26th Feb. 2021 | Shift - 2
CHEMISTRY

JEE | NEET | Foundation

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1. 2,4-DNP test can be used to identify:
(1) aldehyde
(2) halogens
(3) ether
(4) amine

Ans. (1)

Sol.

\[
\begin{align*}
R-\text{CHO} + H_2\text{N} - \text{NH} & \rightarrow \text{R-CH=N-NH} \\
-\text{H}_2\text{O} & \rightarrow \text{R-CH=N-NH}
\end{align*}
\]

2. Identify A in the following chemical reaction.

\[
\begin{align*}
\text{CHO} & \rightarrow \text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3 \\
\text{CH}_3\text{O} & \rightarrow \text{CH}_3\text{OH}
\end{align*}
\]

(1) (2) (3) (4)
3. The nature of charge on resulting colloidal particles when FeCl₃ is added to excess of hot water is:

(1) positive

(2) neutral

(3) sometimes positive and sometimes negative

(4) negative

Ans. (1)

Sol. If FeCl₃ is added to excess of hot water, a positively charged sol of hydrated ferric oxide is formed due to adsorption of Fe³⁺ ions.
4. Match List-I with List-II

**List-I**

(a) \[
\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl}_2} \quad \text{Cl} \quad + \text{N}_2
\]

(b) \[
\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl}} \quad \text{Cl} \quad + \text{N}_2
\]

(c) \[2\text{CH}_3\text{CH}_2\text{Cl} + 2\text{Na} \xrightarrow{\text{Ether}} \text{C}_2\text{H}_5^-\text{C}_2\text{H}_5 + 2\text{NaCl}\]

(d) \[2\text{C}_6\text{H}_5\text{Cl} + 2\text{Na} \xrightarrow{\text{Ether}} \text{C}_6\text{H}_5^-\text{C}_6\text{H}_5 + 2\text{NaCl}\]

**List-II**

(i) Wurtz reaction

(ii) Sandmeyer reaction

(iii) Fitting reaction

(iv) Gatterman reaction

Choose the correct answer from the option given below:

(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

(3) (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

(4) (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

**Ans.** (3)

**Sol.**

(a) \[
\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl}_2} \quad \text{Cl} \quad + \text{N}_2 \quad \text{(Sandmeyer reaction)}
\]

(b) \[
\text{N}_2^+\text{Cl}^- \xrightarrow{\text{CuCl}} \quad \text{Cl} \quad + \text{N}_2 \quad \text{(Gatterman reaction)}
\]

(c) \[2\text{CH}_3\text{CH}_2\text{Cl} + 2\text{Na} \xrightarrow{\text{Ether}} \text{C}_2\text{H}_5^-\text{C}_2\text{H}_5 + 2\text{NaCl} \quad \text{(Wurtz reaction)}
\]

(D) \[2\text{C}_6\text{H}_5\text{Cl} + 2\text{Na} \xrightarrow{\text{Ether}} \text{C}_6\text{H}_5^-\text{C}_6\text{H}_5 + 2\text{NaCl} \quad \text{(Fitting reaction)}
\]
5. In \( CH_2 = C = CH - CH_3 \) molecule, the hybridization of carbon 1, 2, 3 and 4 respectively are:

(1) \( sp^2, sp, sp^2, sp^3 \)
(2) \( sp^2, sp^2, sp^2, sp^3 \)
(3) \( sp^2, sp^3, sp^2, sp^3 \)
(4) \( sp^3, sp, sp^3, sp^3 \)

Ans. (1)

Sol. \( CH_2 = C = CH - CH_3 \)

6. Match List-I with List-II.

**List-I**
(a) Sucrose
(b) Lactose
(c) Maltose

**List-II**
(i) \( \beta - D - Galactose \) and \( \beta - D - Glucose \)
(ii) \( \alpha - D - Glucose \) and \( \beta - D - Fructose \)
(iii) \( \alpha - D - Glucose \) and \( \alpha - D - Glucose \)

Choose the correct answer from the options given below:

(1) (a)-(iii), (b)-(ii), (c)-(i)
(2) (a)-(iii), (b)-(i), (c)-(ii)
(3) (a)-(i), (b)-(iii), (c)-(ii)
(4) (a)-(ii), (b)-(i), (c)-(iii)

Ans. (4)

Sol. Sucrose \( \rightarrow \) \( \alpha - D - Glucose \) and \( \beta - D - Fructose \)
Lactose \( \rightarrow \) \( \beta - D - Galactose \) and \( \beta - D - Glucose \)
Maltose \( \rightarrow \) \( \alpha - D - Glucose \) and \( \alpha - D - Glucose \)

7. Which pair of oxides is acidic in nature?

(1) \( N_2O_4, BaO \)
(2) \( CaO, SiO_2 \)
(3) \( B_2O_3, CaO \)
(4) \( B_2O_3, SiO_2 \)

Ans. (4)

Sol. \( B_2O_3 \) and \( SiO_2 \) both are oxides of non-metal and hence are acidic in nature.
8. Calgon is used for water treatment. Which of the following statement is NOT true about calgon?
(1) Calgon contains the 2nd most abundant element by weight in the earth's crust.
(2) It is also known as Graham's salt.
(3) It is polymeric compound and is water soluble.
(4) It does not remove Ca\(^{2+}\) ion by precipitation.

Ans. (1)
Sol. \(\text{Na}_6(\text{PO}_3)_6\) or \(\text{Na}_6\text{P}_6\text{O}_{18}\)
Order of abundance of element in earth crust is
\(\text{O} > \text{Si} > \text{Al} > \text{Fe} > \text{Ca} > \text{Na} > \text{Mg} > \text{K}\)
So second most abundant element in earth crust is Si not Ca.

9. Ceric ammonium nitrate and CHCl\(_3\)/alc. KOH are used for the identification of functional groups present in ________ and ________ respectively.
(1) alcohol, amine
(2) amine, alcohol
(3) alcohol, phenol
(4) amine, phenol

Ans. (1)
Sol. Alcohol give positive test with ceric ammonium nitrate and primary amines gives carbyl amine test with CHCl\(_3\), KOH.

10. Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R.
Assertion A: In TlI\(_3\), isomorphous to CsI\(_3\), the metal is present in +1 oxidation state.
Reason R: Tl metals has fourteen \(f\) electrons in its electronic configuration.
In the light of the above statements, choose the most appropriate answer from the options given below:
(1) Both A and R are correct and R is the correct explanation of A
(2) A is not correct but R is correct
(3) Both A and R are correct R is NOT the correct explanation of A
(4) A is correct but R is not correct

Ans. (3)
Sol. TlI\(_3\) is Tl\(^{+}\) I\(_3^-\)
CsI\(_3\) is Cs\(^+\) I\(_3^-\)
Thallium shows Tl\(^{+}\) state due to inert pair effect.
11. The correct order of electron gain enthalpy is:
   (1) S > Se > Te > O
   (2) O > S > Se > Te
   (3) S > O > Se > Te
   (4) Te > Se > S > O

   Ans. (1)

   Sol. Electron gain enthalpy of O is very low due to small size.

12. Identify A in the given chemical reaction.

   \[
   \begin{align*}
   &\text{CH}_2\text{CH}_2\text{CHO} \\
   &\text{CH}_2\text{CH}_2\text{CHO} \\
   &\text{NaOH} \\
   &\text{C}_2\text{H}_5\text{OH, H}_2\text{O, }\Delta \\
   &\rightarrow \text{A (Major product)}
   \end{align*}
   \]

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

   Ans. (1)

   Sol. (Internal aldol condensation)

13. Match List-I with List-II

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Siderite</td>
<td>(i) Cu</td>
</tr>
<tr>
<td>(b) Calamine</td>
<td>(ii) Ca</td>
</tr>
<tr>
<td>(c) Malachite</td>
<td>(iii) Fe</td>
</tr>
<tr>
<td>(d) Cryolite</td>
<td>(iv) Al</td>
</tr>
<tr>
<td>(v) Zn</td>
<td></td>
</tr>
</tbody>
</table>

   Choose the correct answer from the options given below:
   (1) (a)-(i), (b)-(ii), (c)-(v), (d)-(iii)  
   (2) (a)-(iii), (b)-(v), (c)-(i), (d)-(iv)  
   (3) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)  
   (4) (a)-(iii), (b)-(i), (c)-(v), (d)-(ii)
Ans. (2)
Sol. Siderite - FeCO$_3$
        Calamine - ZnCO$_3$
        Malachite - CuCO$_3$.Cu(OH)$_2$
        Cryolite - Na$_3$AlF$_6$

14. Identify A in the given reaction

\[
\text{CH}_2\text{OH} \quad \text{SOCl}_2 \quad A \quad \text{(Major product)}
\]

(1) \quad \text{OH} \\
(2) \quad \text{OH} \\
(3) \quad \text{OH} \\
(4) \quad \text{OH} \\

Ans. (2)

Sol.

\[
\text{HO} \quad \text{CH}_2\text{OH} \quad \text{SOCl}_2 \quad \text{OH} \quad \text{Cl} \quad \text{CH}_2\text{Cl}
\]
15. Match List-I with List-II.

<table>
<thead>
<tr>
<th>List-I</th>
<th>List-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Sodium Carbonate</td>
<td>(i) Deacon</td>
</tr>
<tr>
<td>(b) Titanium</td>
<td>(ii) Caster-Kellner</td>
</tr>
<tr>
<td>(c) Chlorine</td>
<td>(iii) Van-Arkel</td>
</tr>
<tr>
<td>(d) Sodium hydroxide</td>
<td>(iv) Solvay</td>
</tr>
</tbody>
</table>

Choose the correct answer from the option given below:

(1) (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
(2) (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
(3) (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
(4) (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

Ans. (2)

Sol. Sodium carbonate $Na_2CO_3$ & $NaHCO_3$

Titanium:

$$Ti + I_2 \xrightarrow{Van arkel method} TiI_4 (g)$$

$$TiI_4 (g) \xrightarrow{Refined titanium} Ti + 2I_2$$

Chlorine: Decon's process

$$HCl + O_2 \xrightarrow{Cl} H_2O + Cl_2$$

Sodium hydroxide: Caster-Kellner cell

16. Match List-I with List-II.

<table>
<thead>
<tr>
<th>List-I (Molecule)</th>
<th>List-II (Bond order)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a) Ne$_2$</td>
<td>(i) 1</td>
</tr>
<tr>
<td>(b) N$_2$</td>
<td>(ii) 2</td>
</tr>
<tr>
<td>(c) F$_2$</td>
<td>(iii) 0</td>
</tr>
<tr>
<td>(d) O$_2$</td>
<td>(iv) 3</td>
</tr>
</tbody>
</table>

Choose the correct answer from the options given below:

(1) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
(2) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(3) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
(4) (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Ans. (1)

Sol. $Ne_2O$ BO = 0
$N_2$ BO = 3
$F_2$ BO = 1
$O_2$ BO = 2

As per molecular orbital theory
17. Which of the following forms of hydrogen emits low energy $\beta^-$ particles?
(1) Proton $H^+$
(2) Deuterium $^2H$
(3) Protium $^1H$
(4) Tritium $^3H$

Ans. (4)

Sol. Tritium isotope of hydrogen is radioactive and emits low energy $\beta^-$ particles. It is because of high n/p ratio of tritium which makes nucleus unstable.

18. A. Phenyl methanamine
B. N, N-Dimethylaniline
C. N-Methyl aniline
D. Benzenamine

Choose the correct order of basic nature of the above amines.
(1) D > C > B > A
(2) D > B > C > A
(3) A > C > B > D
(4) A > B > C > D

Ans. (4)

Sol.

19. 

Considering the above reaction, the major product among the following is:

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

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20. Seliwanoff test and Xanthoproteic test are used for the identification of _________ and _________ respectively

(1) ketoses, proteins  (2) proteins, ketoses  
(3) aldoses, ketoses  (4) ketoses, aldoses

Ans. (1)
Sol. Seliwanoff test and Xanthoproteic test are used for identification of 'Ketoses' and proteins respectively.

Section - B

1. The NaNO3 weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na⁺ per mL is_______ g. (Rounded off to the nearest integer) 
[Given: Atomic weight in g mol⁻¹. Na: 23; N: 14; O : 16]

Ans. 13
Sol. Na⁺ = 70 mg/mL

\[ W_{Na} \text{ in } 50\text{mL solution} = 70 \times 50\text{mg} = 3500 \text{ mg} = 3.5 \text{ gm} \]

Moles of Na⁺ in 50 ml solution = \( \frac{3.5}{23} \)

Moles of NaNO₃ = moles of Na⁺

\[ = \frac{3.5}{23} \text{ mol} \]

Mass of NaNO₃ = \( \frac{3.5}{23} \times 85 = 12.934 \)

\[ \approx 13\text{gm} \text{ Ans.} \]
2. The number of stereoisomers possible for \([\text{Co(ox)}_2(\text{Br})(\text{NH}_3)]^{2-}\) is ____________ \([\text{ox} = \text{oxalate}]\)

Ans. 3

Sol. \([\text{Co(ox)}_2(\text{Br})(\text{NH}_3)]^{2-}\)

\[
\begin{array}{c}
\text{Optically active} \\
\text{Mirr or image} \\
\text{Total stereoisomer} = 2 \text{ (OI)} + 1 \text{ POE (pair of enantiomers)} = 3
\end{array}
\]

3. The average \(S-F\) bond energy in kJ mol\(^{-1}\) of \(\text{SF}_6\) is __________. (Rounded off to the nearest integer)

[Given: The values of standard enthalpy of formation of \(\text{SF}_6(g), S(g)\) and \(F(g)\) are \(-1100, 275\) and \(80\) kJ mol\(^{-1}\) respectively.]

Ans. 309

Sol. \(\text{SF}_6(g) \rightarrow S(g) + 6F(g)\)

\[
\Delta H^\circ_{\text{reaction}} = 6 \times E_{S-F} = \Delta H^\circ_f[S(g)] + 6 \times \Delta H^\circ_f[F(g)] - \Delta H^\circ_f[\text{SF}_6(g)]
\]

\[
6 \times E_{SF} = 275 + 6 \times 80 - (-1100)
\]

\[
= 275 + 480 + 1100
\]

\[
6 \times E_{SF} = 1855
\]

\[
E_{SF} = \frac{1855}{6} = 309.1667
\]

\(\approx 309\) kJ/mol Ans.
4. Emf of the following cell at 298 K in V is \(x \times 10^{-2}\).
Zn|Zn\(^{2+}\) (0.1 M)||Ag\(^{+}\) (0.01 M)| Ag
The value of \(x\) is \(\ldots\). (Rounded off to the nearest integer)

[Given: \(E_{Zn^{2+}/Zn}^0 = -0.76V; E_{Ag^{+}/Ag}^0 = +0.80V; \frac{2.303RT}{F} = 0.059\)]

**Ans.** 147

**Sol.**

\[
\begin{align*}
\text{Zn(s)} & \rightleftharpoons \text{Zn}^{2+}(0.1 \text{M}) || \text{Ag}^{+}(0.01 \text{M}) || \text{Ag(s)} \\
\text{Zn(s)} + 2 \text{Ag}^{+} & \rightleftharpoons 2 \text{Ag(s)} + \text{Zn}^{2+} \\
E^0 = 0.80 + 0.76 & = 1.56; \quad Q = \left(\frac{\text{Zn}^{2+}}{(\text{Ag}^{+})^2}\right) \\
E &= E^0 - \frac{0.059}{n} \log(Q) \\
E &= 1.56 - \frac{0.059}{2} \log \left(\frac{0.1}{(0.01)^2}\right) \\
E &= 1.56 - \frac{0.059}{2} \log(10)^3 \\
E &= 1.4715 = 147.15 \times 10^{-2} \text{ volt} \\
x &= x \times 10^{-2} \\
X &= 147.15 \approx 147 \text{ Ans.}
\end{align*}
\]

5. A ball weighing 10g is moving with a velocity of 90m/s\(^{-1}\). If the uncertainty in its velocity is 5%, then the uncertainty in its position is \(\ldots\) \(\times 10^{-33}\) m. (Rounded off to the nearest integer)

[Given : \(h = 6.63 \times 10^{-34}\) Js]

**Ans.** 1

**Sol.**

\[
\begin{align*}
m &= 10 \text{ g} = 10^{-2} \text{ Kg} \\
v &= 90 \text{ m/sec.} \\
\Delta v &= v \times 5\% = 90 \times \frac{5}{100} = 4.5 \text{ m/sec} \\
m . \Delta v . \Delta x & \geq \frac{h}{4\pi} \\
10^{-2} \times 4.5 \times \Delta x & \geq \frac{6.63 \times 3 \times 10^{-34}}{4 \times \frac{22}{7}} \\
\Delta x & \geq \frac{6.63 \times 7 \times 2 \times 10^{-34}}{9 \times 4 \times 22 \times 10^{-2}} \\
\Delta x & \geq 1.17 \times 10^{-33} = x \times 10^{-33} \\
x &= 1.17 \approx 1
\end{align*}
\]
6. In mildly alkaline medium, thiosulphate ion is oxidized by \( \text{MnO}_4^- \) to "A". The oxidation state of sulphur in "A" is \( \underline{} \).

**Ans. 6**

**Sol.**

\[
\text{S}_2\text{O}_3^{2-} + \text{MnO}_4^- \rightarrow \text{A} \\
\text{A} \rightarrow \text{SO}_4^{2-}
\]

\[\therefore \text{Oxidation no. of 'S' = +6 Ans.}\]

7. When 12.2 g of benzoic acid is dissolved in 100 g of water, the freezing point of solution was found to be \( -0.93^\circ\text{C} \) (\( \text{K}_f (\text{H}_2\text{O}) = 1.86 \text{ K kg mol}^{-1} \)). The number \( (n) \) of benzoic acid molecules associated (assuming 100% association) is \( \underline{} \).

**Ans. 2**

**Sol.**

\[n = \frac{\text{PhCOOH}}{(\text{PhCOOH})_n}\]

\[N = \frac{1}{X} = i \{\text{As } \alpha = 1\}\]

\[\Delta T_f = i \times k_f \times m\]

\[0.93 = \frac{1}{n} \times 1.86 \times \frac{12.2 \times 1000}{122 \times 100}\]

\[n = 2\]

8. If the activation energy of a reaction is 80.9 kJ mol\(^{-1}\), the fraction of molecules at 700K, having enough energy to react to form products is \( e^{-x} \). The value of \( x \) is \( \underline{} \).

(Rounded off to the nearest integer)

[Use \( R = 8.31 \text{ JK}^{-1} \text{ mol}^{-1} \)]

**Ans. 14**

**Sol.**

\[E_a = 80.9 \text{kJ} / \text{mol}\]

\[\text{Fraction of molecules able to cross energy barrier} = e^{-\frac{E_a}{RT}} = e^{-x}\]

\[x = \frac{E_a}{RT} = \frac{80.9 \times 1000}{8.31 \times 700} = 13.91\]

\[x \simeq 14 \text{ Ans}\]
9. The pH of ammonium phosphate solution, if $pK_a$ of phosphoric acid and $pK_b$ of ammonium hydroxide are 5.23 and 4.75 respectively, is ___________.

**Ans.** 7

**Sol.**

\[ (NH_4)_3PO_4 \rightarrow 3NH_4^+ + PO_4^{3-} \]

\[ [H^+] = K_a \times \frac{K_w}{K_a \times K_b} \]

\[ pH = pK_a + \frac{1}{2} \{ pK_w - pK_a - pK_b \} \]

\[ pH = 5.23 + \frac{1}{2} (14 - 5.23 - 4.75) \]

\[ pH = 5.23 + \frac{1}{2} (4.02) = 7.24 = 7 \text{(Nearest integer)} \]

10. The number of octahedral voids per lattice site in a lattice is ___________.

(Rounded off to the nearest integer)

**Ans.** 1

**Sol.** Assuming FCC

No of lattice sites = 6 face centre + 8 corner = 14

No. of octahedral voids = 13

Ratio = \[ \frac{13}{14} = 0.92857 = 1 \text{ (Nearest integer)} \]
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