MARKING SCHEME CHEMISTRY MODEL PAPER CLASS XI

Section A

Time: 20 minutes **Marks:** 18

1. For a reaction $CO_{(g)} + Cl_{2(g)} \rightleftharpoons COCl_{2(g)}$, $\frac{kp}{kc}$ is equal to:
   (a) $\frac{1}{RT}$ (b) 1.0 (c)$\sqrt{RT}$ (d)RT

2. Spectral line of Lyman Series lies in:
   (a) ultra violet region (b) visible region (c) near IR (d) far IR

3. How many moles of Aluminum oxide is formed when 6 moles of oxygen is used?
   $Al + O_2 \longrightarrow Al_2O_3$
   (a) 4 mol (b) 6mol (c) 8 mol (d) 10 mol

4. Which of the following series shows correct bond angle order?
   (a) $NH_3 > BF_3 > C_2H_6$ (b)$BF_3 > NH_3 > C_2H_6$ (c) $NH_3 > C_2H_6 > BF_3$ **(d) $BF_3 > C_2H_6 > NH_3$**

5. What is the ratio between Sigma and pi bonds in acetylene molecule?
   (a) 1:4 (b) 4:1 **(c) 3:2** (d) 2:3

6. Which property of liquid crystals resemble with solids?
   (a) expansion **(b) optical** (c) density (d) hardness

7. What will be the change in temperature of a gas if its volume increases four times from its initial volume at 0°C?

   (a) 819 ^{0}C (b) 819K (c) 1092^{0}C (c) 1192K

8. Conversion of gas into solid is called
   a) sublimation (b) condensation (c) **deposition** (d) solidification

9. The most unsymmetrical crystal system is called:
   (a) triclinic (b) cubic (c) tetragonal (d) rhombic

10. Solution contains 36g of water and 2 mole of methanol, mole fraction of H_2O will be:
    (a) 0.5 (b) 0.4 (c) 0.3 (d) 0.1

11. In which of the following compound nitrogen exhibit -1 oxidation state?
    (a) N_2O (b) NO_2^- **(c) NH_2OH** (d) N_2O_4

12. When ideal gas expands from 15dm^3 to 20dm^3 against standard external pressure, the work done will be:
    (a) 10 atm dm^3 (b) -10 atm dm^3 (c) 5 atm dm^3 **(d)-5 atm dm^3**

13. Which of the following is not the example of giant covalent structure?
    (a) diamond **(b) solid carbon dioxide** (c) graphite (d) silicon dioxide

14. pH of 0.001 M H_2SO_4 is:
    (a) 3.0 **(b) 2.69** (c) 2.9 (d) 1

15. For a reaction; $2A + B \rightleftharpoons 3C + D$ by doubling the concentration of C, the value of equilibrium constant (Kc) would be:
    (a) double (b) half (c) increase by 2 **(d) not change**

16. Reverse of salt hydrolysis is known as:

    (a) Combustion **(b) neutralization** (c) fusion (d) dissociation

17. Which of the following element cannot oxidize by hydrogen in galvanic cell?
    (a) Al (b) Mn **(c) Ag** (d)Zn

18. If a reaction rate is represented as rate = k[A]$^{-2}$[B], the reaction's order will be:
    (a) 3 (b) -3 (c) 2 **(d) -1**

Section-B

Item no	Question (Description)	Reference
i	Calculate the number of molecule in $8cm^3$ of CO_2? (C=12, O=16)	KPTBB Grade XI Page#12,13
Possible Answer	**Given** Volume of $CO_2 = 8cm^3 = 0.08dm^3$ Number of molecules of CO_2= ? **Solution** First we have to calculate number of moles **Number of moles of gas =** $$\frac{volume(dm^3)at\ STP}{molar\ volume(22.4\ dm^3/mol)at\ STP}$$ (1 mark) $= \frac{0.08\ dm^3}{22.4\ dm^3/mol}$ = 0.000357mol (1 mark) **Number of molecules = no. of moles × N_A** **(1 mark)** $= 0.000357 \times 6.022 \times 10^{23}$ $= 0.002 \times 10^{23}$ (1 mark)	
Marking	1+1+1+1	4
ii	Which one is limiting reagent if 24g of carbon reacts with 32g of oxygen to form CO_2? $C + O_2 \rightarrow CO_2$	KPTBB Grade XI Page# 15
Possible Answer	**Given** The balanced chemical equation $C + O_2 \rightarrow CO_2$ **First we convert the amount of both reactants into moles**, Mass of carbon = 24g Molar mass of carbon= 12g Moles of C = 24/12= 2 moles (1 mark) Mass of oxygen = 32g Molar mass of oxygen = 32g Moles of O_2 = 32/32 = 1moles (1 marks) **Calculation of moles of product (CO_2) from the number of moles of each reactants**. From balanced chemical equation we have,	

	1 mole of C ≅ 1 mole of CO_2 2 mole of C ≅ 2 mole of CO_2 1 mole of O_2 ≅ 1 mole of CO_2 (1 mark) **So oxygen is a limiting reagent** (1mark)	
Marking	1+1+1+1=	4
iii	Determine the wave number of photon emitted when electron jumps from 5^{th} to 2^{nd} shell in hydrogen atom?	KPTBB Grade XI Page#42
Possible Answer	**Given**: $n_1 = 2$ $n_2 = 5$ **Using formula**: $\acute{\upsilon} = 1.09 \times 10^7 \left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$ (1 mark) $= 1.09 \times 10^7 \left(\frac{1}{2^2} - \frac{1}{5^2}\right)$ (1 mark) $= 1.09 \times 10^7 \left(\frac{1}{4} - \frac{1}{25}\right)$ (1 mark) $= 0.2289 \times 10^7\ m^{-1}$ (1 mark)	
Marking	1+1+1+1	4
iv	Why in hetero- nuclear molecules, bond length deviates from calculated sum of covalent radii? Justify with the help of an example.	KPTBB Grade XI Page#95
Possible Answer	**For hetero- nuclear diatomic molecules** bond length shortened and become deviates from calculated sum of individual covalent radii , due to increase in difference of electro-negativity. (2 marks) **Example** Experimentally calculated bond length of HCl is 127pm , where as calculated value of atomic radii of H= 37pm and Cl =99pm gives H-Cl bond length equals to 136pm. The calculated values are always higher than experimental values for hetero-nuclear molecules. This is due to the difference in electro-negativity, which produces polarity. This results in the shortening of bond length due to force of attraction between polar ends. (2 marks)	
Marking	2+2	4
v	Derive ideal gas equation for 3 mol of an ideal gas?	KPTBB Grade XI Page#118
Possible Answer	**Solution** It is derived by combining Boyle's, Charles and Avogadro's laws. **According to boyle's law** $V \propto \frac{1}{p}$ **According to Charles law** $V \propto T$ **According to Avagadro's law** $V \propto n$ (1 mark)	

	By combining these three laws we get, $V \propto \frac{T}{p} n$ (1 mark) $PV \propto nT$ $P V = n RT$ (1 mark) **For 3 mol of gas** $P V = 3 RT$ (1 mark)	
Marking	1+1+1+1	4
vi	A buffer solution is made of CH_3COOH and CH_3COONa, what happens to this solution by the addition of strong acid and strong base?	KPTBB Grade XI Page#258
Possible Answer	**Definition** **Buffer solution :** A buffer solution which contains acetic acid and sodium acetate, these two substances has the ability to neutralize the added acid or base. The pH of buffer is governed by equilibrium $CH_3COOH \leftrightharpoons CH_3COO^- + H^+$ (1 mark) Sodium acetate a strong electrolyte dissociates in water. $CH_3COONa \leftrightharpoons CH_3COO^- + Na^+$ (1 mark) **Addition of strong base** When a small amount of strong base is added it will increase the concentration of OH^-. As a result equilibrium shifts towards right to produce more H^+ ions till all the excess OH^- ions are neutralized and the original pH of the buffer is restored. (1 mark) **Addition of strong acid** When a strong acid is added, H^+ ion of the acid reacts with acetate ion of the buffer. Both of these reactions go to completion. Hence the added OH^- and H^+ ions are removed and the pH of the buffer solution remains constant. (1 mark)	
Marking	1+1+1+1	4
vii	What is the role of hydrogen bonding in strength of acid and solubility of substances in water?	KPTBB Grade XI Page#157
Possible Answer	**Role of hydrogen bonding in strength of acid**: H-F is weaker acid than H-Cl, H-Br and H-I because hydrogen atom is entrapped between two highly electronegative atoms in H-F due to hydrogen bonding. (2 marks) **Role of hydrogen bonding in solubility** Organic substances which forms hydrogen bonds with water molecules, are soluble in water, for example ethyl alcohols miscible with water in all proportions because its molecules can form hydrogen bonds with molecules of water. (2 marks)	
Marking	2+2	4

viii	5g of NaOH dissolved in water to form 100g of solution calculate molality?	KPTBB Grade XI Page#306
Possible Answer	**Given data** Given mass of NaOH= 5g Molar mass of NaOH= 40g/mol Mass of solvent = 100 -5 = 95g (1 mark) As we know, **Molality =** $\frac{\textbf{mass of substance}}{\textbf{molar mass}} \times \frac{\textbf{mass of solvent}}{\textbf{1000}}$ (1 Mark) $= \frac{5g}{40g/mol} \times \frac{95}{1000}$ (1mark) = 0.01 mole (1 mark)	
Marking	1+1+1+1	4
ix	Write properties of liquid crystals.	KPTBB Grade XI Page#173
Possible Answer	Properties of liquid crystals: i. They have some degree of order like crystalline solid. ii. They have fluidity like liquids. iii. They have properties such as surface tension, viscosity etc. like liquids. iv. They have optical properties like crystalline solids.	
Marking	1+1+1+1	4
x	Differentiate between rate of reaction and rate constant?	KPTBB Grade XI Page#271 and 275
Possible Answer	**Rate of reaction** 1) It is change in concentration of reactants or products per unit time. 2) its unit is $mol\ L^{-1}sec^{-1}$. 3) It can vary over time as reactants are consumed and products are formed. 4) it depends upon concentration. **Rate constant** 1) It is equal to rate of reaction when the concentration of reactant is unity. 2) Its unit depends upon the order of reaction. 3) Each reaction has its own rate constant, which is determined experimentally. 4) It does not depend upon concentration.	
Marking	1+1+1+1	4
xi.	Why hydrogen show positive deviation while carbon dioxide shows negative than positive deviation from ideal behavior.	KPTBB Grade XI Page#125
Possible Answer	**H_2**: As H_2 is non polar and has small size when the pressure increases it shows only repulsive forces, so it shows positive deviation. (2 Mark) **CO_2**: CO_2 is also non polar but due to larger size when pressure increases it shows attractive force initially due to which it shows negative deviation, but further increases in pressure. Molecule of CO_2	

	become very close and show repulsive forces means positive deviation. (2 Mark)	
Marking	1+1+1+1	4
Xii	Define Hess's law. Calculate ΔH sublimation for the given reactions. $H_{2\,(g)} + I_{2\,(s)} \longrightarrow 2\,HI_{(g)} \quad \Delta H = 51.8KJ/mol$ $H_{2\,(g)} + I_{2\,(g)} \longrightarrow 2\,HI_{(g)} \quad \Delta H = -10.5KJ/mol$	KPTBB Grade XI Page#347
Possible Answer	**Definition** **Hess's law:** Hess's law states that the amount of heat evolved or absorbed in a chemical reaction is the same whether the reaction take place in a single or several step. (1 mark) **Calculation of ΔH sublimation** $H_{2(g)} + I_{2(s)} \longrightarrow 2\,HI_{(g)} \quad \Delta H = 51.8KJ/mol$ (1 mark) $2HI_{(g)} \rightarrow H_{2(g)} + I_{2(g)} \quad \Delta H = 10.5KJ/mol$ (1mark) ———————————————————— $I_{2(s)} \rightarrow I_{2(g)} \quad \Delta H = \frac{62.3KJ}{mol}$ (1 mark)	
Marking	1+1+1+1	4
Xiii	Calculate cell voltage for the following reaction. $Cu^{+2} + 2e^- \longrightarrow Cu \quad Ered^O = +0.34$ $Mn^{+2} + 2e^- \longrightarrow Mn \quad Ered^O = -1.03$	KPTBB Grade XI Page#368
Possible Answer	**Reaction at anode** $Mn \rightarrow Mn^{+2} + 2e^- \quad E_{oxid} = -1.03$ (1 mark) **Reaction at cathode** $Cu^{+2} + 2e^- \longrightarrow Cu \quad E_{red} = +0.34$ (1 mark) **Cell voltage** $E^{\circ}_{cell} = E^{\circ}_{oxi} + E^{\circ}_{red}$ (1 mark) = 1.03 + 0.34 = 1.37 V (1 mark)	
Marking	1+1+1+1	4

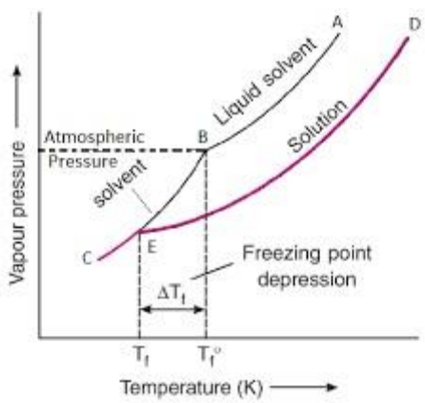
Section-C

Item no	Question(Description)	Reference
2.(a)	**Calculate radius of 3rd and 6th orbit of hydrogen atom? (4 marks)**	KPTBB Grade XI Page#37
Possible answer	**Solution** **Radius of 3rd shell** n = 3 $r_3 = n^2 (0.529\ A^{\circ})$	

	$= (3)^2 \times (0.529\ A^\circ)$ $= 4.76\ A^\circ$ (2 marks) **Radius of 6th shell** n = 6 $r_3 = n^2 (0.529\ A^\circ)$ $= (6)^2 \times (0.529\ A^\circ)$ $= 19.0\ A^\circ$ (2 marks)	
Marking	2+2	4
2.(b)	Complete the following table. Total number of electron pair present / Types of electron pairs / Name of molecular shape / Example 2 / **?** / Linear / $BeCl_2$ 3 / 2 bond pair 1 lone pair / **?** / **?** 4 / 3 bond pair 1 lone pair / **?** / NH_3 4 / **?** / angular / H_2O	KPTBB Grade XI Page#78,79
Possible answer	**Solution** Total number of electron pair present / Types of electron pairs / Name of molecular shape / Example 2 / **2 bond pair 0 lone pair** / Linear / $BeCl_2$ 3 / 2 bond pair 1 lone pair / **angular** / **$SnCl_2$** 4 / 3 bond pair 1 lone pair / **Trigonal pyramidal** / NH_3 4 / **2 bond pair 2 lone pair** / angular / H_2O	
Marking	1+1+1+1+1	5
3.(a)	5.6 g of solid CO_2 is put in an empty sealed 4.00L container at a temperature of 300K. When all the solid CO_2 becomes gas, what will be pressure in this container? (4 marks)	KPTBB Grade XI Page#155,156
Possible answer	**Given** Mass of CO_2= 5.6g Volume = 4L = $4dm^3$ Temperature = 300K Pressure = ?	

	First of all calculate moles of CO_2 Number of moles = $\frac{given\ mass}{molar\ mass}$ $=\frac{5.6}{44}$ =0.127mol (1 mark) **For calculating pressure using formula** PV = nRT where. R=0.0821dm^3/mol/K (1 mark) P = $\frac{nRT}{V}$ P = $\frac{0.127\times0.0821\times300}{4}$ (1 mark) = 0.78 atm (1 mark)	
Marking	1+1+1+1	4
3.(b)	Define unit cell? Write four factors that affect the shape of ionic crystal? (5marks)	KPTBB Grade XI Page#197
Possible answer	**Definition** **Unit cell** The smallest portion of a crystal lattice that shows the three dimensional pattern of the entire lattice is called a unit cell. (1 mark) **Factors that affect the shape of ionic crystal** **(i) Electrostatic force of attraction** Ionic crystals are strongly held together due to electrostatic forces. This strength is known as lattice energy. Due to high lattice energy ions are strongly held together and crystal acquires a definite shape. (1 mark) **(ii) Radius ratio** The coordination number of ionic compounds is related with relative size of cation and anion, called as radius ratio which is the ratio of size of cation to that of anion.e.g. for NaCl the radius ratio of Na^+ to Cl^- is 0.54 which has coordination number of 6 and acquire an octahedral crystal structure. (1 mark) **(iii) Effect of temperature** A perfect crystal would acquire cooling of liquid phase at a very slow rate so as to allow ions to find their proper position in lattice. In this way proper temperature has significant impact upon crystal formation. (1 mark) **(iv) Effect of impurity** If there are impurities in solution from which the crystallization of a substance is to be carried out, the resulting crystal will have defects,	

	called crystal defect. These impurity particles will fit into holes of the crystal lattice causing a defect in crystal structure. (1 mark)	
Marking	1+1+1+1+1	5
4.(a)	When $50cm^3$ of 1 molar HCl is added into 1 molar of NaOH the temperature raised from 21.0 to 27.5 ^{0C}. Determine the enthalpy of neutralization. (Specific heat capacity of H_2O IS $4.2Jg^{-1k}k^{-1}$) (4 marks)	KPTBB Grade XI Page#346
Possible answer	**Solution** **1. Calculate Moles of HCl / NaOH** No. of moles of HCl = $\frac{50}{1000} \times 1 = 0.05mol$ No. of moles of NaOH = $\frac{50}{1000} \times 1 = 0.05mol$ (1mark) Total volume of solution= 50+50= $100cm^3$ Using density of water = $1gm/cm^3$ Mass of solution= dv= $1 \times 100 = 100g$ (1 mark) **2. Calculate heat of neutralization** Heat of neutralization= m $\times \Delta t \times c_w$ = 100g × 6.5 × 4.2 = 2730J/ 0.05mol (1 mark) **3. Conversion** For 1 mol $= \frac{2730J}{0.05mol} \times 1mol$ = - 54600J = -54.6KJ/mol (1mark)	
Marking	1+1+1+1	4
4.(b)	Define ionic product and solubility product constant? What information we got from ionic and solubility product constant? (5marks)	KPTBB Grade XI Page#227
Possible answer	**Definition** **Solubility product (K_{sp})** The solubility product of a substance is the product of molar concentrations of its ions in the saturated solution each raised to an exponent equal to the coefficient of each ion in the balanced equation. (1mark) **Ionic product (IP)** It is the product of concentrations of ions of electrolyte at any concentration of solution each raised to the power of their coefficient in the balanced chemical equation. (1mark) **Information we get is as follows:** **(1) IP= K_{sp}**	

	When actual amount of ions in solution is maximum, the resulting solution will be saturated but there is no precipitation. (1 mark) **(2) IP < K_{sp}** When actual amount of ions in solution is less than equilibrium concentration, the resulting solution will be unsaturated but there is no precipitation. (1 mark) **(3) IP> K_{sp}** When actual amount of ions is more than equilibrium concentration, the resulting solution will be supersaturated and it accommodating more ions that it can keep in solution. (1 mark)	
Marking	1+1+1+1=1	5
5.(a)	What do you know about freezing point depression? Justify your answer with the help of graph? (5marks)	KPTBB Grade XI Page#316
	Definition **Freezing point depression** The freezing point of a liquid is a temperature at which solid phase begins to separate out from the liquid phase. (1 mark) **Graphical representation**  (2 marks) **Explanation** Above graph shows the vapour pressure of solution and pure solvent as a function of temperature. Where, **T_1° represents the freezing point of pure solvent** **T_1 represents the freezing point of solution** Hence,	

	$\Delta T_f = T_1^\circ - T_1$ where, ΔT_f, is the depression in freezing point. (2 marks)	
Marking	1+2+2	5
5.(b)	Balance following equation by half -cell reaction method? (4 marks) $S_2O_3^{-2} + OCl^{-1} \longrightarrow Cl^- + S_4O_6^{-2}$ $(ACIDIC\ MEDIUM)$	KPTBB Grade XI Page#363
Possible answer	**Given** $S_2O_3^{-2} + OCl^{-1} \longrightarrow Cl^- + S_4O_6^{-2}$ $(ACIDIC\ MEDIUM)$ **Solution** (i)Balance the atoms other than oxygen and hydrogen $2\ S_2O_3^{-2} \rightarrow S_4O_6^{-2}$ $OCl^{-1} \longrightarrow Cl^-$ (1 mark) (ii) In acidic medium H^+ ion is used for greater number of oxygen and H_2O can be added to other side. $2\ S_2O_3^{-2} \rightarrow S_4O_6^{-2}$ $2H^+ + OCl^{-1} \longrightarrow Cl^- + H_2O$ (1 mark) (iii) Multiply each half reaction by a number chosen so that the total number of electrons lost by reducing agent becomes equal electrons gained by the oxidizing agent. $2\ S_2O_3^{-2} \rightarrow S_4O_6^{-2} + 2e^-$ $2e^- + 2H^+ + OCl^{-1} \longrightarrow Cl^- + H_2O$ (1 mark) (iv) After multiplication by cancel similar things on both sides in the net equation we got final balance chemical equation. $\mathbf{2S_2O_3^{-2} + 2H^+ + OCl^{-1} \longrightarrow S_4O_6^{-2} + Cl^- + H_2O}$ **(1 mark)**	
Marking	1+1+1+1	4