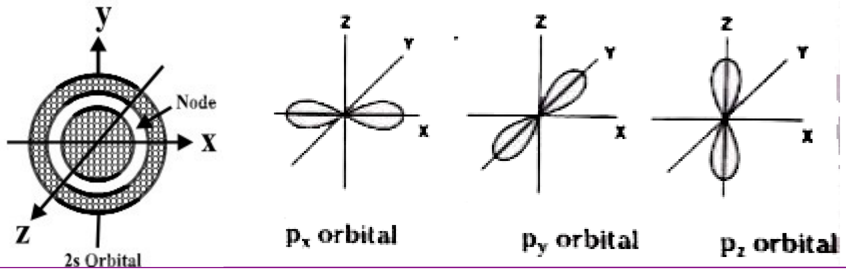
FIRST YEAR HIGHER SECONDARY SECOND TERM EXAMINATION
DECEMBER 2025 - ANSWER KEY

Subject: CHEMISTRY **Qn. Code: FY 3025**

Qn. No.	Sub Qns.	Answer Key/Value Points	Score	Total
		Answer any 4 questions from 1 to 5. Each carries 1 score		
1.		21.6 (1.2 x 18)	1	1
2.		c) 30	1	1
3.		Fluorine (F)	1	1
4.		a) H_2S (CO_2, CCl_4 and BF_3 molecules have zero dipole moment)	1	1
5.		NH_4^+ (Ammonium ion)	1	1
		Answer any 8 questions from 6 to 15. Each carries 2 score		
6.		Law of conservation of mass states that matter can neither be created nor be destroyed. Or, in a chemical reaction, total mass of reactants = total mass of products. Explanation: In the reaction $C_{(s)} + O_{2\,(g)} \rightarrow CO_{2(g)}$ Total mass of reactants = 12 + 32 = 44g Total mass of Product = 44g i.e. Total mass of reactants = Total mass of products OR, any other correct explanation.	1 1	2
7.		This is because molality is temperature independent, while molarity changes with temperature.	2	2
8.			½ x 4 = 2	2
9.		The electronic configuration of Na is: $1s^2\ 2s^2\ 2p^6\ 3s^1$ Here the valence electron is in 3s orbital. For this: n =3, l = 0, m = 0 and s = + ½ or – ½	½ x 4	2
10.	i) ii)	Uue (Ununennium) Metallic character increases along a group and decreases along a period.	1 ½+½	2
11.	i) ii)	These are species having same number of electrons. F- Due to greater electronic repulsion in F^-. OR, lesser effective nuclear charge in F^- (anion).	1 ½ ½	2
12.		2 Cl(g) → Cl_2(g) ΔH is -ve (Here a bond is formed between 2 Cl atoms. Enthalpy of bond formation is -ve) ΔS is -ve (Since the no. of gaseous species decreases during the reaction). ***[But in the question, the state of Cl_2 is not mentioned].***	1 1	2
13.		From Gibbs equation ΔG = ΔH - TΔS At equilibrium, ΔG = 0 So, 0 = ΔH – TΔS Or, ΔH = TΔS So, T = ΔH/ΔS = 45.84/0.999 = 45.89 K. So at 45.89 K, the reaction is at equilibrium.	1 1	2

14.	i)	$K_c = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$ OR, $K_c = \frac{[NO]^4}{[NH_3]^4[O_2]^5}$ [Since concentration of any pure liquid is taken as unity, $[H_2O] = 1$]	1	2
	ii)	When the reaction is reversed, the new equilibrium constant will be the reciprocal of K_c. OR, the new equilibrium constant, $K_c' = 1/K_c$	1	
15.		$MgSO_4(s) \rightleftharpoons Mg^{2+}(aq) + SO_4^{2-}(aq)$ $K_{SP} = S^2$ Here $K_{SP} = 9 \times 10^{-6}$ So, $S = \sqrt{K_{sp}} = \sqrt{(9 \times 10^{-6})} = 3 \times 10^{-3}$ M	 1 1	2
		Answer any 8 questions from 16 to 26. Each carries 3 score		
16.	i)	1 mol is the amount of substance that contains as many particles as there are atoms in exactly 12g C^{12} isotope. OR, it is the amount of substance that contains Avogadro number of particles.	1	3
	ii)	Molar mass of $CuSO_4 = 63.5 + 32 + 4 \times 16 = 159.5$ g mol^{-1} 159.5 g $CuSO_4$ contains 63.5 g Cu So, 79.5 g $CuSO_4$ contains 63.5 x 79.5/159.5 = 31.65 g Cu ***[In the Question, the atomic masses of S and O are wrongly given as 64 and 32 respectively. Their actual atomic masses are 32 and 16 respectively].***	1 1	
17.	i)	The important postulates of Bohr model of hydrogen atom are: 1. 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. 2. 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 and when it emits energy, it will move towards the nucleus. 3. The radius of nth orbit of hydrogen atom can be given by the equation: $r_n = a_0 n^2$, where $a_0 = 52.9$ pm. 4. The energy of electron in the nth orbit of hydrogen atom is given by the expression: $E_n = -R_H(1/n^2)$, where n = 1,2,3…… and $R_H = 2.18 \times 10^{-18}$ J, the Rydberg constant. 5. The frequency of radiation absorbed or emitted when transition occurs between two stationary states that differ in energy by ΔE, is given by: $\nu = \Delta E/h$ 6. The angular momentum of an electron is an integral multiple of $h/2\pi$. i.e. $m_e vr = nh/2\pi$ ***[Any 2 postulates required]***	½ x 2 =1	3
	ii)	The radius of nth orbit, $r_n = 52.9 \times n^2/Z$ pm For Li^{2+} ion, Z = 3 and for 2nd orbit, n = 2 So, $r_2 = 52.9 \times 2^2/3 =$ **70.53 pm** ***[Here the Question is 'Calculate the radius of second orbit of lithium'. But Bohr atom model is applicable only to single electron species like H, He^+, Li^{2+} etc.]***	1 1	
18.	i)	Matter has both particle nature and wave nature. This is known as dual behaviour of matter.	1	3
	ii)	From the de Broglie's equation, $\lambda = h/mv$ $v = \frac{h}{m\lambda} = \frac{6.626 \times 10^{-34} Js}{(9.1 \times 10^{-31} kg \times 7 \times 10^{-7} m)} = 0.104 \times 10^4 ms^{-1}$ $K.E = ½ mv^2$ $= ½ \times 9.1 \times 10^{-31} kg \times (0.104 \times 10^4 ms^{-1})^2 = \mathbf{0.049 \times 10^{-23} J}$	½ ½ ½ ½	
19.	i)	Modern periodic law states that the properties of elements are the periodic functions of their atomic number.	1	3
	ii)	Merits of Mendeleev's periodic table are: 1) It was the first comprehensive classification of elements. 2) He corrected the wrong atomic weights of some elements and placed them in correct position in the periodic table. 3) He left vacant places for undiscovered elements and predicted some of their properties. 4) Elements with similar properties are placed in the same group. ***[Any 2 required]***	2x 1 = 2	

20.		The electronic configuration of Na and Mg are: $_{11}$Na – [Ne] $3s^1$ and $_{12}$Mg - [Ne] $3s^2$ After the removal of one electron, Na gets the stable noble gas configuration. So it has lower first ionization enthalpy. Due to the greater stability of Na^+ ion, it does not readily lose one more electron. So the second ionization enthalpy is higher. OR, Any other correct explanation.	1½ 1½	3
21.		The important postulates of VSEPR theory are: 1) The shape of the molecule depends on the number of valence shell electron pairs (VSEPs) around the central atom. 2) The valence shell electron pairs repel each other. 3) To reduce repulsion, the electron pairs stay at maximum distance. 4) The valence shell is taken as a sphere with the electron pairs locating on the spherical surface at maximum distance from one another. 5) A multiple bond is treated as if it is a single electron pair and the two or three electron pairs of a multiple bond are treated as a single super pair. 6) If a molecule has resonance structures, the VSEPR model is applicable to any such structure. 7) Presence of lone pairs of electron causes distortion in the expected geometry of the molecule. 8) The repulsion between two lone pairs of electrons is different from those between two bond pairs or between a lone pair and bond pair. The repulsion decreases in the order lone pair - lone pair repulsion > lone pair - bond pair repulsion > bond pair - bond pair repulsion. 9) As the angle between the electron pairs increases, the repulsion decreases. ***[Any 3 postulates required]***	3 x 1 = 3	3
22.		In water molecule, there are two lone pairs of electrons and these are occupied in two sp^3 hybrid orbitals. Due to the greater lone pair – lone pair repulsion and lone pair – bond pair repulsion, the shape is distorted to bent structure or angular shape or inverted 'V' shape. OR, Due to the presence of lone pairs of electrons on oxygen atom.	3	3
23.	i)	Hess's law states that the total enthalpy change for a process is the same whether the reaction takes place in a single step or in several steps. Or, the total enthalpy change for a process is independent of the path followed.	1	3
	ii)	The required equation is: $C(graphite) + 2H_2(g) + ½ O_2(g) \rightarrow CH_3OH(l)$ The given data are: $CH_3OH(l) + 3/2 O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$; $\Delta H = -726 \text{ kJ mol}^{-1}$ .... (1) $C(graphite) + O_2(g) \rightarrow CO_2(g)$; $\Delta H = -393 \text{ kJ mol}^{-1}$ .... (2) $H_2(g) + ½ O_2(g) \rightarrow H_2O(l)$; $\Delta H = -286 \text{ kJ mol}^{-1}$ .... (3) On reversing equation (1), we get $CO_2(g) + 2H_2O(l) \rightarrow CH_3OH(l) + 3/2 O_2(g)$; $\Delta H = 726 \text{ kJ mol}^{-1}$ .... (4) On multiplying eqn. (3) by 2, we get $2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$; $\Delta H = -2 \times 286 = -572 \text{ kJ mol}^{-1}$.......................... (5) Add equations (2) + (4) + (5): $C(graphite) + 2H_2(g) + ½ O_2(g) \rightarrow CH_3OH(l)$, $\Delta_fH = -393 + 726 + -572 =$ **-239 kJ mol^{-1}**	1 1	
		OR, Combustion of methanol can be represented by the equation: $CH_3OH(l) + 3/2 O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ The Std. Enthalpy change for this reaction is $\Delta_rH^0 = \sum\Delta_fH^0_{(P)} - \sum\Delta_fH^0_{(R)}$ $= [\Delta_fH^0(CO_2) + 2 \times \Delta_fH^0(H_2O)] - [\Delta_fH^0(CH_3OH) + 3/2 \times \Delta_fH^0(O_2)]$ $-726 = [-393 + 2 \times -286] – [\Delta_fH^0(CH_3OH) + 3/2 \times 0]$ $\Delta_fH^0(CH_3OH) = [-393 – 572] + 726 =$ **-239 kJ mol^{-1}** ***[In the question, enthalpy of combustion of methane is given, but methanol is required].***	1 1	

<table>
<tr><td>24.</td><td>i)
ii)</td><td>Enthalpy of solution is the enthalpy change when one mole of a substance is dissolved in a specified amount of solvent.
Enthalpy of dilution is the enthalpy change when a solution is diluted (i.e. more solvent is added to the solution).</td><td>1½
1½</td><td>3</td></tr>
<tr><td>25.</td><td>
i)

ii)
iii)</td><td>2 $NO_2(g) \rightleftharpoons N_2O_4(g)$; $\Delta H = -52.7$ kJ mol^{-1}
Shifts the reaction to backward direction OR, the rate of forward reaction decreases (Since ΔH is negative).
Rate of forward reaction increases (Since due to forward reaction, no. of molecules decreases)
Rate of forward reaction increases.
<i>[In the Question, the state of N_2O_4 is not given and also the reaction is given as irreversible. Also instead of ΔH, H is given].</i></td><td>1

1
1</td><td>3</td></tr>
<tr><td>26.</td><td>i)

ii)</td><td>$\overset{+3}{Fe}_2O_3 + 3\overset{+2}{C}O \rightarrow 2\overset{0}{Fe} + 3\overset{+4}{C}O_2$
Here there is both increase and decrease in oxidation number (i.e. both oxidation and reduction). So it is a redox reaction.
$4\overset{-3}{N}H_3 + 5\overset{0}{O}_2 \rightarrow 4\overset{+2}{N}O + 6H_2\overset{-2}{O}$
Here there is both increase and decrease in oxidation number (i.e. both oxidation and reduction). So it is a redox reaction.</td><td>1
½
1
½</td><td>3</td></tr>
<tr><td colspan="5">Answer any 4 questions from 27 to 31. Each carries 4 score.</td></tr>
<tr><td>27.</td><td>i)

ii)</td><td>$\text{Mass percent} = \frac{\text{Mass of the element in the compound x 100}}{\text{Molar mass of the compound}}$
$\text{OR, Mass percent} = \frac{\text{Mass of the solute} \times 100}{\text{Mass of solution}}$
<table>
<tr><th>Element</th><th>%</th><th>Atomic mass</th><th>$\frac{\%}{\text{Atomic mass}}$</th><th>Simple ratio</th><th>Simplest whole number ratio</th></tr>
<tr><td>C</td><td>24.27</td><td>12</td><td>24.27/12 = 2.02</td><td>2.02/2.02 = 1</td><td>1</td></tr>
<tr><td>H</td><td>4.07</td><td>1</td><td>4.07/1 = 4.07</td><td>4.07/2.02 = 2</td><td>2</td></tr>
<tr><td>Cl</td><td>71.65</td><td>35.5</td><td>71.65/35.5 = 2.02</td><td>2.02/2.02 = 1</td><td>1</td></tr>
</table>
Empirical Formula = CH_2Cl
Empirical Formula Mass (EFM) = 12 + 2 + 35.5 = 49.5
Molar mass (MM) = 96.96
n = MM/EFM = 96.96/49.5 = 1.96 ≈ 2
Molecular formula = Empirical formula x n
= $(CH_2Cl) \times 2 = C_2H_4Cl_2$</td><td>1
2
½
½</td><td>4</td></tr>
<tr><td>28.</td><td>i)

ii)</td><td>a) Pauli’s Exclusion Principle: It states that no two electrons in an atom can have the same set of four quantum numbers.
OR, an orbital can accommodate a maximum of only 2 electrons with opposite spin.
b) Hund’s Rule of Maximum Multiplicity: It states that electron pairing takes place only after partially filling all the degenerate orbitals.

Energy given = Work function + Kinetic energy
Since the electrons are ejected with zero velocity, K.E of ejected electron = 0
Here wavelength $\lambda = 6800 \text{ A}^0 = 6800 \times 10^{-10}$ m
Threshold frequency $(\nu_0) = c/\lambda$
$= \frac{3 \times 10^8 \text{ ms}^{-1}}{6800 \times 10^{-10} \text{ m}} = \mathbf{4.14 \times 10^{14} \ s^{-1}}$</td><td>1
1
½
½</td><td>4</td></tr>
</table>

		Work function = $h\nu_0$ $= 6.626 \times 10^{-34}$ J s x 4.14 x 10^{14} s^{-1} **= 2.74 x 10^{-19} J**	½ ½	
29.		M.O configuration of N_2 is: $\sigma1s^2$ σ^*1s^2 $\sigma2s^2$ σ^*2s^2 $\pi2px^2$ $\pi2py^2$ $\sigma2pz^2$. Bond order (B.O) = ½ [$N_b - N_a$] = ½ [10 – 4] = ½ x 6 = 3 M.O configuration of F_2 is $\sigma1s^2$ σ^*1s^2 $\sigma2s^2$ σ^*2s^2 $\sigma2pz^2$ $\pi2px^2$ $\pi2py^2$ π^*2px^2 π^*2py^2 Bond order (B.O) = ½ [$N_b - N_a$] = ½ [10 – 8] = ½ x 2 = 1	1 ½ ½ 1 ½ ½	4
30.	i)	A process that takes place without the help of any external agency is called a spontaneous process. Or, it is a process that has a natural tendency to occur OR, a spontaneous process is an irreversible process and may only be reversed by some external agency.	1	4
	ii)	For a spontaneous process ΔG should be negative. OR, $\Delta G < 0$	2	
	iii)	Mathematical expression for first law of Thermodynamics is $\Delta U = q + w$ OR, $\Delta U = q - p\Delta V$	1	
31.	i)	Buffer solutions are solutions which resist the change in pH on dilution or with the addition of small amount of acid or alkali. E.g. An equimolar mixture of acetic acid and sodium acetate around a pH of 4.75. OR, An equimolar mixture of NH_4OH and NH_4Cl around a pH of 9.25. OR, Carbonate – bicarbonate buffer in blood.	1 1	4
	ii)	For an acidic buffer, Henderson – Hasselbalch equation is: $pH = pKa + \log \frac{[salt]}{[acid]}$ Here [acid] = 0.1M, [salt] = 0.5M and Ka = 1.8 x 10^{-6} pKa = -log Ka = - log(1.8 x 10^{-6}) = 5.7447 $pH = pKa + \log \frac{[salt]}{[acid]}$ = 5.7447 + log [0.5]/[0.1] = **6.44**	1 1	

##