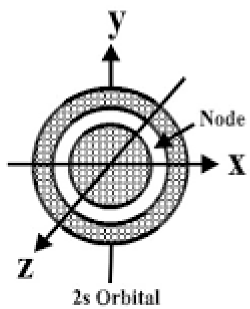
FIRST YEAR HIGHER SECONDARY EXAMINATION JUNE 2022

CHEMISTRY - *ANSWER KEY (Unofficial)* *Question Code: FY 25*

<table>
<tr><th>Qn. No.</th><th>Sub Qns.</th><th>Answer Key/Value Points</th><th>Score</th><th>Total</th></tr>
<tr><td colspan="5">Answer any 8 questions from 1 to 11. Each carry 2 scores</td></tr>
<tr><td>1.</td><td>(i)

(ii)</td><td>(A) n = 1, l = 0, m = 0, s = + ½


</td><td>1

1</td><td>2</td></tr>
<tr><td>2.</td><td></td><td>From the de Broglie's equation,
$\lambda = \frac{h}{mv}$
Here m = 9.1×10^{-31} kg and v = 10 m/s
So, $\lambda = \frac{6.626 \times 10^{-34}}{(9.1 \times 10^{-31} \times 10)}$ = <u>7.281×10^{-5} m</u></td><td>1

1</td><td>2</td></tr>
<tr><td>3.</td><td></td><td>According to Fajans rule, the smaller the size of the cation and the larger the size of the anion, the greater the covalent character of an ionic bond. So LiCl shows covalent character.
OR,
In LiCl, the size of the cation, Li^+ ion is small and that of the anion, Cl^- is large. So it shows covalent character.</td><td>2</td><td>2</td></tr>
<tr><td>4.</td><td></td><td><table>
<tr><th>Molecule</th><th>Hybridisation of central atom</th><th>Shape of molecule</th></tr>
<tr><td>CH_4</td><td>sp^3</td><td>Tetrahedral</td></tr>
<tr><td>BF_3</td><td>sp^2</td><td>Trigonal planar or,
Planar triangular</td></tr>
<tr><td>SF_6</td><td>sp^3d^2</td><td>Octahedral</td></tr>
</table></td><td>½ x 4</td><td>2</td></tr>
<tr><td>5.</td><td></td><td>Oxidising agent: HCl

Reducing agent: Zn</td><td>1

1</td><td>2</td></tr>
</table>

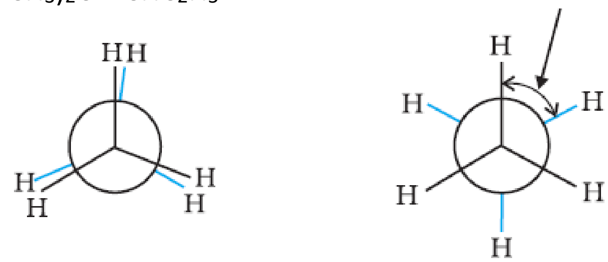
6.		Heavy water is Deuterium Oxide (D_2O). It is used as moderator in Nuclear reactors. It is also used for the study of reaction mechanism. [Any one use is required]	1 1	2
7.		**Column A** / **Column B** (a) $Na_2CO_3.10H_2O$ — (iii) Forms soda ash on heating (b) $NaHCO_3$ — (iv) Used in fire extinguishers (c) $Ca(OH)_2$ — (ii) Preparation of bleaching powder (d) $CaSO_4$. ½ H_2O — (i) Forms plastic mass when water is added.	4 x ½	2
8.		In Diamond, each carbon atom is in sp^3 hybridisation and hence it has a three dimensional net-work structure. So it is hard. Due to the absence of free electrons, it is a non- conductor. But in graphite, each carbon atom is in sp^2 hybridisation. Hence it has a layered structure, in which there is only a weak van der Waal's force of attraction between different layers. So it is soft. Due to the presence of free electrons, it is a conductor of electricity.	1 1	2
9.	(i) (ii)	2,5,6-Trimethyloctane 5-Oxohexanoic acid	1 1	2
10.		A reagent that takes away an electron pair is called an electrophile. Or, electrophiles are electron deficient species attack at electron rich centre. E.g. carbocations (R^+), -CHO, >CO etc.[Any ***one*** example is required] A reagent that brings an electron pair is called a nucleophile. Or, nucleophiles are electron rich species attack at electron deficient centre. E.g. OH^- , CN^- , NO_2^- , Cl^- , Br^- , I^- , H_2O [Any ***one*** example is required]	1 1	2
11.		When the p^H of the rain water is below 5.6, it is called acid rain. The harmful effects of acid rain are: • Acid rain is harmful for agriculture, trees and plants. • It causes respiratory ailments and skin cancer in human beings and animals. • It affects plants and animal life in aquatic ecosystem. • It corrodes water pipes resulting in the dissolution of heavy metals into the drinking water. • Acid rain damages buildings and other structures made of stone or metal. [Any ***1*** required]	2	2
		Answer any 8 questions from 12 to 23. Each carry 3 scores		
12.	(i) (ii)	2 Law of Multiple proportions states that if two elements combine to form more than one compound, the different masses of one of the elements that combine with a fixed mass of the other element, are in small whole number ratio. Illustration: Hydrogen combines with oxygen to form two compounds – water and hydrogen peroxide. $H_2 + ½ O_2 \rightarrow H_2O$ 2g 16g 18g $H_2 + O_2 \rightarrow H_2O_2$ 2g 32g 34g Here, the masses of oxygen (i.e. 16 g and 32 g) which combine with a fixed mass of	1 1 1	3

		hydrogen (2g) bear a simple ratio, i.e. 16:32 or 1: 2.		
13.	(i) (ii)	Number of moles of H_2 = $\frac{\text{Given mass in gram}}{\text{Molar mass}} = \frac{3}{2}$ = 1.5 mol Number of moles of O_2 = $\frac{\text{Given mass in gram}}{\text{Molar mass}} = \frac{30}{32}$ = 0.9375 mol $H_2 (g) + ½ O_2 (g) \longrightarrow H_2O (g)$ 2g 16g 18g According to the equation, 2g H_2 ≡ 16g O_2 So, 3g H_2 ≡ $\frac{16 \times 3}{2}$ = 24 g O_2 3g H_2 reacts with 24g O_2. So H_2 is completely used up and hence it is the limiting reagent. Amount of water produced = 3 + 24 = **27 g**	1 1 1	3
14.	(i) (ii)	(B) $ns^2 np^3$ Atomic radius increases from top to bottom in a group. This is due to increase in the no. of shells and screening effect from top to bottom in a group.	1 1 1	3
15.	(i) (ii) (iii)	Electronegativity of an atom in a compound is the ability of the atom to attract shared pair of electrons. Pauling scale, Mulliken-Jaffe scale, Allred-Rochow scale [Any ***1*** required] Fluorine (F)	1 1 1	3
16.		According to Boyle's law: $V \alpha 1/P$ (At constant T and n) According to Charles' Law: $V \propto T$ (At constant p and n) According to Avogadro Law: $V \propto n$ (At constant p and T) On combining these three laws we get: $V \propto n \times T \times 1/P$ Or, $V = R \times n \times T \times 1/P$ (where R is a constant called universal gas constant) Or, $PV = nRT$ This equation is known as ideal gas equation.	3	3
17.	(i) (ii)	Critical temperature of a gas is highest temperature at which liquifaction of the gas first occurs. OR, It is the temperature below which a gas can be liquified by the application of pressure. B can be easily liquified. This is because B has the highest critical temperature. The higher the critical temperature, higher is the intermolecular force of attraction and easier is the liquefaction of the gas.	1 1 1	3
18.	(i) (ii)	(D) $\Delta U \neq 0$ Work done (w) = $-p.\Delta V$ $= - p (V_2 – V_1)$ = - 1 (10 – 2) = **- 8 litre-atm** i.e. 8 litre-atm work is done by the system.	1 1 1	3
19.	(i) (ii)	Back-ward direction OR, from right to left. $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g)$; ΔH = -92.38 kJ/mol Here, the forward reaction is no. of moles decreasing reaction. So high pressure	1 1	3

		favours the forward reaction. (High pressure favours the formation of NH_3). Here the forward reaction is exothermic. So low temperature favours the forward reaction (formation of ammonia).	1	
20.		Since the method is not specified, we can use either oxidation number method or half reaction method. Oxidation number method: *Step 1: The skeletal equation is:* $Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$ *Step 2: Assign oxidation number each element and identify the elements undergoing change in oxidation number.* +2 +6 -2 +3 +3 $Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$ *Step 3: Calculate the change in oxidation number and make them equal by multiplying with suitable number. Here the oxidation number of Cr is decreased by 3 and that of Fe is increased by 1. In order to equate them multiply* Fe^{2+} *by 6.* $6\ Fe^{2+} + Cr_2O_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$ *Step 4: Now balance all the atoms except Oxygen and Hydrogen* $6\ Fe^{2+} + Cr_2O_7^{2-} \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+}$ *Step 5: Now balance the ionic charges on both sides. Here the net ionic charge on LHS is* +10 and on *RHS is +24. To equate them add* $14\ H^+$ *on LHS, since the reaction takes place in acidic medium.* $6\ Fe^{2+} + Cr_2O_7^{2-} + 14\ H^+ \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+}$ *Step 6: Now balance hydrogen atoms by adding sufficient number of* H_2O *molecules. Here add 7* H_2O *molecules on RHS.* $6\ Fe^{2+} + Cr_2O_7^{2-} + 14\ H^+ \rightarrow 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$ OR, Half Reaction Method: *Ans: Step-1: Assign the oxidation number of each element and find out the substance oxidised and reduced.* +2 +6 +3 +3 $Fe^{2+} + Cr_2O_7^{2-} \longrightarrow Fe^{3+} + Cr^{3+}$ *Here Fe is oxidised and Cr is reduced.* *Step-2: Separate the equation into 2 half reactions -oxidation half reaction and reduction half reaction.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} \longrightarrow Cr^{3+}$ *Step-3: Balance the atoms other than O and H in each half reaction individually.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} \longrightarrow 2\ Cr^{3+}$ *Step-4: Now balance O and H atoms. Add* H_2O *to balance O atoms and* H^+ *to balance H atoms since the reaction occurs in acidic medium.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+}$ *Reduction half:* $Cr_2O_7^{2-} + 14H^+ \longrightarrow 2\ Cr^{3+} + 7\ H_2O$ *Step -5: Now balance the ionic charges. For this add electrons to one side of the half reaction.* *Oxidation half:* $Fe^{2+} \longrightarrow Fe^{3+} + e^-$ *Reduction half:* $Cr_2O_7^{2-} + 14H^+ + 6\ e^- \longrightarrow 2\ Cr^{3+} + 7\ H_2O$ *Step-6: Now add the two half reactions after equating the electrons.* *Oxidation half:* $(Fe^{2+} \longrightarrow Fe^{3+} + e^-) \times 6$ *Reduction half:* $(Cr_2O_7^{2-} + 14H^+ + 6\ e^- \longrightarrow 2\ Cr^{3+} + 7\ H_2O) \times 1$ *Overall reaction is:* $6\ Fe^{2+} + Cr_2O_7^{2-} + 14H^+ \longrightarrow 6\ Fe^{3+} + 2\ Cr^{3+} + 7\ H_2O$ *Now the equation is balanced.*	3	3
21.		Hydrides are classified into three: i) ***Ionic or saline or salt-like hydrides:*** These are formed by s-block elements. They are crystalline, non-volatile solids and conduct electricity in the molten state or in aqueous solution state. E.g. NaH, KH, CaH_2, BaH_2 etc. ii) ***Covalent or Molecular Hydrides:*** These are the hydrides of p-block elements. They are volatile compounds and non-conductors of electricity. E.g. CH_4, NH_3,	1 1	3

<table>
<tr><td></td><td></td><td>H_2O and HF.
iii) Metallic or interstitial Hydrides: These are formed by d-block and f-block elements. They are almost nonstoichiometric, conduct heat and electricity.
E.g. $LaH_{2.87}$, $YbH_{2.55}$, $TiH_{1.5–1.8}$, $ZrH_{1.3–1.75}$, $VH_{0.56}$, $NiH_{0.6–0.7}$, $PdH_{0.6–0.8}$ etc.
[Any one example is required from each category]</td><td>1</td><td></td></tr>
<tr><td>22.</td><td>(i)

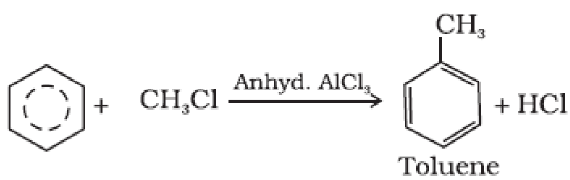
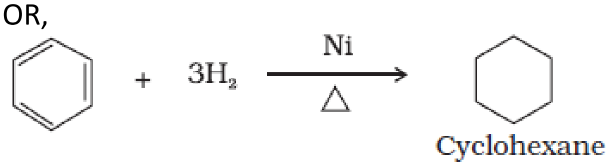
(ii)</td><td>(D) $CH_3)_2C = CHC_2H_5$


(i) Eclipsed   (ii) Staggered</td><td>1

2</td><td>3</td></tr>
<tr><td>23.</td><td>(i)
(ii)</td><td>(C) Nitrate
<table>
<tr><th>Classical Smog</th><th>Photochemical Smog</th></tr>
<tr><td>It occurs in cool and humid climate.</td><td>It occurs in warm, dry and sunny climate</td></tr>
<tr><td>The main components are smoke, fog and sulphur dioxide.</td><td>The main components are oxides of nitrogen, unburnt hydrocarbons, formaldehyde etc.</td></tr>
<tr><td>It is a reducing smog.</td><td>It is an oxidizing smog</td></tr>
</table>
[Any 2 differences required]</td><td>1

2</td><td>3</td></tr>
<tr><td colspan="5">Answer any 5 questions from 24 to 31. Each carry 4 scores</td></tr>
<tr><td>24.</td><td></td><td>The important postulates of Bohr model of hydrogen atom are:
(i) The electron in the hydrogen atom can move around the nucleus in circular paths of fixed radius and energy. These paths are called orbits or stationary states or allowed energy states.
(ii) The energy of an electron in an orbit does not change with time. However, when an electron absorbs energy, it will move away from the nucleus.
(iii) The radius of orbits can be given by the equation $r_n = a_0 n^2$ where $a_0 = 52.9$ pm.
(iv) The energy of electron in an orbit is given by the expression: $E_n = -R_H (1/n^2)$, where n = 1,2,3…… and R_H is a constant called Rydberg constant. Its value is 2.18×10^{-18} J.
(v) The frequency of radiation absorbed or emitted when transition occurs between two stationary states that differ in energy by ΔE, is given by:
$\nu = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$
(vi) The angular momentum of an electron is an integral multiple of h/2π.
i.e. $m_e vr = \frac{nh}{2\pi}$
Demerits:
1. It could not explain the fine spectrum of hydrogen atom.
2. It could not explain the spectrum of atoms other than hydrogen.
3. It was unable to explain the splitting of spectral lines in the presence of electric field (Stark effect) and in magnetic field (Zeeman effect).</td><td>3</td><td>4</td></tr>
</table>

		4. It could not explain the ability of atoms to form molecules by chemical bonds. 5. It did not consider the wave character of matter and Heisenberg's uncertainty principle. [***Any 2*** demerits are required]	1	
25.		M.O configuration of N_2 is: $\sigma 1s^2\ \sigma^*1s^2\ \sigma 2s^2\ \sigma^*2s^2\ \pi 2px^2\ \pi 2py^2\ \sigma 2pz^2$. Bond order (B.O) = ½ [Nb – Na] = ½ [10 – 4] = ½ x 6 = 3 N_2 is diamagnetic, due to the absence of unpaired electron.	1 2 1	4
26.	(i) (ii) (iii)	Entropy is the degree of disorderness or randomness of a system. (a) Entropy decreases. This is because in solids, the particles have well-ordered arrangement/due to the closely packed arrangement of particles in solids. (b) Entropy increases. This is because when temperature increases, disorderness increases and hence the entropy increases. Relationship between Entropy and Gibb's energy is: G = H – TS	1 1 1 1	4
27.	(i) (ii) (iii)	(D) BCl_3 Solutions which resist the change in p^H on dilution or with the addition of small amount of acid or alkali are called Buffer solutions. E.g. An equimolar mixture of acetic acid and sodium acetate Or, an equimolar mixture of NH_4OH and NH_4Cl. (A) CH_3-COONa	1 1 1 1	4
28.	(i) (ii)	Similarities between Li and Mg are: • Both Li and Mg are harder but lighter than other elements of the respective group. • They do not form superoxides. • Their carbonates decompose easily on heating to form oxides and CO_2. • Their bicarbonates are stable only in solution. [***Any 2*** required] ***Biological importance of Sodium:*** Na^+ ions participate in the transmission of nerve signals, in regulating the flow of water across the cell membranes and in the transport of sugars and aminoacids. [***Any one*** required] ***Biological importance of Calcium:*** Ca is present in bones and teeth in the form of calcium phosphate. It also plays important roles in neuromuscular function, interneuronal transmission, cell membrane integrity and blood coagulation. [***Any one*** required]	2 1 1	4
29.	(i) (ii) (iii)	On heating, borax first loses water molecules and swells up. On further heating it turns into a transparent liquid, which solidifies into glass like material known as borax bead. OR, $Na_2B_4O_7.10H_2O \xrightarrow{\Delta} Na_2B_4O_7 \xrightarrow{\Delta} 2NaBO_2 + B_2O_3$ (Sodium metaborate) (Boric anhydride) When boric acid is added to water, it behaves as a Lewis acid and accepts one pair of electrons from a hydroxyl ion. OR, $B(OH)_3 + 2H_2O \rightarrow [B(OH)_4]^- + H_3O^+$ Diborane react with ammonia to form $B_2H_6.2NH_3$ which on further heating gives Borazine ($B_3N_3H_6$), commonly known as inorganic benzene. $3B_2H_6 + 6NH_3 \rightarrow 3\ B_2H_6.2NH_3 \rightarrow 2\ B_3N_3H_6 + 12H_2$	2 1 1	4

30.	(i) (ii)	(C) Carius method (a) Sublimation: It is the process of conversion of a solid substance directly to vapour by heating. It is used to separate sublimable compounds from non-sublimable impurities. (b) Crystallisation: It is based on the difference in the solubilities of the compound and the impurities in a suitable solvent. (c) Simple distillation: The principle of this method is that liquids having different boiling points vaporise at different temperatures. The vapours are cooled and the liquids so formed are collected separately.	1 1 1 1	4
31.	(i) (ii)	The major product is 2-bromopropane [CH_3-CHBr-CH_3] and the minor product is 1-bromopropane [CH_3-CH_2-CH_2Br]. OR, CH_3-CH=CH_2 + HBr ⟶ CH_3-CHBr-CH_3 + CH_3-CH_2-CH_2-Br (major) (minor) (a) Toluene (C_6H_5-CH_3) OR,  (b) Cyclohexane (C_6H_{12}) OR, 	2 1 1	4

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