Marking Scheme
Sample Question Paper
Chemistry XI
2026-27

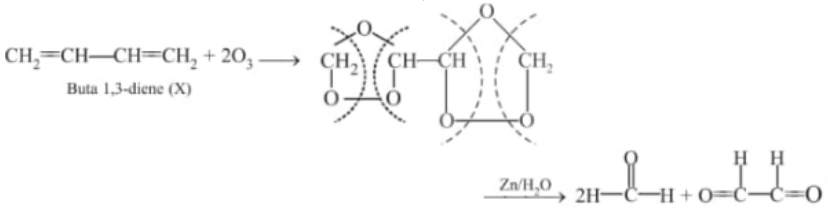
Q. No	Sub part	Value Points	Step wise marks	Total Marks
1		D	1	1
2		C	1	1
3		B	1	1
4		D	1	1
5		C	1	1
6		A	1	1
7		C ($\mathbf{W_{rev}} = \mathbf{x + y}$)	1	1
8		A (**+2 to +3; oxidation state**)	1	1
9		B (**Cadmium**)	1	1
10		A	1	1
11		A	1	1
12		C	1	1
13		A	1	1
14		D	1	1

15		A	1	1
16		C	1	1
17		Using the **Heisenberg Uncertainty Principle**: $\Delta x \Delta p \geq 4\pi h$ $\Delta x = 2.0 \times 10^{-10}$ m $h = 6.626 \times 10^{-34}$ J s Substituting the values: $\Delta p = 6.626 \times 10^{-34} / 4\pi \times 2.0 \times 10$ $= 2.64 \times 10^{-25}$ kg m s^{-1}	½ ½ 1	2
18		For particles with the same kinetic energy, $\lambda = h/\sqrt{2mK}$ Hence, $\lambda \propto 1/\sqrt{m}$ $\lambda e/\lambda p = \sqrt{mp}/ me$ $= \sqrt{1836}$ ≈ 42.8	½ ½ 1	2
19		$Kp = Kc(RT)^{\Delta n}$ $\Delta n = 2-3 = -1$ $Kp = 100(RT)^{-1}$ $= 100 / RT$ Taking R=0.0821 L atm $mol^{-1}K^{-1}$, $=100/ 0.0821x500$ $= 2.44$ OR $Kp = \alpha^2 P/1-\alpha 2$ $=(0.4)^2 x2 /1-0.16$ $=0.32/0.84$ $=0.381$	½ ½ ½ ½ 1 1	2 2

20.	(a) (b) (c)	x= 14 y=7H_2O Iodide ion/I^- 6 electrons	½ ½ ½ ½	 2
21		The student has made the **incorrect choice**. For this mixture, fractional distillation should be used instead of simple distillation as the difference in boiling point is less than 25K.	1 1	 2
22.		$K_{max}=h(\nu-\nu0)$ $=6.63\times10^{-34}(8.5-5.5)\times10^{14}$ $=1.99\times10^{-19}$ J Converting into eV: Kmax $=1.99\times10^{-19}/1.6\times10^{-19}=1.24$ eV Kmax=1.24 eV	1 1 1	 3
23.		(a).The first ionization enthalpy of calcium is higher than that of potassium because calcium has a higher effective nuclear charge and a smaller atomic size. (b)Oxygen generally shows a valency of 2, while sulfur can expand its covalency to 2, 4, and 6 due to the absence of d-orbitals in oxygen.. (c) The chloride ion has a larger radius than a neutral chlorine atom. The addition of an extra electron increases electron-electron repulsion within the valence shell, causing the electron cloud to expand outward. Consequently, the effective nuclear charge per electron decreases, making Cl^- larger than Cl. (d) The element with the electronic configuration [Ne]$3s^2$ is Magnesium. (Any 3 parts to be done)	1 1 1 1X3=3	 3

24.	(a)	X_2^- (17 electrons): Paramagnetic (one unpaired electron) X_2^{2-} (18 electrons): Diamagnetic (all electrons are paired)	½ ½	
	(b)	X_2^- is more stable because it has a higher bond order (1.5) than X_2^{2-} (1.0).	½ ½	
	(c)	X_2^{2-} has the longer bond length because it has the lower bond order.	1	

25.	(a)	Both PCl_5 and SF_4 have sp^3d hybridisation, which corresponds to a trigonal bipyramidal electron pair geometry according to VSEPR theory.		3
		PCl_5: The central phosphorus atom has 5 bond pairs and no lone pair (AX_5).	1	
		SF_4: The central sulfur atom has 4 bond pairs and 1 lone pair (AX_4E).	1	
	(b)	Xenon in XeF_4 undergoes sp^3d^2 hybridisation and has 6 electron pairs (4 bond pairs and 2 lone pairs).		
		The four Xe–F bond dipole moments are arranged symmetrically and cancel each other completely.	1	

26	(a)	890.3kJ of heat is produced when 1 mole , that is , 16g of methane undergoes combustion. Thus, 445.15 kJ will be produced on combustion of = 8g	1	
	(b)	Enthalpy of formation of HCl = - $\frac{184}{2}$ = = -92kJmol^{-1}	1	
	(c)	Thermally conducting wall	1	3
27.	(a)	(i) Ethyl cation (ii) Propene	½ +½	3
	(b)	Hyperconjugation	1	
	(c)	Sp^2 hybridized	1	
28.	(a)	Hydrogen atom of But-1-yne attached to triply bonded carbon atom is acidic in nature	1	
		X is $H_2C=CH-CH=CH_2$ / Buta-1,3-diene	1	
	(b)		1	3

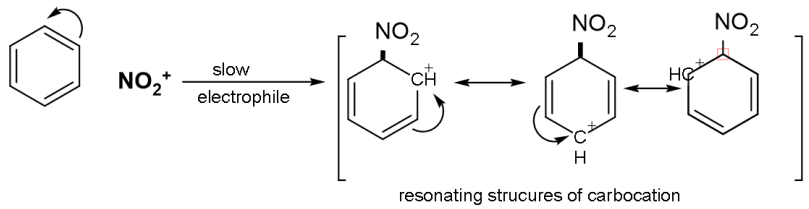
29.	(a)	High pressure is favourable because the reaction involves a decrease in the number of moles of gaseous reactants from 3 moles ($2SO_2 + O_2$) to 2 moles ($2SO_3$). According to Le Chatelier's principle, increasing pressure shifts the equilibrium towards the side with fewer gaseous moles, thereby increasing the yield of SO_3.	1	
	(b)	Since the reaction is exothermic, increasing the temperature shifts the equilibrium in the backward direction (towards SO_2 and O_2). Hence, the equilibrium yield of SO_3 decreases.	1	
	(c)	(i) Effect of decreasing the temperature on the equilibrium constant (K): For an exothermic reaction, decreasing the temperature favours the forward reaction. Therefore, the value of the equilibrium constant (K) increases.	1	
		(ii) Effect of increasing the pressure on the equilibrium constant (K): The equilibrium constant remains unchanged because it depends only on temperature and is independent of pressure.	1	
		OR		
		Effect of catalyst on the equilibrium constant (K): A catalyst does not affect the value of the equilibrium constant (K) because it increases the rates of both the forward and backward reactions equally. It only helps the system attain equilibrium faster without changing the position of equilibrium or the value of K.	1 1	4

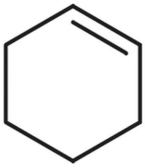
30.	(a)	Fig 2(Thin Layer Chromatography i.e.TLC) primarily separates mixtures based on **adsorption**, where components adhere to a solid stationary phase. In contrast, Fig 3(Partition chromatography) separates components based on differing **solubilities**. OR Column chromatography	1	
	b)	The stationary phase used in Fig 3 is Chromatography paper.	1	
	c)	In chromatography, the R_f value (Retention Factor) is a ratio measuring how far a specific substance travels relative to the solvent front. R_f for fig 4: $R_f = \frac{\text{Distance traveled by the substance}}{\text{Distance traveled by the solvent}}$ $R_f = \frac{4}{8} = 0.5$	1 1	4
31. A	(a)	Moles of Gas A = 2 mol, Molar mass = 20 g/mol Mass of A = 2×20=40 g Moles of Gas B = 3 mol, Molar mass = 30 g/mol Mass of B = 3×30=90 g Total mass = 40+90=130g Total moles = 2+3=5 mol Average molar mass=130/5 =26 g mol^{-1}	½ ½ 1	
	(b)	The required mole ratio is: $H_2 : O_2 = 2 : 1$ The given mole ratio is : $H_2 : O_2$ =3 : 2 =1.5 : 1 For 2 moles of O_2, 4 moles of H_2 are required, but only 3 moles of H_2 are available. Therefore, H_2 is insufficient and will be consumed first. According to the reaction, 1 mol Fe→1 mol FeS Therefore,	 ½ ½	

		Moles of FeS formed=0.05 Molar mass of FeS =56+32=88 g mol−1= 56 + 32 = 88 Mass of FeS formed =0.05×88=4.4 g	½	
		Empirical formula mass:12+(2×1)=14 n=56/14 =4 Molecular formula=$(CH_2)_4=C_4H_8$	½	
	(c)		½	
B	(a)	**Given:** ● **Compound A:** 12 g of carbon combines with 16 g of oxygen. ● **Compound B:** 24 g of carbon combines with 64 g of oxygen. To compare the compounds, fix the mass of carbon at **12 g**. For **Compound B**: 24 g of carbon→64 g of oxygen 12 g of carbon→64×12/24=32 g of oxygen Thus, for **12 g of carbon**: ● Compound A contains **16 g of oxygen**. ● Compound B contains **32 g of oxygen**. Ratio of the masses of oxygen: 16 : 32 = 1 : 2 The compounds obey the **Law of Multiple Proportions** because the masses of oxygen that combine with the same mass (12 g) of carbon are in the simple whole-number ratio **1 : 2**.	½ ½ ½	5
	b)	Molality is preferred over molarity for freezing point depression because molality depends on the mass of the solvent, which does not change with temperature. Molarity depends on the volume of the solution, which changes with temperature. Since colligative properties are temperature-dependent, molality gives more accurate results. Molarity (M) = 4.0 mol L^{-1} Density of solution = 1.20 g mL^{-1} Molar mass of KNO_3 = 101 g mol^{-1} Consider 1 L of solution. Moles of KNO_3=4.0 mol Mass of 1 L solution=1000×1.20=1200 g Mass of KNO_3=4.0×101=404 g Mass of solvent=1200−404=796 g=0.796 kg m=4.0/0.796=5.93 mol Kg^{-1}	½ ½ ½	

32.	a)	The standard enthalpy of a reaction is calculated by subtracting the sum of the enthalpies of formation of the reactants from that of the products: $\Delta_c H^\circ = \left[4 \times \Delta_f H^\circ(CO_2) + 5 \times \Delta_f H^\circ(H_2O)\right] - \left[\Delta_f H^\circ(C_4H_{10}) + \frac{13}{2} \times \Delta_f H^\circ(O_2)\right]$ Substituting the values: $\Delta_f H^\circ(C_4H_{10}) = [4(-393.5) + 5(-285.83)] - (-2658)$ $\Delta_f H^\circ(C_4H_{10}) = [-1574 - 1429.15] + 2658$ $\Delta_f H^\circ(C_4H_{10}) = -3003.15 + 2658 = -345.15 \text{ kJ mol}^{-1}$	1 1 1	
	b)	Rusting is spontaneous because it is highly exothermic (ΔH is negative). The heat released into the surroundings significantly increases the surrounding's entropy, resulting in an overall positive total entropy change for the universe, and an overall negative Gibbs free energy (ΔG) as per the formula given below: $\Delta G = \Delta H - T\Delta S_{sys}$ OR	1 1	5
	a)	By definition, the enthalpy of reaction ($\Delta_r H$) is the total heat energy absorbed or released during a chemical process. The standard enthalpy of formation ($\Delta_f H^0$) is the specific heat change when exactly 1 mole of a compound is formed from its elements in their most stable (standard) states. The two values are equal because both represent the generation of exactly 1 mole of the product. In thermodynamics, the enthalpy of any pure element in its natural standard state is assigned a value of **zero**. Therefore, when calculating the enthalpy of reaction, the elements on the reactant side mathematically drop out, leaving only the enthalpy of the newly formed compound.	1	
	(b)	The given value is the standard enthalpy of formation ($\Delta_f H^\circ$) for 1 mole of NH_3. The balanced reaction produces 2 moles of NH_3. • $\Delta_r H^\circ = 2 \times \Delta_f H^\circ(NH_3)$ • $\Delta_r H^\circ = 2 \times (-46.2 \text{ kJ mol}^{-1})$ • $\Delta_r H^\circ = -92.4 \text{ kJ mol}^{-1} = -92,400 \text{ J mol}^{-1}$		

		• $\Delta_r S^\circ = -198.75\ \text{J K}^{-1}\ \text{mol}^{-1}$ A reaction is spontaneous when the Gibbs free energy change (ΔG°) is negative ($\Delta G^\circ < 0$). At the equilibrium threshold, $\Delta G^\circ = 0$. $$\Delta G^\circ = \Delta_r H^\circ - T\Delta_r S^\circ = 0$$ $$T = \frac{\Delta_r H^\circ}{\Delta_r S^\circ}$$ Substituting the values into the equation: $$T = \frac{-92,400\ \text{J mol}^{-1}}{-198.75\ \text{J K}^{-1}\ \text{mol}^{-1}} \approx 464.91\ \text{K}$$ • Both Δ_H and Δ_S are negative. • The $-T\Delta_S$ term is positive. • Lower temperatures minimize the positive term. • Therefore, the reaction is spontaneous below 464.91 K.	1 1 ½ ½ 1	

33.	(a)	(i) nitronium ion / NO_2^+ (ii)  resonating strucures of carbocation (iii) $C_6H_6NO_2^+ + HSO_4^- \rightarrow C_6H_5NO_2 + H_2SO_4$	1 1 1	
	(b)	B= Sodium benzoate(C_6H_5COONa) or Benzoic acid (C_6H_5COOH) D= Acetophenone / $C_6H_5COCH_3$	1 1	
	(a)	OR An aqueous solution of sodium or potassium salt of a carboxylic acid on electrolysis gives alkane containing even number of carbon atoms at the anode i) $2CH_3COO^-Na^+ \rightleftharpoons 2CH_3 - \overset{O}{\overset{\|}{C}} - O^- + 2Na^+$ ii) **At anode:** $2CH_3 - \overset{O}{\overset{\|}{C}} - O^- \xrightarrow{-2e^-} 2CH_3 - \overset{O}{\overset{\|}{C}} - \dot{O}^- \longrightarrow 2CH_3 + 2CO_2\uparrow$ Acetate ion — Acetate free radical — Methyl free radical iii) $H_3C + CH_3 \rightarrow H_3C - CH_3\uparrow$ iv) **At cathode :** $H_2O + e^- \rightarrow OH^- + H^\bullet$ $2H^\bullet \rightarrow H_2\uparrow$ Overall reaction: $2CH_3COO^-Na^+ + 2H_2O$ Sodium acetate ↓ Electrolysis $CH_3 - CH_3 + 2CO_2 + H_2 + 2NaOH$	 1 1 1	5

	(b)	(i) To prepare Pentan-2-one the required alkyne is Pent-1-yne. (ii) The structure of cyclohexene ,the starting alkene to prepare Hexan-1.6-dioic acid is : 	1 1	