JEE–MAIN EXAMINATION – JUNE, 2022

25 June S - 01 Paper Solution

SECTION-A

1. Bonding in which of the following diatomic molecule(s) become(s) stronger, on the basis of MO Theory, by removal of an electron ?

(A) NO (B) N_2

(C) O_2 (D) C_2

(E) B_2

Choose the most appropriate answer from the options given below :-

(A) (A), (B), (C) only (B) (B), (C), (E) only

(C) (A), (C) only (D) (D) only

Ans. (C)

Sol. Bond strength $\propto$ Bond order

removal of electron from antibonding MO increases B.O.

NO & O_2 has valence e^- in π *orbital.

2. Incorrect statement for Tyndall effect is :-

(A) The refractive indices of the dispersed phase and the dispersion medium differ greatly in magnitude.

(B) The diameter of the dispersed particles is much smaller than the wavelength of the light used.

(C) During projection of movies in the cinemas hall, Tyndall effect is noticed.

(D) It is used to distinguish a true solution from a colloidal solution.

Ans. (B)

Sol. The diameter of dispersed particle should be somewhat below or near the wavelength of light.

3. The pair, in which ions are isoelectronic with Al^{3+} is :-

(A) Br^- and Be^{2+} (B) Cl^- and Li^+

(C) S^{2-} and K^+ (D) O^{2-} and Mg^{2+}

Ans. (D)

Sol. Isoelectronic species have same no. of electrons

Al^{+3}, O^{2-}, Mg^{+2} all have 10 electrons.

4. Leaching of gold with dilute aqueous solution of NaCN in presence of oxygen gives complex [A], which on reaction with zinc forms the elemental gold and another complex [B]. [A] and [B], respectively are :-

(A) $[Au(CN)_4]^-$ and $[Zn(CN)_2(OH)_2]^{2-}$

(B) $[Au(CN)_2]^-$ and $[Zn(OH)_4]^{2-}$

(C) $[Au(CN)_2]^-$ and $[Zn(CN)_4]^{2-}$

(D) $[Au(CN)_4]^{2-}$ and $[Zn(CN)_6]^{4-}$

Ans. (C)

Sol. $Au + NaCN \rightarrow Na[Au(CN)_2]$

$Zn + Na[Au(CN)_2] \rightarrow Na_2[Zn(CN)_4] + Au$

5. Number of electron deficient molecules among the following

PH_3, B_2H_6, CCl_4, NH_3, LiH and BCl_3 is

(A) 0 (B) 1

(C) 2 (D) 3

Ans. (C)

Sol. Electron deficient species have less than 8 electrons (or two electrons for H) in their valence (incomplete octet)

B_2H_6, BCl_3 have incomplete octet.

6. Which one of the following alkaline earth metal ions has the highest ionic mobility in its aqueous solution?

(A) Be^{2+} (B) Mg^{2+}

(C) Ca^{2+} (D) Sr^{2+}

Ans. (D)

Sol. Highest ionic mobility corresponds to lowest extent of hydration and highest size of gaseous ion.

Hence Sr^{2+} has the highest ionic mobility in its aqueous solution

7. White precipitate of AgCl dissolves in aqueous ammonia solution due to formation of :

(A) $[Ag(NH_3)_4]Cl_2$ (B) $[Ag(Cl)_2(NH_3)_2]$

(C) $[Ag(NH_3)_2]Cl$ (D) $[Ag(NH_3)Cl]Cl$

Ans. (C)

Sol. $AgCl + 2NH_3 \rightarrow [Ag(NH_3)_2]^+Cl^-$

soluble

8. Cerium (IV) has a noble gas configuration. Which of the following is correct statement about it?

(A) It will not prefer to undergo redox reactions.

(B) It will prefer to gain electron and act as an oxidizing agent

(C) It will prefer to give away an electron and behave as reducing agent

(D) It acts as both, oxidizing and reducing agent.

Ans. (B)

Sol. Cerium exists in two different oxidation state +3, +4

$Ce^{+4} + e^- \rightarrow Ce^{3+}$ $E^0 = +1.61$ V

$Ce^{+3} + 3e^- \rightarrow Ce$ $E^0 = -2.336$ V

It shows Ce^{+4} acts as a strong oxidising agent & accepts electron.

9. Among the following, which is the strongest oxidizing agent ?

(A) Mn^{3+} (B) Fe^{3+}

(C) Ti^{3+} (D) Cr^{3+}

Ans. (A)

Sol. Strongest oxidising agent have highest reduction potential value

$E^0_{Mn^{+3}/Mn^{+2}} = 1.51V$ (highest)

10. The eutrophication of water body results in :

(A) loss of Biodiversity

(B) breakdown of organic matter

(C) increase in biodiversity

(D) decrease in BOD.

Ans. (A)

Sol. Eutrophication of water body results in loss of Biodiversity.

11. Phenol on reaction with dilute nitric acid, gives two products. Which method will be most effective for large scale separation ?

(A) Chromatographic separation

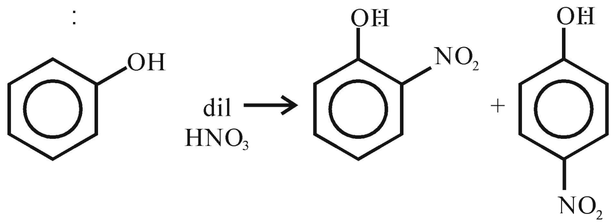
(B) Fractional Crystallisation

(C) Steam distillation

(D) Sublimation

Ans. (C)

Sol.

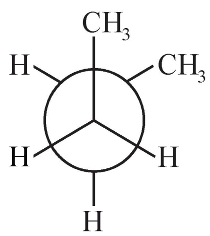


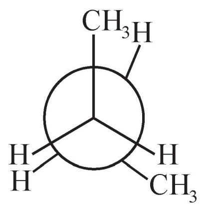
(ortho) (para)

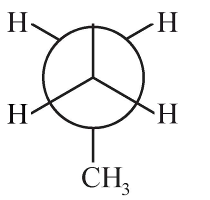
Para product has higher boiling point than ortho as intermolecular H-bond is possible in former, where as intramolecular H-bond is possible in ortho product.

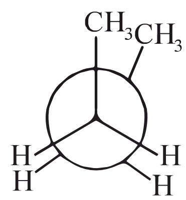
Steam distillation can separate them as ortho product is steam volatile.

12. In the following structures, which one is having staggered conformation with maximum dihedral angle?

(A) 

(B) 

(C) 

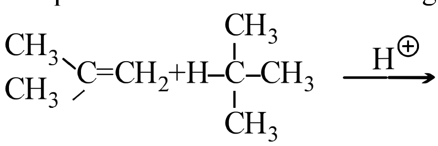
(D) 

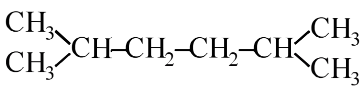
Ans. (C)

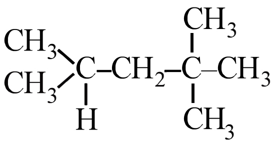
Sol. Dihedral angle : It's the angle b/w 2 specified groups ($-CH_3$ here)

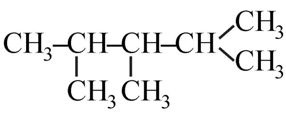
Staggered form is Given in option (C) & the angle is 180^0

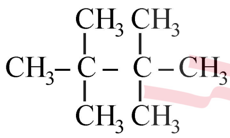
13. The products formed in the following reaction.



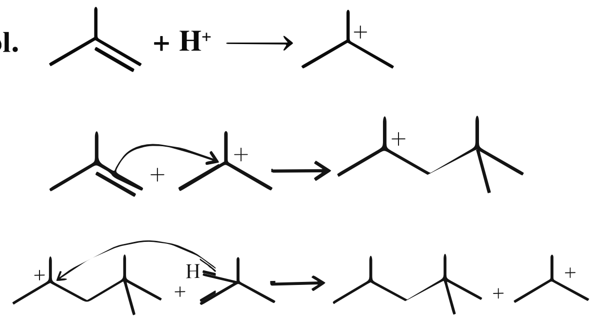
(A) 

(B) 

(C) 

(D) 

Ans. (B)

Sol. 

14. The IUPAC name of ethylidene chloride is :-

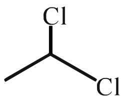
(A) 1-Chloroethene

(B) 1-Chloroethyne

(C) 1,2-Dichloroethane

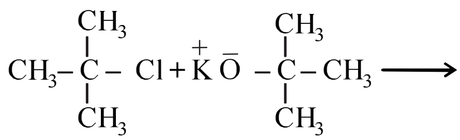
(D) 1,1-Dichloroethane

Ans. (D)

Sol. 

"1, 1-Dichloroethane is Ethylidene chloride"

15. The major product in the reaction



(A) t-Butyl ethyl ether

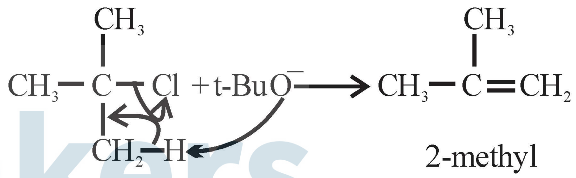
(B) 2,2-Dimethyl butane

(C) 2-Methyl pent-1-ene

(D) 2-Methyl prop-1-ene

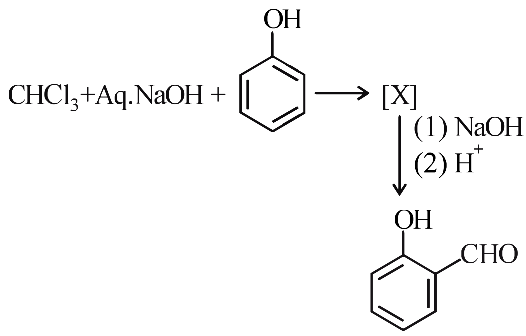
Ans. (D)

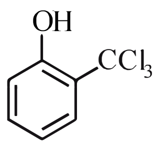
Sol. We have been given a bulky base, hence elimination will take place & not substitution.

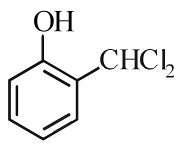


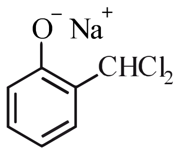
2-methyl prop-1-ene

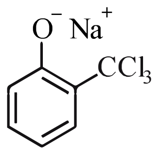
16. The intermediate X, in the reaction



(A) 

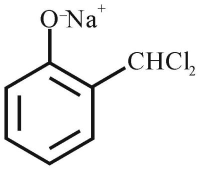
(B) 

(C) 

(D) 

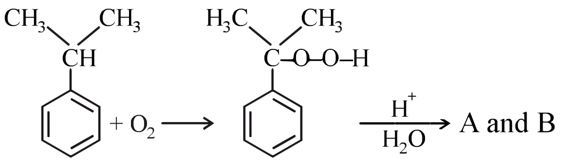
Ans. (C)

Sol. It's a classic Reimer-Tiemann reaction.

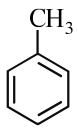


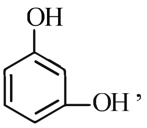
Will be the intermediate formed.

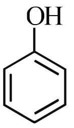
17. In the following reaction :

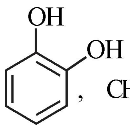


The compounds A and B respectively are :-

(A)  , CH_3COOH

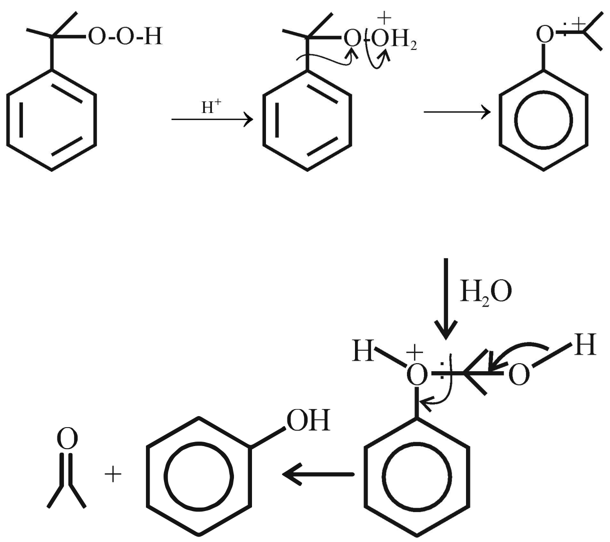
(B)  , CH_3COOH

(C)  , CH_3COCH_3

(D)  , CH_3COCH_3

Ans. (C)

Sol. Given reaction is cumene-Peroxide method for the preparation of phenol.
In this reaction



Acetone Phenol

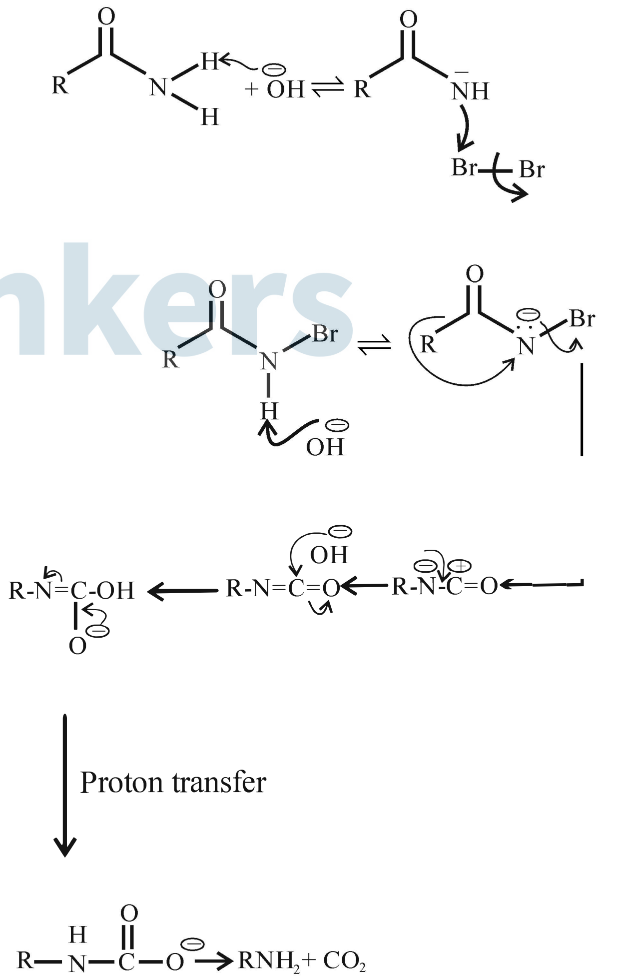
18. The reaction of $R\text{–}\underset{\underset{O}{\|}}{C}\text{–}NH_2$ with bromine and KOH gives RNH_2 as the end product. Which one of the following is the intermediate product formed in this reaction ?

(A) $R\text{–}\underset{\underset{O}{\|}}{C}\text{–}NH\text{–}Br$ (B) R–NH–Br

(C) R–N=C=O (D) $R\text{–}\underset{\|}{C}\text{–}NBr_2$

Ans. (A & C)

Sol. The given reaction is Hoffmann-Bromide degradation method.



19. Using very little soap while washing clothes, does not serve the purpose of cleaning of clothes because

(A) soap particles remain floating in water as ions

(B) the hydrophobic part of soap is not able to take away grease

(C) the micelles are not formed due to concentration of soap, below its CMC value

(D) colloidal structure of soap in water is completely disturbed.

Ans. (C)

Sol. Micelle formation only takes place above CMC.

20. Which one of the following is an example of artificial sweetner ?

(A) Bithional (B) Alitame

(C) Salvarsan (D) Lactose

Ans. (B)

Sol. Alitame is a second generation dipeptide sweetner that is 200 times sweeter than sucrose.

SECTION-B

1. The number of N atoms is 681 g of $C_7H_5N_3O_6$ is $x \times 10^{21}$. The value of x is ______ ($N_A = 6.02 \times 10^{23}$ mol^{-1}) (Nearest Integer)

Ans. (5418)

Sol. M.M. of $C_7H_5N_3O_6$ is 84 + 5 + 42 + 96 = 227

$$n_{C_7H_5N_3O_6} = \frac{681}{227} = 3$$

$$n_N = \frac{681}{227} \times 3 = 9 \text{ mol}$$

no. of N atoms = $9 \times 6.02 \times 10^{23}$

$= 5418 \times 10^{21}$

∴ The answer is 5418.

2. The distance between Na^+ and Cl^- ions in solid NaCl of density 43.1 g cm^{-3} is ________ $\times 10^{-10}$ m. (Nearest Integer)

(Given : $N_A = 6.02 \times 10^{23}$ mol^{-1})

Ans. (1)

Sol. Unit cell formula – Na_4Cl_4

Mass per unit cell = $\frac{Z \times M.M.}{N_A}$ g

$= \frac{4 \times 58.5}{N_A}$ g

$$d_{\text{unit cell}} = \frac{m}{V} = \frac{m}{a^3}$$

$$\Rightarrow \frac{4 \times 58.5}{N_A \cdot a^3} = 43.1$$

$$\Rightarrow a^3 = 9.02 \times 10^{-24} \text{ cm}^3$$

$$\Rightarrow a = 2.08 \times 10^{-8} \text{ cm}$$

$$\Rightarrow a = 2.08 \times 10^{-10} \text{ m}$$

Also $a = 2(r_{Na^+} + r_{Cl^-})$

$$\Rightarrow r_{Na^+} + r_{Cl^-} = 1.04 \times 10^{-10} \text{ m}$$

∴ The answer is 1

3. The longest wavelength of light that can be used for the ionisation of lithium atom (Li) in its ground state is $x \times 10^{-8}$ m. The value of x is ____________. (Nearest Integer)

(Given : Energy of the electron in the first shell of the hydrogen atom is -2.2×10^{-18} J; $h = 6.63 \times 10^{-34}$ Js and $c = 3 \times 10^8$ ms^{-1})

Ans. (Bonus)

Sol. We can not calculate I.E. of lithium atom.

4. The standard entropy change for the reaction $4Fe(s) + 3O_2(g) \rightarrow 2Fe_2O_3(s)$ is -550 JK^{-1} at 298 K.

[Given : The standard enthalpy change for the reaction is -165 kJ mol^{-1}]. The temperature in K at which the reaction attains equilibrium is _________. (Nearest Integer)

Ans. (300)

Sol. $\Delta G = \Delta H - T\Delta S = 0$ at equilibrium

$\Rightarrow -165 \times 10^3 - T \times (-505) = 0$

$\Rightarrow T = 300K$

The answer is 300

5. 1 L aqueous solution of H_2SO_4 contains 0.02 m mol H_2SO_4. 50% of this solution is diluted with deionized water to give 1 L solution (A). In solution (A), 0.01 m mol of H_2SO_4 are added. Total m mols of H_2SO_4 in the final solution is ___________ × 10^3 m mols.

Ans. (0)

Sol. $n_{H_2SO_4}$ in Sol^n A = 50% of original solution

$= 0.01$ m mol.

$n_{H_2SO_4}$ in Final solution $= 0.01 + 0.01$

$= 0.02$ mmol

$= 0.00002 \times 10^3$ mmol

The answer 0

6. The standard free energy change ($\Delta G°$) for 50% dissociation of N_2O_4 into NO_2 at 27°C and 1 atm pressure is –x J mol^{-1}. The value of x is _________. (Nearest Integer)

[Given : R = 8.31 J K^{-1} mol^{-1}, log 1.33 = 0.1239 ln 10 = 2.3]

Ans. (710)

Sol.

	N_2O_4	$\rightleftharpoons$	$2NO_2$
t = 0	1 mol		
t = t	(1-0.5) mol		0.5×2 mol
	= 0.5 mol		1 mol

$$k_P = \frac{\left(\frac{1}{1.5} \times 1\right)^2}{\left(\frac{0.5}{1.5} \times 1\right)} = \frac{1}{0.75} = \frac{100}{75}$$

$= 1.33$

$\Delta G^0 = -RT\ell n k_P$

$= -8.31 \times 300 \times \ell n(1.33) = -710.45$ J / mol

$= -710$ J/mol.

7. In a cell, the following reactions take place

$Fe^{2+} \rightarrow Fe^{3+} e^-$ $\qquad E^o_{Fe^{3+}/Fe^{2+}} = 0.77$ V

$2I^- \rightarrow I_2 + 2e^-$ $\qquad E^o_{I_2/I^-} = 0.54$ V

The standard electrode potential for the spontaneous reaction in the cell is x × 10^{-2}V 298 K. The value of x is __________ (Nearest Integer)

Ans. (23)

Sol. $\underset{\text{Cathode}}{Fe^{+3}} + \underset{\text{anode}}{I^-} \longrightarrow I_2 + Fe^{+2}$

$E^0_{Cell} = E^0_{cathode} - E^0_{anode}$

$= 0.77 - 0.54$

$= 0.23$

$= 23 \times 10^{-2}$ V

8. For a given chemical reaction

$$\gamma_1 A + \gamma_2 B \rightarrow \gamma_3 C + \gamma_4 D$$

Concentration of C changes from 10 mmol dm^{-3} to 20 mmol dm^{-3} in 10 seconds. Rate of appearance of D is 1.5 times the rate of disappearance of B which is twice the rate of disappearance A. The rate of appearance of D has been experimentally determined to be 9 mmol dm^{-3} s^{-1}. Therefore the rate of reaction is ________mmol dm^{-3} s^{-1}. (Nearest Integer)

Ans. (1)

Sol. $\gamma_1 A + \gamma_2 B \longrightarrow \gamma_3 C + \gamma_4 D$

Given : $+\frac{d[D]}{dt} = \frac{-3}{2}\frac{d[B]}{dt}$

$\Rightarrow \frac{-1}{2}\frac{d[B]}{dt} = \frac{+1}{3}\frac{d[D]}{dt}$

$$-\frac{d[B]}{dt} = -2\frac{d[A]}{dt} \Rightarrow -\frac{1}{2}\frac{d[B]}{dt} = \frac{-d(A)}{dt}$$

$$+\frac{d[B]}{dt} = 9 \text{ mmoldm}^{-3}\text{s}^{-1}$$

$$\frac{+d[C]}{dt} = \frac{20-10}{10} = 1\text{mmoldm}^{-3}\text{s}^{-1}$$

$$\frac{+d[C]}{dt} = \frac{1}{9} \times \frac{+d[D]}{dt}$$

$$1A + 2B \longrightarrow \frac{1}{3}C + 3D$$

$$\Rightarrow 3A + 6B \longrightarrow C + 9D$$

Rate of reaction = $\frac{+d[C]}{dt} = 1 \text{ mmol dm}^{-3}\text{ s}^{-1}$

9. If $[Cu(H_2O)_4]^{2+}$ absorbs a light of wavelength 600 nm for d–d transition, then the value of octahedral crystal field splitting energy for $[Cu(H_2O)_6]^{2+}$ will be____________ × 10^{-21} J. (Nearest Integer)

(Given : h = 6.63×10^{-34}Js

and c = 3.08×10^{8} ms^{-1})

Ans. (766)

Sol. $\Delta_t = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3.08 \times 10^{8}}{600 \times 10^{-9}}$

$$\frac{6.63 \times 3.08 \times 10^{-17}}{600}$$

$$= 0.034034 \times 10^{-17}$$

$$= 340.34 \times 10^{-21}\text{ J}$$

$$\Delta_0 = \frac{9}{4}\Delta_t$$

$$= \frac{9}{4} \times 340.34 \times 10^{-21}$$

$$= 765.765 \times 10^{-21}\text{ J}$$

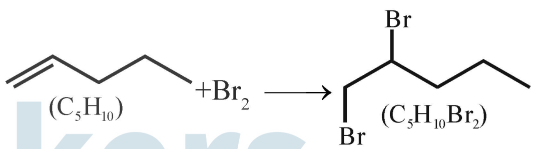
$$\approx 766 \times 10^{-21}\text{ J}$$

Answer = 766

10. Number of grams of bromine that will completely react with 5.0g of pent-1-ene is ________ × 10^{-2}g. (Atomic mass of Br = 80 g/mol) [Nearest Integer)

Ans. (1143)

Sol.



moles of Br_2 = moles of C_5H_{10}

$$\Rightarrow \frac{w}{160} = \frac{5}{70}$$

$$\Rightarrow w = \frac{5 \times 160}{70} g$$

$$= 11.428 \text{ g}$$

$$= 1142.8 \times 10^{\;2} g \approx 1143 \times 10^{\;2} g$$