SECOND YEAR HIGHER SECONDARY FIRST TERM EXAMINATION 2025: CHEMISTRY - ANSWER KEY

<table>
<tr><th>Qn. No.</th><th>Sub Qns.</th><th>Answer Key/Value Points</th><th>Score</th><th>Total</th></tr>
<tr><td colspan="5">Answer any 4 questions from 1 to 5. Each carry 1 score</td></tr>
<tr><td>1.</td><td></td><td>(c) Molarity</td><td>1</td><td>1</td></tr>
<tr><td>2.</td><td></td><td>(c) Nickel-cadmium cell</td><td>1</td><td>1</td></tr>
<tr><td>3.</td><td></td><td>(b) $3d^5$</td><td>1</td><td>1</td></tr>
<tr><td>4.</td><td></td><td>Zero order</td><td>1</td><td>1</td></tr>
<tr><td>5.</td><td></td><td>(c) Statement II is not correct but statement I is correct.</td><td>1</td><td>1</td></tr>
<tr><td colspan="5">Answer any 8 questions from 6 to 15. Each carry 2 score</td></tr>
<tr><td>6.</td><td></td><td>Henry's law states that at constant temperature, the solubility of a gas in a liquid is directly proportional to the pressure of the gas.
Or, at constant temperature, the partial pressure of the gas in vapour phase is proportional to the mole fraction of the gas in the solution.
Or, $p \propto \chi$ Or, $p = K_H.X$ (At constant temperature)
Applications: (i) In the preparation of soda water and soft drinks, the bottle is sealed under high pressure.
(ii) A medical condition known as Bends in Scuba divers.
(iii) A medical condition known as Anoxia in people living at high altitudes or climbers.
<i>[Any one application is required]</i>.</td><td>1
1</td><td>2</td></tr>
<tr><td>7.</td><td></td><td>
<table>
<tr><th></th><th>Order</th><th>Molecularity</th></tr>
<tr><td>1.</td><td>It is the sum of the powers of the concentration terms in the rate law expression.</td><td>It is the total number of reactant species collide simultaneously in a chemical reaction.</td></tr>
<tr><td>2.</td><td>It is an experimental quantity</td><td>It is a theoretical quantity</td></tr>
<tr><td>3.</td><td>It can be zero or fraction</td><td>It cannot be zero or fraction</td></tr>
<tr><td>4.</td><td>It is applicable to both elementary and complex reactions.</td><td>It is applicable only to elementary reactions.</td></tr>
</table>
[Any 2 differences required]</td><td>2 x 1</td><td>2</td></tr>
<tr><td>8.</td><td></td><td>For both strong and weak electrolytes, the molar conductivity increases with dilution, but due to different reasons.
For strong electrolytes, as dilution increases, the force of attraction between the ions decreases and hence the ionic mobility increases. So, molar conductivity increases.
For weak electrolytes, as dilution increases, the degree of dissociation increases. So the number of ions increases and hence the molar conductivity increases.</td><td>1
1</td><td>2</td></tr>
<tr><td>9.</td><td></td><td>We know that $\Delta T_f = \frac{1000\ K_f\ w_2}{w_1 M_2}$
Here w_2 = 0.4 g, w_1 = 20g, ΔT_f = 0.75K, K_f = 5.12 K kg mol^{-1}, M_2 = ?
On substituting in the above equation, we get
$0.75 = \frac{1000 \times 5.12 \times 0.4}{20 \times M_2}$
So, $M_2 = \frac{1000 \times 5.12 \times 0.4}{20 \times 0.75}$ = <u>136.53 g mol^{-1}</u></td><td>1
1</td><td>2</td></tr>
<tr><td>10.</td><td></td><td>When a pressure greater than osmotic pressure is applied to the solution side, solvent molecules will flow from solution side to solvent side through semi-permeable membrane. This is called reverse osmosis.
Application: Desalination of sea water OR, Purification of water.</td><td>1
1</td><td>2</td></tr>
<tr><td>11.</td><td></td><td>Anode reaction: $Pb + SO_4^{2-} \longrightarrow PbSO_4 + 2e^-$
Cathode reaction: $PbO_2 + SO_4^{2-} + 4H^+ + 2e^- \longrightarrow PbSO_4 + 2H_2O$</td><td>1
1</td><td>2</td></tr>
<tr><td>12.</td><td></td><td>Copper (Cu)
This is because the high energy to convert $Cu_{(s)}$ to $Cu^{2+}_{(aq)}$ is not balanced by its hydration enthalpy.
OR, High heat of atomization of Cu(s) and low heat of hydration of $Cu^{2+}_{(aq)}$ ion.</td><td>1
1</td><td>2</td></tr>
<tr><td>13.</td><td></td><td>Pseudo first order reactions are reactions which appear to follow higher order, but actually follow first order kinetics.
E,g, Hydrolysis of ester OR, Inversion of cane sugar <i>[Any one example is required]</i></td><td>1
1</td><td>2</td></tr>
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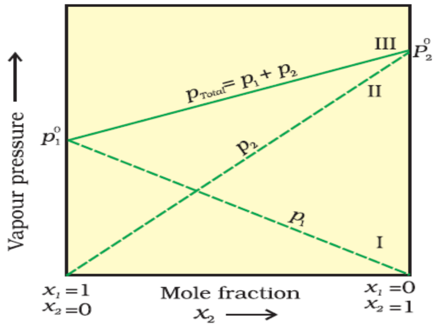
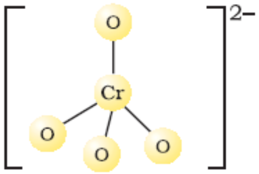
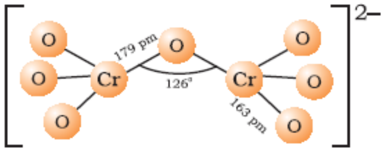
<table>
<tr><td>14.</td><td></td><td>For a first order reaction, $k = \frac{2.303}{t}\log\frac{[R]_0}{[R]}$
Or, $t = \frac{2.303}{k}\log\frac{[R]_0}{[R]}$
For 99% completion, $[R]_0 = 100$ and $[R] = 100 – 99 = 1$.
So, $t_{99\%} = \frac{2.303}{k}\log\frac{100}{1}$
Or, $t_{99\%} = \frac{2.303}{k} \times 2$ .... (1)
For 90% completion, $[R]_0 = 100$ and $[R] = 100 – 90 = 10$.
So, $t_{90\%} = \frac{2.303}{k}\log\frac{100}{10}$
Or, $t_{90\%} = \frac{2.303}{k} \times 1$ .... (2)
$\frac{(1)}{(2)}$ gives: $\frac{t_{99\%}}{t_{90\%}} = \frac{\frac{2.303}{k} \times 2}{\frac{2.303}{k} \times 1} = 2$
Or, $t_{99\%} = 2 \times t_{90\%}$</td><td>½
½
½
½</td><td>2</td></tr>
<tr><td>15.</td><td></td><td><table>
<tr><th>Column I</th><th>Column II</th></tr>
<tr><td>(a) Lanthanoid oxides</td><td>(iv) Petroleum cracking</td></tr>
<tr><td>(b) Mischmetall</td><td>(v) For making bullets and shells</td></tr>
<tr><td>(c) First row transition series element that can show upto +7 oxidation state</td><td>(iii) Manganese</td></tr>
<tr><td>(d) Wacker process</td><td>(ii) Palladium chloride</td></tr>
</table></td><td>4 x ½</td><td>2</td></tr>
<tr><td colspan="5">Answer any 8 questions from 16 to 26. Each carries 3 score</td></tr>
<tr><td>16.</td><td>(i)
(ii)</td><td>Ideal solutions are solutions which obey Raoult’s law at all concentrations.
E.g. solutions of n-hexane and n-heptane, bromoethane and chloroethane, benzene and toluene etc.
<i>[Any one example is required]</i>

 </td><td>1
½
1½</td><td>3</td></tr>
<tr><td>17.</td><td>(i)
(ii)</td><td>Azeotropes are binary mixtures having the same composition in liquid phase and vapour phase and boils at a constant temperature.
Solutions which show a large positive deviation from Raoult’s law form minimum boiling azeotrope.
E.g. 95% aqueous ethanol solution by volume.</td><td>1
1
1</td><td>3</td></tr>
<tr><td>18.</td><td>(a)
(b)
(c)</td><td>Anode: Nickel electrode Or, $Ni|Ni^{2+}$
Cathode: Copper electrode Or, $Cu|Cu^{2+}$
Std. emf of the cell, $E^0_{cell} = E^0_R - E^0_L$
$= 0.34V – (-0.25V) = 0.59V$
The Nernst equation for the cell is $E_{cell} = E^0_{cell} - \frac{2.303\,RT}{2F}\log\frac{[Ni^{2+}]}{[Cu^{2+}]}$ OR, $E_{cell} = E^0_{cell} - \frac{0.0591}{2}\log\frac{[Ni^{2+}]}{[Cu^{2+}]}$
OR, $E_{cell} = E^0_{cell} + \frac{2.303\,RT}{2F}\log\frac{[Cu^{2+}]}{[Ni^{2+}]}$ OR, $E_{cell} = E^0_{cell} + \frac{0.0591}{2}\log\frac{[Cu^{2+}]}{[Ni^{2+}]}$</td><td>½
½
½
½
1</td><td>3</td></tr>
<tr><td>19.</td><td>(i)
(ii)</td><td>Kohlrausch’s law states that the limiting molar conductivity of an electrolyte is the sum of the individual contributions of the anion and the cation of the electrolyte.
$\Lambda^0_{(HCOOH)} = \lambda^0_{(HCOO-)} + \lambda^0_{(H+)}$
$= 54.6\ Scm^2\ mol^{-1} + 349.6\ Scm^2\ mol^{-1} = 404.2\ Scm^2\ mol^{-1}$
Degree of dissociation (α) = $\frac{\Lambda_m}{\Lambda^0_m}$
$= \frac{46.1\ S\ cm^2 mol^{-1}}{404.2\ S\ cm^2 mol^{-1}} = \mathbf{0.114}$</td><td>1
½
½
½
½</td><td>3</td></tr>
</table>

20.	(i)	Anode: Chlorine gas (Cl_2)	½	
		Cathode: Hydrogen gas (H_2)	½	
	(ii)	Given current (I) = 0.5A and time (t) = 2 hr. = 2 x 60 x 60 s		
		Quantity of electricity (Q) = current in Ampere (I) x time in second (t)	½	
		= 0.5 x 2 x 60 x 60 = 3600 C	½	
		Also, Quantity of electricity (Q) = no. of moles of electrons (n) x Faraday's constant (F)		
		So, n = $\frac{Q}{F} = \frac{3600\ C}{96500\ C/mol}$ = 0.037 mol	½	3
		No. of electrons passed through the wire = 0.037 x 6.022 x 10^{23} = **2.23 x 10^{22} electrons**	½	
21.		Given $t_{1/2}$ = 20 s		
		For first order reactions, $t_{\frac{1}{2}} = \frac{0.693}{k}$	½	
		So, k = $\frac{0.693}{t_{1/2}} = \frac{0.693}{20}$ = 0.0346 s^{-1}	½	
		For a first order reaction, t = $\frac{2.303}{k} \log \frac{[R]_0}{[R]}$	1	
		Let $[R]_0$ = x, then [R] = $^1/_{16}$th of x = $^x/_{16}$		
		So, t = $\frac{2.303}{0.0346} \log \frac{x}{x/16} = \frac{2.303}{0.0346} \log 16$	½	3
		= **80.14 s**	½	
22.	(i)	Activation energy: It is the minimum amount of kinetic energy required for the reactant molecules for effective collision during a chemical reaction.	1	
	(ii)	Collision frequency: It is the number of collisions per second per unit volume of the reaction mixture.	1	3
	(ii)	Effective collision: The collision in which molecules collide with sufficient kinetic energy (threshold energy) and proper orientation is called effective collision.	1	
23.	(i)	2	1	
	(ii)	3	1	3
	(iii)	When the concentration of NO is doubled, the rate of the reaction is increased to 4 times.	1	
24.		Potassium dichromate is generally prepared from chromite ore ($FeCr_2O_4$) by the following three steps:		
		1. Conversion of chromite ore to sodium chromate by fusing with sodium carbonate in presence of air.	½	
		$4\ FeCr_2O_4 + 8\ Na_2CO_3 + 7\ O_2 \rightarrow 8\ Na_2CrO_4 + 2\ Fe_2O_3 + 8\ CO_2$	½	
		2. Sodium chromate is acidified with sulphuric acid to form sodium dichromate.	½	3
		$2Na_2CrO_4 + 2\ H^+ \rightarrow Na_2Cr_2O_7 + 2\ Na^+ + H_2O$	½	
		3. Conversion of sodium dichromate to potassium dichromate by treating with potassium chloride.	½	
		$Na_2Cr_2O_7 + 2\ KCl \rightarrow K_2Cr_2O_7 + 2\ NaCl$	½	
25.	(i)	The regular decrease in the atomic and ionic radii along lanthanoid series is known as lanthanoid contraction.	1	
	(ii)	Consequences: 1. The 2nd and 3rd row transition series elements have similar radii. 2. Lanthanoids have similar physical properties and they occur together in nature. So their isolation is difficult. 3. The basicity of hydroxides of lanthanoids decreases from Lanthanum to Lutetium. ***[Any 2 required]***	2 x 1	3
26.	(i)	Sc^{3+} : [Ar] $3d^0$	½	
		Ti^{3+}: [Ar] $3d^1$	½	
		Cr^{3+}: [Ar] $3d^3$	½	
		Cu^+: [Ar] $3d^{10}$	½	3
		The ions which are coloured are Ti^{3+} and Cr^{3+}	½	
	(ii)	In aqueous solution, water molecules act as ligands. So transition metal ions are coloured in aqueous solution.	½	
Answer any 4 questions from 27 to 31. Each carries 4 score				
27.	(i)	Colligative properties: These are properties of dilute solutions, which depend only on the number of solute particles and not on their nature.	1	
		The important colligative properties are: (i) Relative lowering of vapour pressure (ii) Elevation of boiling point (iii) Depression of freezing point (iv) Osmotic pressure **[Any 2 required]**	½ x 2	

	(ii)	Osmotic pressure Proteins are stable only at room temperature. The measurement of osmotic pressure can be done at room temperature. So osmotic pressure measurement is used for the determination of their molar mass.	½ ½	4
	(iii)	Water will flow out of the cells OR, the blood cells shrink.	1	
28.	(i)	The equation relating rate constant and temperature for a chemical reaction is Arrhenius equation. The equation is $k = A.e^{-E_a/RT}$ OR, $\ln k = \ln A - \frac{E_a}{RT}$ OR, $\log k = \log A - \frac{E_a}{2.303\ RT}$	1	4
	(ii)	The rate determining step is: $H_2O_2 + I^- \rightarrow H_2O + IO^-$	1	
	(ii)	Here $T_1 = 27^0C = 27 + 273 = 300\ K$, $T_2 = 37^0C + 273 = 310\ K$, $k_1 = x$, $k_2 = 2x$ and $R = 8.314\ J\ K^{-1}\ mol^{-1}$ We know that, $\log \frac{k_2}{k_1} = \frac{E_a}{2.303\ R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$ $\log \frac{2x}{x} = \frac{E_a}{2.303 \text{ x } 8.314}\ \frac{310 - 300}{300 \text{ x } 310}$ So, $E_a = \frac{2.303 \text{ x } 8.314 \text{ x } 300 \text{ x } 310 \text{ x } \log 2}{10}$ = **535986 J mol^{-1} = 535.986 kJ mol^{-1}**	1 ½ ½	
29.	(i)	Fuel cells are galvanic cells which convert the energy of combustion of fuels (like hydrogen, methane, methanol etc.) directly into electrical energy.	1	4
	(ii)	The advantages of fuel cell are: i) The cell works continuously as long as the fuels are supplied. ii) It has higher efficiency as compared to other conventional cells. iii) It is eco-friendly (i.e. pollution free). iv) Water obtained from $H_2 - O_2$ fuel cell can be used for drinking purpose. ***[Any 2 required]***	2 x ½	
	(iii)	Anode reaction: $2H_{2(g)} + 4OH^-_{(aq)} \longrightarrow 4H_2O_{(l)} + 4e^-$ Cathode reaction: $O_{2(g)} + 2H_2O_{(l)} + 4e^- \longrightarrow 4OH^-_{(aq)}$ The net reaction is $2H_{2(g)} + O_{2(g)} \longrightarrow 2\ H_2O_{(l)}$	½ ½ 1	
30.	(i)	 Chromate ion  O O O Cr 179 pm O 126° Cr O O 163 pm O 2− Dichromate ion	2 x 1	4
	(ii)	Acidified permanganate solution oxidizes: Oxalate to carbon dioxide $5\ C_2O_4^{2-} + 2\ MnO_4^- + 16\ H^+ \longrightarrow 10\ CO_2 + 2\ Mn^{2+} + 8\ H_2O$ Iron(II) to iron(III) $5\ Fe^{2+} + MnO_4^- + 8\ H^+ \longrightarrow 5\ Fe^{3+} + Mn^{2+} + 4\ H_2O$ Iodide to free iodine $10\ I^- + 2\ MnO_4^- + 16\ H^+ \longrightarrow 5\ I_2 + 2\ Mn^{2+} + 8\ H_2O$ [OR, Any other reaction]	1 1	
31.	(i)	van't Hoff factor (i) = $\frac{\text{Normal molar mass}}{\text{Abnormal molar mass}}$ OR, $i = \frac{\text{Observed colligative property}}{\text{Calculated colligative property}}$ OR, $i = \frac{\text{Number of moles of particles after association/dissociation}}{\text{Number of moles of particles before association/dissociation}}$	1	4
	(ii)	Given, $w_2 = 3.33\ g$, $V = 3\ L$, $T = 27^0C = 27 + 273 = 300\ K$, $M_2 = 24 + 35.5 \text{ x } 2 = 95\ u$ and $R = 0.0821\ L\ atm\ K^{-1}\ mol^{-1}$. Osmotic pressure ($\pi$) = i x $\frac{w_2 RT}{M_2 V}$ $= 3 \text{ x } \frac{3.33 \text{ x } 0.0821 \text{ x } 300}{95 \text{ x } 3}$ = **0.8633 atm**	1 1 1	

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