m\lambda^2} = \frac{43.9 \times 10^{-68}}{2 \times 9.1 \times 10^{-31} \times 10.89 \times 10^{-20}}$

$K = 2.215 \times 10^{-18}$

$E_{\text{abs}} = E_{\text{req}} + K$

$\frac{E_{\text{abs}}}{E_{\text{req}}} = 1 + \frac{K}{E_{\text{req}}} = 1 + \frac{2.215 \times 10^{-18}}{13.6 \times 1.602 \times 10^{-19}} = 2.0166$

4. A gaseous mixture of two substances A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. The mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase. The vapour pressure of pure liquid A is \_\_\_\_ atm. (Nearest integer)

**Official Ans. by NTA (2)**

**Allen Ans. (2)**

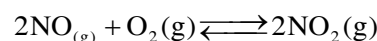
**Sol.**  $Y_A = 0.5 \Rightarrow Y_B = 0.5$

$P_A = P_B = 0.4 \text{ atm}$

$P_A = P_A^0 X_A$

$P_A^0 = 2$

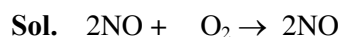
5. At 600K, 2 mol of NO are mixed with 1 mol of  $\text{O}_2$ .



The reaction occurring as above comes to equilibrium under a total pressure of 1 atm. Analysis of the system shows that 0.6 mol of oxygen are present at equilibrium. The equilibrium constant for the reaction is \_\_\_\_\_. (Nearest integer).

**Official Ans. by NTA (2)**

**Allen Ans. (2)**



2	1	-
2-2x	1-x	2x
1.2	0.6	0.8

$K_p = \frac{\left(\frac{0.8}{2.6}\right)^2}{\left(\frac{1.2}{2.6}\right)^2 \left(\frac{0.6}{2.6}\right)} = 1.925$

6. A sample of 0.125 g of an organic compound when analysed by Duma's method yields 22.78 mL of nitrogen gas collected over KOH solution at 280K and 759 mm Hg. The percentage of nitrogen in the given organic compound is \_\_\_\_\_. (Nearest integer).

(a) The vapour pressure of water at 280 K is 14.2 mm Hg

(b)  $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$

**Official Ans. by NTA (22)**

**Allen Ans. (22)**

**Sol.**  $V = 22.78 \text{ ml}, T = 280 \text{ K}$

$$P_{\text{total}} = 759 \text{ mmHg}$$

$$P_{\text{N}_2} = 759 - 14.2 = 744.8 \text{ mmHg}$$

$$n_{\text{N}_2} = \frac{744.8 \times 22.78}{760 \times 1000 \times 0.082 \times 280} = 0.00097$$

$$W_{\text{Nitrogen}} = 0.02716$$

$$\%N = \frac{0.02716}{0.125} \times 1000 = 21.728$$

7. On reaction with stronger oxidizing agent like  $\text{KIO}_4$ , hydrogen peroxide oxidizes with the evolution of  $\text{O}_2$ . The oxidation number of I in  $\text{KIO}_4$  changes to \_\_\_\_\_.

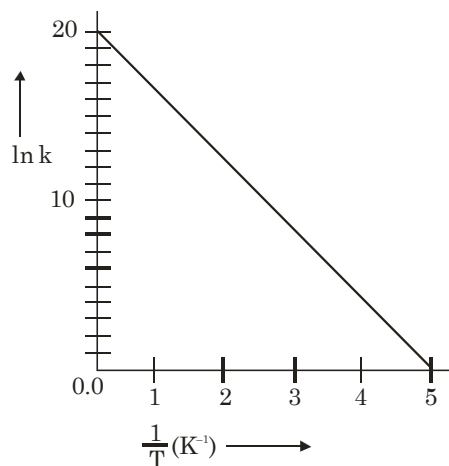
**Official Ans. by NTA (5)**

**Allen Ans. (5)**



8. For a reaction, given below is the graph of  $\ln k$  vs  $\frac{1}{T}$ . The activation energy for the reaction is equal to \_\_\_\_\_  $\text{cal mol}^{-1}$ . (Nearest integer).

(Given :  $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$ )



**Official Ans. by NTA (8)**

**Allen Ans. (8)**

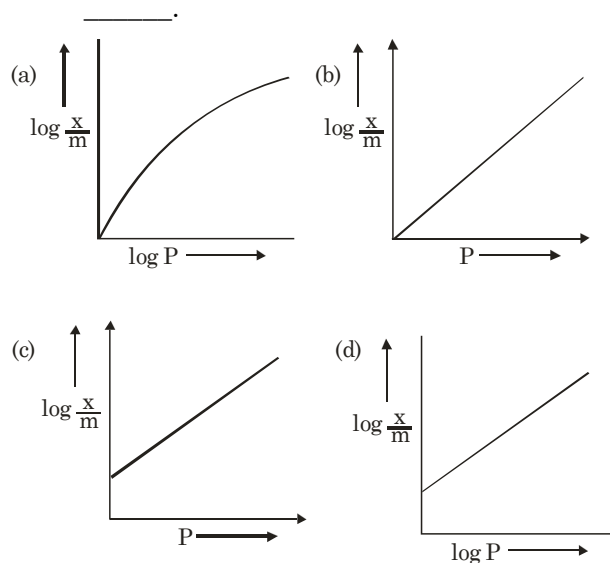
**Sol.**  $K = Ae^{-E_a/RT}$

$$\ln k = \frac{-E_a}{RT} + \ln A$$

$$\text{Slope} = \frac{E_a}{R} = \frac{20}{5}$$

$$E_a = 4R = 8 \text{ Cal/mol}$$

9. Among the following the number of curves not in accordance with Freundlich adsorption isotherm is \_\_\_\_\_.

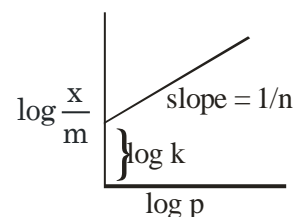


**Official Ans. by NTA (3)**

**Allen Ans. (3)**

**Sol.**  $\frac{x}{m} = KP^n$

$$\log \frac{x}{m} = \frac{1}{n} \log p + \log k$$



10. Among the following the number of state variable is \_\_\_\_\_.

Internal energy (U)

Volume (V)

Heat (q)

Enthalpy (H)

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

**Allen Ans. (3)**

- Sol.** Internal energy, volume enthalpy are state variable