FINAL JEE–MAIN EXAMINATION – JULY, 2022

(Held On Thursday 28th July, 2022) **TIME : 9 : 00 AM to 12 : 00 NOON**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

1. Identify the incorrect statement from the following.

(A) A circular path around the nucleus in which an electron moves is proposed as Bohr's orbit.

(B) An orbital is the one electron wave function (Ψ) in an atom.

(C) The existence of Bohr's orbits is supported by hydrogen spectrum.

(D) Atomic orbital is characterised by the quantum numbers n and *l* only

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. Atomic orbital is characterised by n, *l*, m.

2. Which of the following relation is not correct ?

(A) $\Delta H = \Delta U - P\Delta V$ (B) $\Delta U = q + W$

(C) $\Delta S_{sys} + \Delta S_{surr} \geq 0$ (D) $\Delta G = \Delta H - T\Delta S$

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. If $U + Pv$ (By definition)

$\Delta 14 = \Delta U + \Delta(Pr)$ at constant pressure

$\Delta H = \Delta U + P\Delta V$

3. Match List-I with List-II.

	List-I		List-II
(A)	$Cd(s) + 2Ni(OH)_3(s) \rightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$	(I)	Primary battery
(B)	$Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$	(II)	Discharging of secondary battery
(C)	$2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$	(III)	Fuel cell
(D)	$2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$	(IV)	Charging of secondary battery

Choose the correct answer from the options given below :

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

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

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. (a) $Cd(s) + 2Ni(OH)_3(s) \rightarrow CdO(s) + 2Ni(OH)_2(s) + H_2O(l)$

Discharge of secondary Battery

(b) $Zn(Hg) + HgO(s) \rightarrow ZnO(s) + Hg(l)$

(Primary Battery Mercury cell**)**

(c) $2PbSO_4(s) + 2H_2O(l) \rightarrow Pb(s) + PbO_2(s) + 2H_2SO_4(aq)$

Charging of secondary Battery

(d) $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$ – Fuel cell

4. Match List-I with List-II.

	List-I Reaction		List-II Catalyst
(A)	$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$	(I)	$NO(g)$
(B)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(II)	$H_2SO_4(l)$
(C)	$C_{12}H_{22}O_{11}(aq) + H_2O(l) \rightarrow C_6H_{12}O_6$ (Glucose) + $C_6H_{12}O_6$ (Fructose)	(III)	Pt(s)
(D)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(IV)	Fe(s)

Choose the correct answer from the options given below :

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

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

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.

(a) $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$

Ostwald process 500 K

(b) $N_2 + 3H_2 \xrightarrow{Fe(s)} 2NH_3(g)$

Haber's process

(c) $C_{12}H_{22}O_{11}(aq.) + H_2O(\ell) \xrightarrow{H^+} \underset{(glucose)}{C_6H_{12}O_6} + \underset{(fructose)}{C_6H_{12}O_6}$

Inversion of sugar cane

(d) $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

5. In which of the following pairs, electron gain enthalpies of constituent elements are nearly the same or identical ?

(A) Rb and Cs (B) Na and K

(C) Ar and Kr (D) I and At

Choose the correct answer from the options given below :

(A) (A) and (B) only

(B) (B) and (C) only

(C) (A) and (C) only

(D) (C) and (D) only

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Rb & Cs have nearly same electron gain enthalpy electron gain enthalpy = – 46 kj/ml

Ar & Kr have same ΔH_{eq}. Value is + 96 kj/ml

6. Which of the reaction is suitable for concentrating ore by leaching process ?

(A) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

(B) $Fe_3O_4 + CO \rightarrow 3FeO + CO_2$

(C) $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2Na[Al(OH)_4]$

(D) $Al_2O_3 + 6Mg \rightarrow 6MgO + 4Al$

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. $Al_2O_3 + 2NaOH + 3H_2O \rightarrow 2Na,\left[Al(OH)_4\right]$

Leaching.

7. The metal salts formed during softening of hardwater using Clark's method are :

(A) $Ca(OH)_2$ and $Mg(OH)_2$

(B) $CaCO_3$ and $Mg(OH)_2$

(C) $Ca(OH)_2$ and $MgCO_3$

(D) $CaCO_3$ and $MgCO_3$

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. Clark's Method Reaction

$Ca(HCO_3)_2 + Ca(OH)_2 \rightarrow 2CaCO_3 + 2H_2O$

$Mg(HCO_3)_2 + 2Ca(OH)_2 \rightarrow 2CaCO_3 + Mg(OH)_2 + 2H_2O$

8. Which of the following statement is incorrect ?

(A) Low solubility of LiF in water is due to its small hydration enthalpy.

(B) KO_2 is paramagnetic.

(C) Solution of sodium in liquid ammonia is conducting in nature.

(D) Sodium metal has higher density than potassium metal

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Low solubility of LiF in water is due to high lattice enthalpy

9. Match List-I with List-II, match the gas evolved during each reaction.

	List-I		**List-II**
(A)	$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta}$	(I)	H_2
(B)	$KMnO_4 + HCl \rightarrow$	(II)	N_2
(C)	$Al + NaOH + H_2O \rightarrow$	(III)	O_2
(D)	$NaNO_3 \xrightarrow{\Delta}$	(IV)	Cl_2

Choose the correct answer from the options given below :

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

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

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. $(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$

$KMnO_4 + HCl \rightarrow MnCl_2 + KCl + Cl_2 + H_2O$

$Al + NaOH + H_2O \rightarrow H_2 + Na\left[Al(OH)_4\right]$

$NaNO_3 \longrightarrow NaNO_2 + O_2$

10. Which of the following has least tendency to liberate H_2 from mineral acids ?

(A) Cu (B) Mn

(C) Ni (D) Zn

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Copper is least electropositive among the given metals and it lies below H in reactivity series

11. Given below are two statements :

Statement I : In polluted water values of both dissolved oxygen and BOD are very low.

Statement II : Eutrophication results in decrease in the amount of dissolved oxygen.

In the light of the above statements, choose the most appropriate 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 (D)

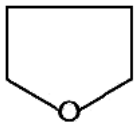
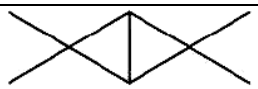
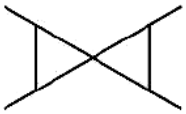
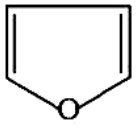
Allen Ans. (D)

Sol. Since eutrophication is result of excessive growth of weed in water bodies, which consume dissolved oxygen of water bodies.

$\therefore$ Eutrophication decreases amount of dissolved oxygen in water bodies.

Polluted water has low value of dissolved oxygen, but high valueof BOD (Biological oxygen demand), since chemical and organic matter requires dissolved oxygen to get decompose.

12. Match List-I with List-II.

	List-I		List-II
(A)		(I)	Spiro compound
(B)		(II)	Aromatic compound
(C)		(III)	Non-planar Heterocyclic compound
(D)		(IV)	Bicyclo compound

Choose the correct answer from the options given below :

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

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

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

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

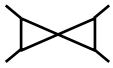
Official Ans. by NTA (C)

Allen Ans. (C)

Sol.

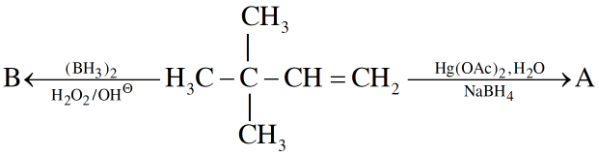
 : Non-planar heterocyclic Compound

 : Bicyclo Compound

 : Spiro Compound

 : Aromatic Compound

13. Choose the correct option for the following reactions.



(A) 'A' and 'B' are both Markovnikov addition products.

(B) 'A' is Markovnikov product and 'B' is anti-Markovnikov product.

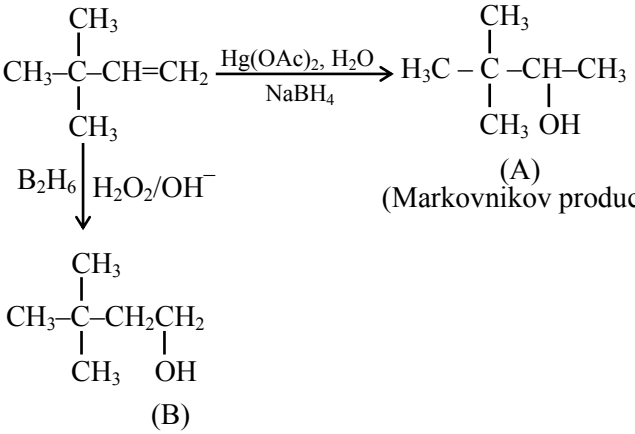
(C) 'A' and 'B' are both anti-Markovnikov products.

(D) 'B' is Markovnikov and 'A' is anti-Markovnikov product.

Official Ans. by NTA (B)

Allen Ans. (B)

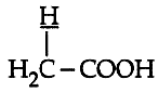
Sol.

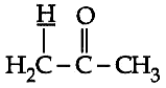


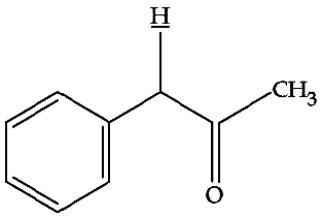
(A)
(Markovnikov product)

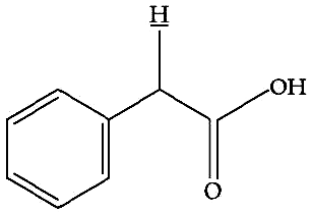
(B)
(Anti Markovnikov product)

14. Among the following marked proton of which compound shows lowest pK_a value ?

(A) 

(B) 

(C) 

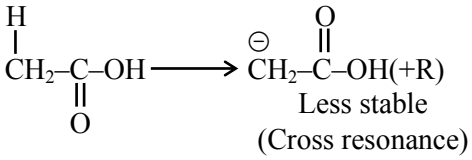
(D) 

Official Ans. by NTA (C)

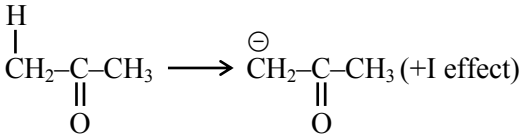
Allen Ans. (C)

Sol.

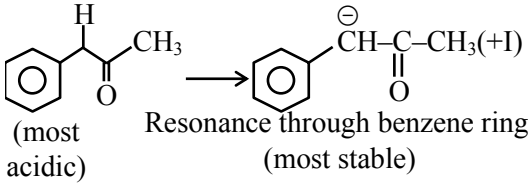
(A)



(B)

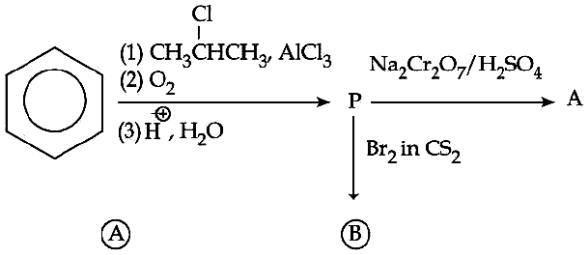


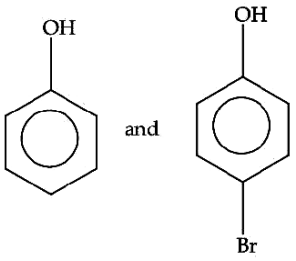
(C)

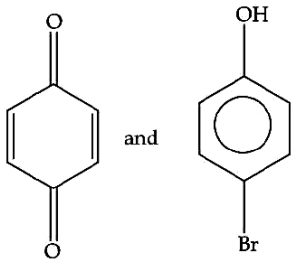


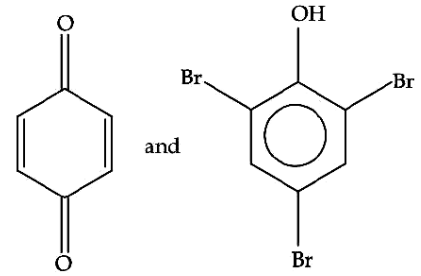
So it has least pK_a value.

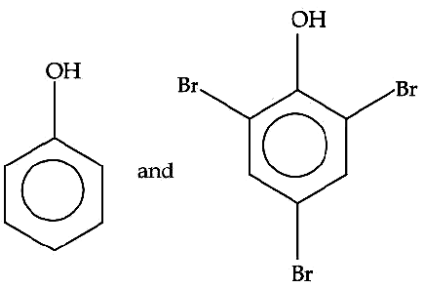
15. Identify the major product A and B for the below given reaction sequence.



(A) 

(B) 

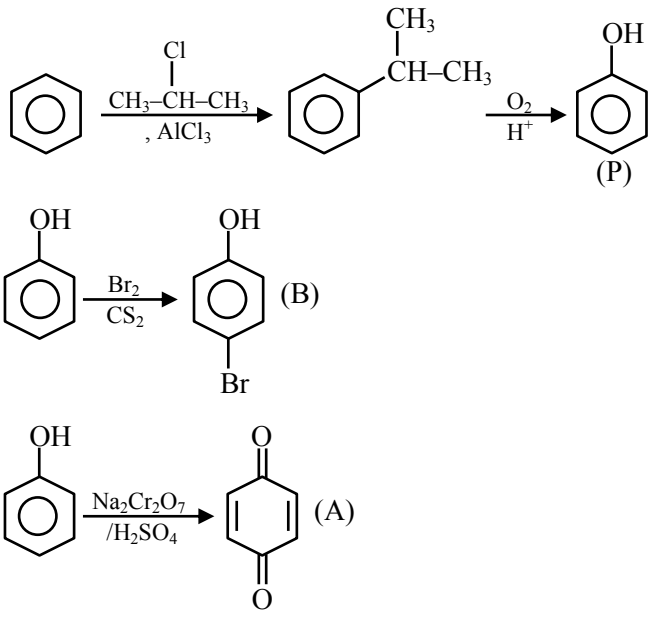
(C) 

(D) 

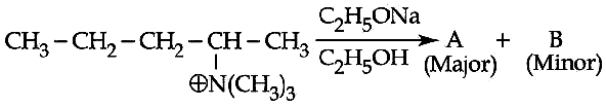
Official Ans. by NTA (B)

Allen Ans. (B)

Sol.



16. Identify the correct statement for the below given transformation.



(A) A - $CH_3CH_2CH = CH–CH_3$,
B – $CH_3CH_2CH_2CH = CH_2$,
Saytzeff products

(B) A - $CH_3CH_2CH = CH–CH_3$,
B – $CH_3CH_2CH_2CH = CH_2$,
Hafmann products

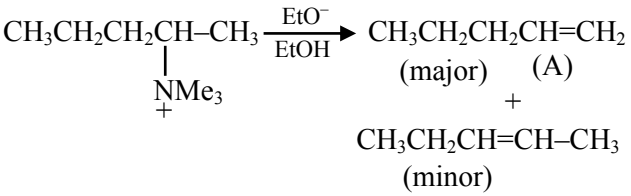
(C) A - $CH_3CH_2CH_2CH = CH_2$,
B – $CH_3CH_2CH = CHCH_3$,
Hofmann products

(D) A - $CH_3CH_2CH_2CH = CH_2$,
B – $CH_3CH_2CH = CHCH_3$,
Saytzeff products

Official Ans. by NTA (C)

Allen Ans. (C)

Sol.



17. Terylene polymer is obtained by condensation of :

(A) Ethane-1, 2-diol and Benzene-1, 3 dicarboxylic acid

(B) Propane-1, 2-diol and Benzene-1, 4 dicarboxylic acid

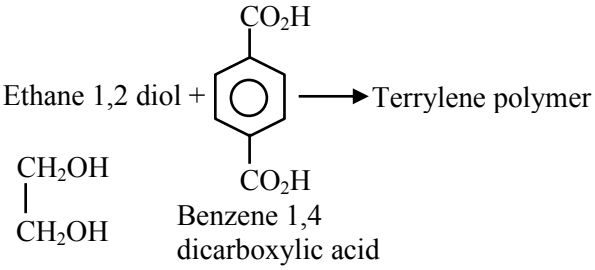
(C) Ethane-1, 2-diol and Benzene-1, 4 dicarboxylic acid

(D) Ethane-1, 2-diol and Benzene-1, 2 dicarboxylic acid

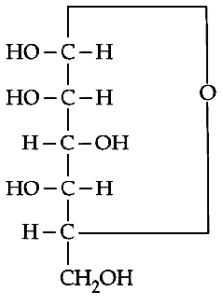
Official Ans. by NTA (C)

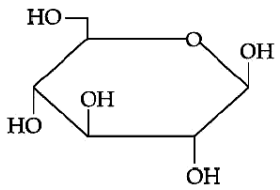
Allen Ans. (C)

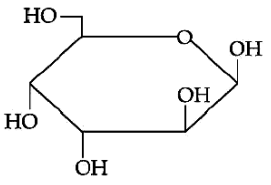
Sol.

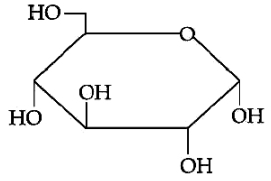


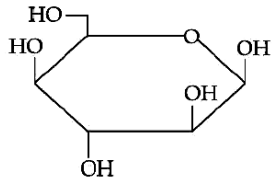
18. For the below given cyclic hemiacetal (X), the correct pyranose structure is :



(A)


(B)


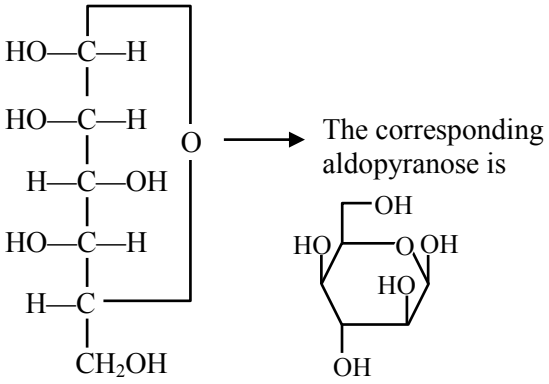
(C)


(D)


Official Ans. by NTA (D)

Allen Ans. (D)

Sol. **Correct pyranose structure is**



X(Hemiacetal)

19. Statements about Enzyme Inhibitor Drugs are given below :

(A) There are Competitive and Non-competitive inhibitor drugs.

(B) These can bind at the active sites and allosteric sites.

(C) Competitive Drugs are allosteric site blocking drugs.

(D) Non-competitive Drugs are active site blocking drugs.

Choose the correct answer from the options given below :

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Enzyme inhibitors can be competitive inhibitors (inhibit the attachment of substrate on active site of enzyme) and non-competitive inhibitor (changes the active site of enzyme after binding at allosteric site.)

20. For kinetic study of the reaction of iodide ion with H_2O_2 at room temperature :

(A) Always use freshly prepared starch solution.

(B) Always keep the concentration of sodium thiosulphate solution less than that of KI solution.

(C) Record the time immediately after the appearance of blue colour.

(D) Record the time immediately before the appearance of blue colour.

(E) Always keep the concentration of sodium thiosulphate solution more than that of KI solution.

Choose the correct answer from the options given below :

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

(B) (A), (D), (E) only

(C) (D), (E) only

(D) (A), (B), (E) only

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. The is recorded immediately after the blue colour appears.

$Na_2S_2O_3$ is kept in limited amount.

SECTION-B

1. In the given reaction,

$$X + Y + 3Z \rightleftarrows XYZ_3$$

if one mole of each of X and Y with 0.05 mol of Z gives compound XYZ_3. (Given : Atomic masses of X, Y and Z are 10, 20 and 30 amu, respectively). The yield of XYZ_3 is _____ g.

(Nearest integer)

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. $\underset{1mol}{X} + \underset{1mol}{Y} + \underset{0.05mol}{3Z} \rightleftharpoons \mathbf{XYZ_3}$

Z is L.R.

$$\frac{0.05}{3} = \text{1 mole of } XYZ_3$$

$$\text{Mass of } XYZ_3 = \frac{0.05}{3} \times (10 + 20 + 30 \times 3)$$

$$= 2g$$

2. An element M crystallises in a body centred cubic unit cell with a cell edge of 300 pm. The density of the element is 6.0 g cm^{-3}. The number of atoms present in 180 g of the element is _____ $\times 10^{23}$.

(Nearest integer)

Official Ans. by NTA (22)

Allen Ans. (22)

Sol. M is body certred cubic , $\therefore$ Z = 2

Let mass of 1 atom of M is A

Edge length = 300 pm

Density = $6g/cm^3$

$$\therefore 6g/cm^3 = \frac{Z \times A}{(300 \times 10^{-10})^3} = \frac{2 \times A}{27 \times 10^{-24}}$$

$$A = 81 \times 10^{-24} g$$

$\therefore$ Atomic mass = 48.6g

$$\therefore \text{Mole in 180g} = \frac{180}{48.6} = 3.7 \text{ moles}$$

Atoms of M = $3.7 \times 6 \times 10^{23}$

$= 22.22 \times 10^{23}$ atoms

3. The number of paramagnetic species among the following is _____.

B_2, Li_2, C_2, C_2^-, O_2^{2-}, O_2^+ and He_2^+

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Paramagnetic $B_2, C_2^-, O_2^+, He_2^+$

4. 150 g of acetic acid was contaminated with 10.2 g ascorbic acid ($C_6H_8O_6$) to lower down its freezing point by ($x \times 10^{-1}$)°C. The value of x is _____. (Nearest integer) [Given $K_f = 3.9$ K kg mol^{-1}; Molar mass of ascorbic acid = 176 g mol^{-1}]

Official Ans. by NTA (15)

Allen Ans. (15)

Sol. 150g CH_3COOH

10.2g ascorbic acid $\Rightarrow$ 0.058 moles

$$\Delta T_f = \left(x \times 10^{-1}\right)°C$$

$$\Delta T_f = k_f \cdot \text{molality}$$

$$= 3.9 \times \frac{0.058}{150} \times 1000$$

$$= 1.5°C$$

$$= 15 \times 10^{-1}°C$$

5. K_a for butyric acid (C_3H_7COOH) is 2×10^{-5}. The pH of 0.2 M solution of butyric acid is ___ $\times 10^{-1}$. (Nearest integer) [Given log 2 = 0.30]

Official Ans. by NTA (27)

Allen Ans. (27)

Sol. K_a of Butyric acid $\Rightarrow 2 \times 10^{-5}$ PKa = 4.7

pH of 0.2 M solution

$$pH = \frac{1}{2} pK_a - \frac{1}{2} \log C$$

$$= \frac{1}{2}(4 \cdot 7) \frac{1}{2} \log(0.2)$$

$$= 2.35 + 0.35 = 2.7$$

$$pH = 27 \times 10^{-1}$$

6. For the given first order reaction

$A \rightarrow B$

the half life of the reaction is 0.3010 min. The ratio of the initial concentration of reactant to the concentration of reactant at time 2.0 min will be equal to _____. (Nearest integer)

Official Ans. by NTA (100)

Allen Ans. (100)

Sol. $A \rightarrow B$ $\quad t_{1/2} = 0.3010$ min

A_0/A_t at time 2 min = ?

$$K = \frac{2.303}{t} \log\left[\frac{A_0}{A_t}\right]$$

$$\Rightarrow \frac{0 \cdot 693}{t_{\frac{1}{2}}} = \frac{2 \cdot 303}{2} \log\left(\frac{A_0}{A_t}\right)$$

$$\text{Or } \frac{2.303 \times 0.3010}{0.3010} = \frac{2.303}{2} \log \frac{A_0}{A_t}$$

$$\log \frac{A_0}{A_t} = 2$$

$$\therefore \frac{A_0}{A_t} = 10^2 = 100$$

7. The number of interhalogens from the following having square pyramidal structure is :

ClF_3, IF_7, BrF_5, BrF_3, I_2Cl_6, IF_5, ClF, ClF_5

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Square pyramidal structures are

BrF_5, IF_5 and ClF_5.

8. The disproportionation of MnO_4^{2-} in acidic medium resulted in the formation of two manganese compounds A and B. If the oxidation state of Mn in B is smaller than that of A, then the spin-only magnetic moment (μ) value of B in BM is _____. (Nearest integer)

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $MnO_4^{2-} \xrightarrow{H^+} MnO_4^- + MnO_2$

No. of unpaired $\bar{e} = 3$

$\therefore \ \mu = \sqrt{15} = 3.877$

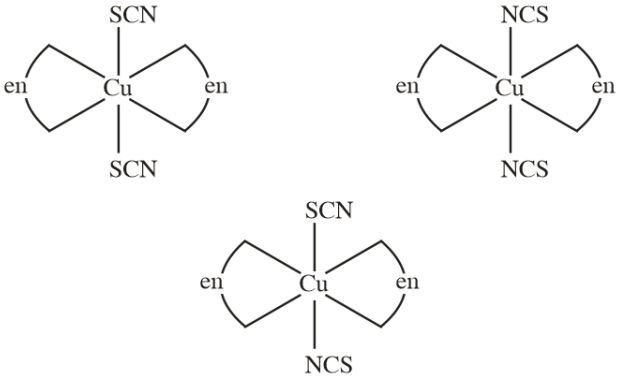
Nearest Integer = 4

9. Total number of relatively more stable isomer(s) possible for octahedral complex $[Cu(en)_2(SCN)_2]$ will be _____.

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. $[Cu(en)_2(SCN)_2]$



10. On complete combustion of 0.492 g of an organic compound containing C, H and O, 0.7938 g of CO_2 and 0.4428 g of H_2O was produced. The % composition of oxygen in the compound is _____.

Official Ans. by NTA (46)

Allen Ans. (46)

Sol. 0.492g of $C_xH_yO_z$

Gives 0.7938 g CO_2 = 0.018 moles

0.4428g H_2O = 0.0246 moles

So moles of C = 0.018 $\Rightarrow$ 0.216 g

Moles of H = 0.049 $\Rightarrow$ 0.049g

$\therefore$ wt. of Oxygen = 0.492 – 0.216 – 0.049

= 0.227g

% of Oxygen = $\frac{0.227}{0.492} \times 100$ 46 (approx.)