61. Match List I with List II

<table>
<thead>
<tr>
<th>LIST – I</th>
<th>LIST – II</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Complex ion)</td>
<td>(Electronic Configuration)</td>
</tr>
<tr>
<td>A. $[\text{Cr(H}_2\text{O)}_6]^{3+}$</td>
<td>I. $t_{2g}^2 e_g^0$</td>
</tr>
<tr>
<td>B. $[\text{Fe(H}_2\text{O)}_6]^{3+}$</td>
<td>II. $t_{2g}^3 e_g^0$</td>
</tr>
<tr>
<td>C. $[\text{Ni(H}_2\text{O)}_6]^{2+}$</td>
<td>III. $t_{2g}^3 e_g^2$</td>
</tr>
<tr>
<td>D. $[\text{V(H}_2\text{O)}_6]^{3+}$</td>
<td>IV. $t_{2g}^6 e_g^2$</td>
</tr>
</tbody>
</table>

Choose the correct answer from the options given below:

(1) A-III, B-II, C-IV, D-I
(2) A-IV, B-I, C-II, D-III
(3) A-IV, B-III, C-I, D-II
(4) A-II, B-III, C-IV, D-I

Ans. (4)

Sol:-

$[\text{Cr(H}_2\text{O)}_6]^{3+}$ Contains $\text{Cr}^{3+} : [\text{Ar}]3d^3 : t_{2g}^1 e_g^0$

$[\text{Fe(H}_2\text{O)}_6]^{3+}$ Contains $\text{Fe}^{3+} : [\text{Ar}]3d^6 : t_{2g}^3 e_g^2$

$[\text{Ni(H}_2\text{O)}_6]^{2+}$ Contains $\text{Ni}^{2+} : [\text{Ar}]3d^8 : t_{2g}^6 e_g^2$

$[\text{V(H}_2\text{O)}_6]^{3+}$ Contains $\text{V}^{3+} : [\text{Ar}]3d^2 : t_{2g}^2 e_g^0$
A sample of CaCO₃ and MgCO₃ weighed 2.21 g is ignited to constant weight of 1.152 g. The composition of mixture is:

(Given molar mass in g mol⁻¹  CaCO₃ : 100, MgCO₃ : 84)

(1) 1.187 g CaCO₃ + 1.023 g MgCO₃

(2) 1.023 g CaCO₃ + 1.023 g MgCO₃

(3) 1.187 g CaCO₃ + 1.187 g MgCO₃

(4) 1.023 g CaCO₃ + 1.187 g MgCO₃

Ans. (1)

Sol:-

\[
\text{CaCO}_3(s) \xrightarrow{\Delta} \text{CaO}(s) + \text{CO}_2(g) \quad \text{MgCO}_3(s) \xrightarrow{\Delta} \text{MgO}(s) + \text{CO}_2(g)
\]

Let the weight of CaCO₃ be x gm

∴ weight of MgCO₃ = (2.21 - x) gm

Moles of CaCO₃ decomposed = moles of CaO formed

\[
\frac{x}{100} = \text{moles of CaO formed}
\]

∴ weight of CaO formed = \[
\frac{x}{100} \times 56
\]

Moles of MgCO₃ decomposed = moles of MgO formed

\[
\frac{(2.21-x)}{84} = \text{moles of MgO formed}
\]

∴ weight of MgO formed = \[
\frac{2.21-x}{84} \times 40
\]

\[
\Rightarrow \frac{2.21-x}{84} \times 40 + \frac{x}{100} \times 56 = 1.152
\]

∴ x = 1.186 g = weight of CaCO₃

& weight of MgCO₃ = 1.0214 g
63. Identify A and B in the following reaction sequence.

\[ \text{Br} \xrightarrow{\text{Conc. HNO}_3} \text{A} \xrightarrow{(i)\ NaOH} \text{B} \xrightarrow{(ii)\ HCl} \]

(i) \(\text{A} = \text{Br} \quad \text{NO}_2 \quad \text{Br} \quad \text{NO}_2\), \(\text{B} = \text{Br} \quad \text{NO}_2 \quad \text{OH} \quad \text{NO}_2\)

(ii) \(\text{A} = \text{Br} \quad \text{NO}_2 \quad \text{OH} \quad \text{NO}_2\), \(\text{B} = \text{Br} \quad \text{NO}_2 \quad \text{OH} \quad \text{NO}_2\)

Ans. (1)

64. Given below are two statements:

**Statement I:** \(S_8\) solid undergoes disproportionation reaction under alkaline conditions to form \(S^{2-}\) and \(S_2O_3^{2-}\)

**Statement II:** \(\text{ClO}_4^-\) can undergo disproportionation reaction under acidic condition.

In the light of the above statements, choose the *most appropriate answer* from the options given below:

(1) Statement I is correct but statement II is incorrect.
(2) Statement I is incorrect but statement II is correct
(3) Both statement I and statement II are incorrect
(4) Both statement I and statement II are correct

Ans. (1)

Sol:-

\(S_1 : S_8 + 12 \text{OH}^{\ominus} \rightarrow 4S^{2-} + 2S_2O_3^{2-} + 6\text{H}_2\text{O}\)

\(S_1 : \text{ClO}_4^{\ominus}\) cannot undergo disproportionation reaction as chlorine is present in it's highest oxidation state.
65. Identify major product ‘P’ formed in the following reaction.

\[ \text{C}_6\text{H}_5 + \text{C}_6\text{H}_5\text{Cl} \xrightarrow{\text{Anhydrous AlCl}_3} \text{P} \] (Major Product)

\( \text{(1)} \) \[ \begin{array}{c}
\text{O} \\
\text{C} \\
\text{O} \\
\text{Cl} \\
\end{array} \]
\( \text{(2)} \) \[ \begin{array}{c}
\text{O} \\
\text{C} \\
\text{H} \\
\end{array} \]
\( \text{(3)} \) \[ \begin{array}{c}
\text{C} \\
\text{O} \\
\text{Cl} \\
\text{Cl} \\
\end{array} \]
\( \text{(4)} \) \[ \begin{array}{c}
\text{C} \\
\text{O} \\
\text{H} \\
\end{array} \]

Ans. (4)

Sol:-

66. Major product of the following reaction is –

\[ \text{D} - \text{Cl} \]

\( \text{(1)} \) \[ \begin{array}{c}
\text{C} \\
\text{H} \\
\text{D} \\
\text{CH}_3 \\
\end{array} \]
\( \text{(2)} \) \[ \begin{array}{c}
\text{C} \\
\text{H} \\
\text{D} \\
\text{Cl} \\
\end{array} \]
\( \text{(3)} \) \[ \begin{array}{c}
\text{C} \\
\text{H} \\
\text{C} \\
\text{D} \\
\end{array} \]
\( \text{(4)} \) \[ \begin{array}{c}
\text{C} \\
\text{H} \\
\text{D} \\
\text{Cl} \\
\end{array} \]

Ans. (3 or 4)

Sol:-
67. Identify structure of 2,3-dibromo-1-phenylpentane.

Ans. (3)

Sol:-

2, 3-dibromo -1-phenylpentane

68. Select the option with correct property -

(1) \([\text{Ni(CO)}_4] \) and \([\text{NiCl}_4]^{2-}\) both diamagnetic

(2) \([\text{Ni(CO)}_4] \) and \([\text{NiCl}_4]^{2-}\) both paramagnetic

(3) \([\text{NiCl}_4]^{2-}\) diamagnetic, \(\chi = \frac{1}{2}\) paramagnetic

(4) \([\text{Ni(CO)}_4] \) diamagnetic, \([\text{NiCl}_4]^{2-}\) paramagnetic

Ans. (4)

Sol:- \([\text{Ni(CO)}_4] \) diamagnetic, \(\text{sp}^3\) hybridisation, number of unpaired electrons = 0

\([\text{NiCl}_4]^{2-}\), paramagnetic, \(\text{sp}^3\) hybridisation, number of unpaired electrons = 2
69. The azo-dye (Y) formed in the following reactions is Sulphanilic acid + NaNO₂ + CH₃COOH → X

\[
X + \begin{array}{c}
\text{NH}_2 \\
\end{array} \rightarrow Y
\]

\[
\text{HSO}_3 - N = N \overset{\text{SO}_3 H}{-} N = N \overset{\text{SO}_3 H}{-} \overset{\text{NH}_2}{-}
\]

1. \[
\text{HO}_3 S - N = N \overset{\text{NH}_2}{-}
\]

2. \[
\text{HO}_3 S - N = N
\]

3. \[
\text{HSO}_3 - N = N \overset{\text{NH}_2}{-}
\]

4. \[
\text{HSO}_3 - N = N \overset{\text{NH}_2}{-}
\]

Ans. (4)

Sol:-

\[
\text{NH}_2 + \text{NaNO}_2 + \text{CH}_3\text{COOH} \rightarrow \overset{\text{O}}{\text{N = N - O - C - CH}_3}
\]

\[
\overset{\text{O}}{\text{N = N - O - C - CH}_3} \overset{\text{SO}_3 H}{-} \overset{\text{SO}_3 H}{-} \overset{\text{NH}_2}{-}
\]

\[
\overset{\text{O}}{\text{N = N - O - C - CH}_3} \overset{\text{SO}_3 H}{-} \overset{\text{SO}_3 H}{-} \overset{\text{NH}_2}{-} \rightarrow \overset{\text{O}}{\text{N = N - O - C - CH}_3} \overset{\text{SO}_3 H}{-} \overset{\text{SO}_3 H}{-} \overset{\text{NH}_2}{-}
\]

\[
\text{HO}_3 S - N = N \overset{\text{NH}_2}{-}
\]

Red azo-dye

This is known as Griess-Ilosvay test.
70. Given below are two statements:

**Statement I:** Aniline reacts with conc. H₂SO₄ followed by heating at 453-473 K gives p-aminobenzene sulphonic acid, which gives blood red colour in the 'Lassaigne's test'.

**Statement II:** In Friedel - Craft's alkylation and acylation reactions, aniline forms salt with the AlCl₃ catalyst. Due to this, nitrogen of aniline acquires a positive charge and acts as deactivating group.

In the light of the above statements, choose the **correct answer** from the options given below:

1. Statement I is false but statement II is true
2. Both statement I and statement II are false
3. Statement I is true but statement II is false
4. Both statement I and statement II are true

Ans. (4)

71. \( A(\varepsilon) \rightleftharpoons B(\varepsilon) + \frac{C}{2}(\varepsilon) \) The correct relationship between \( K_p, \alpha \) and equilibrium pressure \( P \) is:

(1) \( K_p = \frac{\alpha^{\frac{1}{2}} P^{\frac{1}{2}}}{(2 + \alpha)^{\frac{1}{2}}} \)

(2) \( K_p = \frac{\alpha^{\frac{1}{2}} P^{\frac{1}{2}}}{(2 + \alpha)^{\frac{1}{2}}(1 - \alpha)} \)

(3) \( K_p = \frac{\alpha^{\frac{1}{2}} P^{\frac{3}{2}}}{(2 + \alpha)^{\frac{3}{2}}} \)

(4) \( K_p = \frac{\alpha^{\frac{1}{2}} P^{\frac{3}{2}}}{(2 + \alpha)^{\frac{3}{2}}} \)

Ans. (2)

Sol:-

\[ t = t_{eq} \quad (1 - \alpha) \quad \alpha \quad \frac{\alpha}{2} \]

\[ P_B = \frac{\alpha}{(1 + \frac{\alpha}{2})} P, \quad P_A = \frac{(1 - \alpha)}{(1 + \frac{\alpha}{2})} P, \quad P_C = \frac{\alpha}{2} P \]

\[ K_p = \frac{P_B \cdot P_c^{\frac{1}{2}}}{P_A} \]

\[ = \frac{(\alpha)^{\frac{3}{2}} (P)^{\frac{1}{2}}}{(1 - \alpha)(2 + \alpha)^{\frac{3}{2}}} \]
72. Choose the correct statements from the following
A. All group 16 elements form oxides of general formula EO₂ and EO₃ where E = S, Se, Te and Po. Both the types of oxides are acidic in nature.
B. TeO₂ is an oxidising agent while SO₂ is reducing in nature.
C. The reducing property decreases from H₂S to H₂Te down the group.
D. The ozone molecule contains five lone pairs of electrons.
Choose the correct answer from the options given below:
1. A and D only 2. B and C only
3. C and D only 4. A and B only
Ans. (4)
Sol:- (A) All group 16 elements form oxides of the EO₂ and EO₃ type where E = S, Se, Te or Po.
(B) SO₂ is reducing while TeO₂ is an oxidising agent.
(C) The reducing property increases from H₂S to H₂Te down the group.
(D) have six lone pairs

73. Identify the name reaction.

(1) Stephen reaction
(2) Etard reaction
(3) Gatterman-koch reaction
(4) Rosenmund reduction
Ans. (3)
Sol:-

74. Which of the following is least ionic?
(1) BaCl₂  
(2) AgCl
(3) KCl  
(4) CoCl₂
Ans. (2)
Sol:- AgCl < CoCl₂ < BaCl₂ < KCl (ionic character)
Reason: Ag⁺ has pseudo inert gas configuration.
75. The fragrance of flowers is due to the presence of some steam volatile organic compounds called essential oils. These are generally insoluble in water at room temperature but are miscible with water vapour in vapour phase. A suitable method for the extraction of these oils from the flowers is -

1. crystallisation
2. distillation under reduced pressure
3. distillation
4. steam distillation

Ans. (4)

Sol:- Steam distillation technique is applied to separate substances which are steam volatile and are immiscible with water.

76. Given below are two statements:

Statement I: Group 13 trivalent halides get easily hydrolyzed by water due to their covalent nature.

Statement II: AlCl₃ upon hydrolysis in acidified aqueous solution forms octahedral \( \left[ Al(H₂O)_₆ \right]^{3+} \) ion.

In the light of the above statements, choose the correct answer from the options given below:

1. Statement I is true but statement II is false
2. Statement I is false but statement II is true
3. Both statement I and statement II are false
4. Both statement I and statement II are true

Ans. (4)

Sol:- In trivalent state most of the compounds being covalent are hydrolysed in water. Trichlorides on hydrolysis in water form tetrahedral \( \left[ M(OH)_₄ \right]^{-} \) species, the hybridisation state of element M is sp³.

In case of aluminium, acidified aqueous solution forms octahedral \( \left[ Al(H₂O)_₆ \right]^{3+} \) ion.

77. The four quantum numbers for the electron in the outer most orbital of potassium (atomic no. 19) are

(1) \( n = 4, \ l = 2, \ m = -1, \ s = +\frac{1}{2} \)  
(2) \( n = 4, \ l = 0, \ m = 0, \ s = +\frac{1}{2} \)

(3) \( n = 3, \ l = 0, \ m = 1, \ s = +\frac{1}{2} \)  
(4) \( n = 2, \ l = 0, \ m = 0, \ s = +\frac{1}{2} \)

Ans. (2)

Sol:- \(^{19}\text{K} \) \( 1s^2, 2s^2, 2p^6, 3s^2, 3p^6, 4s^1 \).

Outermost orbital of potassium is 4s orbital

\( n = 4, l = 0, m_l = 0, s = \pm \frac{1}{2} \).
78. Choose the correct statements from the following
A. \( \text{Mn}_2\text{O}_7 \) is an oil at room temperature
B. \( \text{V}_2\text{O}_4 \) reacts with acid to give \( \text{VO}_2^{2+} \)
C. \( \text{CrO} \) is a basic oxide
D. \( \text{V}_2\text{O}_5 \) does not react with acid

Choose the correct answer from the options given below:
1. A, B and D only
2. A and C only
3. A, B and C only
4. B and C only

Ans. (2)
Sol:-
(A) \( \text{Mn}_2\text{O}_7 \) is green oil at room temperature.
(B) \( \text{V}_2\text{O}_4 \) dissolve in acids to give \( \text{VO}_2^{2+} \) salts.
(C) \( \text{CrO} \) is basic oxide
(D) \( \text{V}_2\text{O}_5 \) is amphoteric it reacts with acid as well as base.

79. The correct order of reactivity in electrophilic substitution reaction of the following compounds is:

\begin{align*}
\text{A} & \quad \text{CH}_3 \\
\text{B} & \quad \text{Cl} \\
\text{C} & \quad \text{NO}_2 \\
\text{D} & \quad \text{Cl} 
\end{align*}

1. B > C > A > D
2. D > C > B > A
3. A > B > C > D
4. B > A > C > D

Ans. (4)
Sol:-
\( \text{CH}_3 \) shows \(+M\) and \(+I\).
\( \text{Cl} \) shows \(+M\) and \(-I\) but inductive effect dominates.
\( \text{NO}_2 \) shows \(-M\) and \(-I\).

Electrophilic substitution \( \alpha \)
\[
\begin{align*}
\frac{1}{-M \text{ and } -I} & \\
\alpha + M \text{ and } +I 
\end{align*}
\]

Hence, order is \( B > A > C > D \).
80. Consider the following elements. [Periodic table]

Group ↓

A'B' → Period
C'D'

Which of the following is/are true about A', B', C' and D'?

A. Order of atomic radii: B'<A'<D'<C'
B. Order of metallic character: B'<A'<D'<C'
C. Size of the element: D'<C'<B'<A'
D. Order of ionic radii: B'^+ < A'^+ < D'^+ < C'^+

Choose the correct answer from the options given below:

1. A only  
2. A, B and D only  
3. A and B only  
4. B, C and D only  

Ans. (2)

Sol:-
In general along the period from left to right, size decreases and metallic character decrease. In general down the group, size increases and metallic character increases.

B' < A' (size)  C' > A' (size)
D' < C' (size)  D' > B' (size)
B' < A' (metallic character)
D' < C' (metallic character)
B'^+ < A'^+ (size)
D'^+ < C'^+ (size)

∴ C statement is incorrect.

SECTION-B

81. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1Å, then fractional charge on each atom is ______ ×10⁻¹ esu.

(Given 1 D = 10⁻¹⁸ esu cm)

Ans. (0)

Sol:-
μ = 1.2 D = q × d

⇒ 1.2 × 10⁻¹₀ esu Å = q × 1Å

∴ q = 1.2 × 10⁻¹₀ esu
82. $r = k[A]$ for a reaction, 50% of A is decomposed in 120 minutes. The time taken for 90% decomposition of A is ______ minutes.

**Ans.** (399)

**Sol:**

So, order of reaction = 1

$t_{1/2} = 120$ min

For 90% completion of reaction

$$k = \frac{2.303}{t} \log \left( \frac{a}{a - x} \right)$$

$$\Rightarrow \frac{0.693}{t_{1/2}} = \frac{2.303}{t} \log \left( \frac{100}{10} \right)$$

:. $t = 399$ min.

83. A compound (x) with molar mass 108 g mol$^{-1}$ undergoes acetylation to give product with molar mass 192 g mol$^{-1}$. The number of amino groups in the compound (x) is ______.

**Ans.** (2)

**Sol:**

Gain in molecular weight after acylation with one $\text{-NH}_2$ group is 42.

Total increase in molecular weight = 84

:. Number of amino group in $x = \frac{84}{42} = 2$

84. Number of isomeric products formed by mono-chlorination of 2-methylbutane in presence of sunlight is _______.

**Ans.** (6)

**Sol:**

Number of isomeric products = 6
85. Number of moles of \( \text{H}^+ \) ions required by 1 mole of \( \text{MnO}_4^- \) to oxidise oxalate ion to \( \text{CO}_2 \) is ____.

Ans. (8)

Sol:- \[ 2\text{MnO}_4^- + 5\text{C}_2\text{O}_4^{2-} + 16\text{H}^+ \rightarrow 2\text{Mn}^{2+} + 10\text{CO}_2 + 8\text{H}_2\text{O} \]

\( \therefore \) Number of moles of \( \text{H}^+ \) ions required by 1 mole of \( \text{MnO}_4^- \) to oxidise oxalate ion to \( \text{CO}_2 \) is 8

86. In the reaction of potassium dichromate, potassium chloride and sulfuric acid (conc.), the oxidation state of the chromium in the product is (+)______.

Ans. (6)

Sol:- \[ \text{K}_2\text{Cr}_2\text{O}_7(\text{s}) + 4\text{KCl}(\text{s}) + 6\text{H}_2\text{SO}_4(\text{conc.}) \rightarrow 2\text{CrO}_2\text{Cl}_2(\text{g}) + 6\text{KHSO}_4 + 3\text{H}_2\text{O} \]

This reaction is called chromyl chloride test.
Here oxidation state of Cr is +6.

87. The molarity of 1L orthophosphoric acid \( (\text{H}_3\text{PO}_4) \) having 70% purity by weight (specific gravity 1.54 g cm\(^{-3}\)) is ______M.

(Molar mass of \( \text{H}_3\text{PO}_4 = 98 \text{ g mol}^{-1} \))

Ans. (11)

Sol:- Specific gravity (density) = 1.54 g/cc.
Volume = 1L = 1000 ml
Mass of solution = 1.54 x 1000
= 1540 g
% purity of \( \text{H}_2\text{SO}_4 \) is 70%
So weight of \( \text{H}_3\text{PO}_4 = 0.7 \times 1540 = 1078 \text{ g} \)
Mole of \( \text{H}_3\text{PO}_4 = \frac{1078}{98} = 11 \)
Molarity = \( \frac{11}{1L} = 11 \)
88. The values of conductivity of some materials at 298.15 K in Sm⁻¹ are 2.1 × 10³, 1.0 × 10⁻¹⁶, 1.2 × 10⁻¹⁰, 3.91, 1.5 × 10⁻², 1.0 × 10⁻⁷, 1.0 × 10³. The number of conductors among the materials is ______.

Ans. (4)
Sol:-

Conductivity (S m⁻¹)

\[
\begin{align*}
2.1 \times 10^3 & \quad \text{conductors at 298.15 K} \\
1.2 \times 10^{-10} & \\
3.91 & \\
1 \times 10^{-3} & \end{align*}
\]

1.0 × 10⁻¹⁶ Insulator at 298.15 K

1.5 × 10⁻²

1.0 × 10⁻¹⁷ Semiconductor at 298.15 K

Therefore number of conductors is 4.

89. From the vitamins A, B₁, B₆, B₁₂, C, D, E and K, the number of vitamins that can be stored in our body is ______.

Ans. (5)
Sol:- Vitamins A, D, E, K and B₁₂ are stored in liver and adipose tissue.

90. If 5 moles of an ideal gas expands from 10 L to a volume of 100 L at 300 K under isothermal and reversible condition then work, w, is −x J. The value of x is ______.

(Given \( R = 8.314 \text{ J K}^{-1}\text{mol}^{-1} \))

Ans. (28721)
Sol:- It is isothermal reversible expansion, so work done negative

\[
W = -2.303 \text{ nRT} \log \left( \frac{V_2}{V_1} \right)
\]

\[
= -2.303 \times 5 \times 8.314 \times 300 \log \left( \frac{100}{10} \right)
\]

\[
= -28720.713 \text{ J}
\]

\( \equiv -28721 \text{ J} \)