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JEE (MAIN) 2024

MEMORY BASED QUESTIONS & SOLUTIONS

SHIFT-2

DATE & DAY: 30th January 2024 & Tuesday

PAPER-1

Duration: 3 Hrs.
Time: 03:00 PM - 06:00 PM

SUBJECT: CHEMISTRY

REGISTERED & CORPORATE OFFICE (CIN: U80302RJ2007PLC024029):
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PART : CHEMISTRY

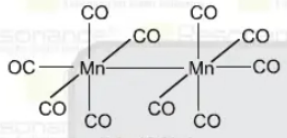
1. Geometry of Decacarbonyl dimanganese (0) is :

(1) Octahedral (2) Square planar

(3) Trigonal bipyramidal (4) Square pyramidal

Ans. **(1)**

Sol.



$[Mn_2(CO)_{10}]$

2. Which of the following species has square pyramidal geometry ?

(1) PCl_5 (2) BrF_5 (3) PF_5 (4) $[Ni(CN)_4]^{2-}$

Ans. **(2)**

Sol. (1) PCl_5 sp^3d (trigonal bipyramidal (5 BP + 0 LP))

(2) BrF_5 sp^3d^2 (square pyramidal (5 BP + 1 LP))

(3) PF_5 sp^3d (trigonal bipyramidal (5 BP + 0 LP))

(4) $[Ni(CN)_4]^{2-}$ dsp^2 (square planar)

3. **Statement-1 :** H_2Te is more acidic than H_2S.

Statement-2 : H_2Te has less bond strength than H_2S.

(1) Statement-1 and Statement-2 are correct.

(2) Statement-1 and Statement-2 are incorrect.

(3) Statement-1 is correct and Statement-2 is incorrect.

(4) Statement-1 is incorrect and Statement-2 is correct.

Ans. **(1)**

Sol. In H_2Te bond length increases and bond energy decreases therefore acid strength increases.

4. Among the following correct statement is :

(1) Stability of hydrides order: $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

(2) Reducing strength order: $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

(3) NH_3 is strongest reducing agent while BiH_3 is mild reducing agent

(4) Basicity of hydrides: $NH_3 < PH_3 < AsH_3 < SbH_3 < BiH_3$

Ans. **(2)**

Sol. Due to increase in bond length down the group reducing strength increases.

5. Given standard electrode potential of BrO_4^-, IO_4^- and ClO_4^- are 1.85 V, 1.65 V and 1.20 V respectively then select order of their oxidizing power :

(1) $ClO_4^- < BrO_4^- < IO_4^-$ (2) $IO_4^- < BrO_4^- < ClO_4^-$

(3) $ClO_4^- < IO_4^- < BrO_4^-$ (4) $BrO_4^- < ClO_4^- < IO_4^-$

Ans. **(3)**

Sol. More reduction potential, more is the oxidizing strength.

6. **Statement-1:** Since fluorine is more electronegative than nitrogen, the resultant dipole moment of NH_3 is greater than that of NF_3.

Statement-2: In case of NH_3 the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of N-H bonds, whereas in NF_3 the orbital dipole is in the direction opposite to the resultant dipole moment of three N-F bonds.

(1) Statement I and Statement II are correct.

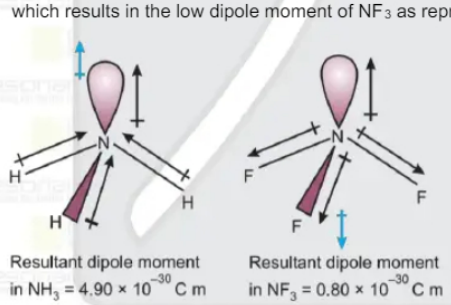
(2) Statement I is correct and Statement II is incorrect

(3) Statement I is incorrect and Statement II is correct

(4) Statement I and Statement II are incorrect

Ans. **(1)**

Sol. The orbital dipole because of lone pair decreases the effect of the resultant N – F bond moments, which results in the low dipole moment of NF_3 as represented below :



7. In a mixture of B & C, A is added. Given moles of A, B & C are respectively n_A, n_B & n_C then determine mole fraction of C.

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

(1) $\frac{\quad}{n_A + n_B + n_C}$ (2) $\frac{\quad}{n_A . n_B + n_C}$ (3) $\frac{\quad}{n_A . n_C + n_B}$ (4) $\frac{\quad}{n_A + n_B}$

Ans. **(1)**

Sol. Mole fraction = $\frac{\text{moles of substance}}{\text{total no. of moles}}$

8. The colour of $KMnO_4$ and $K_2Cr_2O_7$ is due to

(1) d-d transition (2) Metal to ligand charge transfer

(3) Ligand to metal charge transfer (4) F-Center

Ans. **(3)**

Sol. $KMnO_4$ $K_2Cr_2O_7$

(Purple) (Orange Red)

Colour of $KMnO_4$ & $K_2Cr_2O_7$ is due to ligand to metal charge transfer phenomenon.

9. $MnO_2 + KOH + O_2 \xrightarrow{\Delta} [X]$

$[X] \xrightarrow[\text{Process}]{\text{Electrolytic}} [Y]$

Select correct option

	[X]	[Y]
(1)	MnO_4^-	MnO_4^{-2}
(2)	MnO_4^{-2}	MnO_4^-
(3)	Mn_2O_3	Mn
(4)	Mn_2O_7	MnO_4^-

Ans. **(2)**

Sol. $2\,MnO_2 + 4KOH + O_2 \longrightarrow 2K_2MnO_4 + 2H_2O$

$MnO_4^{-2} \xrightarrow[\text{Oxidation}]{\text{Electrolytic}} MnO_4^-$

[X] [Y]

10. $CrO_2Cl_2 + NaOH \longrightarrow [X]$

$[X] + HCl + H_2O_2 \longrightarrow [Y]$

Select correct option

	[X]	[Y]
(1)	Na_2CrO_4	CrO_5
(2)	$Na_2Cr_2O_7$	Cr_2O_3
(3)	CrO_5	Na_2CrO_4
(4)	Cr_2O_3	$Na_2Cr_2O_7$

Ans. **(1)**

Sol. $CrO_2Cl_2 + NaOH \longrightarrow Na_2CrO_4 + NaCl + H_2O$

$CrO_4^{-2} \xrightarrow{H^+} Cr_2O_7^{-2} \xrightarrow{H^+ \,\&\, H_2O_2} CrO_5$

11. Which of the following solution have maximum depression in freezing point ?

(1) 180 g of glucose in water (2) 180 g of Benzoic acid in Benzene

(3) 180 g of Acetic acid in Benzene (4) 180 g of Acetic acid in water

Sol. $\Delta T_f = i K_f m$; $\Delta T_f \propto im$

$\Delta T_f \propto in$

$\Delta T_f \propto i\frac{W}{M}$

For Glucose i = 1 in Water

Benzoic acid i < 1 in Benzene

Acetic acid i < 1 in Benzene

Acetic acid i > 1 in Water

More the number of mole of solute greater is depression in freezing point.

12. Among the following how many are optical active

(i) cis $[Co(en)_2Cl_2]$ (ii) trans $[Co(en)_2Cl_2]$ (iii) cis $[Pt(en)_2Cl_2]^{+2}$

(iv) trans $[Pt(en)_2Cl_2]^{+2}$ (v) $[Pt(en)_3]^{+4}$ (vi) $[Pt(en)Cl_4]$

Ans. **(3)**

Sol.

Complex	**Optical Nature**
(i) cis $[Co(en)_2Cl_2]$	Optical active
(ii) trans $[Co(en)_2Cl_2]$	Optical inactive
(iii) cis $[Pt(en)_2Cl_2]^{+2}$	Optical active
(iv) trans $[Pt(en)_2Cl_2]^{+2}$	Optical inactive
(v) $[Pt(en)_3]^{+4}$	Optical active
(vi) $[Pt(en)Cl_4]$	Optical inactive

13. In He^+ ion an electron Jumps from 5th excited state to 1st excited state, then total number of spectral lines formed are _____.

Ans. **(10)**

Sol. 5th excited state = $n_2 = 6$

1st excited state = $n_1 = 2$

total spectral line

upto 5th state = 1

4th state = 2

3th state = 3

2nd state = 4

total line = 10

14. Using following reaction

(i) $2\,Fe_{(s)} + \frac{3}{2}O_2(g) \longrightarrow Fe_2O_{3(s)}$ $\Delta H^o_{rxn} = -822$ KJ\mole.

(ii) $C_{(s)} + \frac{1}{2}O_{2(g)} \longrightarrow CO_{(g)}$ $\Delta H^o_{rxn} = -110$ KJ/Mole.

The value of ΔH^o_{rxn} for reaction $Fe_2O_{3(s)} + 3C_{(s)} \longrightarrow 2Fe_{(s)} + 3CO$ is _____ KJ [Nearest integer]

Ans. **(492)**

Sol. Target equation = 3 × equation 2 – equation 1

Sol. Target equation = 3 × equation 2 – equation 1

$\Delta H_{rxn} = 3 \times [-110] - [-822] = -330 + 822 = 492$ KJ

15. How many of following species can show redox disproportion reaction.

H_2O_2, P_4, NO_2, Cu^+, ClO_3^-, ClO_4^-, F_2, Cl_2

Ans. **(6)**

Sol. To show disproportion reaction element must show at least 3 oxidation state and element must present in intermediate oxidation state.

$\overset{-1}{H_2O_2}$, $\overset{0}{P_4}$, $\overset{+3}{N}O_2$, $\overset{+1}{Cu}$, $\overset{+5}{Cl}O_3^-$, $\overset{0}{Cl_2}$

can show disproportion reaction.

16. How many of the following can show flame colour test ?

Be, Mg, Sr, Ba, Li, Cu

Ans. **(4)**

Sol. Be & Mg do not show flame colour test.

17. In buffer solution of benzoic acid and sodium benzoate pH of solution is 4.5. then ratio of moles of salt to moles of acid is _____ [Nearest Integer]

[Give pKa (Benzoic acid) = 4.5 and log2 = 0.3]

Ans. **(2)**

Sol. Benzoic acid + sodium benzoate.

Acidic Buffer solution

$$pH = pKa + \log \frac{[Salt]}{[Acid]}$$

$$4.5 = 4.2 + \log \frac{[Salt]}{[Acid]}$$

$$0.3 = \log \frac{[Salt]}{[Acid]}$$

$$\frac{[Salt]}{[Acid]} = 2 \quad \Rightarrow \frac{n_{salt}}{n_{acid}} = 2$$

18. IUPAC name of $CH_3-\underset{\underset{NH_2}{|}}{CH}-CH_2-CN$ is :

(1) 3-Aminobutanenitrile
(2) 3-Aminobutanecarbonitrile
(3) 2-Amino-1-cyanopropane
(4) 3-Aminebutanenitrile

Ans. **(1)**

Sol. $\overset{4}{CH_3}-\overset{3}{\underset{\underset{NH_2}{|}}{CH}}-\overset{2}{CH_2}-\overset{1}{CN}$

19. Which reagent on reaction with phenol give salicyldehyde :

(1) CO_2, NaOH
(2) $CHCl_3$, NaOH
(3) CCl_4, NaOH
(4) H_2O, H^+

Ans. **(2)**

Sol. This reaction is known as Reimer-Tieman reaction.

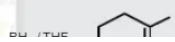
20. The correct order of stability for given carbocations is :

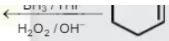
(I) $(CH_3)_3C^+$, (II) $(CH_3)_2CH^+$, (III) $CH_3CH_2^+$, (IV) CH_3^+

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

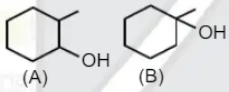
Ans. **(2)**

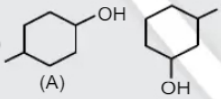
Sol. Greater the number of α-hydrogen, greater the hyperconjugation and stability of carbocation.

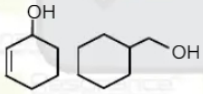


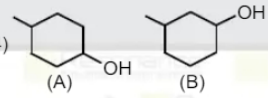
21. (A) $\xleftarrow[H_2O_2/OH^-]{BH_3/THF}$  $\xrightarrow{H^+/H_2O}$ (B) ?

A & B are respectively

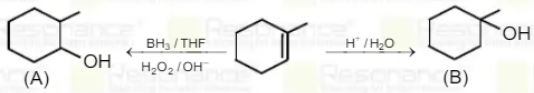
(1) 

(2) 

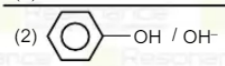
(3) 

(4) 

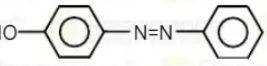
Ans. **(1)**

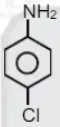
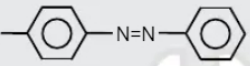
Sol. 

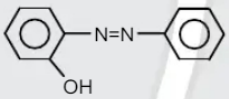
(anti-Marconikov addition of water) (Marconikov addition of water)

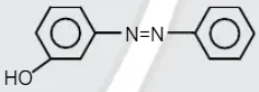
22.  $\xrightarrow[(2)\ Sn/HCl]{(1)\ conc.\ H_2SO_4 + conc.\ HNO_3}$ A $\xrightarrow[(2)\ \text{  OH / OH^-]{(1)\ NaNO_2 + HCl}$ B

What is A and B

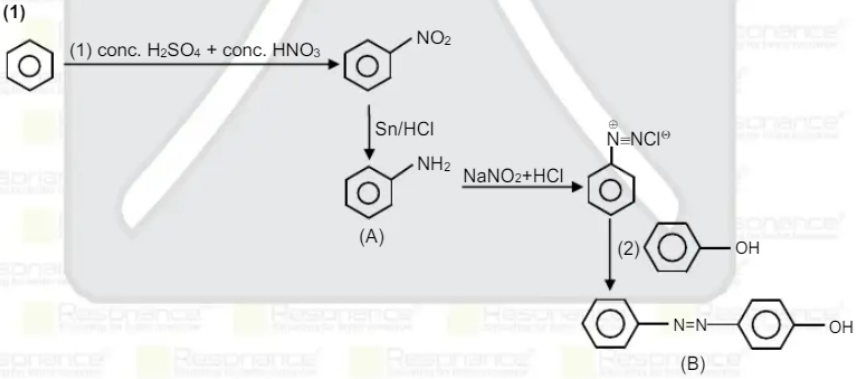
(1) A =  ; B = 

(2) A =  ; B = 

(3) A =  ; B = 

(4) A =  ; B = 

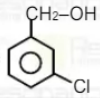
Ans. **(1)**

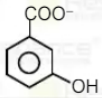
Sol. 

23. 

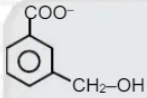
A & B are respectively

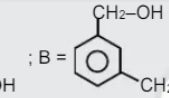
(1) A = 

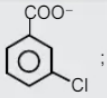
; B = 

(2) A = 

; B = 

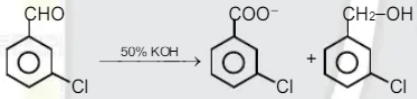
(3) A = 

; B = 

(4) A = 

; B = 

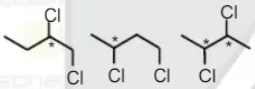
Ans. **(1)**

Sol. 

This is a cannizaro reaction.

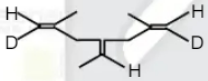
24. Total number of optical isomer formed is
Chlorobutane + $Cl_2 \longrightarrow$ dichlorobutane

Ans. **(7)**

Sol. 

R+S R+S RR,RS & SS

25. Total number of geometrical isomer possible for given compound is ?



Ans. **(4)**