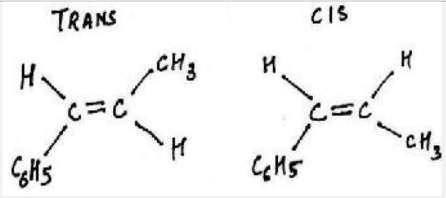
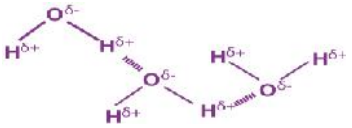
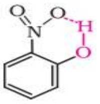
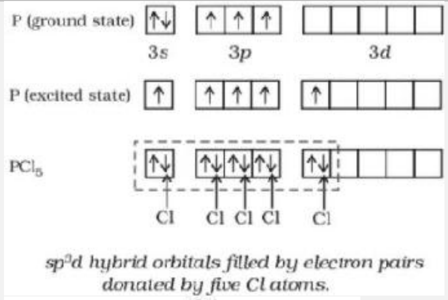
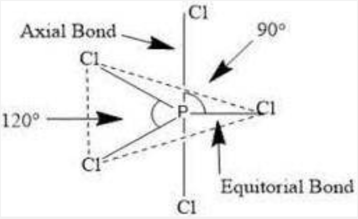
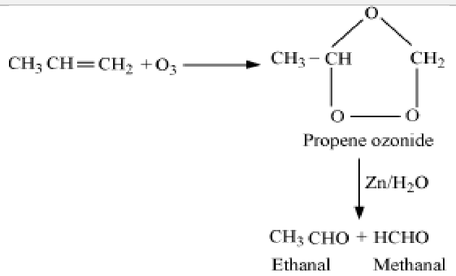
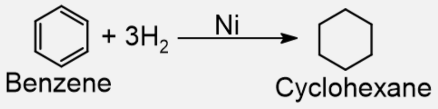
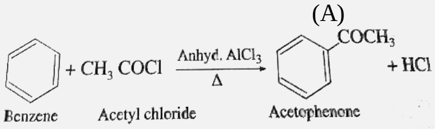
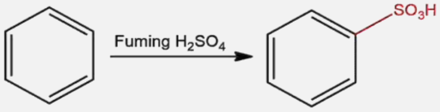
FIRST YEAR HSS MODEL EXAMINATION
FEBRUARY 2023
ANSWER KEY
SSI

<table>
<tr><th>Q No</th><th>Value point</th><th>Mark</th></tr>
<tr><td colspan="3">1 to 5, Any 4 (4 × 1 = 4 Marks)</td></tr>
<tr><td>1</td><td>(d) femto</td><td>1</td></tr>
<tr><td>2</td><td>Unbinilium</td><td>1</td></tr>
<tr><td>3</td><td>$\frac{1}{x}$</td><td>1</td></tr>
<tr><td>4</td><td>Hexane – 2, 5 – dione</td><td>1</td></tr>
<tr><td>5</td><td>Methane</td><td>1</td></tr>
<tr><td colspan="3">6 to 15, Any 8 (8 × 2 = 16 Marks)</td></tr>
<tr><td>6 (i)</td><td>Molarity is volume based and the volume depends on temperature.</td><td>1</td></tr>
<tr><td>(ii)</td><td>Molarity (M) = $\frac{W_B\ x\ 1000}{M_B\ x\ V_{mL}}$
$= \frac{4\ \ x\ 1000}{40\ x\ 250}$ = 0.4 mol/L</td><td>1</td></tr>
<tr><td>7 (i)</td><td>Phenomenon in which electrons are ejected from the surface of a metal when light is incident on it.</td><td>1</td></tr>
<tr><td>(ii)</td><td>Kinetic energy of electrons ejected is proportional to the frequency of light.</td><td>1</td></tr>
<tr><td>8</td><td>It is impossible to determine the exact position and exact velocity of an electron simultaneously.
$\Delta x \times \Delta p \geq \frac{h}{4\pi}$</td><td>1
1</td></tr>
<tr><td>9</td><td>Species with same number of electrons.
N^{3-}, O^{2-}, F^{-}, Ne, Na^{+}, Al^{3+}</td><td>1
1</td></tr>
<tr><td>10</td><td>(1) Grouping of chemically dissimilar elements.
(2) Separation of chemically similar elements
(3) The position of hydrogen
(4) Anomalous pairs</td><td>1
1</td></tr>
<tr><td>11</td><td>The energy of an isolated system is constant.
Mathematical expression: $\Delta U = q + w$</td><td>1
1</td></tr>
<tr><td>12</td><td><table>
<tr><th>Homogeneous equilibrium</th><th>Heterogeneous equilibrium</th></tr>
<tr><td>All reactants and products are in the same phase</td><td>Different phases</td></tr>
<tr><td>$N_2(g) + 3\ H_2(g) \leftrightarrow 2\ NH_3(g)$</td><td>$CaCO_3(s) \leftrightarrow CaO(s) + CO_2(g)$</td></tr>
</table></td><td>1
1</td></tr>
<tr><td>13 (a)</td><td>+ 5</td><td>1</td></tr>
<tr><td>(b)</td><td>– 1</td><td>1</td></tr>
<tr><td>14</td><td>Halogen (X = Cl /Br/ I) containing organic compound is heated with nitric acid and silver nitrate. Halogen is precipitated as silver halide (AgX). From the weight of silver halide, the % of halogen can be calculated.
% of X = $\frac{\text{At.mass of X} \times \text{m} \times 100}{\text{Molecular mass of AgX } \times \text{w}}$
Where m = Mass of AgX formed
w = Weight of organic compound</td><td>1
1</td></tr>
<tr><td>15</td><td>
</td><td>1
1</td></tr>
<tr><td colspan="3">16 to 26, Any 8 (8 × 3 = 24 Marks)</td></tr>
<tr><td>16 (i)</td><td>$2H_2\ (g) + O_2\ (g) \rightarrow 2H_2O(l)$
2 Vol. 1 Vol 2 Vol
12 Vol 6 Vol 12 Vol
The volume of water vapour produced = 12 Vol</td><td>1</td></tr>
<tr><td>(ii)</td><td><table>
<tr><th>Elements</th><th>Atomic ratio</th><th>Simplest ratio</th><th>Simple whole number ratio</th></tr>
<tr><td>C</td><td>$\frac{67.9}{12}$ = 5.65</td><td>$\frac{5.65}{1.88}$ = 3</td><td>3</td></tr>
<tr><td>H</td><td>$\frac{5.70}{1}$ = 5.70</td><td>$\frac{5.70}{1.88}$ = 3.03</td><td>3</td></tr>
<tr><td>N</td><td>$\frac{26.4}{14}$ = 1.88</td><td>$\frac{1.88}{1.88}$ = 1</td><td>1</td></tr>
<tr><td colspan="4">Empirical formula = C_3H_3N</td></tr>
</table></td><td>1
1</td></tr>
<tr><td>17</td><td>$\Delta E = 2.18 \times 10^{-18} [\frac{1}{n_1^2} - \frac{1}{n_2^2}]$
$h\boldsymbol{\upsilon} = 2.18 \times 10^{-18} [\frac{1}{4} - \frac{1}{25}]$
$\boldsymbol{\upsilon} = 3.29 \times 10^{15} [\frac{1}{4} - \frac{1}{25}]\ s^{-1}$
$\boldsymbol{\upsilon} = 3.29 \times 10^{15} [\frac{21}{100}] = 6.909 \times 10^{14}\ s^{-1}$
$\frac{1}{\lambda} = 109677 [\frac{1}{n_1^2} - \frac{1}{n_2^2}]\ cm^{-1}$
$n_1 = 2, n_2 = 5$
$\frac{1}{\lambda} = 109677 [\frac{1}{4} - \frac{1}{25}]\ cm^{-1} = 23032.2\ cm^{-1}$
$\lambda = 4.34 \times 10^{-5}$ cm = 434 nm</td><td>1
½
1
½</td></tr>
<tr><td>18</td><td>The energy required to remove an electron from an isolated gaseous atom in its ground state.
Trend: Along a period, ionization enthalpy increases -
Due to decrease in size and increase in nuclear charge.
Down in a group, ionization enthalpy decreases –
Due to increase in size.</td><td>1
½
½
½
½</td></tr>
<tr><td>19</td><td>The attractive force which binds hydrogen atom of one molecule with the electro-negative atom like F, O or N of another molecule.</td><td>1</td></tr>
</table>

	1. Intermolecular hydrogen bond – Hydrogen bond formed between two Same or different molecules. Eg. Between H_2O, between alcohol and H_2O  2. Intramolecular hydrogen bond – Hydrogen bond formed within the same molecules.  Eg. Ortho – nitrophenol.	1 ½ 1 ½
20	  Hybridisation – sp^3d Shape – Triagonal bipyramidal Bond angles – 90^0 and 120^0	3
21	Required equation: $6C_{(graphite)} + 3H_2(g) \rightarrow C_6H_6(l); \Delta H^0_f = ?$ $C_{(graphite)} + O_2(g) \rightarrow CO_2(g)$ $\Delta H^0 = -393.5\ kJ\ mol^{-1}$ ……. (1) $H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)$ $\Delta H^0 = -285.83\ kJ\ mol^{-1}$ ……. (2) $C_6H_6(l) + 15/2\ O_2(g) \rightarrow 6CO_2(g) + 3H_2O(l);$ $\Delta H^0 = -3267.0\ kJ\ mol^{-1}$ …… (3) Required equation is obtained by 6 × (1) + 3 × (2) – (3) $6C_{(graphite)} + 3H_2(g) \rightarrow C_6H_6(l);$ $\Delta H^0_f = 48.51\ kJ\ mol^{-1}$	1 1 1
22 (i) (ii)	$K_c = \frac{[B]^2[C]}{[A]^2}$ $K_P = K_C\ (RT)^{\Delta n}$ $\mid \Delta n = 3 - 2 = 1$ $K_P = 3.8 \times 10^{-6} (0.0821 \times 1070)^1$ $K_P = 333.8$ atm	1 1 1
23	Step 1. $MnO_4^-(aq) + Br^-(aq) \longrightarrow MnO_2(s) + BrO_3^-(aq)$ Change in oxidation state of Mn, +7 to + 4, so 3 equivalents, change in oxidation state of two Br, – 1 to +5, so it is 6 equivalents. (3:6 = 1:2)	

	Step 2. $2MnO_4^-(aq) + Br^-(aq) \longrightarrow 2MnO_2(s) + BrO_3^-(aq)$ Step 3. $2MnO_4^-(aq) + Br^-(aq) \longrightarrow 2MnO_2(s) + BrO_3^-(aq) + H_2O$ Step 4. $2MnO_4^-(aq) + Br^-(aq) + 2H_2O \longrightarrow 2MnO_2(s) + BrO_3^-(aq) + H_2O + 2OH^-(aq)$ Step 5. $2MnO_4^-(aq) + Br^-(aq) + H_2O \longrightarrow 2MnO_2(s) + BrO_3^-(aq) + 2OH^-(aq)$	1 1 1
24 (i) (ii)	Electrophiles: Electron deficient species attack at electron rich centre (Lewis acid). Eg. Cl^+, ACl_3 Nucleophiles: Electron rich species attack at electron deficient centre (Lewis base). Eg. CN^-, NH_3	1 1 1
25 (i)	Markovnikov rule: When an unsymmetric reagent is added to an unsymmetric alkene, the negative part of the addendum gets attached to the carbon containing lesser number of hydrogen atom. $CH_3\text{-}CH{=}CH_2 + HBr \rightarrow CH_3\text{-}CHBr\text{-}CH_3$ 2 - Bromo propane	1 1
(ii)	 	1
26	 (A)  (B)  Benzene sulphonic acid (C)	1 1 1
	27 to 31, Any 4 (4 × 4 = 16 Marks)	
27 (i)	A set of integers used to represent the energy, position, orientation and spin of electron in an atom. 1. Principal quantum number (n) 2. Azimuthal quantum number (*l*)	1

<table>
<tr><td></td><td>3. Magnetic quantum number (m)
4. Spin quantum number (s).
1. Principal quantum number (n):
It gives the main energy level. It also gives the distance of electron from the nucleus. n = 1, 2, 3, 4 ……
2. Azimuthal quantum number (l): It gives sub shell. l = 0 to (n – 1) values.
It also gives orbital angular momentum of electron.
When n = 1, l = 0 (s – sub shell)
When n = 2, l = 0, 1 (s and p – sub shell)
When n = 3, l = 0, 1, 2
(s, p and d – sub shell)
When n = 4, l = 0, 1, 2, 3
(s, p, d and f – sub shell)</td><td>1
1</td></tr>
<tr><td>(ii)</td><td>3p < 4s < 3d < 4p</td><td>1</td></tr>
<tr><td>28 (i)
(ii)</td><td>MO configuration of N_2 (14 electrons) is:
$\boldsymbol{\sigma 1s^2\ \sigma^*1s^2\ \sigma 2s^2\ \sigma^*2s^2\ \pi 2px^2 = \pi 2py^2\ \sigma 2pz^2}$
Bond order (B.O) = ½ [N_b – N_a]
= ½ [10 – 4] = 3
N_2 is diamagnetic, due to the absence of unpaired electron.</td><td>2
1
1</td></tr>
<tr><td>29 (i)</td><td>The maximum amount of energy available to a system during a process that can be converted into useful work.</td><td>1</td></tr>
<tr><td>(ii)</td><td>G = H – TS</td><td>1</td></tr>
<tr><td>(iii)</td><td><table>
<tr><td>ΔH</td><td>ΔS</td><td>ΔG
(ΔG = ΔH – TΔS)</td><td>Description</td></tr>
<tr><td>(+)</td><td>(+)</td><td>(–)</td><td>Spontaneous high T</td></tr>
<tr><td>(+)</td><td>(–)</td><td>(+)</td><td>Non - spontaneous at all T</td></tr>
</table></td><td>1
1</td></tr>
<tr><td>30 (i)</td><td>Solutions which resist the change in p^H on addition of smallamount of acid or alkali.
Eg. Acidic buffer: An equimolar mixture c weak acid and its conjugate salt.
Eg. An equimolar mixture of acetic acid ar sodium acetate.
Basic buffer: An equimolar mixture of a w base and its conjugate salt.
Eg. An equimolar mixture of NH_4OH and NH_4Cl.</td><td>1
1
1</td></tr>
<tr><td>(ii)</td><td>pH of a buffer solution does not change on dilution.
On dilution, due to buffer action the ratio of concentration of salt and acid or base remains unchanged.</td><td>1</td></tr>
<tr><td>(iii)</td><td>The suppression of degree of dissociation of a weak electrolyte by the addition of a strong electrolyte containing a common ion.
(Application of Common ion effect:
1. Purification of impure NaCl by using HCl
2. Salting out of soap from glycerol by using NaCl.)</td><td>1</td></tr>
</table>

<table>
<tr><td>31
(i)</td><td>The polarity induced in a molecule by the interaction of a lone pair of electrons with a pi bond or the interaction of two pi bonds.</td><td>1</td></tr>
<tr><td>31(ii)</td><td><table>
<tr><td>+ R Effect</td><td>– R Effect</td></tr>
<tr><td>Resonance effect which increases the electron density in a conjugated system with activating group.
Eg. - OH, - OR, - NH_2, - F, - Cl etc.</td><td>Resonance effect which decreases the electron density in a conjugated system with deactivating group.
Eg. - NO_2, - CN, - COOH etc.</td></tr>
</table></td><td>2</td></tr>
<tr><td>(iii)</td><td>+ R Effect: - OH</td><td>1½</td></tr>
<tr><td></td><td>**SUJITH**</td><td></td></tr>
</table>