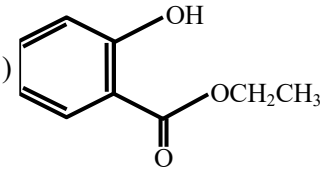
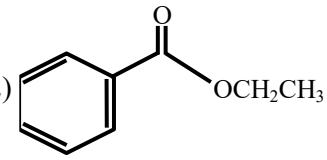
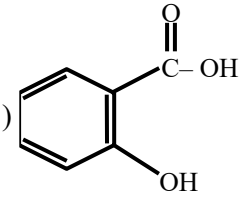
CHEMISTRY

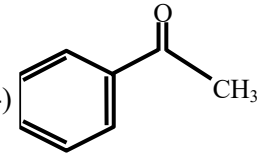
SECTION-A

1. Which one of the following compounds will give orange precipitate when treated with 2,4-dinitrophenyl hydrazine ?

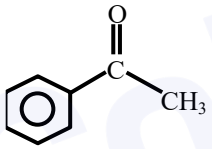
(1) 

(2) 

(3) 

(4) 

Official Ans. by NTA (4)

Sol. 

Explanation ⇒ 2-4-D.N.P test is used for carbonyl compound (aldehyde & ketone)

2. The product obtained from the electrolytic oxidation of acidified sulphate solutions, is :

(1) HSO_4^-

(2) HO_3SOOSO_3H

(3) HO_2SOSO_2H

(4) HO_3SOSO_3H

Official Ans. by NTA (2)

Sol. Electrolysis of concentrated solution of acidified sulphate solution yields $H_2S_2O_8$.

3. The parameters of the unit cell of a substance are a = 2.5, b = 3.0, c = 4.0, $\alpha = 90°$, $\beta = 120°$ $\gamma = 90°$. The crystal system of the substance is :

(1) Hexagonal

(2) Orthorhombic

(3) Monoclinic

(4) Triclinic

Official Ans. by NTA (3)

Sol. $a \neq b \neq c$ and $\alpha = \gamma = 90^o \neq \beta$

are parameters of monoclinic unit cell.

4. The oxidation states of 'P' in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$, respectively, are :

(1) 7, 5 and 6 (2) 5, 4 and 3

(3) 5, 3 and 4 (4) 6, 4 and 5

Official Ans. by NTA (3)

Sol. Oxidation state of P in $H_4P_2O_7$, $H_4P_2O_5$ and $H_4P_2O_6$ is 5, 3 & 4 respectively

$H_4P_2O_7$

$2x + 4(+1) + 7(-2) = 0$

$x = +5$

$H_4\underline{P_2}O_5$

$2x + 4(+1) + 5(-2) = 0$

$x = +3$

$H_4\underline{P_2}O_6$

$2x + 4(+1) + 6(-2) = 0$

$x = +4$

5. For a reaction of order n, the unit of the rate constant is :

(1) $mol^{1-n}\, L^{1-n}\, s$ (2) $mol^{1-n}\, L^{2n}\, s^{-1}$

(3) $mol^{1-n}\, L^{n-1} s^{-1}$ (4) $mol^{1-n}\, L^{1-n}\, s^{-1}$

Official Ans. by NTA (3)

Sol. $Rate = k[A]^n$

comparing units

$$\frac{(mol/\ell)}{sec} = k\left(\frac{mol}{\ell}\right)^n$$

$\Rightarrow k = mol^{(1-n)}\, \ell^{(n-1)}\, s^{-1}$

6. Given below are two statements :

Statement I : Aniline is less basic than acetamide.

Statement II : In aniline, the lone pair of electrons on nitrogen atom is delocalised over benzene ring due to resonance and hence less available to a proton.

Choose the **most appropriate** option ;

(1) Statement I is true but statement II is false.

(2) Statement I is false but statement II is true.

(3) Both statement I and statement II are true.

(4) Both statement I and statement II are false.

Official Ans. by NTA (2)

Sol. Explanation :- aniline is more basic than acetamide because in acetamide, lone pair of nitrogen is delocalised to more electronegative element oxygen.

In Aniline lone pair of nitrogen delocalised over benzene ring.

7. The type of hybridisation and magnetic property of the complex $[MnCl_6]^{3-}$, respectively, are :

(1) sp^3d^2 and diamagnetic

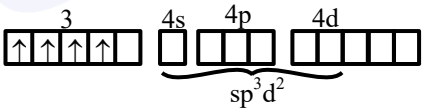
(2) d^2sp^3 and diamagnetic

(3) d^2sp^3 and paramagnetic

(4) sp^3d^2 and paramagnetic

Official Ans. by NTA (4)

Sol. $[MnCl_6]^{3-}$

$Mn^{3+} \rightarrow [Ar]$ 

Paramagnetic and having 4 unpaired electrons.

8. The number of geometrical isomers found in the metal complexes $[PtCl_2(NH_3)_2]$, $[Ni(CO)_4]$, $[Ru(H_2O)_3Cl_3]$ and $[CoCl_2(NH_3)_4]^+$ respectively, are :

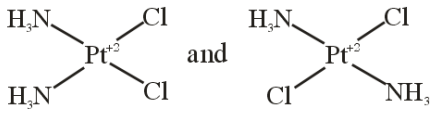
(1) 1, 1, 1, 1 (2) 2, 1, 2, 2

(3) 2, 0, 2, 2 (4) 2, 1, 2, 1

Official Ans. by NTA (3)

Sol.

$[PtCl_2(NH_3)_2]$

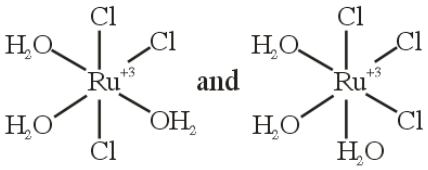


2 Geometrical isomers

$[Ni(CO)_4] \rightarrow$ All ligands are same

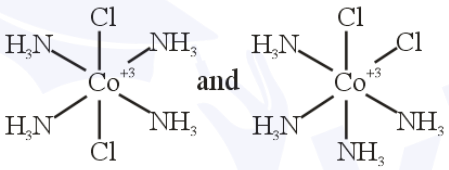
Zero Geometrical isomers

$[Ru(H_2O)_3Cl_3]$



2 Geometrical isomers

$[CoCl_2(NH_3)_4]^+$



2 Geometrical isomers

9. Which one of the following statements is **NOT** correct ?

(1) Eutrophication indicates that water body is polluted ?

(2) The dissolved oxygen concentration below 6 ppm inhibits fish growth

(3) Eutrophication leads to increase in the oxygen level in water

(4) Eutrophication leads to anaerobic conditions

Official Ans. by NTA (3)

Sol. Eutrophication leads to decrease in oxygen level of water.

3^{rd} statement is incorrect

10. Given below are two statements :

Statement I : Rutherford's gold foil experiment cannot explain the line spectrum of hydrogen atom.

Statement II : Bohr's model of hydrogen atom contradicts Heisenberg's uncertainty principle.

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) **Statement I** is true but **statement II** is false.

(3) Both **statement I** and **statement II** are false.

(4) Both **statement I** and **statement II** are true.

Official Ans. by NTA (4)

Sol. Rutherford's gold foil experiment only proved that electrons are held towards nucleus by electrostatic forces of attraction and move in circular orbits with very high speeds.

Bohr's model gave exact formula for simultaneous calculation of speed & distance of electron from the nucleus, something which was deemed impossible according to Heisenberg.

11. Presence of which reagent will affect the reversibility of the following reaction, and change it to a irreversible reaction :

$$CH_4 + I_2 \underset{\text{Reversible}}{\overset{h\nu}{\rightleftharpoons}} CH_3 - I + HI$$

(1) HOCl (2) dilute HNO_2

(3) Liquid NH_3 (4) Concentrated HIO_3

Official Ans. by NTA (4)

Sol. Iodination of alkane is reversible reaction.

It can be irreversible in the presence of strong oxidising agent like conc. HNO_3 or conc. HIO_3

12. Which one among the following chemical tests is used to distinguish monosaccharide from disaccharide ?

(1) Seliwanoff's test (2) Iodine test

(3) Barfoed test (4) Tollen's test

Official Ans. by NTA (3)

Sol. Barford test is used for distinguish mono-saccharide from disaccharide

13. Match **List-I** with **List-II** :

List-I (Drug)	**List-II (Class of Drug)**
(a) Furacin	(i) Antibiotic
(b) Arsphenamine	(ii) Tranquilizers
(c) Dimetone	(iii) Antiseptic
(d) Valium	(iv) Synthetic antihistamines

Choose the **most appropriate** match :

(1) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

(2) (a)-(iii), (b)-(iv), (c)-(ii), (d)-(i)

(3) (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

Official Ans. by NTA (4)

Sol. $\rightarrow$ furacine acts as Antiseptic

$\rightarrow$ Arsphenamine also known as salvarsan acts as antibiotic

$\rightarrow$ Dimetone is synthetic histamine

$\rightarrow$ valium is a Tranqulizer

14. The statement that is INCORRECT about Ellingham diagram is

(1) provides idea about the reaction rate.

(2) provides idea about free energy change.

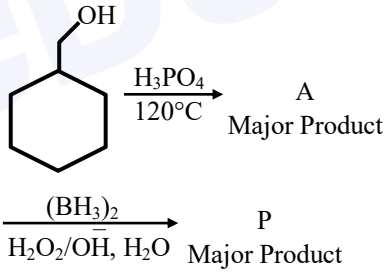
(3) provides idea about changes in the phases during the reaction.

(4) provides idea about reduction of metal oxide.

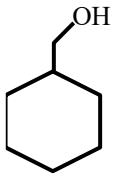
Official Ans. by NTA (1)

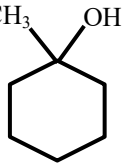
Sol. Ellingham diagram is a plot between ΔG° and T and does not give any information regarding rate of reaction

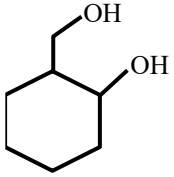
15.

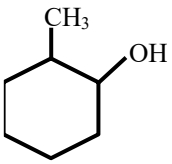


Consider the above reaction and identify the Product P :

(1) 

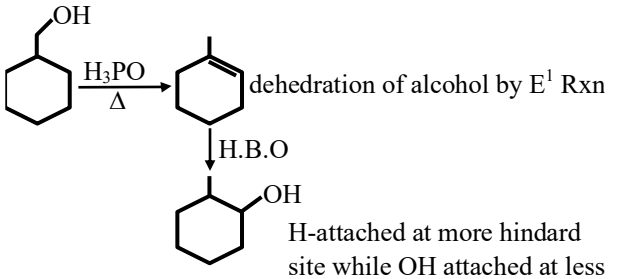
(2) 

(3) 

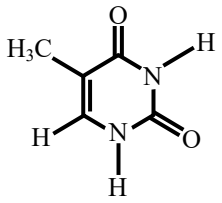
(4) 

Official Ans. by NTA (4)

Sol.



16.



(A)

The compound 'A' is a complementary base of _____ in DNA stands.

(1) Uracil (2) Guanine

(3) Adenine (4) Cytosine

Official Ans. by NTA (3)

Sol. Given structure is Thymine and Thymine being paired with adenine

17. Staggered and eclipsed conformers of ethane are :

(1) Polymers (2) Rotamers

(3) Enantiomers (4) Mirror images

Official Ans. by NTA (2)

Sol. Staggered and eclipsed conformers of ethane also known as rotamers

18. Match **List - I** with **List - II** :

List - I	**List - II**
(a) NaOH	(i) Acidic
(b) $Be(OH)_2$	(ii) Basic
(c) $Ca(OH)_2$	(iii) Amphoteric
(d) $B(OH)_3$	
(e) $Al(OH)_3$	

Choose the **most appropriate** answer from the options given below

(1) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(ii), (e)-(iii)

(2) (a)-(ii), (b)-(iii), (c)-(ii), (d)-(i), (e)-(iii)

(3) (a)-(ii), (b)-(ii), (c)-(iii), (d)-(i), (e)-(iii)

(4) (a)-(ii), (b)-(i), (c)-(ii), (d)-(iii), (e)-(iii)

Official Ans. by NTA (2)

Sol. $NaOH \rightarrow$ Basic

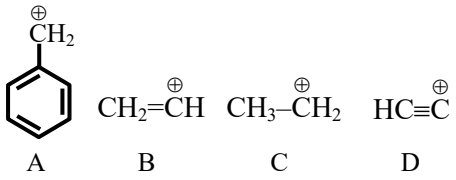
$Be(OH)_2 \rightarrow$ Amphoteric

$Ca(OH)_2 \rightarrow$ Basic

$B(OH)_3 \rightarrow$ Acidic

$Al(OH)_3 \rightarrow$ Amphoteric

19.



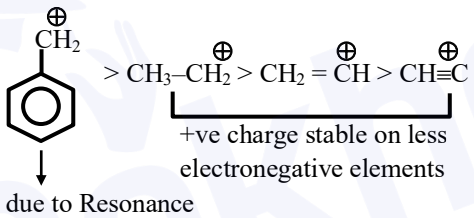
The correct order of stability of given carbocation is :

(1) A > C > B > D (2) D >B > C > A

(3) D > B > A > C (4) C > A > D > B

Official Ans. by NTA (1)

Sol.



20. Given below are two statements : One is labelled as **Assertion A** and the other labelled as **Reason R.**

Assertion A : Lithium halides are some what covalent in nature.

Reason R : Lithium possess high polarisation capability.

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

(1) **A** is true but **R** is false

(2) **A** is false but **R** is true

(3) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**

(4) Both **A** and **R** are true and **R** is the correct explanation of **A**

Official Ans. by NTA (4)

Sol. Lithium due to small size has very high polarization capability and thus increases covalent nature in Halides.

SECTION-B

1. The density of NaOH solution is 1.2 g cm^{-3}. The molality of this solution is _____ m.
(Round off to the Nearest Integer)
[Use : Atomic masses : Na : 23.0 u O : 16.0 u H : 1.0 u
Density of H_2O : 1.0 g cm^{-3}]
Official Ans. by NTA (5)

Sol. Consider 1ℓ solution

mass of solution = (1.2 × 1000)g
= 1200 gm
Neglecting volume of NaOH
Mass of water = 1000 gm
$\Rightarrow$ Mass of NaOH = (1200 – 1000)gm
= 200 gm

$$\Rightarrow \text{Moles of NaOH} = \frac{200\text{g}}{50\text{g/mol}} = 5 \text{ mol}$$

$$\Rightarrow \text{molality} = \frac{5\text{mol}}{1\text{kg}} = 5 \text{ m}$$

2. CO_2 gas adsorbs on charcoal following Freundlich adsorption isotherm. For a given amount of charcoal, the mass of CO_2 adsorbed becomes 64 times when the pressure of CO_2 is doubled.
The value of n in the Freundlich isotherm equation is _____ × 10^{-2}. (Round off to the Nearest Integer)
Official Ans. by NTA (17)

Sol. Freundlich isotherm. ;

$$\frac{x}{m} = k.p^{\frac{1}{n}}$$

Substituting values ;

$$\left(\frac{64}{1}\right) = (2)^{\frac{1}{n}} \Rightarrow n = \frac{1}{6} = 0.166$$

$$\cong 17 \times 10^{-2}$$

3. The conductivity of a weak acid HA of concentration 0.001 mol L^{-1} is 2.0 × 10^{-5} S cm^{-1}. If $\Lambda_m^o(HA) = 190 \text{ S cm}^2 \text{ mol}^{-1}$, the ionization constant (K_a) of HA is equal to _____ × 10^{-6}.
(Round off to the Nearest Integer)
Official Ans. by NTA (12)

Sol. $\Lambda_m = 1000 \times \frac{\kappa}{M}$

$$= 1000 \times \frac{2 \times 10^{-5}}{0.001} = 20 \text{ S cm}^2 \text{ mol}^{-1}$$

$$\Rightarrow \alpha = \frac{\Lambda_m}{\Lambda_m^\infty} = \frac{20}{190} = \left(\frac{2}{19}\right)$$

$$HA \rightleftharpoons H^+ + A^-$$

0.001 (1– α) 0.001α 0.001 α

$$\Rightarrow k_a = 0.001\left(\frac{\alpha^2}{1-\alpha}\right) = \frac{0.001 \times \left(\frac{2}{19}\right)^2}{1-\left(\frac{2}{19}\right)}$$

$$= 12.3 \times 10^{-6}$$

4. 1.46 g of a biopolymer dissolved in a 100 mL water at 300 K exerted an osmotic pressure of 2.42 × 10^{-3} bar.
The molar mass of the biopolymer is _____ × 10^4 g mol^{-1}. (Round off to the Nearest Integer)
[Use : R = 0.083 L bar mol^{-1} K^{-1}]
Official Ans. by NTA (15)

Sol. $\pi = CRT$; π = osmotic pressure
C = molarity
T = Temperature of solution
let the molar mass be M gm / mol
2.42 × 10^{-3} bar =

$$\frac{\left(\frac{1.46\text{g}}{\text{Mgm/mol}}\right)}{0.1\ell} \times \left(\frac{0.083\ell - \text{bar}}{\text{mol} - \text{K}}\right) \times (300\text{K})$$

$$\Rightarrow M = 15.02 \times 10^4 \text{ g/mol}$$

5. An organic compound is subjected to chlorination to get compound A using 5.0 g of chlorine. When 0.5 g of compound A is reacted with $AgNO_3$ [Carius Method], the percentage of chlorine in compound A is _____ when it forms 0.3849 g of AgCl. (Round off to the Nearest Integer)
(Atomic masses of Ag and Cl are 107.87 and 35.5 respectively)
Official Ans. by NTA (19)

Sol. $n_{c\ell}$ in compound = $n_{AgCl} = \frac{0.3849g}{(107.87+35.5)}$ g/mol

$\Rightarrow$ mass of chlorine = $n_{Cl} \times 35.5 = 0.0953$ gm

$\Rightarrow$ % wt of chlorine = $\frac{0.0953}{0.5} \times 100$

$= 19.06\%$

OR

Sol. Mass of organic compound = 0.5 gm.

mass of formed AgCl = 0.3849 gm

$$\%\text{of Cl} = \frac{\text{atomic mass of Cl} \times \text{mass formed AgCl}}{\text{molecular mass of AgCl} \times \text{mass of organic compound}} \times 100$$

$$= \frac{35.5 \times 0.3849}{143.37 \times 0.5} \times 100$$

$= 19.06$

$\boxed{\approx 19}$

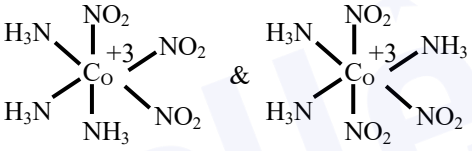
6. The number of geometrical isomers possible in triamminetrinitrocobalt (III) is X and in trioxalatochromate (III) is Y. Then the value of X + Y is _____.

Official Ans. by NTA (2)

Sol. Triamminetrinitrocobalt(III) $\rightarrow [Co(NO_2)_3(NH_3)_3]$

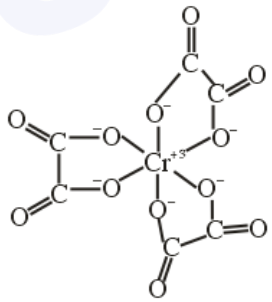
trioxalatochromate(III) ion $\rightarrow [Cr(C_2O_4)_3]^{3-}$

$[Co(NO_2)_3(NH_3)_3]$



Two geometrical isomers (X)

$[Cr(C_2O_4)_3]^{3-}$



Zero geometrical isomer (Y)

X + Y = 2 + 0 = 2.0

7. In gaseous triethyl amine the "–C–N–C–" bond angle is _____ degree.

Official Ans. by NTA (108)

Sol. In gaseous triethyl amine the "–C–N–C–" bond angle is 108 degree.

8. For water at 100°C and 1 bar,

$\Delta_{vap} H - \Delta_{vap} U =$ _____ $\times 10^2$ J mol^{-1}.

(Round off to the Nearest Integer)

[Use : R=8.31 J mol^{-1} K^{-1}]

[Assume volume of $H_2O(l)$ is much smaller than volume of $H_2O(g)$. Assume $H_2O(g)$ treated as an ideal gas]

Official Ans. by NTA (31)

Sol. $H_2O_{(\ell)} \rightleftharpoons H_2O_{(V)}$

$\Delta H = \Delta U + \Delta n_g RT$

for 1 mole waters ;

$\Delta n_g = 1$

$\therefore \Delta n_g RT$ = 1 mol × 8.31 J/mol-k × 373 K

$= 3099.63 \text{ J} \cong 31 \times 10^2$ J

9. $PCl_5 \rightleftharpoons PCl_3 + Cl_3 \quad K_c = 1.844$

3.0 moles of PCl_5 is introduced in a 1 L closed reaction vessel at 380 K. The number of moles of PCl_5 at equilibrium is _____ $\times 10^{-3}$.

(Round off to the Nearest Integer)

Official Ans. by NTA (1396)

Sol. $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)} \quad K_2 = 1.844$

t = 0 3 moles

$t = \infty$ x x

$$\Rightarrow \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{x^2}{3-x} = 1.844$$

$\Rightarrow x^2 + 1.844 - 5.532 = 0$

$$\Rightarrow x = \frac{-1.844 + \sqrt{(1.844)^2 + 4 \times 5.532}}{2}$$

$\cong 1.604$

$\Rightarrow$ Moles of $PCl_5 = 3 - 1.604 \cong 1.396$

10. The difference between bond orders of CO and $NO^{\oplus}$ is $\frac{x}{2}$ where x = _____.

(Round off to the Nearest Integer)

Official Ans. by NTA (0)

Sol. Bond order of CO = 3

Bond order of NO^+ = 3

Difference = $0 = \frac{x}{2}$

x = 0