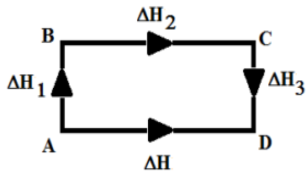
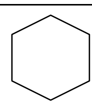
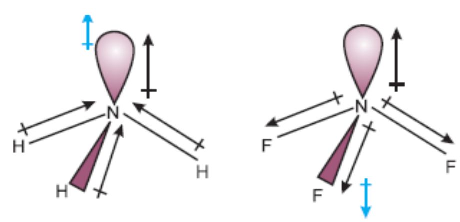
FIRST YEAR HIGHER SECONDARY EXAMINATION MARCH 2023 – ANSWER KEY

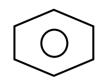
(UNOFFICIAL) **SUBJECT: CHEMISTRY** **Qn. Code: FY 425**

Qn. No.	Sub Qns	Answer Key/Value Points	Score	Total
		Answer any 4 questions from 1 to 5. Each carry 1 score		
1.		5 mol	1	1
2.		Unnilquadium (Unq)	1	1
3.		(c) F^-	1	1
4.		3–Hydroxypentan–1–al (3–Hydroxypentanal)	1	1
5.		Staggered conformation Or, Staggered form	1	1
		Answer any 8 questions from 6 to 15. Each carry 2 scores		
6.	(i) (ii)	Molarity of a solution is the no. of moles of solute in 1 litre of the solution. Or, Molarity (M) = $\frac{\text{no. of moles of solute}}{\text{Volume of solution in litre}}$ Law of definite proportions states that a given compound always contains exactly the same proportion of elements by weight. OR, It states that a given compound always contains the same elements in the same proportion by weight. OR, Explanation with example.	1 1	2
7.		de Broglie equation is $\lambda = h/p$ Or, $\lambda = h/mv$ Where λ is the wavelength, m is the mass, v is the velocity and p is the momentum of the particle.	1 1	2
8.	(i) (ii)	n = 3, l = 0 (b) $1s^2\ 2s^2\ 2p_x^1\ 2p_y^1\ 2p_z^1$ Hund's Rule	1 ½ ½	2
9.	(i) (ii)	Modern periodic law states that the properties of elements are the periodic functions of their atomic numbers. Down a group, the atomic radius increases.	1 1	2
10.	(i) (ii)	Ionization enthalpy is the amount of heat required to remove an electron from the outermost shell of an isolated gaseous atom. OR, it is the amount of heat required to convert a neutral gaseous atom to a unipositive ion in the gaseous state. Due to the stable half–filled electronic configuration ($1s^22s^22p^3$) of N.	1 1	2
11.		The law states that the total enthalpy change for a 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. <u>Illustration:</u> Consider a process in which the reactant A is converted to product D in a single step by involving heat change, ΔH. Let the same reactant A is first converted to B, then to C and finally to D involving heat changes ΔH_1, ΔH_2 and ΔH_3 respectively.	1 1	2

		 Then according to Hess's law: $\Delta H = \Delta H_1 + \Delta H_2 + \Delta H_3$ OR, any other example		
12.	(i) (ii)	According to Bronsted- Lowry concept, acids are proton (H^+) donors and bases are (H^+) acceptors. OR, example: $NH_{3(g)} + H_2O_{(l)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-{}_{(aq)}$ Here NH_3 is a base since it accepts an H^+ ion to form NH_4^+ and H_2O is an acid since it donates an H^+ ion to form OH^- . It is defined as the negative logarithm of the hydrogen ion or hydronium ion concentration in moles per litre (i.e. molarity). i.e. $p^H = -\log[H^+]$ or $p^H = -\log[H_3O^+]$	1 1	2
13.		It is a reaction in which a compound is dissociated (broken down) into two or more components, in which at least one must be in the elemental state. OR, Decomposition reaction may be denoted as $A \rightarrow B + C$ E.g.: $2H_2O \rightarrow 2H_2 + O_2$ $2NH_3 \rightarrow N_2 + 3H_2$ $2SO_3 \rightarrow 2SO_2 + O_2$ OR, Any other reaction *[Any one example is required]*	1 1	2
14.		Buta-1,3-diene OR, 1,3-Butadiene No. of σ bonds = 9 and no. of π bonds = 2	1 1	2
15.	(i) (ii)	Cyclohexane OR,  $C_2H_5–C_2H_5$ OR, $CH_3–CH_2–CH_2–CH_3$ OR, C_4H_{10} OR, Butane	1 1	2
		Answer any 8 questions from 16 to 26. Each carry 3 scores		
16.	(i) (ii)	Molecular formula = Empirical formula x n, where $n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}}$ OR, Empirical formula = $\frac{\text{Molecular formula}}{n}$ Combustion of methane can be represented as: $CH_{4(g)} + 2\,O_{2(g)} \rightarrow CO_{2(g)} + 2\,H_2O_{(g)}$ 16g 64g 44g 36g Amount of O_2 required for the complete combustion of 16g methane = 64g So, the amount of O_2 required for the complete combustion of 48g methane $= \frac{64 \times 48}{16} =$ **192 g O_2**	1 1 1	3
17.		Ans: **Observations:** i. Most of the α– particles passed through the gold foil without any deviation. ii. A small fraction of the α–particles was deflected by small angles. iii. A very few α– particles were rebounded (Or, deflected by nearly 180°).	1½	3

		Conclusions: i. Most space in the atom is empty. ii. In an atom, the positive charge is concentrated in a very small volume at the centre called nucleus. iii. The volume of the nucleus is negligibly small as compared to the total volume of the atom. (The radius of the atom is about 10^{-10} m, while that of nucleus is 10^{-15} m)	1½	
18.	(i) (ii) (iii)	This is because of the greater effective nuclear charge in Na^+. OR, Na^+ has fewer electrons than Na but the same nuclear charge. Because of the absence of vacant d-orbitals in nitrogen. Due to larger size and less electron-electron repulsion in chlorine. [Or, Due to the compactness of the 2p subshell of F, electronic repulsion is greater in F and hence it does not easily add electron].	1 1 1	3
19.	(i) (ii)	Dipole moment is the product of charge at one end (e) and distance between the charges (r). i.e. μ = e x r. This is because in the case of NH_3, the orbital dipole due to lone pair and the resultant dipole moment of the three N – H bonds are in the same direction. So, they get added together. But in NF_3, the orbital dipole is in the opposite direction to the resultant dipole moment of the three N–F bonds. So they get partially cancelled. So NH_3 has higher dipole moment than NF_3. OR,  NH_3 NF_3	1 2	3
20.	(i) (ii)	Octet rule states that atoms containing 8 electrons in their valence shell are stable. OR, atoms undergo chemical reaction in order to attain 8 electrons in the valence shell. Limitations of Octet Rule: 1) It could not explain the stability of compounds containing less than 8 electrons around the central atom. E.g. LiCl, BeH_2, BCl_3 etc. 2) It could not explain the stability of molecules containing odd number of electrons (like NO, NO_2 etc.). 3) It could not explain the stability of molecules containing more than 8 electrons around the central atom (i.e. expanded octet). E.g. PF_5, SF_6, H_2SO_4, 4) Octet rule is based upon the chemical inertness of noble gases. But some noble gases like xenon and krypton form compounds with F and O. 5) This theory does not account for the shape of molecules. 6) It does not explain the relative stability of the molecules. *[Any 2 Required]*	1 2	3
21.	(i)	It states that the entropy of the universe always increases during every spontaneous process.	1	3

	(ii) (iii)	Entropy is a measure of degree of disorderness or randomness of a system. If Gibb's energy change (ΔG) is negative, the process is spontaneous process.	1 1	
22.	(i) (ii) (iii)	Solutions which resist the change in pH on dilution or with the addition of small amount of acid or alkali is called Buffer solution. E.g. for acidic buffer is an equimolar mixture of acetic acid and sodium acetate/ OR, an equimolar mixture of HCN and NaCN/ OR, an equimolar mixture of Boric acid and Borax/ OR, an equimolar mixture of any other weak acid and its salt with a strong base. E.g. for a basic buffer is an equimolar mixture of NH_4OH and NH_4Cl/ OR, an equimolar mixture of NH_4OH and NH_4NO_3/ OR, an equimolar mixture of any other weak base and its salt with a strong acid. Common ion effect is the suppression of the dissociation of a weak electrolyte by the addition of a strong electrolyte containing a common ion/ OR, Example	1 ½ ½ 1	3
23.		Oxidation number method: Step 1: The skeletal equation is: $MnO_4^- + I^- \rightarrow MnO_2 + I_2$ Step 2: Assign the oxidation number of each element and identify the elements undergoing change in oxidation number. $\overset{+7\ -2}{MnO_4^-} + \overset{-1}{I^-} \rightarrow \overset{+4\ -2}{MnO_2} + \overset{0}{I_2}$ Here the oxidation number of Mn and I are changed. Step 3: Calculate the change in oxidation number and make them equal by multiplying with suitable number. Here the oxidation number of Mn is decreased by 3 and that of I is increased by 1. In order to equate them, multiply MnO_4^- by 2 and I^- by 6. $2\ MnO_4^- + 6\ I^- \rightarrow MnO_2 + I_2$ Step 4: Now balance all the atoms except Oxygen and Hydrogen $2\ MnO_4^- + 6\ I^- \rightarrow 2\ MnO_2 + 3\ I_2$ Step 5: Now balance the ionic charges on both sides. Here the net ionic charge on LHS is -8 and on RHS is 0. To equate them, add 8 OH^- on RHS [since the reaction takes place in basic medium]. $2\ MnO_4^- + 6\ I^- \rightarrow 2\ MnO_2 + 3\ I_2 + 8\ OH^-$ Step 6: Now balance hydrogen atoms by adding sufficient number of H_2O molecules. Here add 4 H_2O molecule on LHS. **$2\ MnO_4^- + 6\ I^- + 4\ H_2O \rightarrow 2\ MnO_2 + 3\ I_2 + 8\ OH^-$** Now the equation is balanced.	6 x ½	3
24.	(i) (ii)	**Detection of Nitrogen:** To a little of sodium fusion extract add freshly prepared ferrous sulphate ($FeSO_4$) solution. Heated to boiling, cooled and acidified with dil. H_2SO_4. Blue or green colouration or precipitate indicates the presence of nitrogen. **Detection of Sulphur:** To a little of the sodium fusion extract, add sodium nitroprusside solution. A violet colouration indicates the presence of sulphur. OR, The sodium fusion extract is acidified with acetic acid and lead acetate is added to it. A black precipitate indicates the presence of sulphur.	1½ 1½	3
25.	(i)	$CH_3–CHBr–CH_3$ (2–Bromopropane)	1	

	(ii)	Markownikoff's rule [Markovnikov's rule] The rule states that when an unsymmetrical reagent is added to an unsymmetrical alkene, the negative part of the reagent gets attached to the carbon containing lesser number of hydrogen atoms.	1 1	3
26.	(i) (ii) (iii)	**Isomerisation**: n-Alkanes on heating in the presence of anhydrous aluminium chloride and hydrogen chloride gas isomerise to branched chain alkanes. **OR,** $CH_3-(CH_2)_4-CH_3 \xrightarrow{\text{Anhydrous } AlCl_3/HCl} CH_3-CH(CH_3)-CH_2-CH_2-CH_3 + CH_3-CH_2-CH(CH_3)-CH_2-CH_3$ (n-hexane) (2-Methylpentane) (3-Methyl pentane) **Aromatization**: n-Alkanes having six or more carbon atoms on heating to 773K at 10-20 atm pressure in the presence of oxides of vanadium, molybdenum or chromium supported over alumina, we get aromatic compounds. This reaction is known as aromatization. **OR,** $CH_3-(CH_2)_4-CH_3 \xrightarrow[773K,\ 10-20\ atm]{Cr_2O_3 \text{ or } V_2O_5 \text{ or } Mo_2O_3}$  n-hexane Benzene **Pyrolysis**: Alkanes having six or more carbon atoms on heating at higher temperature decompose to form lower alkanes, alkenes etc. This reaction is known as pyrolysis. **OR,** $C_6H_{14} \xrightarrow{773K}$ $C_6H_{12} + H_2$ $C_6H_{14} \xrightarrow{773K}$ $C_4H_8 + C_2H_6$ $C_6H_{14} \xrightarrow{773K}$ $C_3H_6 + C_2H_4 + CH_4$	1 1 1	3
Answer any 4 questions from 27 to 31. Each carry 4 scores				
27.	(i) (ii)	Lyman Series, Balmer series, Paschen series, Brackett series, Pfund series. *[Any 4 required]* **Limitations of Bohr atom model:** (i) It could not explain the fine spectrum of hydrogen atom. (ii) It could not explain the spectrum of atoms other than hydrogen. (iii) It could not explain Stark effect and Zeeman effect. (iv) It could not explain the ability of atoms to form molecules by chemical bonds. (v) It did not consider the wave character of matter and Heisenberg's uncertainty principle. *[Any 2 required]*	2 2	4
28.	(i)	1) In molecules, the electrons are present in some special type of orbitals called molecular orbitals (M.Os). 2) The atomic orbitals (A.Os) of comparable energy and proper symmetry combine to form molecular orbitals. 3) Atomic orbitals are monocentric, while molecular orbitals are polycentric. 4) The number of molecular orbitals formed = the number of atomic orbitals combined. i.e. if 2 atomic orbitals combined, 2 molecular orbitals are formed. One is called bonding molecular orbital (BMO) and the other is called anti-bonding molecular orbitals (ABMO)	2	4

		5) The BMO has lower energy and greater stability than the corresponding ABMO. 6) The molecular orbitals give the electron probability distribution around a group of nuclei. The molecular orbitals are filled according to 3 rules – Aufbau principle, Pauli's exclusion principle and Hund's rule. *[Any 2 required]*		
	(ii)	(see table below)	4 x ½	

	A		B
I.	$BeCl_2$	d.	sp
II.	PCl_5	a.	sp^3d
III.	CH_4	b.	sp^3
IV.	BCl_3	c.	sp^2

29.	(i)	It is the standard enthalpy change for the formation of one mole of a compound from its elements in their most stable state of aggregation (reference state). OR, It is the enthalpy of formation of a compound in the standard state [i.e. at 1 bar pressure, generally 298 K temperature and the substances are in their pure form.]	1	4
	(ii)	The required equation is: C(graphite) + $2H_2(g)$ + ½ $O_2(g)$ ⟶ $CH_3OH(l)$ The given data are: $CH_3OH(l)$ + 3/2 $O_2(g)$ ⟶ $CO_2(g)$ + $2H_2O(l)$; Δ_rH^0 = -726 kJ/mol .... (1) C (graphite) + $O_2(g)$ ⟶ $CO_2(g)$; Δ_rH^0 = -393 kJ/mol .... (2) $H_2(g)$ + ½ $O_2(g)$ ⟶ $H_2O(l)$; Δ_rH^0 = -286 kJ/mol .... (3) On reversing equation (1), we get $CO_2(g)$ + $2H_2O(l)$ ⟶ $CH_3OH(l)$ + 3/2 $O_2(g)$; Δ_rH^0 = 726 kJ/mol .... (4) On multiplying eqn. (3) by 2, we get $2H_2(g)$ + $O_2(g)$ ⟶ $2H_2O(l)$; Δ_rH^0 = -2 x 286 = -572 kJ/mol .... (5) Now add equations (2) + (4) + (5) and simplify. Then we get, C(graphite) + $2H_2(g)$ + ½ $O_2(g)$ → $CH_3OH(l)$, Δ_rH^0 = -393 + 726 + -572 = **-239 kJ/mol**	1 1 1	
30.	(i)	An equilibrium reaction in which all the reactants and products are in the same phase is called homogeneous equilibrium. E.g. $N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$ OR, $2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$ OR, Any other correct example.	1 1	4
	(ii)	$K_p = K_c.(RT)^{\Delta n}$ Here Δn = 2 – 2 = 0. *[Assuming H_2, I_2 and HI are in gaseous state]* So $K_p = K_c$	1 1	
31.	(i)	Sublimation/Crystallisation/Simple Distillation/Steam distillation/Fractional distillation/Distillation under reduced pressure/Differential extraction/Chromatography etc. [Any 2 methods required].	1	4
	(ii)	Distillation under reduced pressure.	1	
	(iii)	Electromeric effect is defined as the complete transfer of a shared pair of π-electrons to one of the atoms joined by a multiple bond in presence of an attacking reagent. There are two types of E effects: Positive Electromeric effect (+E effect) and Negative Electromeric effect (-E effect).	1 1	

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