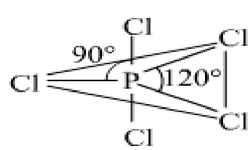
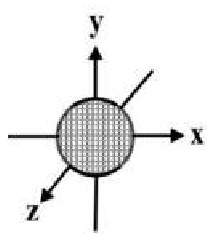
FIRST YEAR HIGHER SECONDARY MODEL EXAMINATION 2024 – ANSWER KEY

SUBJECT: CHEMISTRY **Qn. Code: 125**

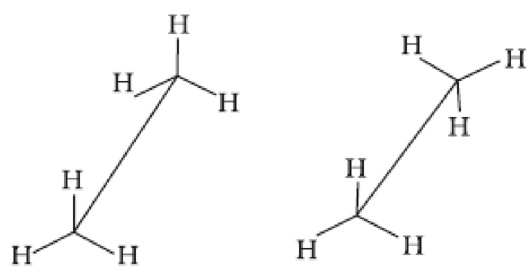
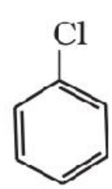
Qn. No.	Sub Qns	Answer Key/Value Points	Score	Total
		Answer any 4 questions from 1 to 5. Each carries 1 score		
1.		2	1	1
2.		Pauling scale OR, Mulliken-Jaffe scale OR, Allred-Rochow scale	1	1
3.		sp^3	1	1
4.		d) NH_4Cl	1	1
5.		Metamerism	1	1
		Answer any 8 questions from 6 to 15. Each carries 2 scores		
6.	(i) (ii)	Law of definite proportions states that a given compound always contains exactly the same proportion of elements by weight. OR, the same compound always contains the same elements combined in the same ratio by mass. Carbon dioxide can be formed in the atmosphere by various methods like respiration, burning of fuels, reaction of metal carbonates and bicarbonates with acid etc. All these samples of CO_2 contain only two elements Carbon and Oxygen combined in a mass ratio 3:8. OR, any other example	1 1	2
7.		(i) Rutherford's atom model could not explain the stability of the atom. (ii) He could not explain the electronic structure of atom.	1 1	2
8.	(i) (ii)	de Broglie equation is $\lambda = \frac{h}{p}$ Or, $\lambda = \frac{h}{mv}$ Azimuthal quantum number OR, Orbital angular momentum quantum number OR, Subsidiary quantum number	1 1	2
9.	(i) (ii)	Trigonal bipyramidal OR,  Because of the repulsion between electron pairs in axial bond and equatorial bond OR, because of its unsymmetric structure. OR, because of the greater axial bond length than the equatorial bond length.	1 1	2
10.	(i) (ii)	Entropy is the degree of disorderness or randomness of a system. Entropy decreases OR, ΔS is negative.	1 1	2
11.	(i)	$K_c = \frac{[NO]^2}{[N_2]\,[O_2]}$ OR, $K_p = \frac{p^2_{NO}}{p_{N_2}p_{O_2}}$	1	

	(ii)	The important characteristics of equilibrium constant are: 1. Equilibrium constant is applicable only when the concentrations of the reactants and products have attained their equilibrium state. 2. The value of equilibrium constant is independent of the initial concentrations of reactants and products. 3. The value of equilibrium constant depends on temperature. 4. The equilibrium constant for the reverse reaction is the reciprocal of that of the forward reaction. 5. If for the reaction A $\rightleftharpoons$ B, the value of equilibrium constant is K, then for the reaction nA $\rightleftharpoons$ nB, its value is K^n. ***[Any 2 required]***	1	2
12.	(i) (ii)	The blue colour of the solution fades OR, the colour fades. $Zn + Cu(NO_3)_2 \rightarrow Zn(NO_3)_2 + Cu$ $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$	1 1	2
13.	(i) (ii)	Inductive effect OR, I effect OR, - I effect. It is the permanent shifting of sigma electrons through a carbon chain when an atom or group of atom having different electronegativity is attached to it.	1 1	2
14.	(i) (ii)	3,3-Dimethylpentane 3-Ethyl-5-methylheptane	1 1	2
15.		Wurtz reaction: Alkyl halides react with metallic sodium in dry ether to form alkanes. This reaction is known as Wurtz reaction. OR, $R\text{-}X + 2\,Na + X\text{-}R \xrightarrow{\text{Dry ether}} R\text{-}R + 2\,NaX$ E.g. $CH_3\text{-}Br + 2Na + Br\text{-}CH_3 \xrightarrow{\text{Dry ether}} CH_3 - CH_3 + 2\,NaBr$ OR, any other example.	1 1	2
		Answer any 8 questions from 16 to 26. Each carries 3 scores		
16.	(i) (ii)	Empirical formula is the simplest formula which gives the ratio of different elements present in the compound. While molecular formula is the actual formula that gives the exact number of different elements present in the compound. Molecular formula = Empirical formula x n Where n = $\frac{Molar\ mass}{Empirical\ formula\ mass}$	2 1	3
17.	(i) (ii) (iii)	Pauli's Exclusion principle states that no two electrons in an atom can have the same set of 4 quantum numbers. OR, an orbital can accommodate a maximum of only 2 electrons with opposite spin.  Zero	1 1 1	3
18.	(i) (ii)	The similarities in properties shown by the diagonally placed elements of the 2nd and 3rd periods in the Modern periodic table is called Diagonal relationship. Anomalous behaviour is due to their small size, large charge to radius ratio, high electronegativity and absence of vacant d-orbitals. ***[Any 2 reasons required]***	1 2	3

19.	(i) (ii)	Electron gain enthalpy is the enthalpy change when an electron is added to the outer most shell of an isolated gaseous atom. Down a group, electron gain enthalpy becomes less negative and along a period electron gain enthalpy becomes more negative.	1 2	3
20.	(i) (ii)	The important postulates of VSEPR theory are: 1) The shape of the molecule depends on the number of valence shell electron pairs (VSEPRs) around the central atom. 2) The valence shell electron pairs repel each other. 3) In order to reduce the repulsion, the electron pairs stay at maximum distance. 4) The valence shell is taken as a sphere with the electron pairs localising 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 > lone pair - bond pair > bond pair - bond pair. 9) As the angle between the electron pairs increases, the repulsion decreases. ***[Any 2 postulates required]*** In water, there are 4 VSEPs – 2 lone pairs and 2 bond pairs. So the expected shape is tetrahedral. But due to the presence of lone pairs, the shape is distorted **to bent or angular or inverted v shape** and the bond angle is **104.5^0**. OR, 	2 1	3
21.	(i) (ii) (iii)	First law of Thermodynamics 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. OR, the mathematical equation: $\Delta U = q + w$ It is a process that occurs at constant heat energy. OR, It is a process in which no heat enters into or leaves from the system. OR, a process in which q= 0. Examples for state function are temperature (T), pressure (p), volume (V), internal energy (U), enthalpy (H), entropy (S), Gibb's energy (G) etc. ***[Any 2 required]***	1 1 1	3
22.	(i) (ii)	The acid-base pair that differs by only one proton is called a conjugate acid–base pair. OR, explanation with example. Ionic product is the product of the molar concentration of hydrogen ion (hydronium ion) and hydroxyl ion in water or in any aqueous solution.	1 1	3

	(iii)	OR, the equation: $K_w = [H^+][OH^-]$ or, $K_w = [H_3O^+][OH^-]$ Solutions which resist the change in p^H on dilution or with the addition of small amount of acid or alkali is called Buffer solution.	1	
23.	(i)	According to oxidation number concept, oxidation is the process of increase in the oxidation number of an element and reduction is the process of decrease in the oxidation number of an element.	2	3
	(ii)	Oxidation number of Mn in $KMNO_4$ is +7 Oxidation number of Cr in $K_2Cr_2O_7$ is +6	½ ½	
24.	(i)	Column chromatography OR, Thin layer chromatography	1	3
	(ii)	(matching table below)	4 x ½ = 2	

Column A		Column B	
I.	Distillation	d.	Aniline and Chloroform
II.	Fractional distillation	c.	Fractions of crude oil
III.	Distillation under reduced pressure	a.	Glycerol from spent lye
IV.	Steam distillation	b.	Aniline and Water

25.	(i)	Decarboxylation reaction OR, By heating sodium salt of carboxylic acids with soda lime (a mixture of NaOH and CaO). OR, $R\text{-}COONa + NaOH \xrightarrow{CaO} R\text{-}H + Na_2CO_3$ OR, $CH_3COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$ **OR,** Kolbe's Electrolytic method OR, by the electrolysis of an aqueous solution of sodium or potassium salt of a carboxylic acid. OR, $2\ RCOONa + 2\ H_2O \xrightarrow{Electrolysis} R - R + 2CO_2 + 2NaOH + H_2$ OR, $2\ CH_3COONa + 2\ H_2O \xrightarrow{Electrolysis} CH_3 - CH_3 + 2CO_2 + 2NaOH + H_2$	1	3
	(ii)	 (i) Eclipsed (ii) Staggered	2	
26.	(i)	$CH_2 = CH_2$ OR, Ethene	1	3
	(ii)	$CH_3 - CHBr - CH_3$ OR, 2-Bromopropane	1	
	(iii)	Chlorobenzene OR, $C_6H_5\text{-}Cl$ OR, 	1	

		Answer any 4 questions from 27 to 31. Each carries 4 scores		
27.	(i)	The important postulates of his theory 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 loses energy, it will move towards the nucleus. 3. The radius of n^{th} orbit of H atom can be given by $r_n = a_0 n^2$ where a_0 = 52.9 pm. 4. The energy of electron in an orbit is given by the expression: $E_n = - R_H . \frac{1}{n^2}$ Where n = 1,2,3…… and R_H is a constant called 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: $\nu = \frac{\Delta E}{h} = \frac{E_2 - E_1}{h}$ Where E_1 and E_2 are the energies of lower and higher energy levels respectively. 6. The angular momentum of an electron is quantized. i.e. it is an integer multiple of $\frac{nh}{2\pi}$. Or, Angular momentum, $m_e vr = \frac{nh}{2\pi}$ **[Any 2 postulates required]**	2	4
	(ii)	Here $\Delta x = 0.1\ A^0 = 0.1 \times 10^{-10}$ m, $h = 6.626 \times 10^{-34}$ Js, $m = 9.1 \times 10^{-31}$ kg, Δv = ? We know that $\Delta x.m.\Delta v = \frac{h}{4\pi}$ So, $\Delta v = \frac{h}{4\pi m.\Delta x} = \frac{6.626 \times 10^{-34}}{4 \times 3.14 \times 9.1 \times 10^{-31} \times 0.1 \times 10^{-10}}$ = **$5.8 \times 10^6 ms^{-1}$**	1 1	
28.	(i)	O_2 molecule contains 16 electrons. Its M.O configuration is: $\sigma 1s^2\ \sigma^*1s^2\ \sigma 2s^2\ \sigma^*2s^2\ \sigma 2p_z^2\ \pi 2p_x^2\ \pi 2p_y^2\ \pi^*2p_x^1\ \pi^*2p_y^1$.	1	4
	(ii)	O_2 molecule is paramagnetic.	1	
	(iii)	Bond order (B.O) = ½ $[N_b – N_a]$ = ½ [10 – 6] = ½ x 4 = 2	1 1	
29.	(i)	Hess's law states that the total enthalpy change for a physical or chemical process is the same whether the reaction taking place in a single step or in several steps. Or, the total enthalpy change for a process is independent of the path followed. *Application of Hess's law:* Determination of enthalpy reaction/ Determination of Bond enthalpy/ Determination of enthalpy of formation/ Born-Haber cycle/ Any other application.	1 1	4
	(ii)	$CaCO_3 \rightarrow CaO + CO_2$ Given $\Delta_f H^0_{(CaCO3)}$ = -1206.9 kJ mol^{-1}, $\Delta_f H^0_{(CaO)}$ = -635.1 kJ mol^{-1} and $\Delta_f H^0_{(CO2)}$ = -393.5 kJ mol^{-1} $\Delta_r H^0 = \Sigma \Delta_f H^0_{(products)} - \Sigma \Delta_f H^0_{(reactants)}$ = $[\Delta_f H^0_{(CaO)} + \Delta_f H^0_{(CO2)}] – [\Delta_f H^0_{(CaCO3)}]$ = [(-635.1) + (-393.5)] – (-1206.9) = **178.3 kJ mol^{-1}**	1 1	
30.	(i)	According to Lewis concept, acids are electron pair acceptors and bases are electron pair donors.	2	

		OR, Substances which accept electron pair are called Lewis acids and substances which donate electron pair are called Lewis bases.		
	(ii)	Example for Lewis acids are BF_3, $AlCl_3$, H^+, Co^{3+}, Mg^{2+} OR, Any cations. Example for Lewis bases are NH_3, H_2O, OH^-, Cl^-, Br^- OR, Any anions. ***[Any one example for each is required]***	½ ½	4
	(iii)	p^H is the negative logarithm of hydrogen ion concentration (hydronium ion concentration) in moles per litre or molarity. OR, $p^H = -log[H^+]$ OR, $p^H = -log[H_3O^+]$	1	
31.	(i)	Nucleophile: A reagent that brings an electron pair. OR, It is an electron rich species attacks at electron deficient centre. Examples for nucleophile are OH^-, CN^-, NO_2^-, Cl^-, Br^-, I^-, H_2O, NH_3, $R\text{-}NH_2$ etc. ***[Any one example required]*** Electrophile: A reagent that takes away an electron pair. OR, It is an electron deficient species attacks at electron rich centre. Examples for electrophile are carbocations (R^+), -CHO, >CO, X^+ (halonium ion), NO_2^+ (nitronium ion), SO_2 etc. ***[Any one example required]***	1 ½ 1 ½	4
	(ii)	To a little of the sodium fusion extract, add sodium nitroprusside solution. A violet colour indicates the presence of sulphur. OR, A little of the sodium fusion extract is acidified with acetic acid and then add lead acetate solution. A black precipitate indicates the presence of sulphur.	1	

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