PART : CHEMISTRY

SECTION – 1 : (Maximum Marks 80)

Straight Objective Type (

This section contains **20 multiple choice questions.** Each question has 4 choices (1), (2), (3) and (4) for its answer, out of which **Only One** is correct.

---

1. 5 g of Zn reacts with
(I) Excess of NaOH (II) Dilute HCl, then volume ratio of H_2 gas evolved in (I) and (II) is
(1) 2 : 1 (2) 1 : 2 (3) 1 : 1 (4) 3 : 1

Ans. **(3)**

Sol. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$
$Zn + 2HCl \longrightarrow ZnCl_2 + H_2$
According to stoichiometry in both the reactions, equal number of moles of H_2 are evolved.

2. Given K_{sp} for $Cr(OH)_3$ is 6×10^{-31} then determine $[OH^-]$.
(Neglect the contribution of OH^- ions from H_2O)

(1) $(18 \times 10^{-31})^{1/4}$ M (2) $(18 \times 10^{-31})^{1/2}$ M (3) $(6 \times 10^{-31})^{1/4}$ M (4) $\left(\frac{6}{27} \times 10^{-31}\right)^{1/4}$ M

Ans. **(1)**

Sol. $Cr(OH)_3 \longrightarrow Cr^{+3} + 3OH^-$
s 3s
$K_{sp} = s \cdot (3s)^3$
$\Rightarrow \quad 6 \times 10^{-31} = 27.s^4$
$\Rightarrow \quad s = \left(\frac{6}{27} \times 10^{-31}\right)^{1/4}$
$[OH^-] = 3s$
$= 3 \times \left(\frac{6}{27} \times 10^{-31}\right)^{1/4} = (18 \times 10^{-31})^{1/4}$ M

3. Select the correct statements among the followings
(A) LiCl does not dissolve in pyridine
(B) Li does not react ethyne to form ethynide.
(C) Li and Mg react slowly with water.
(D) Among alkali metals Li has highest hydration tendency.

(1) B, C, D (2) A, B, C, D (3) A, B, C (4) C, D

Ans. **(1)**

Sol.

4. Given an element having following ionisation enthalpies $IE_1 = 496 \frac{kJ}{mol}$ and $IE_2 = 4562 \frac{kJ}{mol}$ one mole hydroxide of this element is treated separated with HCl and H_2SO_4 respectively. Moles of HCl and H_2SO_4 reacted respectively is

(1) 1, 0.5 (2) 0.5, 1 (3) 2, 0.5 (4) 0.5, 2

Ans. (1)

Sol. According to the given data of I.E, This element must belong to group 1 and thus is monovalent & form hydroxide of the type M(OH).

$MOH + HCl \longrightarrow MCl + H_2O$

1 mole 1 mole

$2MOH + H_2SO_4 \longrightarrow M_2SO_4 + H_2O$

1 mole 1/2 mole

Sol.

M(OH)

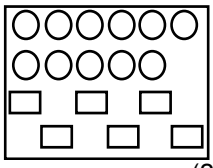
$MOH + HCl \longrightarrow MCl + H_2O$

1 mole 1 mole

$2MOH + H_2SO_4 \longrightarrow M_2SO_4 + H_2O$

1 mole 1/2 mole

5. Reactant A represented by square is in equilibrium with product B represented by circles. Then value of equilibrium constant is



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

Ans. (2)

6. Given following complexes

(I) $Na_4[Fe(CN)_6]$ (II) $[Cr(H_2O)_6]\ Cl_2$

(III) $(NEt_4)_2\ [CoCl_4]$ (IV) $Na_3[Fe(C_2O_4)_3]$ ($\Delta_0 > P$)

Correct order of spin only magnetic moment for the above complexes is.

(I) $Na_4[Fe(CN)_6]$ (II) $[Cr(H_2O)_6]\ Cl_2$

(III) $(NEt_4)_2\ [CoCl_4]$ (IV) $Na_3[Fe(C_2O_4)_3]$ ($\Delta_0 > P$)

(1) (II) > (III) > (IV) > I (2) (II) > (IV) > (III) > (I)

(3) (I) > (IV) > (III) > (II) (4) (II) > (I) > (IV) > (III)

Ans. (1)

Sol. As, $\mu_s = \sqrt{n(n+2)}$

Complex (I) $\rightarrow Fe^{+2} \Rightarrow$ S.F.L $\Rightarrow t_{2g}^{2,2,2}\ e_g^{0,0} \Rightarrow \mu_s = 0$

Complex (II) $\rightarrow Cr^{+2} \Rightarrow$ W.F.L $\Rightarrow t_{2g}^{1,1,1}\ e_g^{1,0} \Rightarrow \mu_s = \sqrt{24}$ B.M.

Complex (III) $\rightarrow Co^{+2} \Rightarrow$ W.F.L $\Rightarrow e_g^{2,2}\ t_{2g}^{1,1,1} \Rightarrow \mu_s = \sqrt{15}$ B.M.

Complex (IV) $\rightarrow Fe^{+3} \Rightarrow$ S.F.L $\Rightarrow t_2^{2,2,1}\ e_g^{0,0} \Rightarrow \mu_s = \sqrt{3}$ B.M.

7. Select the correct option :
(1) Entropy is function of temperature and also entropy change is function of temperature.
(2) Entropy is a function of temperature & entropy change is not a function of temperature.
(3) Entropy is not a function of temperature & entropy change is a function of temperature.

Ans. **(1)**

Sol. $\Delta S = \int \frac{dq}{T}$

$S_T = \int_O^T \frac{ncdT}{T}$

8. A compound (A ; $B_3N_3H_3Cl_3$) reacts with $LiBH_4$ to form inorganic benzene (B). (A) reacts with (C) to form $B_3N_3H_3(CH_3)_3$. (B) and (C) are respectively.
(1) Boron nitride, MeMgBr (2) Boron nitride, MeBr
(3) Borazine, MeBr (4) Borazine, MeMgBr

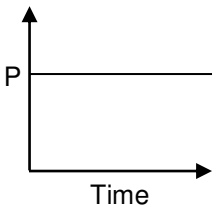
,

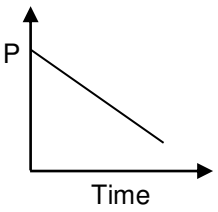
Ans. (4)

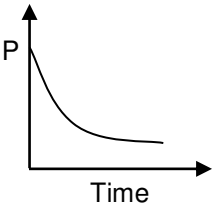
Sol. $B_3N_3H_3Cl_3 + LiBH_4 \longrightarrow B_3N_3H_6 + LiCl + BCl_3$
(A) (B)

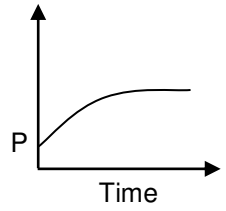
$B_3N_3H_3Cl_3 + 3MeMgBr \longrightarrow B_3N_3H_3(CH_3)_3 + 3MgBrCl$
(A) (C)

9. In a box a mixture containing H_2, O_2 and CO along with charcoal is present then variation of pressure with the time will be as follows :

(1) 

(2) 

(3) 

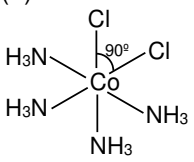
(4) 

Ans. (3)

10. Given complex $[Co(NH_3)_4Cl_2]$. In it if Cl – Co – Cl bond angle is 90º then it is :
(1) Cis-isomer (2) Trans- isomers
(3) Meridional and trans (4) Cis and trans both

Ans. (1)

Sol.



Cis form

11. Amongst the following which has minimum conductivity.
(1) Distilled water (2) Sea water
(3) Saline water used for intra venous injection (4) Well-water

Ans. **(1)**
Sol. Theory based.

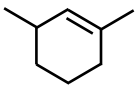
12. Number of sp^2 hybrid orbitals in Benzene is :

(1) 18 (2) 24 (3) 6 (4) 12

Ans. **(1)**
Sol. In benzene total six sp^2 hybrid carbon atoms are present. Each carbon atom has 3 sp^2 hybrid orbitals. Therefore total sp^2 hybrid orbitals are 18 in benzene.
Sol.

13. Which of the following reaction will not form racemic mixture as product?

(1) $CH_3CH_2-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow{HCN}$ (2) $(CH_3)_2CH-CH=CH_2 \xrightarrow{HCl}$

(3)  $\xrightarrow{HCl}$ (4) $CH_3CH_2-CH=CH_2 \xrightarrow{HBr}$

Ans. **(2)**

Sol. $(CH_3)_2CH-CH=CH_2 \xrightarrow{HCl} (CH_3)_2\overset{\oplus}{C}H-CH_3 \xrightarrow{\text{Hydride shift}} CH_3-\underset{\underset{CH_3}{|}}{\overset{\oplus}{C}}-CH_2-CH_3$

$\downarrow$

$CH_3-\underset{\underset{CH_3}{|}}{\overset{Cl}{\overset{|}{C}}}-CH_2-CH_3$

In this reaction, major product is not chiral.

14. In which compound C–Cl bond length is shortest?

(1) $Cl–CH=CH_2$ (2) $Cl–CH=CH–CH_3$
(3) $Cl–CH=CH–OCH_3$ (4) $Cl–CH=CH–NO_2$

Ans. (4)

Sol. Resonance form of $Cl–CH=CH–NO_2$ is more stable than resonance form of any other given compounds. Hence, double bond character in carbon-chlorine bond is maximum and bond length is shortest.

15. Biochemical oxygen demand (BOD) is defined as ..... in ppm of O_2.
(1) Required to sustain life
(2) The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water.
(3) The amount of oxygen required by anaerobic bacteria to break down the inorganic matter present in a certain volume of a sample of water.
(4) Required photochemical reaction to degrade waste.

Ans. (2)

Sol. The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water, is called **Biochemical Oxygen Demand (BOD).**

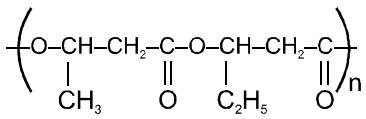
16. Monomer(s) of which of the given polymer is chiral?
Buna-S Neoprene (3) Nylon-6,6 (4) PHBV

Ans. (4)

Sol.

Polymers	**Monomers**
(1) Buna-S $-[CH_2-\underset{\displaystyle Ph}{\underset{\vert}{CH}}-CH_2-CH=CH-CH_2]-$	$CH_2=CH–Ph$ & $CH_2=CH–CH=CH_2$
(2) Neoprene $–[CH_2-CH=\underset{\displaystyle Cl}{\underset{\vert}{C}}-CH_2]_n–$	$CH_2=CH–\underset{\displaystyle Cl}{\underset{\vert}{C}}=CH_2$
(3) Nylon-6,6 $\sim[CO(CH_2)_4CO–NH(CH_2)_6NH]_n\sim$	$HO_2C–(CH_2)_4–CO_2H$ & $H_2N–(CH_2)_6–NH_2$
(4) $\left(O–\underset{\displaystyle CH_3}{\underset{\vert}{CH}}–CH_2–\underset{\displaystyle O}{\underset{\Vert}{C}}–O–\underset{\displaystyle C_2H_5}{\underset{\vert}{CH}}–CH_2–\underset{\displaystyle O}{\underset{\Vert}{C}}\right)_n$ PHBV	$CH_3-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_2-COOH$ (3 – Hydroxybutanoic acid) & $CH_3-CH_2-\underset{\displaystyle OH}{\underset{\vert}{CH}}-CH_2-COOH$ (3 – Hydroxypentanoic acid)

In PHBV, both monomers have chiral centre.

	(polymers)	**(monomers)**
(1)	ब्युना-S -[CH_2-$\underset{\displaystyle Ph}{\underset{\vert}{CH}}$-$CH_2$-CH=CH-$CH_2$]-	CH_2=CH–Ph & CH_2=CH–CH=CH_2
(2)	नियोप्रीन –[CH_2-CH=CCl-CH_2]$_n$–	$CH_2=CH-\underset{\displaystyle Cl}{\underset{\vert}{C}}=CH_2$
(3)	नायलॉन-6,6 ~[$CO(CH_2)_4CO–NH(CH_2)_6NH]_n$~	$HO_2C–(CH_2)_4–CO_2H$ & $H_2N–(CH_2)_6–NH_2$
(4)		$CH_3-\underset{\displaystyle (3-Hydroxybutanoic\ acid)}{\underset{\vert}{\overset{\displaystyle OH}{\overset{\vert}{CH}}}}-CH_2-COOH$ & $CH_3-CH_2-\underset{\displaystyle (3-Hydroxypertanoic\ acid)}{\underset{\vert}{\overset{\displaystyle OH}{\overset{\vert}{CH}}}}-CH_2-COOH$

17.

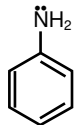
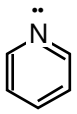
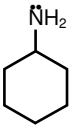
Lab tests			
Compound	**Molisch's test**	**Barfoed test**	**Biuret test**
A	✓	×	×
B	✓	✓	×
C	×	×	✓

Which of the following options is correct ?

	A	B	C
(1)	Lactose	Glucose	Albumin
(2)	Lactose	Glucose	Alanine
(3)	Lactose	Fructose	Alanine
(4)	Glucose	Sucrose	Albumin

Ans. (1)
Sol.

18. The order of basic character is :

(I)  (II)  (III)  (IV) 

(1) I > II > III > IV (2) IV > III > I > II (3) II > I > III > IV (4) IV > I > II > III

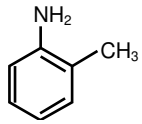
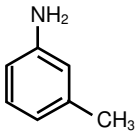
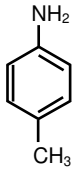
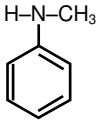
Ans. **(2)**

Sol. Basic strength depends upon availability of lone pairs. Greater the resonance of lone pairs lesser the basic strength.

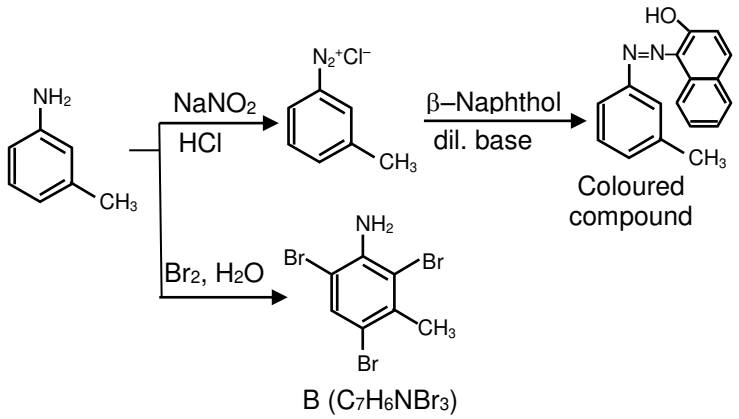
19. Compound A —(1) $NaNO_2$, HCl; β–Naphthol, dil. base → Coloured compound

Compound A —(2) Br_2, H_2O → B ($C_7H_6NBr_3$)

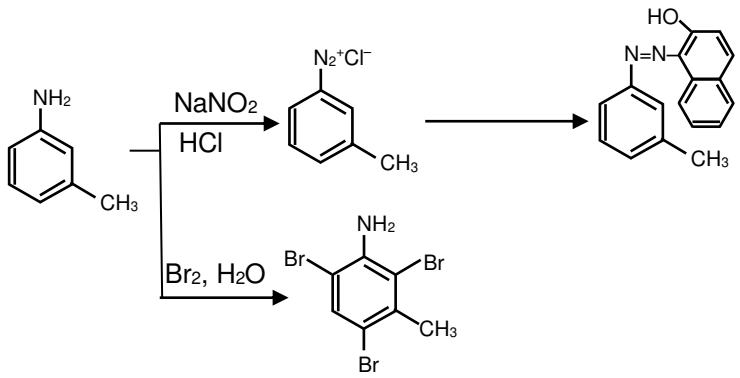
Compound A will be :

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

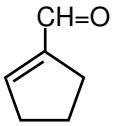
Ans. **(2)**

Sol. 

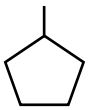
B ($C_7H_6NBr_3$)

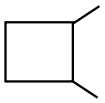


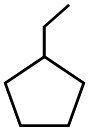
B ($C_7H_6NBr_3$)

20. Compound X $\xrightarrow[(2)\ alc.KOH\ (3)\ O_3\ (4)\ Me_2S\ (5)\ dil.\ NaOH,\ \Delta]{(1)\ Br_2,\ h\nu}$ 

Compound X will be :

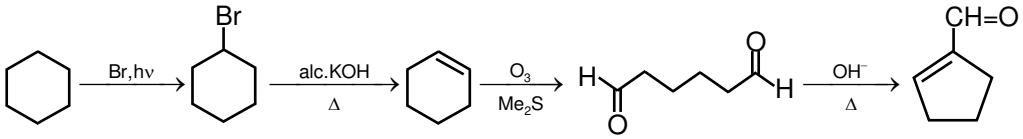
(1) 

(2) 

(3) 

(4) 

Ans. (4)

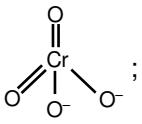
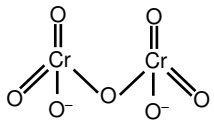
Sol. 

SECTION – 2 : (Maximum Marks : 20)

- This section contains **FIVE (05)** questions. The answer to each question is **NUMERICAL VALUE** with two digit integer and decimal upto one digit.
- If the numerical value has more than two decimal places **truncate/round-off** the value upto **TWO** decimal places.
  - Full Marks : **+4** If ONLY the correct option is chosen.
  - Zero Marks : **0** In all other cases

21. Total number of Cr–O bonds in Chromate ion and dichromate ion is.

Ans. **12.00**

Sol. Chromate ion ⟶  ; Dichromate ion ⟶ 

$\Rightarrow$ Total number of Cr and O bonds is 12.

22. Lacto bacillus has generation time 60 min. at 300 K and 40 min. at 400 K. Determine activation energy in $\frac{kJ}{mol}$. ($R = 8.3\ J\ K^{-1}mol^{-1}$) $\left[\ln\left(\frac{2}{3}\right) = -0.4\right]$ (given wrong in paper)

Ans.

Sol. $\ln \frac{K_2}{K_1} = \frac{Ea}{R}\left[\frac{1}{T_1} - \frac{1}{T_2}\right]$

$\ln\left(\frac{60}{40}\right) = \frac{E_a}{8.3} \times \frac{100}{400\times300}$

$\ln(3/2) \times 8.3 \times 1200 = E_a$

$\Rightarrow \quad E_a = 0.4 \times 8.3 \times 1200$

$\Rightarrow \quad E_a = 3984$ J/mol.

$\Rightarrow \quad E_a = 3.984$ kJ/mol.

23. One litre sea water ($d = 1.03 g/cm^3$) contains 10.3 mg O_2 gas. Determine concentration of O_2 in ppm.

Ans. **10.00**

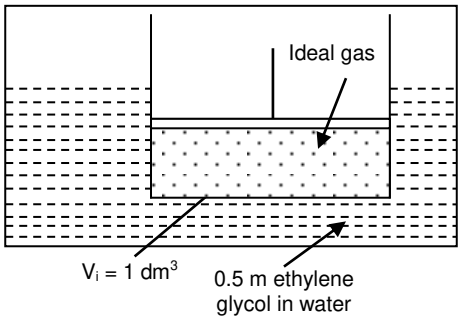
Sol. $ppm = \frac{10.3\times10^{-3}}{1030} \times 10^6 = 10$

24. 0.1 ml of an ideal gas has volume 1 dm^3 in a locked box with friction less piston. The gas is in thermal equilibrium with excess of 0.5 m aqueous ethylene glycol at its freezing point. If piston is released all of a sudden at 1 atm then determine the final volume of gas in dm^3 ($R = 0.08$ atm L mol^{-1} K^{-1} $K_f = 2.0$ K $molal^{-1}$

$molal^{-1}$).

Ans. (2.176 dm^3, 2.18)

Sol.



$K_f = 2.0$
$m = 0.5$ m
$\Delta T_f = K_f m$
$= 0.5 \times 2$
$T_{initial} = 272$ K
$n = 0.1$ mol
$V = 1$ dm^3

$$P_{gas} = \frac{nRT}{V} = \frac{0.1 \times 0.08 \times 272}{1}$$

$= 2.176$ atm
After releasing piston $P_1V_1 = P_2V_2$
पिस्टन छोडने के पश्चात् $P_1V_1 = P_2V_2$

$2.176 \times 1 = 1 \times V_2$
$V_2 = 2.176$ dm^3

25. Compound A $\xrightarrow[H_3O^+]{CH_3MgBr}$ B $\xrightarrow[573\ K]{Cu}$ $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH–CH_3$

Percentage carbon in compound A is:

यौगिक A $\xrightarrow[H_3O^+]{CH_3MgBr}$ B $\xrightarrow[573\ K]{Cu}$ $CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH–CH_3$

Ans. 66.67

Sol. $CH_3–\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}–CH_2–CH_3 \xrightarrow{CH_3MgBr} CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle O^-}{\overset{\displaystyle |}{C}}}–CH_2–CH_3 \xrightarrow{H_3O^+} CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle OH}{\overset{\displaystyle |}{C}}}–CH_2–CH_3 \xrightarrow[573\ K]{Cu} CH_3–\underset{\displaystyle CH_3}{\overset{\displaystyle |}{C}}=CH–CH_3$

Compound A is $CH_3–\overset{\displaystyle O}{\overset{\displaystyle ||}{C}}–CH_2–CH_3$ (C_4H_8O)

Percentage carbon in compound A = $\left(\frac{12 \times 4}{48 + 16 + 8} \times 100\right) = 66.67$