



Our country, our future

525/1

S6 CHEMISTRY

Exam 1

PAPER 1

DURATION: 2 HOUR 45 MINUTES

For Marking guide contact and consultations: Dr. Bbosa Science 0776 802709,

Instructions

- This paper consists of two sections A and B
- Section A is compulsory
- Attempt only six questions in section B
- Answers must be written in the spaces provided only.

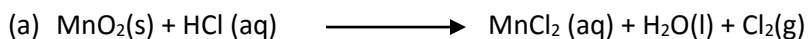
Where necessary use the following:

Molar gas constant, R	= $8.31\text{JK}^{-1}\text{mol}^{-1}$
Molar volume of a gas at s.t.p	= 22.4litres
Standard temperarue	= 273K
Standard pressure	= 10125Nm^{-2}

For Examiner's Use Only																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17

SECTION A

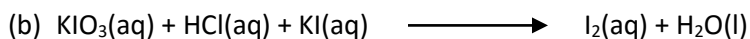
1. Write a balanced overall ionic equation for the following reactions:



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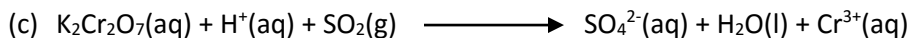
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2. The osmotic pressure of an aqueous solution of a non- electrolyte containing 5.43 gdm^{-3} of solution is $7.093 \times 10^4 \text{ Nm}^{-2}$ at 25°C . Calculate the freezing point of solution. (K_f for water = $18.6^\circ\text{C per } 100\text{gmol}^{-1}$)

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3. (a) Define the term “disproportionation.”

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(b) Write the ionic equation for the disproportionation of the following species.

(i) MnO_4^{2-} in acidic media.

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(ii) copper (I) in aqueous solution.

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(iii) Chlorine in hot concentrated sodium hydroxide solution

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4. The following data was obtained for the reaction between hydrogen peroxide and iodine ions and hydrogen ions

Expt. No.	Concentration (mol dm ⁻³)			Rate of reaction (mol dm ⁻³ s ⁻¹)
	I ⁻ (aq) ion	H ₂ O ₂ (aq)	H ⁺ (aq) ions	
1	0.010	0.010	0.010	1.76 x 10 ⁻⁶
2	0.010	0.030	0.010	5.25 x 10 ⁻⁶
3	0.020	0.030	0.010	1.05 x 10 ⁻⁵
4	0.020	0.030	0.020	1.05 x 10 ⁻⁵

(i) State the order of reaction with respect to

H₂O₂

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I⁻

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H⁺

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(ii) Write the rate equation for the reaction:

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(iii) Calculate the rate constant (K) for the reaction and indicate its units.

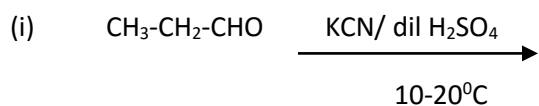
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5. Complete each of the following equations and write the accepted mechanism.

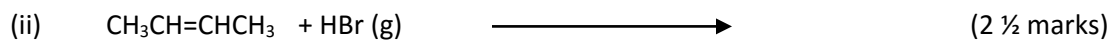


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6. (a) Define the term “standard enthalpy of atomization”

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(b) Bond energies for some bonds are given below.

Bond	Bond energy
C-O	358
C-H	413
O-H	464

Calculate the standard enthalpy of atomization of methanol

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(d) Explain why ammonium nitrate is readily soluble in water even though the standard enthalpy of solution has a positive value.

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7. Name the reagent that can be used to distinguish between Co^{2+} and Mn^{2+} ions. State what is observed when the aqueous solution of each ion is separately treated with the reagent.

Reagent

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Observations:

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(b) Cobalt forms a complex of formula $\text{Co}(\text{NH}_3)_n^{3+}3\text{Cl}^-$.

5×10^{-3} moles of a complex were heated in excess alkali and the ammonia liberated was absorbed in 50 cm^3 of dilute sulphuric acid of concentration 0.5M. The excess acid remaining after the absorption required 20.00 cm^3 of 1M sodium hydroxide for complete neutralization. Calculate the value of N in the formula of the complex.

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8(a) Explain what is meant by the term “**condensation polymerization?**”

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(b) Nylon 6,10 can be made by reacting 1,6-diaminohexane with decanedioyl chloride $\text{ClOC}(\text{CH}_2)_8\text{COCl}$.

Write the structural formula of:

(i) 1,6-diaminohexane

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(ii) Nylon 6,10

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(c) State one use of nylon 6,10.

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9. Ammonium carbamate (NH_4CONH_2) decomposes according to the following equation:



(a) Write the expression for the equilibrium constant (K_p)

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(b) At equilibrium, the total pressure of the system is 0.36 atm. at 40°C . Calculate the value of K_p for the reaction at 40°C (indicate units).

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(c) State what happens to the K_p calculated in (a)(i) if

(i) More solid ammonium carbamate is added to the equilibrium mixture.

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(ii) The temperature is increased to 80°C .

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SECTION B

10 Show how the following organic conversions can be effected. (Indicate suitable reagents and conditions of reaction's n each). (3marks each)

(a) $(\text{CH}_3)_3\text{COH}$ from CH_3COCH_3

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(b) $\text{H}_2\text{C}_2\text{O}_4$ from $\text{CH}_2=\text{CH}_2$

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(c) CH_3NH_2 from CH_3COOH

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11. Explain the following observations

(a) Silicon and phosphorus are both covalent substances, but the melting of silicon is much higher than that of phosphorus. (3marks)

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(b) Magnesium oxide (MgO) has the same crystalline structure as sodium chloride (NaCl) but the lattice energy of MgO is more exothermic than that of NaCl. (3marks)

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(c) A concentrated solution of calcium chloride forms a precipitate with sodium hydroxide but no precipitate form with aqueous ammonia. (3marks)

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12.(a) Phenylamine was mixed with concentrated hydrochloric acid and sodium nitrite at 0-5°C. The resultant solution Y was then treated with a mixture of phenol in aqueous sodium hydroxide. State what is observed and write the equation of reaction that takes place between:

(i) Phenylamine and a mixture of concentrated hydrochloric acid and sodium nitrite.

Observation (½ mark)

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Equation: (1½ marks)

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(ii) Y and phenol in aqueous sodium hydroxide

Observation

(½ mark)

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Equation:

(1 ½ marks)

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(b) 20 cm³ of 0.05M aqueous phenylamine was mixed with 50ccm³ of 1M sodium bromide and electrolyzed at current of 0.2A. The first permanent bromine color was observed after 49.93 minutes; then electrolysis was stopped. (Faradays constant =96500Cmol⁻¹).

(i) Calculate the moles of bromine that reacted with 1 mole of phenylamine

(3 ½ marks)

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(iii) Hence write equation of the reaction between bromine and phenylamine. Name the product

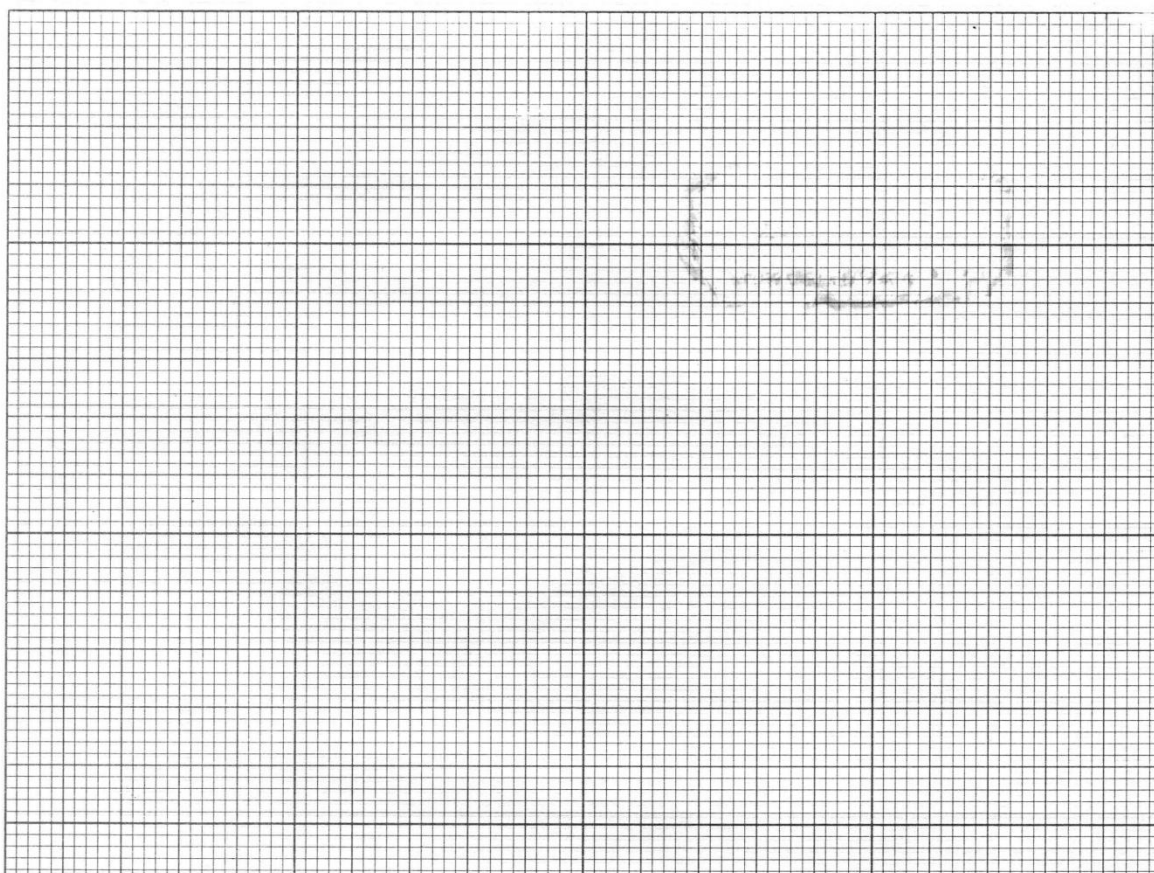
(1 ½ marks)

13. The table below gives data obtained when 100cm³ of propanoic acid was titrated with 1.0M sodium hydroxide solution.

Volume of 1M NaOH added/ cm ³	0.0	1.0	5.0	9.0	10.5	11.0	15.0
pH of solution	2.94	3.92	4.87	5.82	11.70	12.00	12.70

(a) (i) Plot a graph of pH against volume of 1M sodium hydroxide

(3marks)



- (ii) Using the graph determine the pH and volume 1.0M sodium hydroxide used at equivalent point (1mark)

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- (iii) Name the suitable indicator that can be used for the titration (½ mark)

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- (b) Explain the shape of the graph.

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14. The table below shows formulae of oxides of silicon, Aluminium and phosphorus. (Indicate the chemical nature, bonding type and the structure adopted by the oxide)

Oxide	Chemical nature	Bonding	Structure
SiO ₂			

Al_2O_3			
P_4O_{10}			

(c) Write equations of reaction to illustrate the chemical nature of

(i) P_4O_{10}

Equation

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(ii) Al_2O_3

Equation

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15 (a) Define the term "Phase"

(1mark)

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(b) The melting points of various composition of Naphthalene-biphenyl system are given below:

Mole fraction of Naphthalene	0.800	0.625	0.275	0.125
Melting points/ $^{\circ}\text{C}$	72.6	58.0	56.0	64.5

Naphthalene-biphenyl system form a eutectic mixture of composition of 0.47 mole fraction of naphthalene at temperature of 41.0°C

- (i) Plot a phase diagram for naphthalene-biphenyl system and label all regions. Melting point pure Naphthalene = 80°C and mpt. Of biphenyl = 71°C (5marks)

(ii) Describe what happens when a mixture containing 0.70 mole fraction of biphenyl is

Cooled.

(2marks)

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(c) State one application of eutectic mixture

(½ mark)

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16. 3.70g of an organic compound Q containing carbon, hydrogen and oxygen was exploded in excess oxygen, 4.50g of water and 6.48dm³ of gaseous substance were passed through sodium hydroxide solution, 2.0dm³ of oxygen was found unreacted. (All volumes of gaseous substances were measured at stp).

(a) (i) Determine the empirical formula of Q:

(4marks)

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(iii) If the vapor density of Q is 37, determine the molecular formula of Q (1½ marks)

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(d) Q reacts with a mixture of sodium hydroxide and iodine solution to give a yellow precipitate

(i) Identify Q (1mark)

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(ii) Name the reagent(s) used to confirm the functional group in Q. (½ marks)

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17. (a) Explain what is meant by the term “salt hydrolysis” (1½ marks)

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(b) Sodium sulphide undergoes hydrolysis. Write the

(i) equation for hydrolysis of sodium sulphide

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(iii) expression for hydrolysis constant (K_h), for sodium sulphide.

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(c)(i) Calculate the pH of solution containing 3.9gdm^{-3} of sodium sulphide (Hydrolysis constant at 25°C of sodium sulphide = $1.25 \times 10^{-10} \text{mol dm}^{-3}$) (4marks)

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(iv) State whether the resultant solution in (a)(i) is basic, neutral or acid (Give a reason for your answer) (1marks)

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