

FINAL JEE–MAIN EXAMINATION – JANUARY, 2024

(Held On Thursday 01st February, 2024)

TIME : 3 : 00 PM to 6 : 00 PM

SECTION-A

61. The transition metal having highest 3rd ionisation enthalpy is :

- (1) Cr (2) Mn
(3) V (4) Fe

Ans. (2)

Sol. 3rd Ionisation energy : [NCERT Data]

V : 2833 KJ/mol

Cr : 2990 KJ/mol

Mn : 3260 KJ/mol

Fe : 2962 KJ/mol

alternative

Mn : 3d⁵ 4s²

Fe : 3d⁶ 4s²

Cr : 3d⁵ 4s¹

V : 3d³ 4s²

So Mn has highest 3rd IE among all the given elements due to d⁵ configuration.

62. Given below are two statements :

Statement (I) : A π bonding MO has lower electron density above and below the inter-nuclear axis.

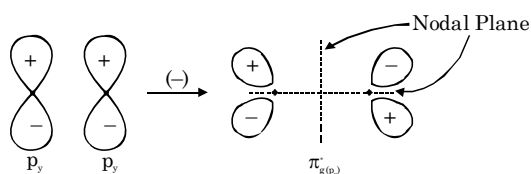
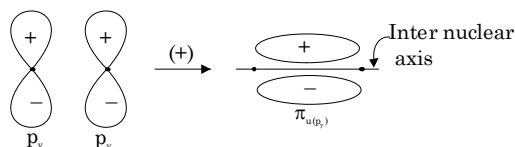
Statement (II) : The π^* antibonding MO has a node between the nuclei.

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

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

Ans. (3)

Sol. A π bonding molecular orbital has higher electron density above and below inter nuclear axis



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

Assertion (A) : In aqueous solutions Cr²⁺ is reducing while Mn³⁺ is oxidising in nature.

Reason (R) : Extra stability to half filled electronic configuration is observed than incompletely filled electronic configuration.

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

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

Ans. (1)

Sol. Cr²⁺ is reducing as its configuration changes from d⁴ to d³ due to formation of Cr³⁺, which has half filled t_{2g} level, on other hand, the change Mn³⁺ to Mn²⁺ results in half filled d⁵ configuration which has extra stability.

64. Match List - I with List - II.

List-I

(Reactants)

- (A) Phenol, Zn/ Δ
 (B) Phenol, CHCl_3 , NaOH, HCl
 (C) Phenol, CO_2 , NaOH, HCl
 (D) Phenol, Conc. HNO_3

List-II

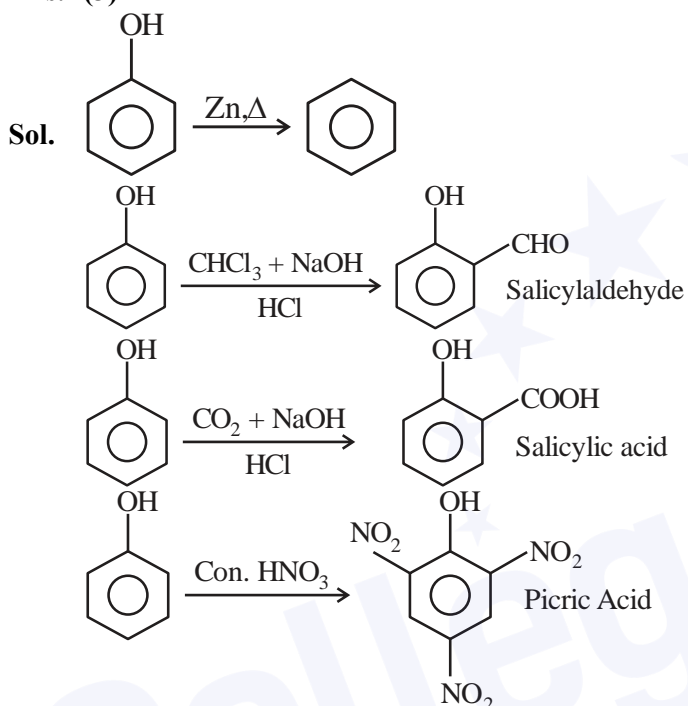
Products

- (I) Salicylaldehyde
 (II) Salicylic acid
 (III) Benzene
 (IV) Picric acid

Choose the correct answer from the options given below.

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

Ans. (3)



65. Given below are two statements :

Statement (I) : Both metal and non-metal exist in p and d-block elements.

Statement (II) : Non-metals have higher ionisation enthalpy and higher electronegativity than the metals.

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

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

Ans. (2)

Sol. **I.** In p-Block both metals and non metals are present but in d-Block only metals are present.

II. EN and IE of non metals are greater than that of metals

I - False, II-True

66. The strongest reducing agent among the following is:

- (1) NH_3 (2) SbH_3
 (3) BiH_3 (4) PH_3

Ans. (3)

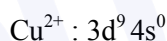
Sol. Strongest reducing agent : BiH_3 explained by its low bond dissociation energy.

67. Which of the following compounds show colour due to d-d transition?

- (1) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (2) $\text{K}_2\text{Cr}_2\text{O}_7$
 (3) K_2CrO_4 (4) KMnO_4

Ans. (1)

Sol. $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$

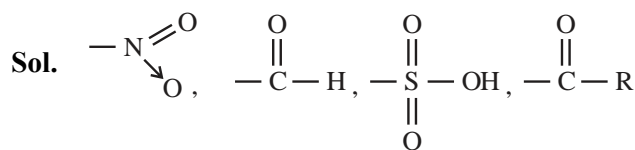


unpaired electron present so it show colour due to d-d transition.

68. The set of meta directing functional groups from the following sets is:

- (1) $-\text{CN}$, $-\text{NH}_2$, $-\text{NHR}$, $-\text{OCH}_3$
 (2) $-\text{NO}_2$, $-\text{NH}_2$, $-\text{COOH}$, $-\text{COOR}$
 (3) $-\text{NO}_2$, $-\text{CHO}$, $-\text{SO}_3\text{H}$, $-\text{COR}$
 (4) $-\text{CN}$, $-\text{CHO}$, $-\text{NHCOCH}_3$, $-\text{COOR}$

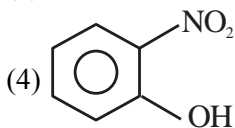
Ans. (3)



All are -M, Hence meta directing groups.

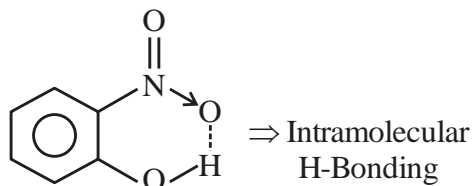
69. Select the compound from the following that will show intramolecular hydrogen bonding.

- (1) H₂O
 (2) NH₃
 (3) C₂H₅OH



Ans. (4)

Sol. H₂O, NH₃, C₂H₅OH ⇒ Intermolecular H-Bonding



70. Lassaigne's test is used for detection of :

- (1) Nitrogen and Sulphur only
 (2) Nitrogen, Sulphur and Phosphorous Only
 (3) Phosphorous and halogens only
 (4) Nitrogen, Sulphur, phosphorous and halogens

Ans. (4)

Sol. Lassaigne's test is used for detection of all element N, S, P, X.

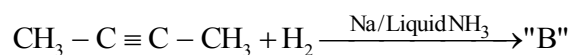
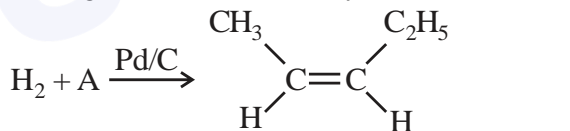
71. Which among the following has highest boiling point?

- (1) CH₃CH₂CH₂CH₃
 (2) CH₃CH₂CH₂CH₂-OH
 (3) CH₃CH₂CH₂CHO
 (4) H₃C₂-O-C₂H₅

Ans. (2)

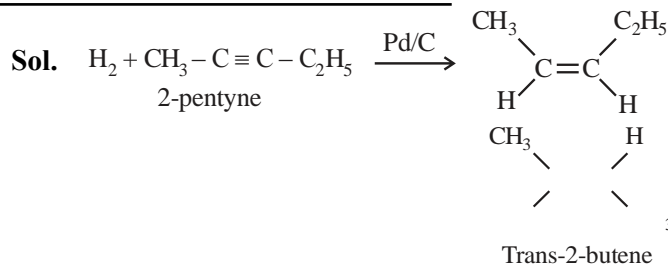
Sol. Due to H-bonding boiling point of alcohol is High.

72. In the given reactions identify A and B.



- (1) A : 2-Pentyne B : trans - 2 - butene
 (2) A : n - Pentane B : trans - 2 - butene
 (3) A : 2 - Pentyne B : Cis - 2 - butene
 (4) A : n - Pentane B : Cis - 2 - butene

Ans. (1)



73. The number of radial node/s for 3p orbital is:

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

Ans. (1)

Sol. For 3p : n = 3, ℓ = 1

Number of radial node = n - ℓ - 1
 = 3 - 1 - 1 = 1

74. Match List - I with List - II.

List - I	List - II
Compound	Use
(A) Carbon tetrachloride	(I) Paint remover
(B) Methylene chloride	(II) Refrigerators and air conditioners
(C) DDT	(III) Fire extinguisher
(D) Freons	(IV) Non Biodegradable insecticide

Choose the correct answer from the options given below :

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

Ans. (2)

Sol. CCl₄ used in fire extinguisher. CH₂Cl₂ used as paint remover. Freons used in refrigerator and AC. DDT used as non Biodegradable insecticide.

75. The functional group that shows negative resonance effect is:

- (1) -NH₂ (2) -OH
 (3) -COOH (4) -OR

Ans. (3)

Sol.
$$\begin{array}{c} \text{O} \\ || \\ \text{— C — OH} \end{array}$$
 shows -R effect, while rest 3 groups shows +R effect via lone pair.

80. Given below are two statements :

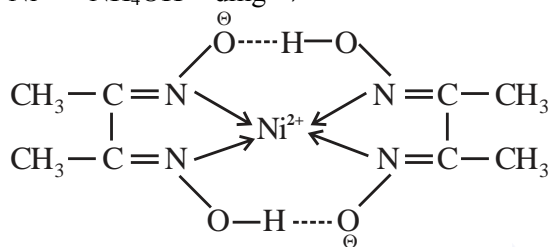
Statement (I) : Dimethyl glyoxime forms a six-membered covalent chelate when treated with NiCl_2 solution in presence of NH_4OH .

Statement (II) : Prussian blue precipitate contains iron both in (+2) and (+3) oxidation states. In the light of the above statements, choose the most appropriate answer from the options given below:

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

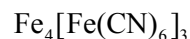
Ans. (1)

Sol. $\text{Ni}^{2+} + \text{NH}_4\text{OH} + \text{dmg} \rightarrow$



2 Five member ring

III II

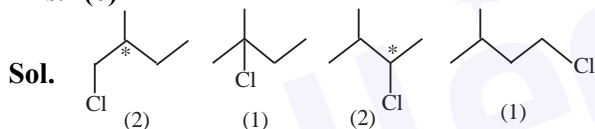


Prussian Blue

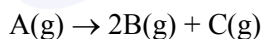
SECTION-B

81. Total number of isomeric compounds (including stereoisomers) formed by monochlorination of 2-methylbutane is _____.

Ans. (6)



82. The following data were obtained during the first order thermal decomposition of a gas A at constant volume:



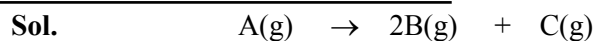
S.No Time/s Total pressure/(atm)

1. 0 0.1

2. 115 0.28

The rate constant of the reaction is _____ $\times 10^{-2} \text{s}^{-1}$ (nearest integer)

Ans. (2)



$t = 0$ 0.1

$t = 115 \text{ sec.}$ $0.1 - x$ $2x$ x

$0.1 + 2x = 0.28$

$2x = 0.18$

$x = 0.09$

$K = \frac{1}{115} \ln \frac{0.1}{0.1 - 0.09}$

$= 0.0200 \text{ sec}^{-1}$

$= 2 \times 10^{-2} \text{ sec}^{-1}$

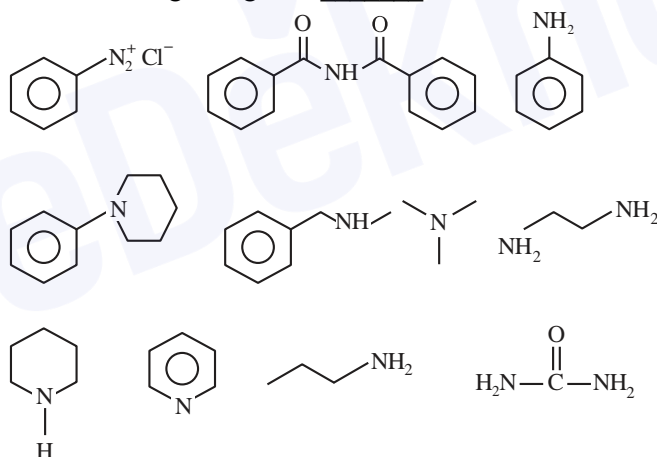
83. The number of tripeptides formed by three different amino acids using each amino acid once is _____.

Ans. (6)

Sol. Let 3 different amino acid are A, B, C then following combination of tripeptides can be formed-

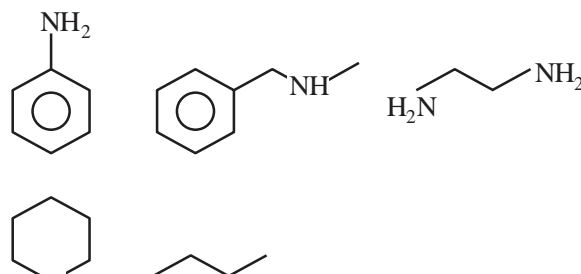
ABC, ACB, BAC, BCA, CAB, CBA

84. Number of compounds which give reaction with Hinsberg's reagent is _____.



Ans. (5)

Sol.



85. Mass of ethylene glycol (antifreeze) to be added to 18.6 kg of water to protect the freezing point at -24°C is _____ kg (Molar mass in g mol^{-1} for ethylene glycol 62, K_f of water = $1.86 \text{ K kg mol}^{-1}$)

Ans. (15)

Sol. $\Delta T_f = iK_f \times \text{molality}$

$$24 = (1) \times 1.86 \times \frac{W}{62 \times 18.6}$$

$$W = 14880 \text{ gm}$$

$$= 14.880 \text{ kg}$$

86. Following Kjeldahl's method, 1g of organic compound released ammonia, that neutralised 10 mL of 2M H_2SO_4 . The percentage of nitrogen in the compound is _____ %.

Ans. (56)

Sol. $\text{H}_2\text{SO}_4 + 2\text{NH}_3 \rightarrow (\text{NH}_4)_2 \text{SO}_4$

Millimole of $\text{H}_2\text{SO}_4 \rightarrow 10 \times 2$

So Millimole of $\text{NH}_3 = 20 \times 2 = 40$

Organic \rightarrow NH_3

Compound 40 Millimole

$$\therefore \text{Mole of N} = \frac{40}{1000}$$

$$\text{wt. of N} = \frac{40}{1000} \times 14$$

% composition of N in organic compound

$$= \frac{40 \times 14}{1000 \times 1} \times 100$$

$$= 56\%$$

87. The amount of electricity in Coulomb required for the oxidation of 1 mol of H_2O to O_2 is _____ $\times 10^5 \text{C}$.

Ans. (2)

Sol. $2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$

$$\frac{W}{E} = \frac{Q}{96500}$$

$$\text{mole} \times n\text{-factor} = \frac{Q}{96500}$$

$$1 \times 2 = \frac{Q}{96500}$$

$$Q = 2 \times 96500 \text{ C}$$

$$= 1.93 \times 10^5 \text{ C}$$

88. For a certain reaction at 300K, $K = 10$, then ΔG° for the same reaction is _____ $\times 10^{-1} \text{ kJ mol}^{-1}$. (Given $R = 8.314 \text{ JK}^{-1} \text{ mol}^{-1}$)

Ans. (57)

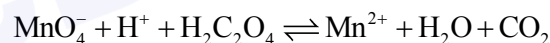
Sol. $\Delta G^\circ = -RT \ln K$

$$= -8.314 \times 300 \ln (10)$$

$$= 5744.14 \text{ J/mole}$$

$$= 57.44 \times 10^{-1} \text{ kJ/mole}$$

89. Consider the following redox reaction :



The standard reduction potentials are given as below (E_{red}°)

$$E_{\text{MnO}_4^-/\text{Mn}^{2+}}^\circ = +1.51\text{V}$$

$$E_{\text{CO}_2/\text{H}_2\text{C}_2\text{O}_4}^\circ = -0.49\text{V}$$

If the equilibrium constant of the above reaction is given as $K_{\text{eq}} = 10^x$, then the value of $x =$ _____ (nearest integer)

Ans. (338 OR 339)

Sol. Cell Rx^n ; $MnO_4^- + H_2C_2O_4 \rightarrow Mn^{2+} + CO_2$

$$E_{cell}^{\circ} = E_{op}^{\circ} \text{ of anode} + E_{RP}^{\circ} \text{ of cathode}$$

$$= 0.49 + 1.51 = 2.00V$$

At equilibrium

$$E_{cell} = 0,$$

$$E_{cell}^{\circ} = \frac{0.059}{n} \log K$$

(As per NCERT $\frac{RT}{F} = 0.059$ But $\frac{RT}{F} = 0.0591$

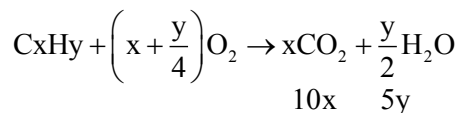
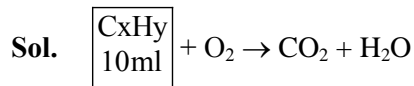
can also be taken.)

$$2 = \frac{0.059}{10} \log K$$

$$\log K = 338.98$$

90. 10 mL of gaseous hydrocarbon on combustion gives 40 mL of $CO_2(g)$ and 50 mL of water vapour. Total number of carbon and hydrogen atoms in the hydrocarbon is _____.

Ans. (14)



$$10x = 40$$

$$x = 4$$

$$5y = 50$$

$$y = 10$$

