1. Out of $\text{N}_2\text{O}_3$, $\text{N}_2\text{O}_4$, $\text{N}_2\text{O}_5$ and $\text{N}_2\text{O}_6$. How many of them contain $\text{N}–\text{N}$ bond
   (1) 1  (2) 2  (3) 3  (4) 4
   Sol. Answer (2)

Only $\text{N}_2\text{O}_3$ and $\text{N}_2\text{O}_4$ contains $\text{N}–\text{N}$ bond

2. Photochemical smog contains?
   (1) $\text{O}_3$  (2) $\text{N}_2$  (3) $\text{SF}_4$  (4) $\text{F}_2$
   Sol. Answer (1)

   Photochemical smog contains $\text{O}_3$, PAN, nitric oxide, acrolein and formaldehyde.

3. Which of the following is a basic oxide
   (1) $\text{Al}_2\text{O}_3$  (2) $\text{SiO}_2$
   (3) $\text{Na}_2\text{O}$  (4) $\text{NO}_2$
   Sol. Answer (3)

   Metal oxides $\Rightarrow$ basic
   Non-metal oxides $\Rightarrow$ Acidic
   Hence, $\text{Na}_2\text{O}$ is a basic oxide
   $\text{NO}_2$, $\text{SiO}_2$ are acidic oxides
   $\text{Al}_2\text{O}_3$ is an amphoteric oxide

4. Which of the following set of Quantum numbers is valid?
   (1) $n \ell m s$  (2) $n \ell m s$
   (3) $n \ell m s$  (4) $n \ell m s$
   Sol. Answer (1)

   $n$ can take integral values, $\ell$ can take values from 0 to $(n - 1)$, $m$ can takes values from $-\ell$ to $+\ell$ including zero and $s$ is either $+\frac{1}{2}$ or $-\frac{1}{2}$

   Hence, following quantum numbers are correct:
   
   $n = 4 \quad \ell = 3 \quad m = 0 \quad s = +\frac{1}{2}$

5. There are three isotopes of hydrogen, identify the difference between them.
   (1) Number of protons
   (2) Number of electrons in neutral state
   (3) Electronic configuration in neutral state
   (4) Number of neutron
   Sol. Answer (4)

<table>
<thead>
<tr>
<th>Isotope</th>
<th>Protons</th>
<th>Neutrons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protium</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Deuterium</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Tritium</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

   Hence, they differ in the number of neutrons.

6. $\text{FeO} + \text{SiO}_2 \rightarrow \text{FeSiO}_3$
   $\text{SiO}_2$ and $\text{FeSiO}_3$ are respectively
   (Considering the extraction of copper)
   (1) Flux & slag  (2) Slag and flux
   (3) Gangue & flux  (4) Gangue and slag
   (A-Z)
7. The correct IUPAC name of the compound

\[ \text{O}_2\text{N} \quad \text{C} \quad \text{C} \quad \text{C} \quad \text{H} \]

(1) 1-formly-4-nitrobutanal
(2) 4-nitro-3-oxo-butanal
(3) 4-oxo-3-nitrobutanal
(4) 3-oxo-4-nitropropanal

Sol. Answer (2)

\[ \text{O}_2\text{N} \quad \text{C} \quad \text{C} \quad \text{C} \quad \text{H} \]

4-nitro-3-oxobutanal

–CHO group has highest priority. Hence it will be our principal functional group.

8. In which of the following compounds sulphur shows two different oxidation states

(1) \( \text{H}_2\text{S}_2\text{O}_3 \)
(2) \( \text{H}_2\text{S}_2\text{O}_6 \)
(3) \( \text{H}_2\text{S}_2\text{O}_7 \)
(4) \( \text{H}_2\text{S}_2\text{O}_8 \)

Sol. Answer (1)

\[ \text{S}^{2-} \quad \text{O} \quad \text{H} \]

\( \text{H}_2\text{S}_2\text{O}_3 \) (Thiosulphuric acid)

\( \text{sp}^3 \)hybridized S is more electronegative than \( \text{sp}^3 \)hybridized S.

Hence it shows –2 oxidation state.

9. Isobutyraldehyde \( \xrightarrow{\text{HCHO}} \text{A} \xrightarrow{\text{CN}} \text{B} \xrightarrow{\text{H}_2\text{O}} \text{P} \)

The product P is

(1) \( \text{CH}_3\text{C} = \text{CHOH} \)
(2) \( \text{CH}_3\text{C} = \text{CH} - \text{OH} \)
(3) \( \text{CH}_3\text{COO} \)
(4) \( \text{OH} \quad \text{O} \quad \text{H} \)

Sol. Answer (3)

10. Find empirical formula of a compound which contains 74% C, 17.3% N and 8.7% H by mass

(1) \( \text{C}_4\text{H}_7\text{N} \)
(2) \( \text{C}_5\text{H}_7\text{N} \)
(3) \( \text{C}_6\text{H}_7\text{N} \)
(4) \( \text{C}_7\text{H}_7\text{N}_2 \)

Sol. Answer (2)

<table>
<thead>
<tr>
<th>Element</th>
<th>mass%</th>
<th>Atomic mass</th>
<th>moles</th>
<th>simplest ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>74</td>
<td>12</td>
<td>( \frac{74}{12} = 6.16 )</td>
<td>( \frac{6.16}{1.23} = 5 )</td>
</tr>
<tr>
<td>N</td>
<td>17.3</td>
<td>14</td>
<td>( \frac{17.3}{14} = 1.23 )</td>
<td>( \frac{1.23}{1.23} = 1 )</td>
</tr>
<tr>
<td>H</td>
<td>8.7</td>
<td>1</td>
<td>( \frac{8.7}{1} = 8.7 )</td>
<td>( \frac{8.7}{1.23} = 7 )</td>
</tr>
</tbody>
</table>

Empirical formula = \( \text{C}_5\text{H}_7\text{N} \)
12. Consider the following reaction

\[ \text{A} \xrightarrow{1. \text{Cl}_2/\text{h}\nu} \xrightarrow{2. \text{KCN}} \xrightarrow{3. \text{H}_2\text{O}^+ / \Delta} \text{4-bromophenylacetic acid} \]

Option (2) is correct answer

13. A sugar 'X' is hydrolysed forms isomers one of the compound form is laevorotatory then 'X' can be

(1) Maltose  (2) Sucrose  
(3) Lactose  (4) Dextrose

Sol. Answer (2)

Sucrose (Dextrorotatory) on hydrolysis gives equimolar mixture of D-(+)-Glucose (Dextrorotatory) and D-(−)-Fructose (Laevorotatory) and net rotation of PPL is in anti-clock wise direction. Therefore this reaction is called inversion of sugar, So compound X is sucrose.

14. The correct statement about photochemical smog is,

(1) It is caused by chemical reaction of Hydrocarbon
(2) Reducing in Nature
(3) It is caused by SO\(_2\) dust
(4) Humid climate

Sol. Answer (1)

Photochemical smog or Los Angeles smog is oxidising in nature, produced in warm, dry and sunny climate on reaction of hydrocarbon, nitrogen oxide in sun light or UV light.

Eg. NO\(_2\), O\(_3\), PAN, aldehydes etc.

\[ \text{CH}_1 + \text{O}_3 \rightarrow \text{H} - \text{C} - \text{H} \]

\[ \text{NO} + \text{O}_3 \rightarrow \text{NO}_2 + \text{O}_2 \]

15. The pH of a buffer solution of acetic acid is 4.

Find the value of \( [\text{CH}_3\text{COO}^-] \)

Given \( K_a \) of acetic acid = 1.3x10\(^{-5}\)

(1) 2.3  (2) 10.2  
(3) 0.13  (4) 1.5

Sol. Answer (3)

pH of acidic buffer solution,

\( K_a = 1.3 \times 10^{-5} \)

\( pK_a = 5 - \log 1.3 \)

\( = 4.89 \)

\[ \text{pH} = pK_a + \log \frac{[\text{salt}]}{[\text{acid}]} \]

\[ 4 = 4.89 + \log \frac{[\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} \]

\[ \log \frac{[\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = 4.00 - 4.89 \]

\[ = -0.89 \]

\[ \frac{[\text{CH}_3\text{COO}^-]}{[\text{CH}_3\text{COOH}]} = 0.13 \]
16. Nature of colloidal solution of Fe(OH)$_3$ is
   (1) Neutral  (2) Positive
   (3) Negative  (4) Amphoteric

   **Sol. Answer (2)**
   Fe(OH)$_3$ is positively charged colloid due to adsorption of Fe$^{3+}$ according to preferential absorption theory
   
   $\text{FeCl}_3 \rightarrow \text{Fe}^{3+} + 3\text{Cl}^-$
   $\text{Fe}^{3+} + 3\text{H}_2\text{O} \rightarrow \text{Fe(OH)}_3 + 3\text{H}^+$
   $\text{Fe(OH)}_3 + \text{Fe}^{3+} \rightarrow \text{Fe(OH)}_3|\text{Fe}^{3+}$

17. Consider the structure of SF$_4$ the no. of lone pair, position of lone pair and no. of lone pair-bond pair repulsion respectively are
   (1) 1, equatorial position, 4
   (2) 2, axial position, 4
   (3) 1, axial position, 3
   (4) 1, equatorial position, 6

   **Sol. Answer (1)**

   ![Structure of SF4](image)

   No. of lone pairs = 1
   Position of lone pairs = equatorial position
   No. of lone pair – bond pair repulsion = 4

18. The structure of Tagamet (cimetidine)
   (1) ![Structure of Tagamet 1](image)
   (2) ![Structure of Tagamet 2](image)
   (3) ![Structure of Tagamet 3](image)
   (4) ![Structure of Tagamet 4](image)

   **Sol. Answer (2)**
   Tagamet (Cimetidine) is

   ![Cimetidine Structure](image)

19. Consider the following complexes
   $[\text{Fe(CN)}_6]^{3-}, [\text{Ni(CN)}_4]^{2-}$ and $[\text{Fe(CN)}_3]^{4-}$
   How many complexes is/are paramagnetic?

   **Sol. Answer (1)**
   $[\text{Fe(CN)}_6]^{3-}$
   e$^-$ configuration of Fe$^{3+} = [\text{Ar}]3d^6 4s^0$
   $t_{2g}^6 e_g^0 \rightarrow 1$ unpaired e$^- \Rightarrow$ paramagnetic

   $[\text{Ni(CN)}_4]^{2-}$
   e$^-$ configuration of Ni$^{2+} = [\text{Ar}]3d^8 4s^0$
   $t_{2g}^6 e_g^0 \rightarrow 0$ unpaired e$^- \Rightarrow$ diamagnetic

   $[\text{Fe(CN)}_3]^{4-}$
   e$^-$ configuration of Fe$^{2+} = [\text{Ar}]3d^6 4s^0$
   $t_{2g}^6 e_g^0 \Rightarrow 0$ unpaired e$^- \Rightarrow$ diamagnetic

20. If for Sn$^{4+} + 4e^- \rightarrow \text{Sn} \quad E_0^{\text{Sn}^{4+}/\text{Sn}} = 0.0203 \text{ V}$
    and for Sn$^{2+} + 2e^- \rightarrow \text{Sn} \quad E_0^{\text{Sn}^{2+}/\text{Sn}} = -0.14 \text{ V}$
    What is value of $E_0^{\text{Sn}^{2+}/\text{Sn}^2}$ (in V)

   **Sol. Answer (0.1806)**
   $\text{Sn}^{4+} + 4e^- \rightarrow \text{Sn} \quad E_0^{\text{Sn}^{4+}/\text{Sn}} = 0.0203 \text{ V}$
   $\text{Sn} \rightarrow \text{Sn}^{2+} + 2e^- \quad E_0^{\text{Sn}/\text{Sn}^{2+}} = 0.14 \text{ V}$
   $\text{Sn}^{4+} + 2e^- \rightarrow \text{Sn}^{2+} \quad E_0^{\text{Sn}^{4+}/\text{Sn}^{2+}} = ?$

   
   $n_1E_0^{\text{Sn}^{4+}/\text{Sn}} = n_2E_0^{\text{Sn}^{2+}/\text{Sn}}$

   $E_0^{\text{Sn}^{4+}/\text{Sn}} = 4(0.0203) + 2(0.14)$

   $= 0.1806 \text{ V}$

21. The half-life of substance is 200 days. Find the % activity of remaining substance after 83 days if it decays through first order kinetics.
   [Round off to the nearest integer]
Sol. Answer (15)

\[ t_{1/2} = 200 \text{ days} \Rightarrow \lambda = \frac{\ln 2}{t_{1/2}} \]

\[ \ln \left( \frac{[N]_0}{[N]_t} \right) = \lambda t \]

\[ \Rightarrow [N]_t = [N]_0 e^{-\lambda t} = 0.75 [N]_0 \]

\[ \therefore \% \text{ activity of the remaining substance} = 15\% \]

Number of carbon atoms to which Cl is attached

Sol. Answer (4)

Total no. of monohalogenated products = 4