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.

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1. Correct bond energy order of following is-

(1) C–Cl > C–Br > C–I > C–F
(2) C–F < C–Cl < C–Br < C–I
(3) C–F > C–Cl > C–Br > C–I
(4) C–I < C–Br < C–F < C–Cl

Ans. (3)

Sol. Bond energy $\propto \frac{1}{\text{Bond length}}$

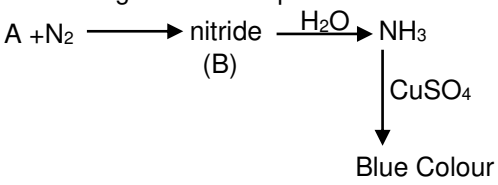
2. Determine Bohr's radius of Li^{2+} ion for n = 2. Given (Bohr's radius of H-atom = a_0)

(1) $\frac{3a_0}{4}$ (2) $\frac{4a_0}{3}$ (3) $\frac{a_0}{3}$ (4) $\frac{16a_0}{9}$

Ans. (2)

Sol. $r = \frac{a_0 n^2}{Z}$

3. Given the following reaction sequence



A & B are respectively

(1) Mg, Mg_3N_2
(2) Na Na_3N
(3) Mg $Mg(NO_3)_2$
(4) Na $NaNO_3$

Ans. (1)

Sol. $3Mg + N_2 \longrightarrow \underset{(B)}{Mg_3N_2} \xrightarrow{H_2O} Mg(OH)_2 + NH_3$

4. Correct order of magnetic moment (spin only) for the following complexes

(a) $[Pd(PPh_3)_2Cl_2]$ (b) $[Ni(CO)_4]$
(c) $[Ni(CN)_4]^{2-}$ (d) $[Ni(H_2O)_6]^{2+}$
(1) a = b = c < d (2) a < b < c < d
(3) a > b > c > d (4) a = b > c > d

Ans. (1)

Sol.

$[Pd(PPh_3)_2Cl_2]$	$Pd^{2+} = 4d^8$	M = 0
$[Ni(CO)_4]$	$Ni = 3d^8 4s^2$(SFL)	M = 0
$[Ni(CN)_4]^{2-}$	$Ni^{2+} = 3d^8$ (SFL)	M = 0
$[Ni(H_2O)_6]^{2+}$	$Ni^{2+} = 3d^8$ (WFL)	$t_{2g}^{2,2,2}, e_g^{1,1}$ So, unpaired electron is 2

5. Determine total number of neutrons in three isotopes of hydrogen.

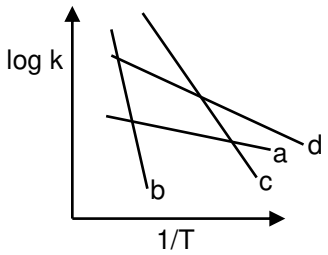
(1) 1 (2) 2 (3) 3 (4) 4

Ans. (3)

Sol.

	^1_1H $^2_1H(D)$ $^3_1H(T)$
Number of neutrons	0 + 1 + 2 = 3

6.



Compare E_a (activation energy) for a, b, c and d.

(1) $E_b > E_c > E_d > E_a$ (2) $E_a > E_d > E_c > E_b$
(3) $E_c > E_b > E_a > E_d$ (4) $E_d > E_a > E_b > E_c$

Ans. (1)

Sol. $\log k = \log A - \dfrac{E_a}{2.303\,RT}$

slope $= -\dfrac{E_a}{2.303\,R} \Rightarrow E_b > E_c > E_d > E_a$

7. Which of the following exhibit both Frenkel & Schottky defect?

(1) AgBr (2) KCl (3) CsCl (4) ZnS

Ans. (1)

Sol. Only AgBr can exhibit both Schottky and Frenkel defect.

8. Given:

$P_4 + NaOH + H_2O \longrightarrow PH_3 + A$

$A \xrightarrow{HCl} B$

Basicity of B is:

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

Ans. (1)

Sol. $P_4 + NaOH + H_2O \longrightarrow PH_3 + NaH_2PO_2$

$NaH_2PO_2 \xrightarrow{HCl} H_3PO_2$

Basicity = 1

9. Which reaction does not occurs in the blast furnace in the metallurgy of Fe

(a) $CaO + SiO_2 \longrightarrow CaSiO_3$

(b) $Fe_2O_3 + CO \longrightarrow Fe_3O_4 + CO_2$

(c) $FeO + SiO_2 \longrightarrow FeSiO_3$

(d) $FeO \xrightarrow{\Delta} Fe + \frac{1}{2}O_2$

(1) a & b (2) a,b & c (3) c & d (4) a, b, c, d

Ans. (3)

Sol. Theory based

10. Correct order of radius of elements is:

C, O, F, Cl, Br

(1) Br > Cl > C > O > F (2) Br < Cl < C < O < F

(3) Cl < C < O < F < Br (4) C > F > O > Br > Cl

Ans. (1)

Sol.

C N O F → Size decreases

Cl

Br

↓ Size increases

11. Amongs the following which will show geometrical isomerism.

(a) $[Ni(NH_3)_5Cl]^+$ (b) $[Ni(NH_3)_4ClBr]$ (c) $[Ni(NH_3)_3Cl]^+$ (d) $[Ni(NH_3)_2(NO_2)_2]$

(1) b, d (2) a, b (3) a, b & c (4) a, b, c & d

Ans. (1)

Sol. Ma_4bc can show 2 G.I.

Ma_2b_2 can show 2 G.I.

(Square planar)

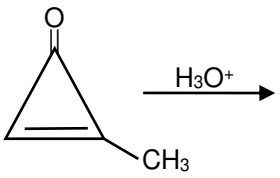
12. **Assertion:** pH of water increases on increasing temperature.
Reason: $H_2O \rightarrow H^+ + OH^-$ is an exothermic process.
(1) Both assertion and reason are correct and reason is correct explanation of assertion.
(2) Both assertion and reason are correct and reason is not correct explanation of assertion.
(3) Assertion is true & reason is false.
(4) Both assertion and reason are incorrect.

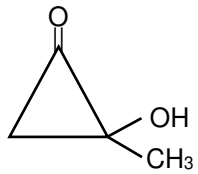
Ans. (4)
Sol. Theory Based

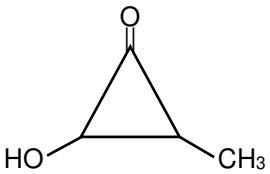
13. **Assertion:** It has been found that for hydrogenation reaction the catalytic activity increases from group-5 to group-11 metals with maximum activity being shown by groups 7-9 elements of the periodic table.
Reason: For 7-9 group elements adsorption rate is maximum.
(1) Both assertion and reason are correct and reason is correct explanation of assertion.
(2) Both assertion and reason are correct and reason is not correct explanation of assertion.
(3) Assertion is true & reason is false.
(4) Both are incorrect

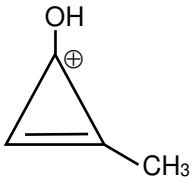
Ans. (1)
Sol. Theory Based

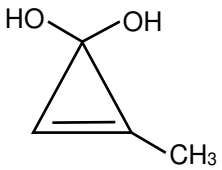
14. The major product of the following reactions is



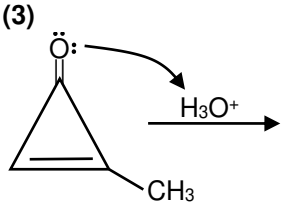
(1) 

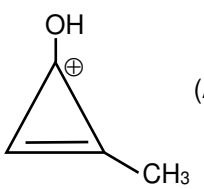
(2) 

(3) 

(4) 

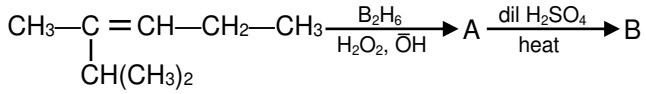
Ans. **(3)**

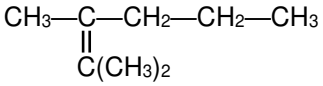
Sol. 

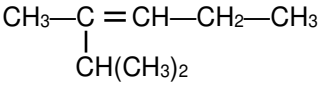


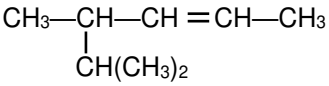
(Aromatic)

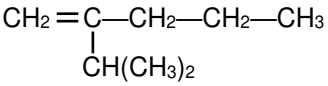
15. Find the final major product of the following reactions-



(1) 

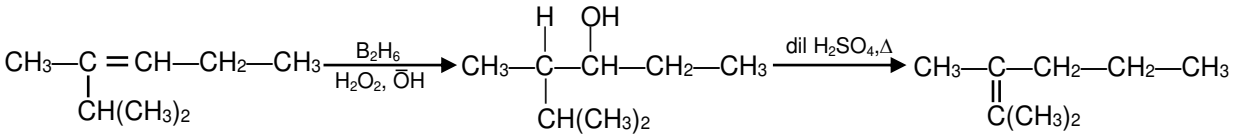
(2) 

(3) 

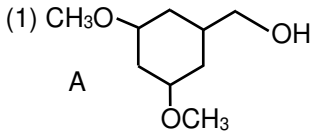
(4) 

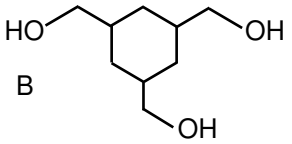
Ans. **(1)**

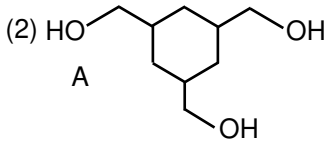
Sol.

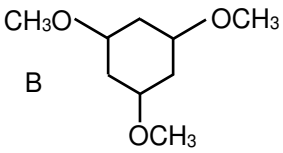


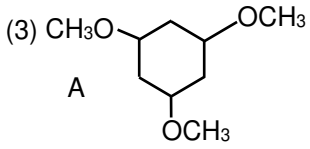
16. There are two compounds A and B of molecular formula $C_9H_{18}O_3$. A has higher boiling point than B. What are the possible structures of A and B?

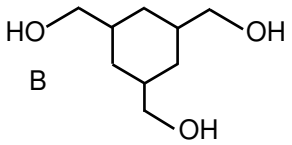
(1) 

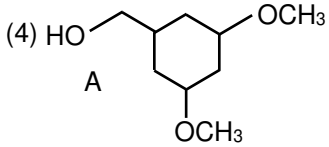


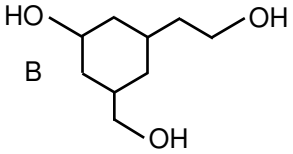
(2) 



(3) 



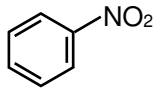
(4) 

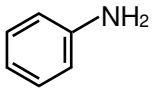


Ans. **(2)**

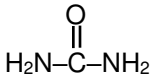
Sol. In (A), extensive inter-molecular H-bonding is possible while in (B) there is no Inter-molecular H-bonding.

17. Kjeldahl method cannot be used for :

(1) 

(2) 

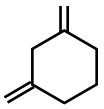
(3) $CH_3–CH_2–CH_2–C\equiv N$

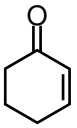
(4) 

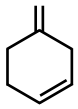
Ans. **(1)**

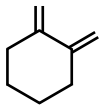
Sol. Kjeldahl method is not applicable to nitro or diazo groups present in the ring, as nitrogen atom can't be converted to ammonium sulfate under the reaction conditions.

18. A compound X that adds 2 hydrogen molecules on hydrogenation. The compound X also gives 3-oxohexanedioic acid on oxidative ozonolysis. The compound 'X' is:

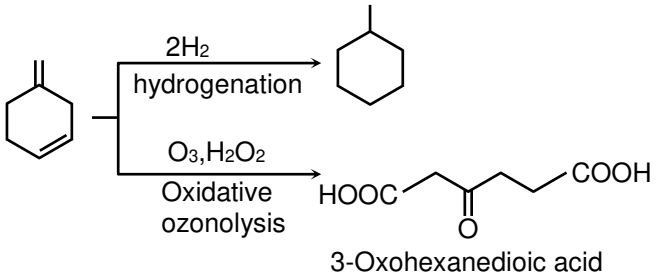
(1) 

(2) 

(3) 

(4) 

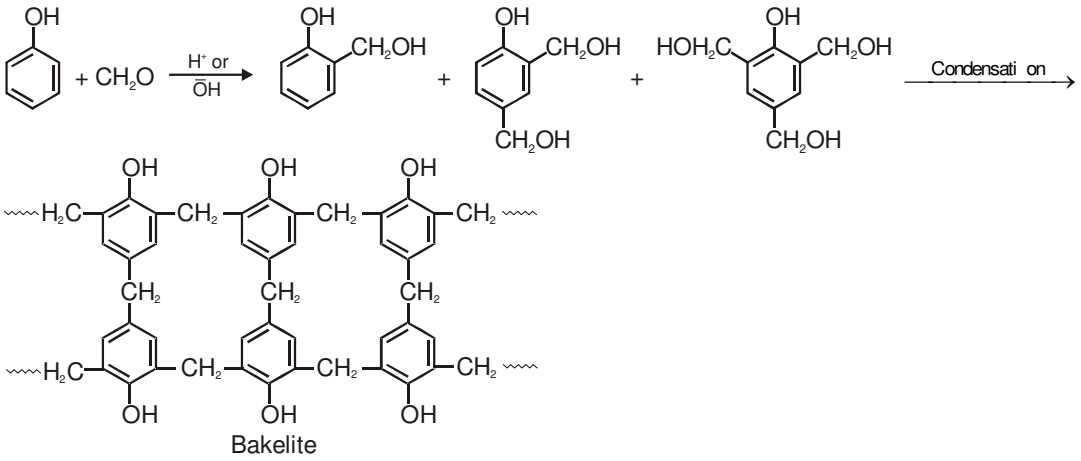
Ans. **(3)**

Sol. 

3-Oxohexanedioic acid

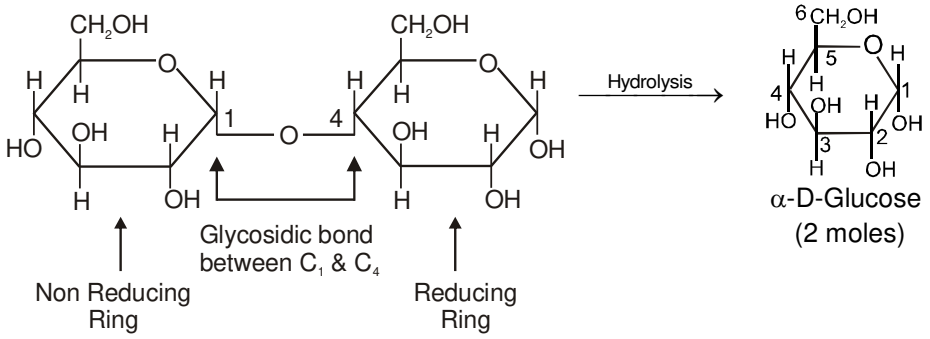
19. Formation of Bakelite follows :
(1) Electrophilic substitution followed by condensation.
(2) Nucleophilic addition followed by dehydration.
(3) Electrophilic addition followed by dehydration.
(4) Hydration followed by condensation.

Ans. **(1)**
Sol. Formation of Bakelite follows electrophilic substitution reaction of phenol with formaldehyde followed by condensation.



20. Products formed by hydrolysis of maltose are
(1) α-D-Glucose, α-D-Glucose (2) α-D-Glucose, β-D-Glucose
(3) α-D-Galactose, β-D-Glucose (4) β-D-Galactose, α-D-Glucose

Ans. **(1)**
Sol. Maltose on hydrolysis gives 2 moles of α-D-glucose.



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. Temperature of 4 moles of gas increases from 300 K to 500 K find 'C_v' if $\Delta U = 5000$ J.

Ans. 06.25

Sol. $\Delta U = nC_v\Delta T$

$5000 = 4 \times C_v (500 - 300)$

$C_v = 6.25\ JK^{-1}\ mol^{-1}$

22. Given : $E^0_{Sn^{2+}/Sn} = -0.14$ V; $E^0_{Pb^{2+}/Pb} = -0.13$ V

Determine $\frac{[Sn^{2+}]}{[Pb^{2+}]}$ at equilibrium

For cell reaction $Sn\,|\,Sn^{2+}\,||\,Pb^{2+}\,|\,Pb$

take $\frac{2.303RT}{F} = 0.06$ V

Ans. 02.15

Sol. At Equilibrium state. $E_{cell} = 0$; $E^{\circ}_{cell} = 0.01$ V

$Sn + Pb^{2+} \longrightarrow Sn^{2+} + Pb$

$$0 = 0.01 - \frac{0.06}{2}\log\left\{\frac{[Sn^{2+}]}{[Pb^{2+}]}\right\}$$

$$0.01 = \frac{0.06}{2}\log\left\{\frac{[Sn^{2+}]}{[Pb^{2+}]}\right\}$$

$$\frac{1}{3} = \log\left\{\frac{[Sn^{2+}]}{[Pb^{2+}]}\right\} \Rightarrow \frac{[Sb^{2+}]}{[Pb^{2+}]} = 10^{1/3} = 2.1544$$

23. Given following reaction,
$NaClO_3 + Fe \rightarrow O_2 + FeO + NaCl$
In the above reaction 492 L of O_2 is obtained at 1 atm & 300 K temperature.
Determine mass of $NaClO_3$ required (in kg).
($R = 0.082$ L atm mol^{-1} K^{-1})

($R = 0.082$ L atm mol^{-1} K^{-1})

Ans. **02.13**

Sol. mol of $NaClO_3$ = mol of O_2

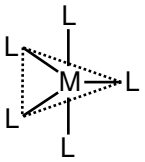
mol of $O_2 = \frac{PV}{RT} = \frac{1 \times 492}{0.082 \times 300} = 20$ mol

mass of $NaClO_3 = 20 \times 106.5 = 2130$ g

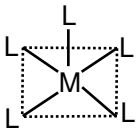
24. Complex $[ML_5]$ can exhibit trigonal bipyramidal and square pyramidal geometry. Determine total number of 180º, 90º & 120º L-M-L bond angles.

Ans. 20.00

Sol.



$\angle 120º = 3$; $\angle 90º = 6$; $\angle 180º = 1 \Rightarrow$ Total = 10



$\angle 90º = 8$; $\angle 180º = 2 \Rightarrow$ Total = 10

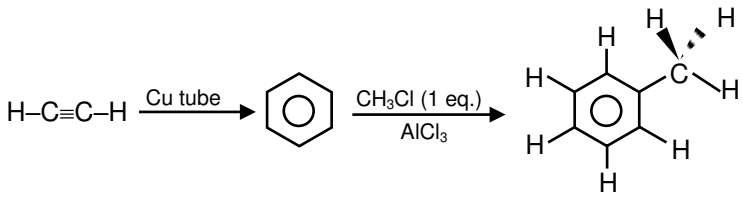
25. How many atoms lie in the same plane in the major product (C) ?

$$A \xrightarrow{\text{Cu tube}} B \xrightarrow[AlCl_3]{CH_3Cl\ (1\ eq.)} C$$

(Where A is the alkyne of lowest molecular mass)

Ans. 13.00

Sol.



Number of atoms in one plane = 13