CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

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

Answer (C)

Sol. If an electron is removed from the anti-bonding orbital, then it will tend to increase the bond order.

The HOMO in NO and O_2 is antibonding molecular orbital .

Hence, in NO and O_2 bond order will increase on loss of electron.

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.

Answer (B)

Sol. For Tyndall effect, the diameter of the dispersed particles is not much smaller than the wavelength of the light used.

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+}

Answer (D)

Sol. O^{2-}, Mg^{2+} and Al^{3+} are isoelectronic. 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 $[Zn(CN)_6]^{4-}$

Answer (C)

Sol. In the metallurgy of gold

$4Au + 8CN^- + 2H_2O + O_2 \rightarrow 4[Au(CN)_2]^- + 4OH^-$

$2[Au(CN)_2]^- + Zn \rightarrow [Zn(CN)_4]^{2-} + 2Au$

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

Answer (C)

Sol. Only B_2H_6 and BCl_3 are e^- deficient among the given molecules.

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+}

Answer (D)

Sol. In aqueous solution, the ionic mobility is inversely proportional to the charge density on the ion. Hence Sr^{2+} has highest ionic mobility in water.

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) $[Ag(NH_3)Cl]Cl$

Answer (C)

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

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.

Answer (B)

Sol. E° value of $Ce^{+4}|Ce^{+3}$ is 1.74 V, which suggests that it is a very good oxidising agent.

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

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

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

Answer (A)

Sol. $E°_{Fe^{3+}|Fe^{2+}} = +0.77V$ $E°_{Ti^{3+}|Ti^{2+}} = -0.37\ V$

$E°_{Mn^{+3}|Mn^{+2}} = +1.57\ V$ $E°_{Cr^{3+}|Cr^{2+}} = -0.41\ V$

Mn^{+3} is the best oxidising agent among the given series.

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.

Answer (A)

Sol. Eutrophication is the process in which nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity.

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

(A) Chromatographic separation

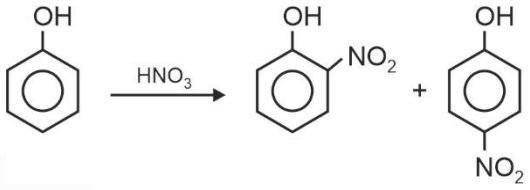
(B) Fractional crystallisation

(C) Steam distillation

(D) Sublimation

Answer (C)

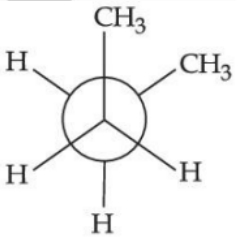
Sol.



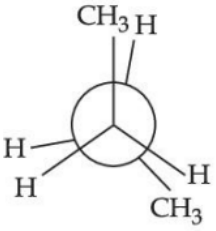
o-Nitrophenol and p-Nitrophenol can be easily separated by steam distillation.

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

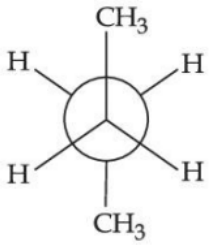
(A)



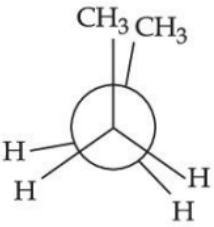
(B)



(C)

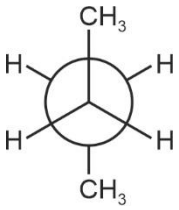


(D)



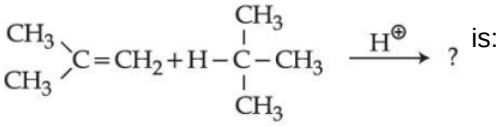
Answer (C)

Sol.

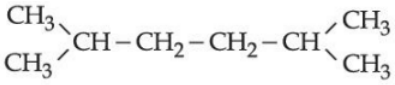


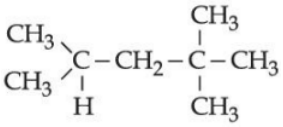
It is the staggered conformation with maximum dihedral angle.

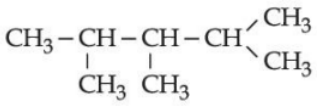
13. The product formed in the following reaction.

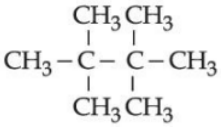


is:

(A) 

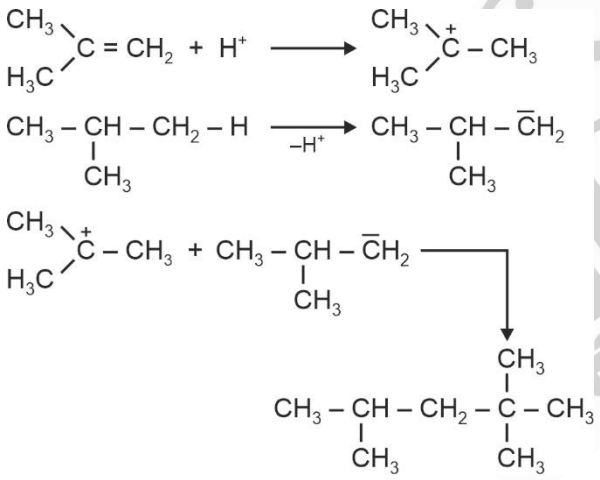
(B) 

(C) 

(D) 

Answer (B)

Sol.



14. The IUPAC name of ethylidene chloride is:

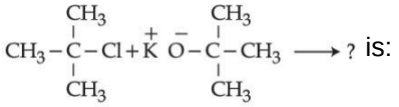
(A) 1-Chloroethene (B) 1-Chloroethyne

(C) 1, 2-Dichloroethane (D) 1, 1-Dichloroethane

Answer (D)

Sol. Ethylidene chloride is $CH_3 - CHCl_2$, its IUPAC name is 1,1-Dichloromethane.

15. The major product in the reaction



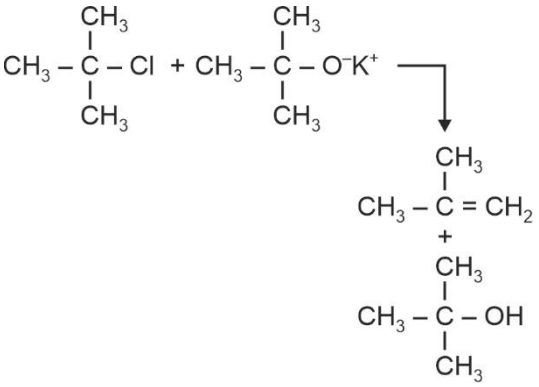
is:

(A) *t*-Butyl ethyl ether (B) 2, 2-Dimethyl butane

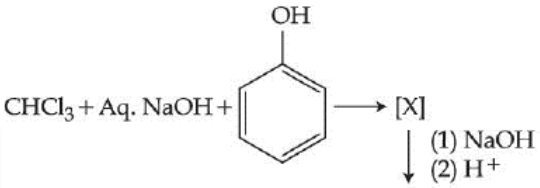
(C) 2-Methyl pent-1-ene (D) 2-Methyl prop-1-ene

Answer (D)

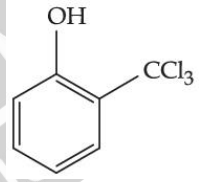
Sol.

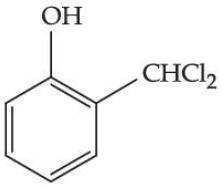


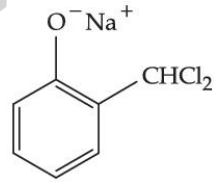
16. The intermediate X, in the reaction :

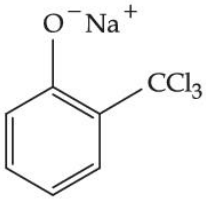


is :

(A) 

(B) 

(C) 

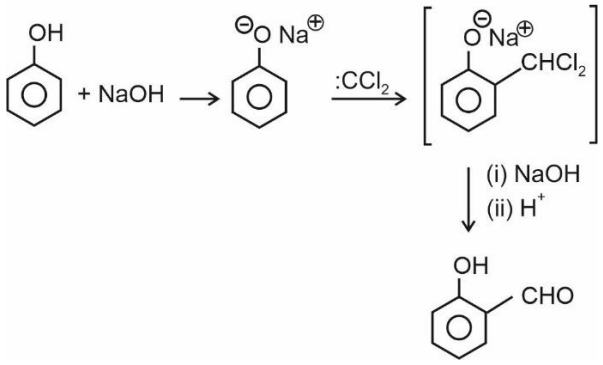
(D) 

Answer (C)

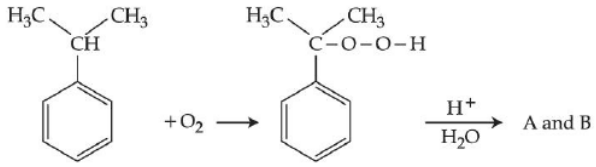
$CHCl_3 - NaOH \longrightarrow :CCl_2$

(dichloro carbene)

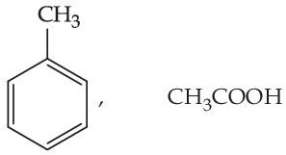
Sol.

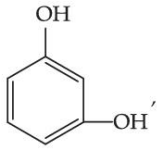


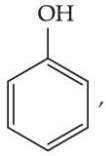
17. In the following reaction:

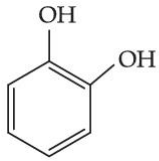


The compound A and B respectively are:

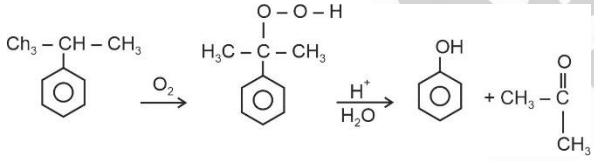
(A)  , CH_3COOH

(B)  , CH_3COCH_3

(C)  , CH_3COCH_3

(D)  , CH_3COCH_3

Answer (C)

Sol. 

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

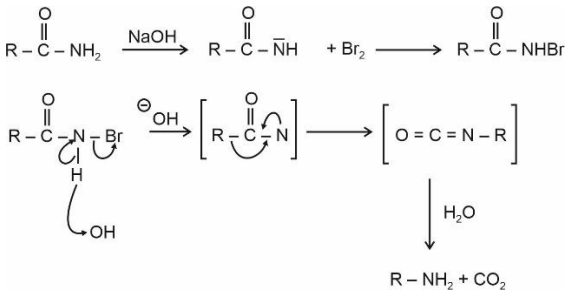
(A) $R-\underset{\underset{O}{\|}}{C}-NH-Br$

(B) R – NH – Br

(C) R – N = C = O

(D) $R-\underset{\underset{O}{\|}}{C}-NBr_2$

Answer (C)

Sol. 

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 distributed.

Answer (C)

Sol. The little amount of using soap while washing clothes, does not serve the purpose of cleaning of clothes because the micelles are not formed due to the low concentration of soap as it is below CMC.

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

(A) Bithional (B) Alitame

(C) Salvarsan (D) Lactose

Answer (B)

Sol. Alitame is an artificial sweetner.

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

1. The number of N atoms in 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)

Answer (5418)

Sol. Molar mass of $C_7H_5N_3O_6$ = 227 g/mol

681 g of $C_7H_5N_3O_6$ = 3 mol

$\therefore$ 681 g of $C_7H_5N_3O_6$ has 9 mole of N.

$= 54.18 \times 10^{23}$ N atoms

$= 5418 \times 10^{21}$

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})

Answer (1)

Sol. $\rho = \dfrac{Z \times M}{a^3 \times N_A}$

$$43.1 = \frac{4 \times 58.5}{a^3 \times 6.02 \times 10^{23}}$$

$a^3 = 0.9 \times 10^{-23}$

$= 9 \times 10^{-24}$

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

$= 2.08 \times 10^{-10}$ m

for NaCl, distance between Na^+ and Cl^- = $\dfrac{a}{2}$

$= 1.04 \times 10^{-10}$ m

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})

Answer (4)

Sol. Energy required for ionisation of Li atom

$= 2.2 \times 10^{-18} \times \dfrac{9}{4}$ J [Assume this formule is True for Li atom]

$\because$ $E = \dfrac{hc}{\lambda}$

$$2.2 \times 10^{-18} \times \frac{9}{4} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{\lambda}$$

$\lambda = 4 \times 10^{-8}$ m

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

Answer (300)

Sol. $\because$ $\Delta S = \dfrac{\Delta H}{T}$

$\therefore$ $T = \dfrac{\Delta H}{\Delta S}$

$= \dfrac{165 \times 10^3}{550}$

= 300 K

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 _____ $\times 10^3$ m mols.

Answer (0.02×10^{-3})

Sol. Initially one litre contains 0.02 mole

$\therefore$ 50% of this solution will contains 0.01 m mol

After adding 0.01 mol, final solution will contain 0.02 m mol of H_2SO_4

= 0.02 m mol

Correct answer should be 0.02×10^{-3}

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]

Answer (710)

Sol.

	N_2O_4 $\rightleftharpoons$	$2NO_2$
t = 0	1	0
$t = t_{eq.}$	1 – 0.5	2 × 0.5

$P_{N_2O_4} = 0.33$ atm

$$P_{NO_2} = 0.66\,atm$$

$$K_p = \frac{(P_{NO_2})^2}{P_{N_2O_4}} = \frac{(0.66)^2}{0.33} = 1.33$$

$\because \quad \Delta G = -RT\ln K_p$

$$= -8.31 \times 300 \times 2.3 \times \log 1.33$$

$$\approx 710 \ Jmol^{-1}$$

7. In a cell, the following reactions take place

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

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

The standard electrode potential for the spontaneous reaction in the cell is $x \times 10^{-2}$ V at 208 K. The value of x is _____. (Nearest Integer)

Answer (23)

Sol. $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.77 - 0.54$

$= 0.23\ V$

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

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)

Answer (1)

Sol. $\text{Rate} = \frac{1}{r_1}\left(\frac{-d[A]}{dt}\right) = \frac{1}{r_2}\left(\frac{-d[B]}{dt}\right) = \frac{1}{r_3}\left(\frac{-d[C]}{dt}\right)$

$$= \frac{1}{r_4}\left(\frac{d[D]}{dt}\right)$$

$$\frac{d[D]}{dt} = \frac{r_4}{r_2}\left(\frac{-d[B]}{dt}\right)$$

$$\frac{r_4}{r_2} = \frac{3}{2}$$

$$\frac{-d[B]}{dt} = \frac{r_2}{r_1}\left(\frac{-d[A]}{dt}\right) \Rightarrow \frac{r_2}{r_1} = 2$$

$r_2 = 2r_1$

$r_4 = 1.5r_2 = 3r_1$

$\frac{d[C]}{dt}$ = 1 m.mol dm^{-3} sec^{-1}

$\frac{d[D]}{dt}$ = 9 m.mol dm^{-3} sec^{-1}

$$\frac{d[D]}{dt} = \frac{r_4}{r_3}\cdot\frac{d[C]}{dt} \Rightarrow \frac{r_4}{r_3} = 9$$

$r_4 = 9r_3 = 3r_1$

$\Rightarrow r_1 = 3r_3$

$3r_3A + 6r_3B \rightarrow r_3C + 9r_3D$

$\therefore$ rate of reaction = $\frac{1}{9} \times 9$ m.mol dm^{-3} sec^{-1}

= 1 m.mol dm^{-3} sec^{-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 _____ $\times 10^{-21}$ J. [Nearest integer]

(Given : $h = 6.63 \times 10^{-34}$ Js and $c = 3.08 \times 10^8$ ms^{-1})

Answer (765)

Sol. $[Cu(H_2O)_4]^{2+}$ is tetrahedral

$[Cu(H_2O)_6]^{2+}$ is octahedral

$\because \quad \Delta_t = \frac{4}{9} \times \Delta_0$

$$\Delta_t = \frac{6.63\times10^{-34}\times3.08\times10^8}{600\times10^{-9}}$$

$$\Delta_0 = \frac{9}{4}\times\frac{6.63\times10^{-34}\times3.08\times10^8}{600\times10^{-9}} \approx 765\times10^{-21}\,J$$

10. Number of grams of bromine that will completely react with 5.0 g of pent-1-ene is _____ $\times 10^{-2}$g. (Atomic mass of Br = 80 g/mol) [Nearest integer]

Answer (1143)

Sol. $CH_3–CH_2–CH_2–CH = CH_2 + Br_2$

$\downarrow$

$$CH_3 - CH_2 - CH_2 - \underset{\displaystyle Br}{\underset{|}{CH}} - \overset{\displaystyle Br}{\overset{|}{CH_2}}$$

$\frac{5}{70}$ moles of pentene will react with $\frac{5}{70}$ moles of Br_2

$$= \frac{5}{70} \times 160$$

$= 11.43$ g

$= 1143 \times 10^{-2}$ g