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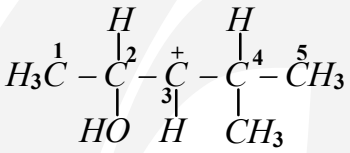
# IIT-JEE 2009 Chemistry Paper- II

## PART I - Chemistry
## SECTION I - Straight Objective Type

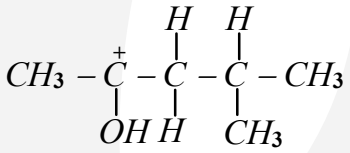
1. The spin only magnetic moment value (in Bohr magneton units) of $Cr(CO)_6$ is
(A) 0 (B) 2.84 (C) 4.90 (D) 5.92

1. **(A)** $Cr = Ar 3d^5\ 3d^1$
$CO$ being strong legand forms inner orbital complex. $\mu$ = zero

2. In the following carbocation, $H/CH_3$ that is most likely to migrate to the positively charged carbon is



(A) $CH_3$ at $C$-4 (B) $H$ at C-4 (C) $CH_3$ at $C$-2 (D) $H$ at $C$-2

2. **(D)**  is very stable

3. For a first order reaction $A \rightarrow P$, the temperature (T) dependent rate constant ($k$) was found to follow the equation $\log k = -(2000)\frac{1}{T} + 6.0$. The pre-exponential factor $A$ and the activation energy $E_a$, respectively, are
(A) $1.0 \times 10^6\ s^{-1}$ and 9.2 kJ mol$^{-1}$ (B) $6.0\ s^{-1}$ and 16.6 kJ mol$^{-1}$
(C) $1.0 \times 10^6\ s^{-1}$ and 16.6 kJ mol$^{-1}$ (D) $1.0 \times 10^6\ s^{-1}$ and 38.3 kJ mol$^{-1}$

3. **(D)** $K = Ae^{-(Ea / RT)}$
$ln\ k = ln\ A - (Ea / RT)$
$ln\ k = ln\ A - (Ea / 2.303\ RT)$
$\therefore A = 10^6$ and $(Ea / (2.303 \times R) = 2000$
$Ea = 2000 \times (25 / 3) \times 10^{-3} \times 2.303 = (50 \times 2.3) / 3 = 5 \times 7.66 = 38.30$

4. The correct stability order of the following resonance structures is

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

(A) (I) > (II) > (IV) > (III) (B) (I) > (III) > (II) > (IV)
(C) (II) > (I) > (III) > (IV) (D) (III) > (I) > (IV) > (II)

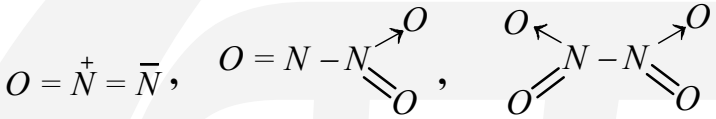
4. **(B)** Smaller the separation of opposite charge greater is the stability 1st structure is more stable because of the fact that –ve charge existing on the electronegative atom.

## SECTION II - Multiple Type

5. In the reaction $2X + B_2H_6 \rightarrow [BH_2(X)_2]^+ [BH_4]^-$ the amine(s) $X$ is(are)
(A) $NH_3$ (B) $CH_3NH_2$ (C) $(CH_3)_2NH$ (D) $(CH_3)_3N$

5. **(ABCD)**

6. The nitrogen oxide(s) that contain(s) $N - N$ bond(s) is(are)
(A) $N_2O$ (B) $N_2O_3$ (C) $N_2O_4$ (D) $N_2O_5$

6. **(ABC)** 

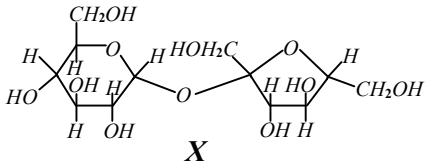
7. For the reduction of $NO_3^-$ ion in an aqueous solution, $E^0$ is +0.96 V. Values of $E^0$ for some metal ions are given below

$V^{2+}(aq) + 2e^- \rightarrow V$ $E^0 = -1.19$ V
$Fe^{3+}(aq) + 3e^- \rightarrow Fe$ $E^0 = -0.04$ V
$Au^{3+}(aq) + 3e^- \rightarrow Au$ $E^0 = +1.40$ V
$Hg^{2+}(aq) + 2e^- \rightarrow Hg$ $E^0 = +0.86$ V

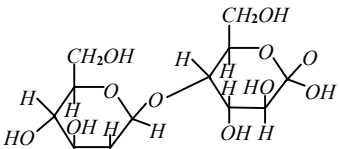
The pair(s) of metals that is(are) oxidized by $NO_3^-$ in aqueous solution is(are)
(A) $V$ and $Hg$ (B) $Hg$ and $Fe$ (C) $Fe$ and $Au$ (D) $Fe$ and $V$

7. **(ABD)** $M \mid M^{+x} \parallel NO_3^- \rightarrow$ reduced state eng should be +ve
$+1.19$ $V \mid V^{+2} \parallel 0.96$
$+0.04$ $F \mid Fe^{+3} \parallel 0.96$
$-0.86$ $Hg \mid Hg^{+2} \parallel 0.96$

8. The correct statement(s) about the following sugars ***X*** and ***Y*** is(are)



***X***



***Y***

(A) ***X*** is a reducing sugar and ***Y*** is a non-reducing sugar
(B) ***X*** is a non-reducing sugar and ***Y*** is a reducing sugar
(C) The glucosidic linkages in ***X*** and ***Y*** are α and β**,** respectively
(D) The glucosidic linkages in ***X*** and ***Y*** are β and α, respectively

8. **(BC)**

9. Among the following, the state function(s) is(are)
(A) Internal energy (B) Irreversible expansion work
(B) Reversible expansion work (D) Molar enthalpy

9. **(AD)**

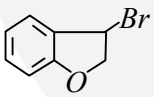
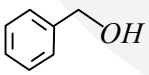
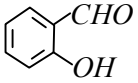
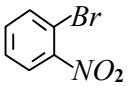
## SECTION III- Matrix Match Type

10. Match each of the reactions given in **Column I** with the corresponding products(s) given in **Column II**.

| **Column I** | **Column II** |
|---|---|
| (A) $Cu$ + dil $HNO_3$ | (p) $NO$ |
| (B) $Cu$ + conc $HNO_3$ | (q) $NO_2$ |
| (C) $Zn$ + dil $HNO_3$ | (r) $N_2O$ |
| (D) $Zn$ + conc $HNO_3$ | (s) $Cu(NO_3)_2$ |
| | (t) $Zn(NO_3)_2$ |

10. **A → ps ; B → qs ; C → rt ; D → pqt ;**

11. Match each of the compouns given in **Column I** with the reaction(s), that they can undergo, given in **Column II.**

| **Column I** | **Column II** |
|---|---|
| (A)  | (p) Nucleophilic substitution |
| (B)  | (q) Elimination |
| (C)  | (r) Nucleophilic addition |
| (D)  | (s) Esterification with acetic anhydride |
| | (t) Dehydrogenation |

11. **A → pqs ; B → pst ; C → rs ; D → p ;**

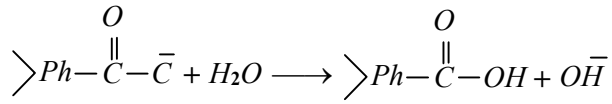
## SECTION IV - Integer Answer Type

12. The number of water molecule(s) directly bonded to the metal centre in $CuSO_4.5H_2O$ is

12. **4** $[Cu(H_2)_4]SO_4.H_2O$

13. The dissociation constant of a substituted benzoic acid at 25°C is $1.0 \times 10^{-4}$. The pH of a 0.01 M solution of its sodium salt is

13. **8**



$x^2 / (0.01 - x) = 10^{-14} / 10^{-4} = 10^{-10}$

$x^2 = 10^{-12} \quad x = 10^{-6}$

$POH = 6$

$\therefore PH = 8$

14. The oxidation number of $Mn$ in the product of alkaline oxidative fusion of $MnO_2$ is

14. **6** $MnO_4 + OH^- \rightarrow MnO_4^{-2}$

15. At 400 K, the root mean square (rms) speed of a gas **X** (molecular weight = 40) is equal to the most probable speed of gas **Y** ast 60 K. The molecular weight of the gas **Y** is

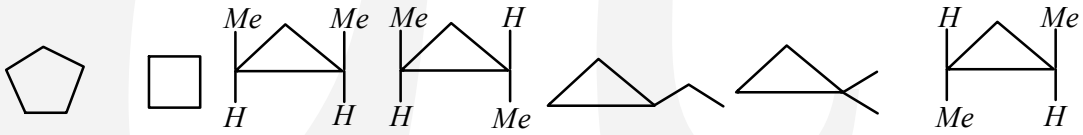
15. **4** $\sqrt{3RT_1 / M_1} = \sqrt{2RT_2 / M_2}$

$= 3T_1 / M_1 = 2T_2 / M_2$

$M_2 = \{(2 \times 60 \times 40) / (3 \times 400)\} = 4$

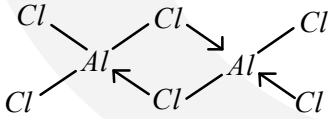
16. The total number of cyclic structural as well as stereo isomers possible for a compound with the molecular formula $C_5H_{10}$ is

16. **7**




17. The coordination number of $Al$ in the crystalline state of $AlCl_3$ is

17. **4**



18. In a constant volume calorimeter, 3.5 g of a gas with molecular weight 28 was burnt in excess oxygen at 298.0 K. The temperature of the calorimeter was found to increase from 298.0 K to 298.45 K due to the combustion process. Given that the heat capacity of the calorimeter is 2.5 kJ $K^{-1}$, the numerical value for the enthalpy of combustion of the gas in kJ $mol^{-1}$ is

18. **4** $q_v = 0.45 \times 2.5 \times (2.8 / 3.5)$

$= 0.45 \times 25 \times (4 / 5) = 9 = C_v$

assuming the gas is $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

$\Delta H = 9 + \{-2 \times (25 / 3) \times 10^{-3} \times 298\}$

$= 9 + (-5)$

$= 4$

19. The total number of $\alpha$ and $\beta$ particles emitted in the nuclear reaction $^{238}U_{92} \rightarrow {}^{214}Pb_{82}$ is

19. **8** $^{238}U_{92} \rightarrow {}^{218}Pb_{82} + x\ {}_2\alpha^4 + y_{-1}\ \beta^0$

$\therefore\ \alpha = 6\ \ \beta = 2 \qquad = 8$