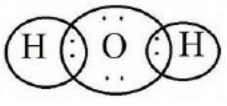
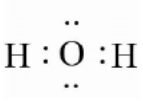
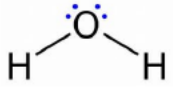
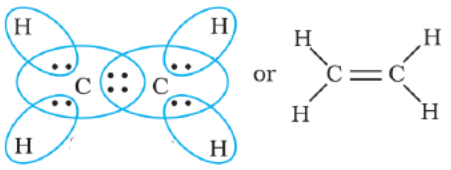
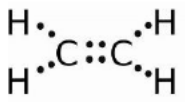
FIRST YEAR HIGHER SECONDARY SECOND TERMINAL EXAMINATION

DECEMBER 2023 – ANSWER KEY

SUBJECT: CHEMISTRY **Qn. Code: FY 25**

Qn. No.	Sub Qns	Answer Key/Value Points	Score	Total
		Answer any 4 questions from 1 to 5. Each carries 1 score		
1.		Goldstein/Rutherford	1	1
2.		Unbitrium	1	1
3.		Tetrahedral	1	1
4.		Isolated system	1	1
5.		c) -1	1	1
		Answer any 8 questions from 6 to 15. Each carries 2 scores		
6.		Molar volume of $CO_{2(g)}$ at STP = 22.4 L Mass of 22.4 L $CO_{2(g)}$ at STP = its molar mass = 44g Or, 44g $CO_{2(g)}$ at STP ≡ 22.4 L So, 8.8g $CO_{2(g)}$ at STP ≡ $\frac{22.4 \times 8.8}{44}$ = **4.48 L** **OR,** Number of moles of $CO_{2(g)}$ = Given mass in gram/Molar mass = 8.8/44 = 0.2 mol Volume of 1 mol of $CO_{2(g)}$ (i.e. molar volume) at STP = 22.4 L So, volume of 0.2 mol $CO_{2(g)}$ at STP = 22.4 x 0.2 = **4.48 L**	1 1 1 1	2
7.		Limitations of Bohr atom model are: 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 could not explain Stark effect and Zeeman effect. 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 required]**	2 x 1 = 2	2
8.		Mendeleev's periodic law states that the properties of elements are the periodic functions of their atomic weights. Modern periodic law states that the properties of elements are the periodic functions of their atomic numbers.	1 1	2
9.	a) b)	Ethane - no. of sigma bonds: 7, no. of pi bonds: 0 Ethene - no. of sigma bonds: 5, no. of pi bonds: 1	1 1	2
10.	a)	 **OR,**  **OR,** 	1	

	b)	 or OR, 	1	2
11.		Extensive properties are properties which depend on the amount of matter or mass present in the system. **OR,** these are properties which change when a system is further divided. E.g. Volume (V), internal energy (U), enthalpy (H) etc. Intensive properties are properties which do not depend on the amount of matter or mass present in the system. **OR,** these are properties which do not change when a system is further divided. E.g. Temperature (T), pressure (p), molar volume (V_m) etc. ***[Example not necessary]***	1 1	2
12.		According to Lewis concept, acids are electron pair acceptors and bases are electron pair donors. Examples for Lewis acid: BF_3, $AlCl_3$, H^+, Co^{3+}, Mg^{2+} etc. Examples for Lewis bases: NH_3, H_2O, R-OH, OH^-, Cl^-, Br^- etc. ***[Any one example required]***	1 1	2
13.		Solution which resists the change in p^H on dilution or with the addition of small amount of acid or alkali is called Buffer solution. E.g. an equimolar mixture of acetic acid and sodium acetate. **OR,** an equimolar mixture of NH_4OH and NH_4Cl. ***[Any one example required]***	1 1	2
14.	a) b)	SnO_2 $Fe_2(SO_4)_3$	1 1	2
15.		The four types of redox reactions are combination reaction, decomposition reaction, displacement reaction and disproportionation reaction.	4 x ½	2
		Answer any 8 questions from 16 to 26. Each carries 3 scores		
16.	a) b)	Limiting reagent is a reagent that is completely consumed (used up) in a reaction. **OR,** it is the reagent that limits a reaction. The chemical equation for the reaction is: $2H_{2(g)} + O_{2(g)} \longrightarrow 2H_2O_{(l)}$ 4g 32g 36g 4g H_2 requires 32g O_2, according to the equation. Here there are 4g H_2 and 64g O_2. So ***H_2*** is completely used up and hence it ***is the limiting reagent***.	1 2	3
17.	a) b)	(i) $_{29}Cu$ - [Ar] $3d^{10}4s^1$ (ii) $_{24}Cr$ - [Ar] $3d^5 4s^1$ Extra stability is due to the presence of completely filled electronic configuration in copper and half-filled electronic configuration in chromium.	1 1 1	3
18.	a) b)	Balmer series $\lambda = \frac{h}{mv}$ Here m = 9.1×10^{-31} kg, v = 1.6×10^6 m/s and h = 6.626×10^{-34} Js So, $\lambda = \frac{6.626 \times 10^{-34}}{9.1 \times 10^{-31} \times 1.6 \times 10^6}$ = **4.55×10^{-10} m OR, 4.55 A^0**	1 1 1	3

19.	a)	Due to the smaller size, electron – electron repulsion is greater in fluorine. So fluorine does not readily add electron. **OR,** In Fluorine, the incoming electron is added to smaller 2p sub-shell, but in Cl, it is added to larger 3p subshell. So electronic repulsion is less in Cl and hence it readily adds electron. So electron gain enthalpy of Cl is more negative than that of fluorine.	1	3
	b)	They are species with same number of electrons.	1	
	c)	Isoelectronic species are: O^{2-}, Mg^{2+}, Na^{+} and F^{-}	1	
20.	a)	Bond order is the number of bonds between 2 atoms in a molecule. **OR,** It is the half of the difference between the number of bonding electrons (N_b) and the number of anti-bonding electrons (N_a). **OR,** Bond order (B.O) = ½ [$N_b - N_a$]	1	3
	b)	Here there is an error in the question. He^{2+}, is not a molecule or molecular ion. So there is no bond and bond order. [The correct question is He_2^{+}. Then B.O = ½] In Li_2^{-}, there are 7 electrons. Its M.O configuration is: Li_2^{-} - $\sigma 1s^2$ $\sigma^* 1s^2$ $\sigma 2s^2$ $\sigma^* 2s^1$ Bond Order = ½ [$N_b - N_a$] = ½ [4 – 3] = ½ x 1 = ½	1 1	
21.	a)	Hybridisation is the process of inter mixing of atomic orbitals having slightly different energies to form new orbitals having equivalent energy and identical shape.	1	3
	b)	A: 1) sp – B: c) Linear 2) sp^2 – e) Trigonal planar 3) sp^3 – b) Tetrahedral 4) sp^3d – a) Trigonal bipyramidal	4 x ½ = 2	
22.		Enthalpy of combustion of methane can be given by: $CH_{4(g)} + 2\ O_{2(g)} \rightarrow CO_{2(g)} + 2\ H_2O_{(l)}$; Δ_cH^0 = ? Given that $\Delta_fH^0(CH_4)$ = -74.85 kJ/mol, $\Delta_fH^0(CO_2)$ = -393.5 kJ/mol and $\Delta_fH^0(H_2O)$ = -286 kJ/mol We know that Δ_rH^0 = sum of the enthalpies of formation of products - sum of the enthalpies of formation of reactants = $\Sigma\ \Delta_fH^0$(products) – $\Sigma\ \Delta_fH^0$(reactants) = [$\Delta_fH^0(CO_2)$ + 2 x $\Delta_fH^0(H_2O)$] – [$\Delta_fH^0(CH_4)$ – 2 x $\Delta_fH^0(O_2)$] = [-393.5 + 2x -286] – [-74.85 + 2 x 0] = **-890.65 kJ/mol**	1 1 1	3
23.	a)	It states that energy can neither be created nor be destroyed. **OR,** The total energy of the universe is always constant. **OR,** The total energy of an isolated system is always constant.	1	3
	b)	Mathematically, $\Delta U = q + w$	1	
	c)	Standard enthalpy of formation is the enthalpy change for the formation of one mole of a compound from its elements in their most stable states of aggregation (or, in the pure form at 1 bar pressure and generally 298K temperature).	1	

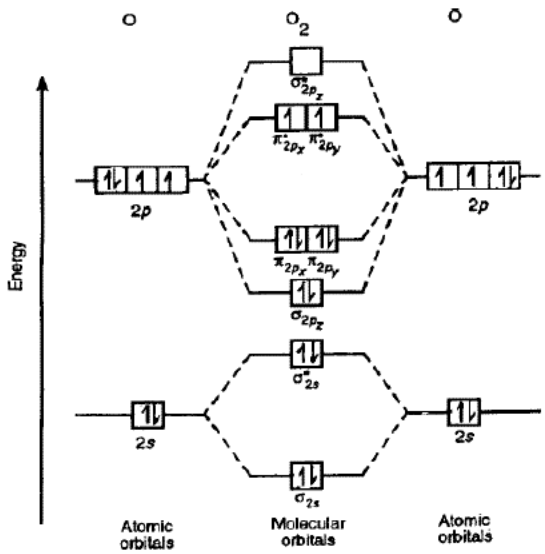
24.	a) b)	For a spontaneous process, ΔG should be negative (OR, ΔG < 0). Here ΔH = 490 kJ/mol = 490 x 10^3 J/mol and ΔS = 198 J/K/mol From Gibbs equation; ΔG = ΔH - TΔS At equilibrium, ΔG = 0 So, 0 = ΔH - TΔS Or, ΔH = TΔS T = ΔH/ΔS = 490 x 10^3/198 = **2474.74 K** At this temperature, the reaction is at equilibrium. Or, above **2474.74K**, the reaction is spontaneous [Since ΔH and ΔS are positive].	1 1 1	3
25.	a) b)	pH is the negative logarithm of hydrogen ion concentration or hydronium ion concentration in mol/L **OR,** pH = -log[H^+] **OR,** pH = -log[H_3O^+] Here [H^+] = 0.01 M = 10^{-2} M pH = -log[H^+] = - log(10^{-2}) = **2**	1 1 1	3
26.	a) b)	1/K **OR,** $K = \frac{[A][B]}{[C][D]}$ $K^{½}$ **OR,** $\sqrt{K}$ **OR,** $K = \frac{[C]^{½}[D]^{½}}{[A]^{½}[B]^{½}}$	1½ 1½	3
		Answer any 4 questions from 27 to 31. Each carries 4 scores		
27.	a) b)	Molecular formula = Empirical formula x n Where n = $\frac{Molar\ mass}{Empirical\ formula\ mass}$	1	4

Element	%	Atomic mass	$\frac{\text{Percentage}}{\text{Atomic mass}}$	Simple ratio	Simplest whole no. ratio
C	24.27	12	$\frac{24.27}{12}$ = 2.02	$\frac{2.02}{2.02}$ = 1	1
H	4.07	1	$\frac{4.07}{1}$ = 4.07	$\frac{4.07}{2.02}$ = 2	2
Cl	71.65	35.5	$\frac{71.65}{35.5}$ = 2.02	$\frac{2.02}{2.02}$ = 1	1

2

Empirical Formula = CH_2Cl
Empirical Formula Mass (EFM) = 12 + 2 + 35.5 = 49.5
Molar mass (MM) = 98.96
n = MM/EFM = 98.96/49.5 = 2
Molecular formula = Empirical formula x n
= (CH_2Cl) x 2 = $C_2H_4Cl_2$

1

28.	a)	***Photoelectric effect:*** It is the phenomenon of ejection of electrons by certain metals (like potassium, rubidium, caesium etc.) when light of suitable frequency incident on them.	1	
	b)	***Paulis 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.	1	
	c)	***Heisenberg's uncertainty principle:*** It states that it is impossible to determine simultaneously, the exact position and exact momentum (or velocity) of an electron. ***OR,*** the mathematical equation: $\Delta x.\ \Delta p \geq \frac{h}{4\pi}$ OR, $\Delta x.\ \Delta v \geq \frac{h}{4\pi m}$ Where Δx is the uncertainty in position and Δp (or, Δv) is the uncertainty in momentum (or velocity) of the particle.	1	4
	d)	***Hund's rule of maximum multiplicity:*** It states that electron pairing takes place in degenerate orbitals only after partially filling all such orbitals. **OR,** Pairing of electrons in the orbitals of the same subshell does not take place until each orbital belonging to that subshell has got one electron each. (i.e., it is singly occupied).	1	
29.	a)	The first ionisation enthalpy of nitrogen is greater than that of oxygen. This is because nitrogen has half filled subshell electronic configuration ($1s^2 2s^2 2p^3$), which is more stable. So more energy is required to remove an electron from nitrogen atom.	2	4
	b)	This is due to their small size, large charge to radius ratio, high electronegativity and absence of vacant d-orbitals.	2	
30.	a)	M.O configuration of O_2 is = $\sigma 1s^2\ \sigma^* 1s^2\ \sigma 2s^2\ \sigma^* 2s^2\ \sigma 2p_z^2\ \pi 2p_x^2\ \pi 2p_y^2\ \pi^* 2p_x^1\ \pi^* 2p_y^1$  	2	4

	b)	This is because of the presence of inter molecular hydrogen bonding in water, which is absent in H_2S. So water molecules get associated and hence exist as a liquid.	2	
31.	a)	$K_p = K_c(RT)^{\Delta n}$	1	4
	b)	Le Chatelier's principle states that whenever there is a change in concentration, pressure or temperature of a system at equilibrium, the system will try to readjust in such a way so as to cancel the effect of that change.	1	
	c)	The following conditions are to be applied to maximize the production of ammonia: i) Concentration: Increase the concentration of N_2 or H_2 or both, or remove the ammonia formed from the reaction mixture. ii) Temperature: Since the forward reaction is exothermic, low temperature favours the reaction. iii) Pressure: Here the forward reaction results in the decrease in no. of moles of gaseous species. So high pressure favours forward reaction. ***[Any 2 conditions required]***	2	

##########