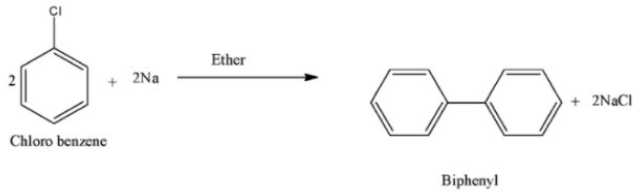


MARKING SCHEME

SUBJECT: 313 - Chemistry

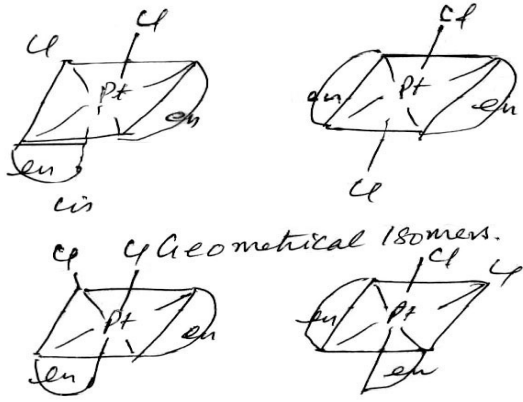
MAX. MARKS: 80

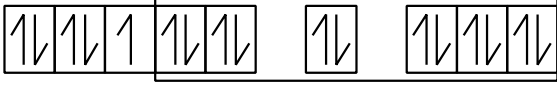
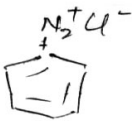



Q. NO			EXPECTED VALUE POINTS FOR EACH STEP	DISTRIBUTION OF MARKS	TOTAL MARKS															
SET																				
A	B	C																		
1	-	-	(C)	1	1															
2	9	7	(B)	1	1															
3	-	-	(B)	1	1															
4	7	10	(D)	1	1															
5	-	-	(B)	1	1															
6	5	1	(C)	1	1															
7	-	-	(D)	1	1															
8	3	5	(A)	1	1															
9	2	4	(C)	1	1															
10	1	2	(D)	1	1															
11	19	15	(i) NH ₃ (ii) CH ₂ O (iii) CH (iv) S	4x½	2															
12	-	-	The given data can be tabulated as : <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Element</th> <th>%Composition</th> <th>Atomic Mass</th> <th>Atomic moles</th> <th>Simplest Atomic Mass</th> </tr> </thead> <tbody> <tr> <td>B</td> <td>78.2</td> <td>11</td> <td>78.2/11=7.1</td> <td>7.1/7.1=1</td> </tr> <tr> <td>H</td> <td>21.8</td> <td>1</td> <td>21.8/1=21.8</td> <td>21.8/7.1=3</td> </tr> </tbody> </table> Thus the empirical the compound is BH ₃	Element	%Composition	Atomic Mass	Atomic moles	Simplest Atomic Mass	B	78.2	11	78.2/11=7.1	7.1/7.1=1	H	21.8	1	21.8/1=21.8	21.8/7.1=3	1 1	2
Element	%Composition	Atomic Mass	Atomic moles	Simplest Atomic Mass																
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H	21.8	1	21.8/1=21.8	21.8/7.1=3																
13	15	19	The radial distribution curve for a 2s orbital shows two maxima as compared to 1s orbital which shows only one maxima For 1s = n - 1 = 1 - 0 = 1 For 2s = n - 1 = 2 - 0 = 2	1 ½+½	2															
14	-	-	In liquids, the attractive forces are strong enough to keep the molecules moving within a definite boundary. Thus they maintain definite volume. These intermolecular forces are not strong enough to keep them in a definite position. The molecules can, therefore, move around and take the shape of the container in which they are kept.	1 1	2															
15	-	-	Enthalpy of combustion is the enthalpy change (heat evolved) accompanying the complete combustion of 1 mole of a	1	2															

			<p>substance in oxygen at a given temperature and 1 bar pressure. For example. $C_2H_5OH(l) + 3O_2(g) \rightarrow 2CO_2 + 3H_2O$ $\Delta H_c^\circ = -1366.8 \text{ kJ mol}^{-1}$ Enthalpy of combustion of C_2H_5OH is $= -1366.8 \text{ kJ mol}^{-1}$</p>	1									
16	14	17	<p>(A) 5 Chlorides (B) $Cl_2(g)$ (C) N_2 (D) Cl_2O</p>	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$	2								
17	13	14	<p>(i)</p>  <p>Chloro benzene + 2Na $\xrightarrow{\text{Ether}}$ Biphenyl + 2NaCl</p> <p>(ii) $C_2H_5OH \xrightarrow[416 \text{ K}]{\text{Conc. } H_2SO_4} CH_3CH_2OCH_2CH_3$</p>	1 1	2								
18	-	-	<p>Polymers present in plants and animals which control various life processes in plants and animals are called biopolymers. Examples : (i) Starch (ii) Cellulose (Or any other suitable example)</p>	1 $\frac{1}{2}$ $\frac{1}{2}$	2								
19	11	12	<p>Butyl rubber Uses (i) Making inner tubes of tyres (ii) Making conveyor belts etc.</p>	1 $\frac{1}{2}$ $\frac{1}{2}$	2								
20	-	-	<p>Since $MgSO_4$ is an ionic compound so undergoes complete ionization in the following :</p> $MgSO_4 \rightarrow Mg^{2+} + SO_4^{2-}$ <table style="margin-left: 40px;"> <tr> <td>Initial moles</td> <td>1</td> <td>0</td> <td>0</td> </tr> <tr> <td>After dissociation</td> <td>0</td> <td>1</td> <td>1</td> </tr> </table> <p>The number of moles of $MgSO_4$ $n = \text{Mass}/\text{molar mass}$ $= 4g/120g \text{ mol}^{-1} = 0.03333 \text{ mol}$. Mass of water is 100 g or 100g/1000g kg⁻¹ = 0.1 kg The molality of the solution is $m = \text{moles of } MgSO_4 / \text{mass of the water in kg}$ $m = 0.03333 \text{ mol} / 0.1 \text{ kg} = 0.3333m$ The vant Hoff factor $i = 2$ (as dissociation of 1 molecule of magnesium sulphate gives 2 ions)</p> <p>The elevation in the boiling point $\Delta T_b = i \times K_b m$ $m = 2 \times 0.52 \times 0.3333 = 0.3466K$</p> <p>The boiling point of pure water is 373.15 K.</p> <p>The boiling point of solution will</p>	Initial moles	1	0	0	After dissociation	0	1	1	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 1	4
Initial moles	1	0	0										
After dissociation	0	1	1										

			be $373.15+0.3466=373.4966\text{K}\approx 373.5\text{K}$.																				
21	24	26	$\text{HC}\equiv\text{CH}+\text{H}_2\rightarrow\text{C}_2\text{H}_4$ $\Delta_r H^\circ = \text{B.E. (Reactants)} - \text{B.E. (Products)}$ $=[\text{B.E.}(\text{C}\equiv\text{C})+2\times\text{B.E.}(\text{C}-\text{H})+\text{B.E.}(\text{H}-\text{H})]-[\text{B.E.}(\text{C}=\text{C})+4\text{B.E.}(\text{C}-\text{H})]$ $[827.6+2\times 414.0+430.5]-[606.0+4\times 414.0]=-175.9\text{kJmol}^{-1}$	$\frac{1}{2}$ $\frac{1}{2}$ 1 1 1	4																		
22	23	25	<p>Expression of Ostwald's dilution law in the case of a weak electrolyte</p> <p>Consider the dissociation of a weak electrolyte BA. Let V dm³ of a solution contain one mole of the electrolyte. Then the concentration of a solution is, $C = 1/V$ mol dm⁻³. Let α be the degree of dissociation of the electrolyte.</p> <table style="margin-left: auto; margin-right: auto;"> <tr> <td></td> <td style="text-align: center;">BA</td> <td style="text-align: center;">\rightleftharpoons</td> <td style="text-align: center;">B^+</td> <td style="text-align: center;">$+$</td> <td style="text-align: center;">A^-</td> </tr> <tr> <td>Initial moles :</td> <td style="text-align: center;">1</td> <td></td> <td style="text-align: center;">0</td> <td></td> <td style="text-align: center;">0</td> </tr> <tr> <td>Moles of equilibrium :</td> <td style="text-align: center;">$(1-\alpha)$</td> <td></td> <td style="text-align: center;">α</td> <td></td> <td style="text-align: center;">α</td> </tr> </table> <p>Concentration at equilibrium (mol dm⁻³): $\frac{(1-\alpha)}{V}$ $\frac{\alpha}{V}$ $\frac{\alpha}{V}$</p> <p>Applying the law of mass action to this dissociation equilibrium, we have,</p> $K = \frac{[\text{B}^+][\text{A}^-]}{[\text{BA}]}$ $\therefore K = \frac{\frac{\alpha}{V} \times \frac{\alpha}{V}}{\frac{(1-\alpha)}{V}} = \frac{\alpha^2}{(1-\alpha)V}$ <p>As the electrolyte is weak, α is very small as compared to unity,</p> $\therefore (1-\alpha) \approx 1.$ $\therefore K = \frac{\alpha^2}{V} \quad \therefore \alpha = \sqrt{KV} \quad \therefore \alpha \propto \sqrt{V}$ $\frac{1}{V} = C, \text{ where } C = \text{concentration in mol dm}^{-3}$ $\therefore K = \alpha^2 C \quad \therefore \alpha = \sqrt{\frac{K}{C}}$ $\therefore \alpha = \sqrt{K \times V}$ $\therefore C = \frac{1}{V} \text{ or } V = \frac{1}{C}$ $\alpha = \sqrt{\frac{K}{C}}$ <p>This is the expression of Ostwald's dilution law. Thus, the degree of dissociation of a weak electrolyte is directly proportional to the square root of the volume of the solution containing 1 mole of an electrolyte.</p>		BA	\rightleftharpoons	B^+	$+$	A^-	Initial moles :	1		0		0	Moles of equilibrium :	$(1-\alpha)$		α		α	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 1	4
	BA	\rightleftharpoons	B^+	$+$	A^-																		
Initial moles :	1		0		0																		
Moles of equilibrium :	$(1-\alpha)$		α		α																		
23	25	21	<p>(a) BaCO_3</p> <p>It is because as the size of cation increase polarizing power of cation decreases, stability increases</p> <p>(b) This happens because the energy difference between 5f, 6d and 7s subshells of the actinoids is very small and</p>	1 1	4																		

			<p>hence electron can be accommodated in any of them.</p> <p>(c) All the outer electrons participate in bonding due to comparable energy of 5f, 6d & 7s orbitals.</p>	1 1	
24	22	20	<p>(A) $\text{FeO} \cdot \text{Cr}_2\text{O}_3$</p> <p>(B) Na_2CrO_4</p> <p>(C) $\text{Na}_2\text{Cr}_2\text{O}_7$</p> <p>(D) $\text{K}_2\text{Cr}_2\text{O}_7$</p> <p>$4\text{FeO} \cdot \text{Cr}_2\text{O}_3 + 8\text{Na}_2\text{CO}_3 + 7\text{O}_2(\text{au}) \rightarrow$ $2\text{Fe}_2\text{O}_3 + 8\text{Na}_2\text{CrO}_4 + 8\text{CO}_2$</p> <p>$2\text{Na}_2\text{CrO}_4 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{Cr}_2\text{O}_7 + \text{Na}_2\text{SO}_4 + \text{H}_2\text{O}$</p> <p>$\text{Na}_2\text{Cr}_2\text{O}_7 + 2\text{KCl} \rightarrow \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{NaCl}$</p>	$\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$ 1 $\frac{1}{2}$ $\frac{1}{2}$	4
25	21	22	<p>(i) Aldehyde having α-hydrogen atom on reaction with dilute NaOH give aldols product</p> $2 \underset{\text{Aldehyde}}{\text{R}-\text{CH}_2-\text{CHO}} \xrightarrow{\text{aq. NaOH}} \text{R}-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CHR}-\text{CHO}$ $\text{R}-\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{CHR}-\text{CHO} \xrightarrow[\text{warm}]{-\text{H}_2\text{O}} \text{R}-\underset{\text{OH}}{\text{CH}}=\text{CR}-\text{CHO}$ <p style="text-align: center;">α, β-Unsaturated aldehyde</p> <p>(ii) When primary amine is heated with chloroform in the presence of alcoholic sodium or potassium hydroxide, then the corresponding isocyanide is formed. Isocyanides are also known as carbylamines, hence this reaction is called as Carbylamine reaction.</p> $\text{Me}_3\text{CNH}_2 + \text{CHCl}_3 + 3 \text{NaOH} \rightarrow \text{Me}_3\text{CNC} + 3 \text{NaCl} + 3 \text{H}_2\text{O}$	1 1 1	4
26	20	23	<p>(a) Aliphatic amino $>\text{NH}_3>$ Aromatic amine. The aromatic amines are weaker base than ammonia because the aromatic ring is electron withdrawing. It reduces the electron density at nitrogen whereas aliphatic amines are more basic than ammonia because aliphatic group is electron sealing. It increases the electron density at nitrogen.</p> <p>(b) It is due to the existence of the phenomenon of resonance which cause carbon - halogen bond to acquire double bond character in haloarenes.</p> <p>(c) The greater acidity of phenols than alcohols can be attributed to the resonance stabilization of the phenoxide ion.</p>	1 1 1	4
27	30	29	<p>(a) Calculation of Lattice energy :</p> <p>For LiF: $\Delta_f \text{H}_{\text{LiF}} = \Delta_{\text{sub}} \text{H}_{\text{Li}} + \Delta \text{I}/2\text{H}_{\text{F}-\text{F}} + \Delta_i \text{H}_{\text{Li}} + \Delta_{\text{eg}} \text{H}_{\text{F}} + \Delta_i \text{H}_{\text{LiF}}$ or $-594.1 = 155.2 + 150.6 + 520 - 328 + \Delta_i \text{H}_{\text{LiF}}$</p>	$\frac{1}{2}$	6

			<p>171.6 kJmol⁻¹</p> <p>(b) (i) NH₃ molecule consists of 3 bond pair and one lone pair.</p> <p>(ii) Due to difference in the mutual repulsion between bond pair-bond pair and bond pair-Lone pair is distorted.</p> <p>(c) (i) It has zero dipole moment due to its symmetrical tetrahedral shape.</p> <p>(ii) Dipole moment : Magnitude of charge (Q) X distance of separation (r).</p>	<p>½</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p> <p>1</p>	
28	29	27	<p>(a) We know that $Ae^{-E_a/RT}$ ∴ At T₁, K₁=$Ae^{-E_a/RT}$ and At T₂, K₂=$Ae^{-E_a/RT}$ Dividing K₁ by K₂ we get $\frac{K_1}{K_2} = \frac{Ae^{-E_a/RT}}{Ae^{-E_a/RT}}$</p> <p>taking logarithm $\ln \frac{K_1}{K_2} = \frac{-E_a}{RT} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$ $= \log \frac{K_1}{K_2} = \frac{2-E_a}{2.303R} \left[\frac{1}{T_1} - \frac{1}{T_2} \right]$</p> <p>(b) For first order $t_{1/2} = \frac{0.693}{K}$ $t_{1/2} = \frac{0.693}{5.53 \times 10^{-1} \text{ s}^{-1}}$ $= 1.26310^{14} \text{ s}$ (deduct ½ mark if unit not given)</p> <p>(c) At Cathod : H₂ gas At Anode : O₂ gas</p>	<p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>½</p> <p>1</p> <p>1</p> <p>1</p>	6
29	28	30	<p>(a)</p>  <p>(b) (i) [Fe(CN)₆]³⁻ The element Fe is in +3 oxidation state. As CN⁻</p>	<p>½+½</p> <p>½</p> <p>1</p>	6

		<p>is a strong field ligand, the electron pairing is possible in this case.</p>  <p style="text-align: center;">d^2sp^3</p> <p>(ii) Hybridization d^2sp^3 There is one unpaired electron so it is paramagnetic in nature $m = \sqrt{n(n+2)}$ $\sqrt{1(1+2)} = \sqrt{3} = 1.73\text{BM}$</p> <p>(iii) It is inner orbital or low spin complex</p> <p>(c) (i) Diammine diaquadichlorido platinum ion (iv) $\frac{1}{2}$</p> <p style="text-align: center;">OR</p> <p>(i) Diammine diaquadichlorido platinum ion (iv) $\frac{1}{2}$</p> <p>Coordination number of metal ion = 6</p>	$\frac{1}{2}$	1	$\frac{1}{2}$	1	
30	27	28	<p>(i) </p> <p>(ii) </p> <p>(iii) $\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$</p> <p>(iv) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}(=\text{O})-\text{O}-\text{C}(=\text{O})-\text{CH}_2\text{CH}_2\text{CH}_3$</p> <p>(v) </p> <p>(vi)  Toluene</p>	1	1	1	6
4		(d)		1		1	
6		(c)		1		1	
8		(a)		1		1	
10		(b)		1		1	
12		Biopolymers can be broken into component parts either of enzyme - catalyzed reactions or by themselves during a certain period of time and hence are biodegradable polymer. Examples PHBV, PGA (or any other suitable example)		1	$\frac{1}{2} + \frac{1}{2}$	2	
16		(i) Isothermal process :		1		2	

		<p>When the temperature of the system remains constant during various operations, then the process is said to be isothermal.</p> <p>(ii) In adiabatic process there is no change of heat between the system and the surroundings. Thus, in adiabatic processes there is always a change in temperature.</p>	1																
17		<p>Generally, greater the valency of the flocculating ion added, greater is its power to cause precipitation. This is known as Hardy - Schulze rule. In the coagulation of negative sol, the flocculating power of Na^+, Ba^{2+} and Al^{3+} ions is in the order of $\text{Al}^{3+} > \text{Ba}^{2+} > \text{Na}^+$ similarly, in coagulation of a positive sol, flocculation power of Cl^-, SO_4^{2-} PO_4^{3-} and $[\text{Fe}(\text{CN})_6]^{4-}$ is in the order of $[\text{Fe}(\text{CN})_6]^{4-} > \text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$</p>	1 $\frac{1}{2}$ $\frac{1}{2}$	2															
18		<p>The results can be written as follows :</p> <table border="1"> <thead> <tr> <th>Element</th> <th>Percentage Composition</th> <th>Atomic mass</th> <th>Atomic ratio</th> <th>Simples Atomic ratio</th> </tr> </thead> <tbody> <tr> <td>C</td> <td>75</td> <td>12</td> <td>$\frac{75}{12} = 6.25$</td> <td>$\frac{6.25}{6.25} = 1$</td> </tr> <tr> <td>H</td> <td>25</td> <td>1</td> <td>$\frac{25}{1} = 25$</td> <td>$\frac{25}{6.25} = 4$</td> </tr> </tbody> </table> <p>So the empirical formula CH_4 Empirical formula mass = $12 + 4 = 16$ amu $n = \frac{\text{molecularmass}}{\text{empiricalformulamass}}$ $= \frac{16}{16} = 1$ Molecular formula CH_4</p>	Element	Percentage Composition	Atomic mass	Atomic ratio	Simples Atomic ratio	C	75	12	$\frac{75}{12} = 6.25$	$\frac{6.25}{6.25} = 1$	H	25	1	$\frac{25}{1} = 25$	$\frac{25}{6.25} = 4$	1 $\frac{1}{2}$	2
Element	Percentage Composition	Atomic mass	Atomic ratio	Simples Atomic ratio															
C	75	12	$\frac{75}{12} = 6.25$	$\frac{6.25}{6.25} = 1$															
H	25	1	$\frac{25}{1} = 25$	$\frac{25}{6.25} = 4$															
26		<p>Case I :</p> $BT = Kf \times \frac{WB \times 1000}{MB \times WA}$ $(273.15 - 271) = Kf \times \frac{5 \times 1000}{342 \times 95}$ <p>$Kf = 13.97 \text{ K kg mol}^{-1}$</p> <p>Case II :</p> $\Delta T = Kf \times \frac{WB \times 1000}{MB \times WA}$ $= 13.97 = \frac{5 \times 1000}{180 \times 95} = 4.085$ <p>$T = T_0 - 4.085$ $= 273.15 - 4.085 = -69.065 \text{ K}$</p>	1 1 1 1	4															
	3	(B)	1	1															
	6	(A)	1	1															
	8	(D)	1	1															
	9	(C)	1	1															
	11	These are polymers in which long polymer chains are cross -	1	2															

		linked together to form three dimensional network. These polymers are hard, rigid and brittle. Examples : Bakelite Melamine (or any other suitable example)	1/2 1/2	
13		(i) The standard state of a substance is its most stable state at one bar pressure and at specific temperature. (ii) The enthalpy of formation of the most stable form of an element is zero.	1 1	2
	16	KClO ₃ decomposes as follows : $2\text{KClO}_3 \xrightarrow{\text{heat}} 2\text{KCl(s)} + 3\text{O}_2$ 2 mol 3 mol 2×(39 + 35.5 + 48) 3×22.7 L at STP = 245 g = 68.1 L at STP Thus 245 g of KClO ₃ gives 68.1 L of oxygen 1 g of KClO ₃ gives $\frac{68.1\text{L}}{245}$ of oxygen 12.26 g of KClO ₃ gives $\frac{68.1}{245} \times 12.26$ = 3.407 L of oxygen	1/2 1/2 1	2
	18	(i) Blood is a colloidal solution and is negatively charged. On applying a solution of FeCl ₃ bleeding stops and clotting of the colloidal particles of blood takes place. (ii) It is because colloidal dust particles floating about in the sky scatter blue light and makes the sky blue.	1 1	2
	24	The van't Hoff factor can be calculated by using the following relation $\Delta T_f = i \times K_f \times m$ $\Delta T_f = i \times K_f \times \frac{W_B \times 1000}{M_B \times W_A}$ Given $\Delta T_f = 0.45 \text{ K}$ $K_f = 5.12 \text{ K Kg mol}^{-1}$ $W_B = 0.3 \text{ g}$ $M_B = 60 \text{ g mol}^{-1}$ Putting these values in eq - (i) we get $0.45 = i \times 5.12 \times \frac{0.3 \times 1000}{60 \times 30}$ $i = 0.527$ Since $i < 1$, hence ethanoic acid should be associated in benzene.	1/2 1/2 1 1	4
		- o o o -		