# JEE Mains 2020

# 7th Jan Shift 1 Paper – Chemistry

1. The relative strength of interionic/intermolecular forces is decreasing order is:

   A) ion-dipole > dipole-dipole > ion-ion
   B) dipole-dipole > ion-dipole > ion-ion
   C) ion-ion > ion-dipole > dipole-dipole
   D) ion-dipole > ion-ion > dipole-dipole

   Ans. C

   Sol. The correct order of intermolecular forces is:
   ion-ion>ion-dipole>dipole-dipole

2. Oxidation number of potassium in $K_2O, K_2O_2$ and $KO_2$, respectively:

   Sol. For $K_2O$: $2x - 2 = 0$
   $x = +1$
   For $K_2O_2$: $2x - 2 = 0$ (In peroxide, the oxidation state of oxygen is $-1$)
   $x = +1$
   For $KO_2$: $x - 2\left(\frac{1}{2}\right) = 0$ (In supeoxide, the oxidation state of oxygen is $-\frac{1}{2}$)
   $x = +1$

3. At $35°C$, the vapour pressure of $CS_2$ is 512 $m\ Hg$ and that of acetone is 344 $m\ Hg$. A solution of $CS_2$ in acetone has a total vapour pressure of 600 $mm\ Hg$. The false statement amongst is:

   A) $CS_2$ and acetone are less attracted to each other than the themselves
   B) Heat must be absorbed in order to produce the solution at $35°C$
   C) Raoult's law is not obeyed by this system
   D) A mixture of 100 $mL$ $CS_2$ and 100 $mL$ acetone has a volume of $< 200\ mL$

   Ans. D

   Sol. We have:
   $P_{\text{observed}} = 600\ Hg$
   We know:
   $P_{\text{calc}} = P_A^0 x_A = P_b^0 x_b$
   $= 512x + 344 - 344x = 168x + 344$
   $= 512$ (if $x = 1$ for maximum value)
   Thus, $P_{\text{calc}} < P_{\text{observed}}$

4. The atomic radius of $Ag$ is closest to:

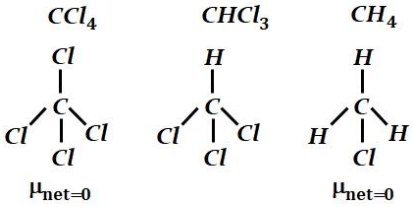
   A) $Ni$
   B) $Cu$
   C) $Au$
   D) $Hd$

   Ans. C

   Sol. The atomic radius of $Ag$ is closest to $Au$

5. The dipole moments of $CCl_4, CHCl_3$ and $CH_4$ are in the order:

   Sol.:



6. In comparison to the zeolite process for the removal of permanent hardness, the synthetic resins method is:

A) Less efficient as it exchanges only anions
B) More efficient as it can exchange only cations
C) Less efficient as the resins cannot be generated
D) More efficient as it can exchange both cations as well as anions

Ans. D

Sol. The synthetic resins method is more efficient as it can exchange both cations and anions.

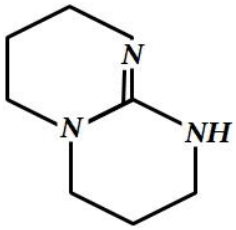
7. Among the following statements that which was not proposed by Dalton was:

I. Matter consist of invisible atoms
II. When gases combine or reproduced in a chemical reaction they do so in a simple ratio by volume provided all gases are the same T & P
III. Chemical reaction involves recognization of atoms. These are neither created now destroyed in a chemical reaction

Sol.: Option II is correct as it was proposed by Gay Lussac's law of gaseous volume.

8. The increasing orders of $pK_b$ for the following compounds will be:

I. $NH_2 - CH = NH$

II. 


III. $CH_3NHCH_3$

Sol.: $pK_b \propto \frac{1}{\text{basicity}} \propto \text{acidity}$

Thus, the increasing order of basicity is:

II > I > $III$

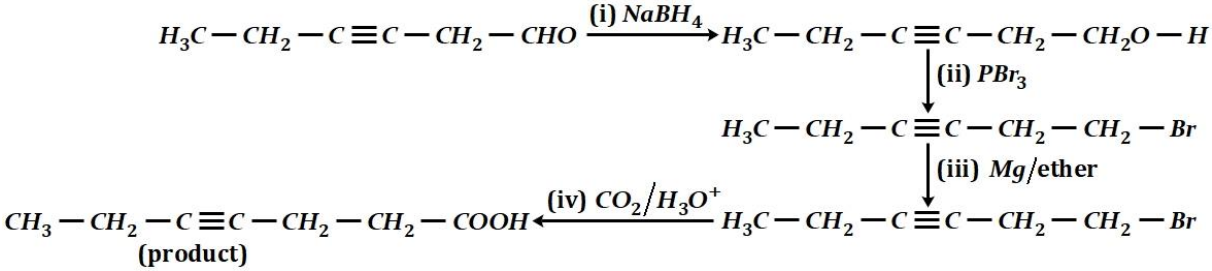
$pK_b$ order is given as:

III > I > II

The conjugate acid of guanidine is most resonance stabilized followed by imidine.

9. What is the product of following reaction? $Hex$-3-$ynal$ $\xrightarrow[\text{(ii)}PBr_3\ \text{(iii)}Mg/\text{ether}\ \text{(iv)}CO_2/H_3O^+]{\text{(i)}NaBH_4}$

Sol.: The reactions occur as follos:




10. The no. of orbitals associated with quantum numbers $n = 5, m_s = +\frac{1}{2}$ is:

Sol.: We have:

$n - 5, m_s = +\frac{1}{2}$

Thus, values of $l$ are from 0 to $(n-1)$

$l = 0$ to 4

Thus, values of $l$ are $5s, 5p, 5d, 5f$ and $5g$

Now, the total number of orbitals $= n^2 = 5^2 = 25$

11. The purest form of commercial iron is:

Sol.: The purest form of iron is wrought iron.

12. The theory that can completely/ properly explain the nature of bonding in $[Ni(CO)_4]$ is

A) Werner's theory
B) Crystal field theory
C) Molecular orbital theory
D) Valence bond theory

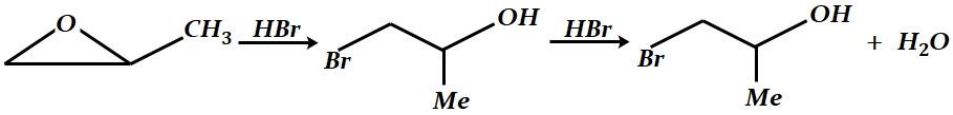
Ans. C

Sol. The metal-carbonyl $\pi$ is formed by the donation of a pair of electrons from a filled $d$ orbital of metal into the vacant antibonding $\pi^*$ orbital of carbon monoxide.

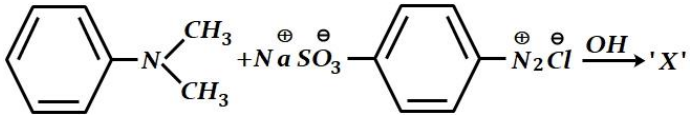
13. The IUPAC name of the complex $[pt(NH_3)_2Cl(NH_2CH_3)]Cl$ is:

Sol.: The IUPAC name of the given compound is:
Diamminechloromethylammineplatium (II)chloride.

14. 1-methyl ethylene oxide when treated with an excess of $HBr$ produces:



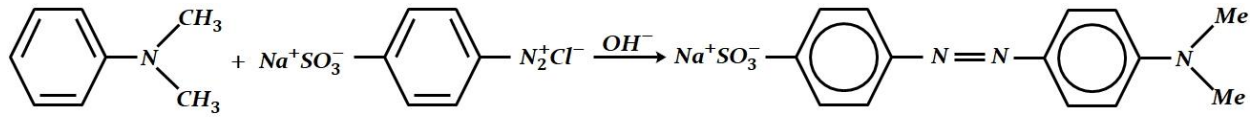

15. Consider the following reaction




The product '$x$' is used:

A) In proteins extimation as an alternative to ninhydrin
B) As food grade covalent
C) In laboratory test for phenols
D) In acid base titration as an indicator

Sol.




**N,N-dimethyl aniline** **methyl orange**

16. Match the following:

| | |
|---|---|
| I. Riboflavin | A. Beriberi |
| II. Thiamine | B. Scurvy |
| III. Pyridoxine | C. Cheilosis |
| IV. Ascorbic acid | D. Convulsions |

| | |
|---|---|
| I. Riboflavin | A. Cheilosis |
| II. Thiamine | B. Beriberi |
| III. Pyridoxine | C. Convulsions |
| IV. Ascorbic acid | D. Scurvy |

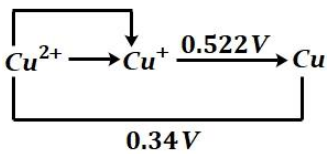
17. Given that the standard potentials ($E°$) of $Cu^{2+}|Cu$ are 0.34 $V$ and 0.522 $V$ respectively, the $E°$ of $Cu^{2+}|Cu^{+}$ is

Sol. We have: $\Delta G = -nFE^0$

$-2 \times F \times 0.34\,V = -1 \times F \times E^0 - 1 \times F \times 0.522\,V$

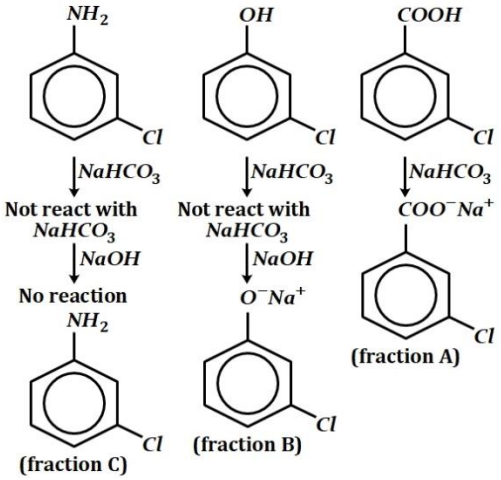
$-E^0 = -2 \times 0.34\,V + 0.522\,V$

Thus, $E^0 = 0.158\,V$



18. A solution of $m$-chloroaniline, $m$-chlorophenol and $m$-chlorobenzoic acid in ethyl acetate was extracted initially with a saturated solution of $NaHCO_3$ to give fraction $A$. The leftover organic phase was extracted with dilute $NaOH$ solution to give fraction $B$. The final organic layer was labelled as fraction $C$. Fraction $A$, $B$ and $C$ contain respectively:

Sol. The reaction occur as follows:




19. The electron gain enthalpy (in $kJ/mol$) of fluorine, chlorine, bromine and iodine respectively are:

Sol. The electron gain enthalpy values are given below:

Fluorine $= -333\ kJ/mol$

Chlorine $= -348\ kJ/mol$

Bromine $= -324\ kJ/mol$

Iodine $-295\ kJ/mol$

Thus the correct order is:

20. Consider the following reactions:

I. $(CH_3)_3CCH(OH)CH_3 \xrightarrow{conc.H_2SO_4}$

II. $(CH_3)_2CHCH\ (Br)CH_3 \xrightarrow{alc.KOH}$

III. $(CH_3)_2CHCH(Br)CH_3 \xrightarrow{(CH_3)_3O^{\ominus}K^{\oplus}}$

IV. $(CH_3)_2\underset{\underset{OH}{|}}{C} - CH_2 - CHO \xrightarrow{\Delta}$

Which of these reaction(s) will not produce Saytzeff product?

Ans. C

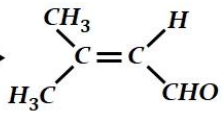
Sol.: The reactions occur as follows:

I. $(CH_3)_3C-\underset{\underset{H}{|}}{\overset{\overset{OH}{|}}{C}}-CH_3 \xrightarrow[\text{dehydration } -H_2O]{\text{conc } H_2SO_4} (CH_3)_3C-\underset{\underset{H}{|}}{\overset{+}{C}}-CH_3$ (Methyl shift) $\rightarrow (H_3C)_2\overset{+}{C}-\underset{\underset{H}{|}}{C}(CH_3)-CH_3 \xrightarrow{-H^+} H_3C-\overset{CH_3}{\overset{|}{C}}=\overset{CH_3}{\overset{|}{C}}-CH_3$ [follows Saytzeff rule]

II. $(CH_3)_2CH-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{alc.\ KOH} H_3C-\overset{CH_3}{\overset{|}{C}}=C-CH_3$ [follows Saytzeff rule]

III. $(CH_3)_2CH-\underset{\underset{Br}{|}}{CH}-CH_3 \xrightarrow{(CH_3)_3O^-K^+} (CH_3)_2CH-CH=CH_2$ [follows Hoffman's rule] because of bulky reagent

$(CH_3)_3O^-K^+$ - Bulky reagent

IV. $(CH_3)_2-\underset{\underset{OH}{|}}{C}-CH_2-CHO \xrightarrow{\Delta}$ 

21. Two solutions $A$ and $B$, each of 100 $L$ was made by dissolving 4 $g$ of $NaOH$ and 9.89 of $H_2SO_4$ in water respectively. The $pH$ of the resultant solution obtained from mixing 40 $L$ of solution $A$ and 10 $L$ of solution $B$ is:

Sol. For given solutions, we have:

Moles of $NAOH\ \frac{4}{40} = 0.1\ moles$

Moles of $H_2SO_4 = \frac{9.8}{98} = 0.1\ moles$

Molarity of $NaOH = \frac{0.1}{100} L$

And molarity of $H_2SO_4 = \frac{0.1}{100}$

Now, 40 $L$ of $NaOH$ solution and 10 $L$ of $H_2SO_4$ solution are added, thus we get,

Total volume $= 50\ L$

Milliequivalents of $NaOH = 40 \times \left(\frac{0.1}{100}\right) \times 1 = 0.04$

Milliequivalents of $H_2SO_4 = 10 \times \left(\frac{0.2}{100}\right) \times 2 = 0.02$

Thus, Meq of $NaOH$ left $= 0.04 - 0.02 = 0.02$

$[OH^-] = 4 \times 10^{-4}$

$pOH = -\log[4 \times 10^{-4}]$

$pOH = -\log 4 - \log 10^{-4}$

$pOH = -0.06 + 4 = 3.4$

Further, we know:

$pH = 14 - 3.4$

$pH = 10.5$

22. During the nuclear explosion, one of the products of $^{90}Sr$ was absorbed in the bones of a newly born baby in place of $Ca$, how much time in years is required to reduced it by 90% if it is not lost metabolically

Sol. We know

$$t = \frac{2.303}{k} \log \frac{[R_0]}{[r]}$$

$$t = \frac{2.303}{k} \log \frac{[R_0]}{[0.1\ R_0]}$$

$$t = \frac{2.303}{k} \log 10$$

$k$ is given as:

$$k = \frac{0.693}{t_{\frac{1}{2}}}$$

$$k = \frac{0.693}{6.93} = 0.1$$

Thus, $t$ is given as:

$$t = \frac{2.303}{0.1}$$

Thus, $t = 23.03\ years$

23. Chlorine reacts with hot and concentrated $NaOH$ and produces compounds $(X)$ and $(Y)$. Compound $(X)$ gives white precipitate with silver nitrate solution. The average bond order between $Cl$ and $O$ atoms in $(Y)$ is

Sol. We have:

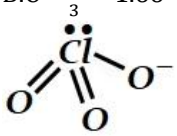
$Cl_2 + 6NaOH$ (hot and conc. )$\rightarrow \underset{Y}{NaClO_3} + 5\underset{X}{NaCl} + 3H_2O$

$NaCl + AgNO_3 \rightarrow \underset{\text{white (ppt)}}{AgCl(s)} + NaNO_3(aq)$

The structure of $NaClO_3^-$ is given below:

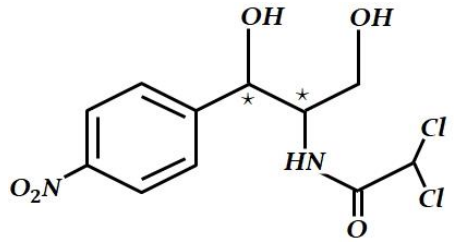
The average bond order is given as:

B.O$= \frac{5}{3} = 1.66$



24. The number of chiral carbons in chloramphenicol is

Sol. The structure of chloramphenicol is given below:




Thus, the number of chiral carbons in chloramphenicol is 2.

25. For the reaction $A(l) \rightarrow 2B(g)$
$\Delta U = 2.1\ Kcal, \Delta S = 20\ cal\ K^{-1}$ at 300 $K$. Hence $\Delta G$ in $Kcal$ is:

Sol. We know:

$\Delta G = \Delta H - T\Delta S$

$\Delta H = \Delta U + 2RT$

Thus, we have:

$\Delta G = \Delta U + 2RT - T\Delta S$

On putting the given values we get:

$\Delta G = 2.1 + 2 \times 2 \times 300 \times 10^{-3} - 300 \times 20 \times 10^{-3}$

$\Delta G = 2.1 + 4 \times 300 \times 10^{-3} - 300 \times 20 \times 10^{-3}$

$\Delta G = 1200 \times 10^{-3} - 6000 \times 10^{-3}$

$\Delta G = 2.1 + 1.2 - 6$

$\Delta G = -22.7\ Kcal$