

**FINAL JEE-MAIN EXAMINATION – JANUARY, 2024**

**(Held On Monday 29<sup>th</sup> January, 2024)**

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

**CHEMISTRY**

**TEST PAPER WITH SOLUTION**

**SECTION-A**

**61.** Given below are two statements : one is labelled as **Assertion A** and the other is labelled as **Reason R**:  
**Assertion A:** The first ionisation enthalpy decreases across a period.

**Reason R:** The increasing nuclear charge outweighs the shielding across the period.

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

- (1) Both A and R are true and R is the correct explanation of A  
(2) A is true but R is false  
(3) A is false but R is true  
(4) Both A and R are true but R is NOT the correct explanation of A

**Ans. (3)**

**Sol.** First ionisation energy **increases** along the period. Along the period Z increases which outweighs the shielding effect

**62.** Match List I with List II

<b>LIST-I</b> <b>(Substances)</b>	<b>LIST-II</b> <b>(Element Present)</b>
A. Ziegler catalyst	I. Rhodium
B. Blood Pigment	II. Cobalt
C. Wilkinson catalyst	III. Iron
D. Vitamin B <sub>12</sub>	IV. Titanium

Choose the correct answer from the options given below:

- (1) A-II, B-IV, C-I, D-III  
(2) A-II, B-III, C-IV, D-I  
(3) A-III, B-II, C-IV, D-I  
(4) A-IV, B-III, C-I, D-II

**Ans. (4)**

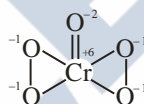
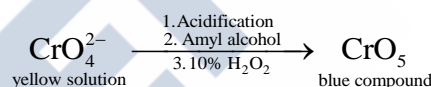
**Sol.** Ziegler catalyst → Titanium  
Blood pigment → Iron  
Wilkinson catalyst → Rhodium  
Vitamin B<sub>12</sub> → Cobalt

**63.** In chromyl chloride test for confirmation of Cl<sup>-</sup> ion, a yellow solution is obtained. Acidification of the solution and addition of amyl alcohol and 10% H<sub>2</sub>O<sub>2</sub> turns organic layer blue indicating formation of chromium pentoxide. The oxidation state of chromium in that is

- (1)+6 (2)+5  
(3)+10 (4)+3

**Ans. (1)**

**Sol.**  $Cl^- + K_2Cr_2O_7 + H_2SO_4 \rightarrow CrO_2Cl_2 \xrightarrow{\text{Basic medium}} CrO_4^{2-} + Cl^-$   
yellow solution



**64.** The difference in energy between the actual structure and the lowest energy resonance structure for the given compound is

- (1) electromeric energy  
(2) resonance energy  
(3) ionization energy  
(4) hyperconjugation energy

**Ans. (2)**

**Sol.** The difference in energy between the actual structure and the lowest energy resonance structure for the given compound is known as resonance energy.

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

**Statement I :** The electronegativity of group 14 elements from Si to Pb gradually decreases.

**Statement II :** Group 14 contains non-metallic, metallic, as well as metalloid elements.

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

- (1) Statement I is false but Statement II is true  
(2) Statement I is true but Statement II is false  
(3) Both Statement I and Statement II are true  
(4) Both Statement I and Statement II are false

**Ans. (1)**



<b>Sol.</b>	Gr-14	EN
	C	2.5
	Si	1.8
	Ge	1.8
	Sn	1.8
	Pb	1.9

The electronegativity values for elements from Si to Pb are almost same. So Statement I is false.

**66.** The correct set of four quantum numbers for the valence electron of rubidium atom ( $Z = 37$ ) is:

- |                             |                             |
|-----------------------------|-----------------------------|
| (1) $5, 0, 0, +\frac{1}{2}$ | (2) $5, 0, 1, +\frac{1}{2}$ |
| (3) $5, 1, 0, +\frac{1}{2}$ | (4) $5, 1, 1, +\frac{1}{2}$ |

**Ans. (1)**

**Sol.**  $Rb = [Kr]5s^1$

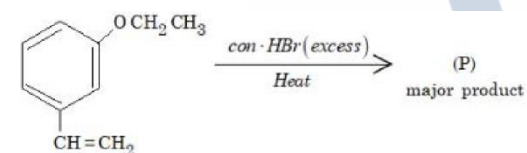
$n = 5$

$l = 0$

$m = 0$

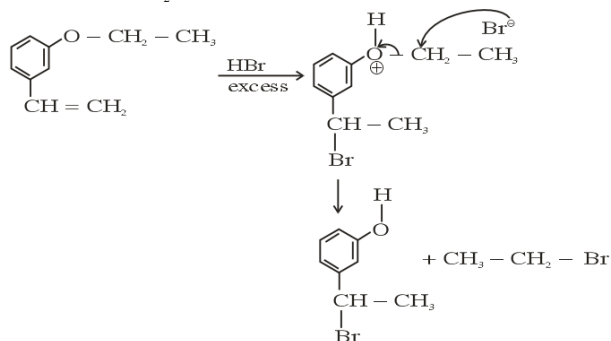
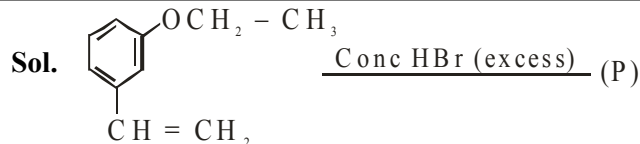
$s = +\frac{1}{2}$  or  $-\frac{1}{2}$

**67.** The major product(P) in the following reaction is

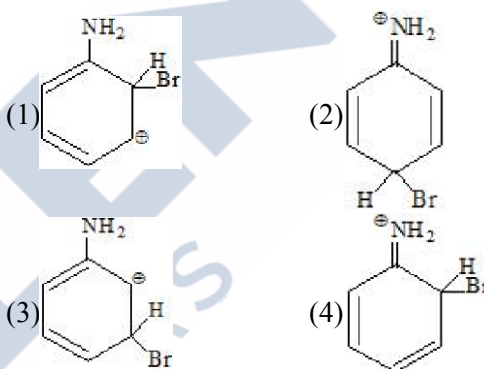


- |     |     |
|-----|-----|
| (1) | (2) |
| (3) | (4) |

**Ans. (4)**

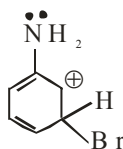


**68.** The arenium ion which is not involved in the bromination of Aniline is.



**Ans. (3)**

**Sol.** Since  $-\ddot{N}H_2$  group is o/p directing hence arenium ion will not be formed by attack at meta position i.e.

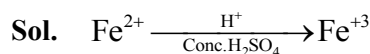


Hence Answer is (3)

**69.** Appearance of blood red colour, on treatment of the sodium fusion extract of an organic compound with  $FeSO_4$  in presence of concentrated  $H_2SO_4$  indicates the presence of element/s

- |             |       |
|-------------|-------|
| (1) Br      | (2) N |
| (3) N and S | (4) S |

**Ans. (3)**



Appearance of blood red colour indicates presence of both nitrogen and sulphur.



70. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R :  
**Assertion A** : Aryl halides cannot be prepared by replacement of hydroxyl group of phenol by halogen atom.

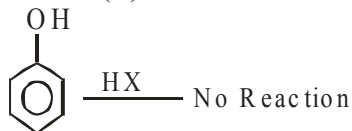
**Reason R** : Phenols react with halogen acids violently. In the light of the above statements, choose the most appropriate from the options given below:

- (1) Both A and R are true but R is NOT the correct explanation of A
- (2) A is false but R is true
- (3) A is true but R is false
- (4) Both A and R are true and R is the correct explanation of A

Ans. (3)

Sol. Assertion (A): Given statement is correct because in phenol hydroxyl group cannot be replaced by halogen atom.

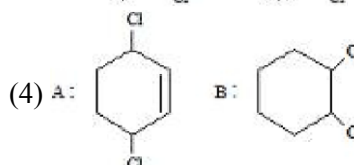
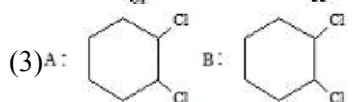
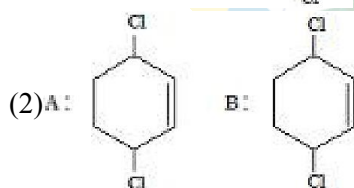
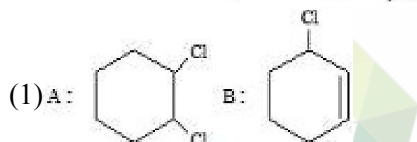
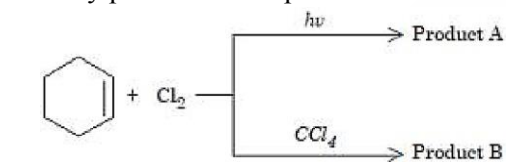
Reason (R) :



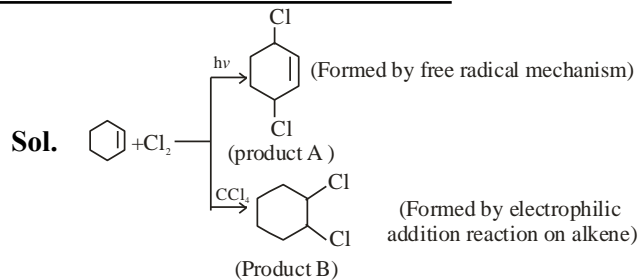
Given reason is false

Hence Assertion (A) is correct but Reason (R) is false

71. Identify product A and product B :



Ans. (4)



Hence correct Ans. (4)

72. Identify the incorrect pair from the following :

- (1) Fluorspar-  $\text{BF}_3$
- (2) Cryolite- $\text{Na}_3\text{AlF}_6$
- (3) Fluoroapatite- $3\text{Ca}_3(\text{PO}_4)_2 \cdot \text{CaF}_2$
- (4) Carnallite- $\text{KCl} \cdot \text{MgCl}_2 \cdot 6\text{H}_2\text{O}$

Ans. (1)

Sol. (1) Fluorspar is  $\text{CaF}_2$

73. The interaction between  $\pi$  bond and lone pair of electrons present on an adjacent atom is responsible for

- (1) Hyperconjugation
- (2) Inductive effect
- (3) Electromeric effect
- (4) Resonance effect

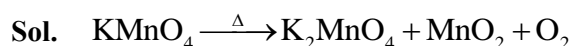
Ans. (4)

Sol. It is a type of conjugation responsible for resonance.

74.  $\text{KMnO}_4$  decomposes on heating at 513K to form  $\text{O}_2$  along with

- (1)  $\text{MnO}_2$  &  $\text{K}_2\text{O}_2$
- (2)  $\text{K}_2\text{MnO}_4$  & Mn
- (3) Mn &  $\text{KO}_2$
- (4)  $\text{K}_2\text{MnO}_4$  &  $\text{MnO}_2$

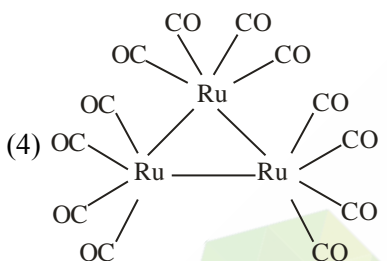
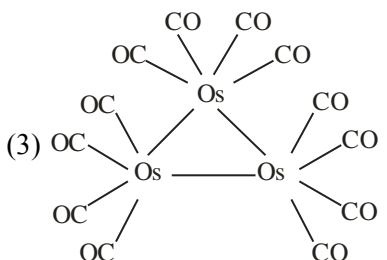
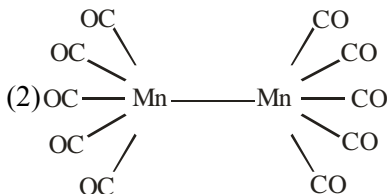
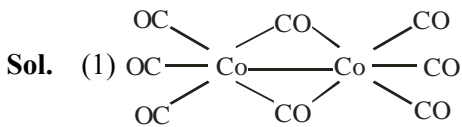
Ans. (4)



75. In which one of the following metal carbonyls, CO forms a bridge between metal atoms?

- (1)  $[\text{Co}_2(\text{CO})_8]$                       (2)  $[\text{Mn}_2(\text{CO})_{10}]$   
(3)  $[\text{Os}_3(\text{CO})_{12}]$                       (4)  $[\text{Ru}_3(\text{CO})_{12}]$

Ans. (1)



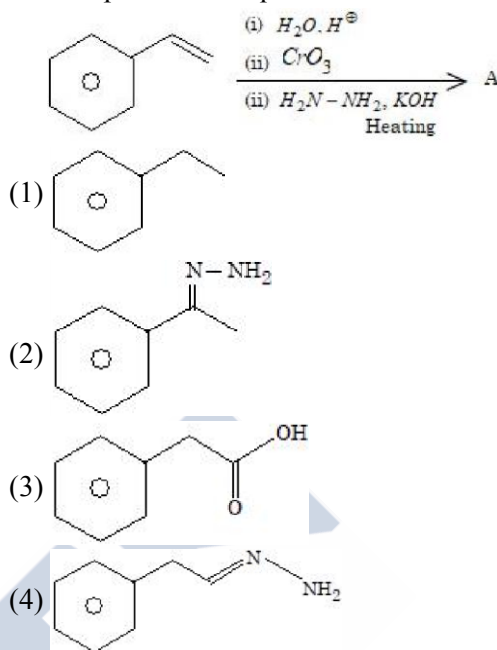
76. Type of amino acids obtained by hydrolysis of proteins is :

- (1)  $\beta$                                               (2)  $\alpha$   
(3)  $\delta$                                               (4)  $\gamma$

Ans. (2)

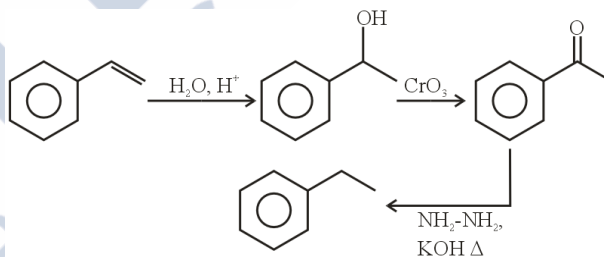
Sol. Proteins are natural polymers composed of  $\alpha$ -amino acids which are connected by peptide linkages. Hence proteins upon acidic hydrolysis produce  $\alpha$ -amino acids.

77. The final product A formed in the following multistep reaction sequence is



Ans. (1)

Sol.



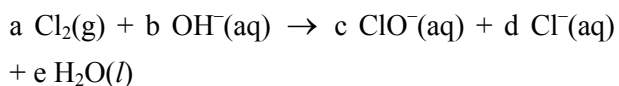
78. Which of the following is **not** correct?

- (1)  $\Delta G$  is negative for a spontaneous reaction  
(2)  $\Delta G$  is positive for a spontaneous reaction  
(3)  $\Delta G$  is zero for a reversible reaction  
(4)  $\Delta G$  is positive for a non-spontaneous reaction

Ans. (2)

Sol.  $(\Delta G)_{p,T} = (+)$ ve for non-spontaneous process

79. Chlorine undergoes disproportionation in alkaline medium as shown below :

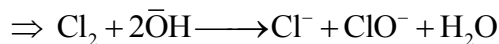
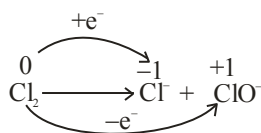


The values of a, b, c and d in a balanced redox reaction are respectively :

- (1) 1, 2, 1 and 1                              (2) 2, 2, 1 and 3  
(3) 3, 4, 4 and 2                              (4) 2, 4, 1 and 3

Ans. (1)

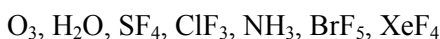
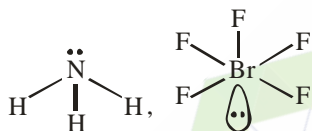
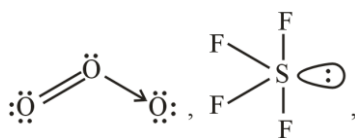
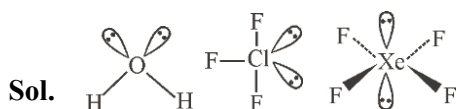


**Sol.**

**80.** In alkaline medium.  $\text{MnO}_4^-$  oxidises  $\text{I}^-$  to

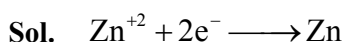
- (1)  $\text{IO}_4^-$                       (2)  $\text{IO}^-$   
 (3)  $\text{I}_2$                           (4)  $\text{IO}_3^-$

**Ans. (4)**


### SECTION-B

**81.** Number of compounds with one lone pair of electrons on central atom amongst following is \_

**Ans. (4)**

**82.** The mass of zinc produced by the electrolysis of zinc sulphate solution with a steady current of 0.015 A for 15 minutes is  $\_\_\_\_ \times 10^{-4}$  g.

(Atomic mass of zinc = 65.4 amu)

**Ans. (45.75) or (46)**


$$W = Z \times i \times t$$

$$= \frac{65.4}{2 \times 96500} \times 0.015 \times 15 \times 60$$

$$= 45.75 \times 10^{-4} \text{ gm}$$

**83.** For a reaction taking place in three steps at same temperature, overall rate constant  $K = \frac{K_1 K_2}{K_3}$ . If

 $E_{a1}, E_{a2}$  and  $E_{a3}$  are 40, 50 and 60 kJ/mol respectively, the overall  $E_a$  is  $\_\_\_\_ \text{ kJ/mol}$ .

**Ans. (30)**

**Sol.**  $K = \frac{K_1 \cdot K_2}{K_3} = \frac{A_1 \cdot A_2}{A_3} \cdot e^{-\frac{(E_{a1} + E_{a2} - E_{a3})}{RT}}$

$$A \cdot e^{-E_a/RT} = \frac{A_1 A_2}{A_3} \cdot e^{-\frac{(E_{a1} + E_{a2} - E_{a3})}{RT}}$$

$$E_a = E_{a1} + E_{a2} - E_{a3} = 40 + 50 - 60 = 30 \text{ kJ/mole.}$$

**84.** For the reaction  $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$ ,  $K_p = 0.492 \text{ atm}$  at 300K.  $K_c$  for the reaction at same temperature is  $\_\_\_\_ \times 10^{-2}$ .

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

**Ans. (2)**

**Sol.**  $K_p = K_c \cdot (RT)^{\Delta n_g}$

$$\Delta n_g = 1$$

$$\Rightarrow K_c = \frac{K_p}{RT} = \frac{0.492}{0.082 \times 300} = 2 \times 10^{-2}$$

**85.** A solution of  $\text{H}_2\text{SO}_4$  is 31.4%  $\text{H}_2\text{SO}_4$  by mass and has a density of 1.25g/mL. The molarity of the  $\text{H}_2\text{SO}_4$  solution is  $\_\_\_\_ \text{ M}$  (nearest integer)

 [Given molar mass of  $\text{H}_2\text{SO}_4 = 98 \text{ g mol}^{-1}$ ]

**Ans. (4)**

**Sol.**  $M = \frac{n_{\text{solute}}}{V} \times 1000$

$$= \left( \frac{31.4}{98} \right) \times 1000 = 4.005 \approx 4$$

**86.** The osmotic pressure of a dilute solution is  $7 \times 10^5 \text{ Pa}$  at 273K. Osmotic pressure of the same solution at 283K is  $\_\_\_\_ \times 10^4 \text{ Nm}^{-2}$ .

**Ans. (72.56) or (73)**

**Sol.**  $\pi = CRT$

$$\Rightarrow \frac{\pi_1}{\pi_2} = \frac{T_1}{T_2}$$

$$\Rightarrow \pi_2 = \frac{\pi_1 T_2}{T_1} = \frac{7 \times 10^5 \times 283}{273}$$

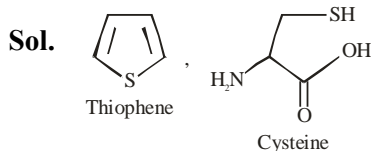
$$= 72.56 \times 10^4 \text{ Nm}^{-2}$$



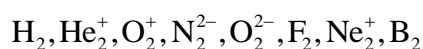
87. Number of compounds among the following which contain sulphur as heteroatom is \_\_\_\_.

Furan, Thiophene, Pyridine, Pyrrole, Cysteine, Tyrosine

Ans. (2)



88. The number of species from the following which are paramagnetic and with bond order equal to one is \_\_\_\_.



Ans. (1)

Sol.	Magnetic behaviour	Bond order
$H_2$	Diamagnetic	1
$He_2^+$	Paramagnetic	0.5
$O_2^+$	Paramagnetic	2.5
$N_2^{2-}$	Paramagnetic	2
$O_2^{2-}$	Diamagnetic	1
$F_2$	Diamagnetic	1
$Ne_2^+$	Paramagnetic	0.5
$B_2$	Paramagnetic	1



89. From the compounds given below, number of compounds which give positive Fehling's test is \_\_\_\_.

Benzaldehyde, Acetaldehyde, Acetone,

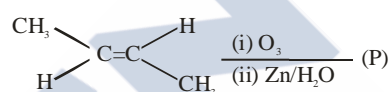
Acetophenone, Methanal, 4-nitrobenzaldehyde, cyclohexane carbaldehyde.

Ans. (3)

Sol. Acetaldehyde ( $CH_3CHO$ ), Methanal ( $HCHO$ ), and

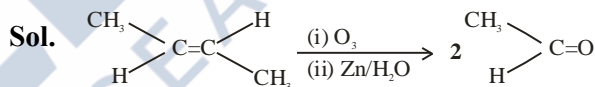
cyclohexane carbaldehyde .

90.

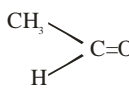


Consider the given reaction. The total number of oxygen atoms present per molecule of the product (P) is \_\_\_\_.

Ans. (1)



Hence total number of oxygen atom present per

molecule  is 1.

