

Name:

Index No..... Signature:

P525/1
Chemistry
Paper 1
July/Aug. 2023
2 $\frac{3}{4}$ hours

ASSHU - KASESE JOINT EXAMINATIONS BOARD (AKJEB)

MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

INSTRUCTIONS TO CANDIDATES:

Answer all questions in section A and six questions in section B

All questions must be answered in the spaces provided

The Periodic Table, with relative atomic masses, is supplied.

Mathematical tables (3-figure tables) are adequate or non-programmable scientific electronic calculators may be used

Illustrate your answers with equations where applicable.

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 is 22.4 litres.

Standard temperature = 273 K

Standard pressure = 101325 N m^{-2}

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

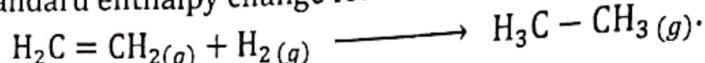
SECTION A (46 MARKS)

Answer all questions from this section.

(01 mark)

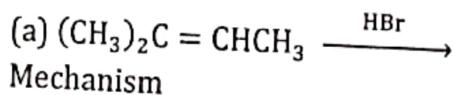
1. (a) Define the term bond energy

(b) The values of the average bond enthalpies for C-C, C=C, C-H and H-H bonds in kJ mol^{-1} are given as 348, 612, 413, and 436 kJ mol^{-1} respectively. Calculate the standard enthalpy change for the reaction;

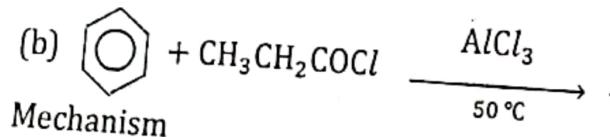


(02 ½ marks)

2. Complete the following equations and in each case write a mechanism for the reaction.



(02 ½ marks)



(02 ½ marks)

3. $\text{Cr}(\text{NH}_3)_6^{3+}$ and $\text{Co}(\text{CN})_4^{2-}$ are complexes formed when $\text{Cr}^{3+}_{(aq)}$ and $\text{Co}^{2+}_{(aq)}$ ions are respectively treated with excess ammonia and potassium thiocyanate (01 mark)
- (a) Name the complex
-
.....
.....
- (b) State what would be observed when;
- (i) $\text{Cr}^{3+}_{(aq)}$ ions are treated with excess concentrated ammonia solution. (01 mark)
-
.....
.....
- (ii) $\text{Co}^{2+}_{(aq)}$ ions are treated with excess concentrated hydrochloric acid. (01 marks)
-
.....
.....
- (c) Write equation(s) for the reaction(s) that takes place in b(i) above. (02 marks)
-
.....
.....
4. Nitrogen reacts with hydrogen to produce ammonia in the Haber process.
- (i) Write an equation to show how ammonia is produced from nitrogen and hydrogen. (1 ½ marks)
-
.....
.....
- (ii) State and explain the effect of decreasing pressure on the position of the equilibrium in the above reaction. (1 ½ marks)
-
.....
.....
- (b) At 400K, 2 moles each of hydrogen and nitrogen were to reach equilibrium. At equilibrium, 0.2 moles of nitrogen had reacted and the equilibrium constant for the reaction at 400 K was 40.7 atm^{-2} . Calculate the total pressure of the system at equilibrium. (03 marks)
-
.....
.....

5. (a) (i) Write down the general electronic configuration of group (IV) elements. (0 ½ mark)

(ii) State the common oxidation states of group (IV) elements in their compounds. (01 mark)

(b) (i) What is meant by the term inert pair effect? (01 mark)

(ii) State and explain the trend in inert pair effect down group (IV) elements. (03 marks)

6. Name a reagent that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed when the reagent you have named is treated separately with each member of the pair.

(a) $(CH_3)_3COH$ and CH_3COCH_3 .

Reagent

(03 marks)

Observation

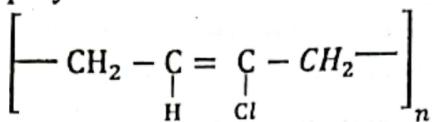
(b) C_6H_5COONa and CH_3COONa .

Reagent

(03 marks)

Observation

7. (a) Neoprene is a synthetic polymer which has the following structure.



- (i) Name the type of polymerization reaction which leads to the formation of neoprene. (01 mark)
- (ii) Write the structure and name of the monomer of neoprene structure. (01 mark)
Structure:
-
-

Name.

- (b) When 350 g of the monomer was polymerised, 9.89×10^{-2} moles of neoprene was formed. Calculate the relative molecular mass of neoprene. (02 marks)
-
-
-
-
-
-
-

- (c) State one use of neoprene. ($\frac{1}{2}$ mark)
-
-

8. The following experimental results were obtained for the reaction $A + 2B \rightarrow$ products.

Experiment	Initial concentrations (mol^{-1})		Initial rate ($\text{mol}^{-1}\text{s}^{-1}$)
	A	B	
1	3.0×10^{-2}	3.0×10^{-2}	2.7×10^{-5}
2	3.0×10^{-2}	6.0×10^{-2}	5.4×10^{-5}
3	6.0×10^{-2}	3.0×10^{-2}	10.8×10^{-5}

- (a) (i) Determine the order of reactions with respect to; (01 mark each)
A
-
-
-
-
-

B

(ii) Write the expression for the rate equation (½ mark)

(b) The rate of reaction for the above reaction under certain conditions of temperature and pressure is X. Express the rate in terms of X when the following changes are made. (½ mark)

(i) The concentration of B is halved. While the concentration of A remains unchanged.

(ii) The rate constant is doubled by decreasing temperature but keeping the concentration of A and B unchanged.

(iii) If 90% of B is removed by precipitation, without affecting concentration of A.

(c) Calculate the value of the rate constant and state its units. (2 marks)

9. Draw the structure and state the shape of each of the following species in the table below.

Species	Structure	(4 ½ marks)

Species	Structure	Shape	(4 ½ marks)
(i) SO_3			
(ii) PO_4^{3-}			
(iii) CrO_4^{2-}			

SECTION B (54 MARKS)

Answer any six questions from this section.

- 10.(a) 50 g of compound T contain 20 g of carbon, 3.34 g of hydrogen and the rest being oxygen. Calculate the empirical formula of T (2 ½ Marks)

(2 ½ Marks)

- (a) A solution containing 56.29 g of T in 500 g of water froze at -3.49°C .

- (i) Determine the molecular mass and hence molecular formula of T.
 (Freezing point constant, K_f of water is $1.86 \text{ }^{\circ}\text{C mol}^{-1}$ per 100 g)

(ii) Write the structural formulae and IUPAC name of all the possible isomers of T. (3 marks)

Name _____
Isomer _____

(b) When ethanol and concentrated Sulphuric acid were added to T and the mixture warmed, a sweet fruity smelling product was obtained.

(i) Identify T (½ mark)

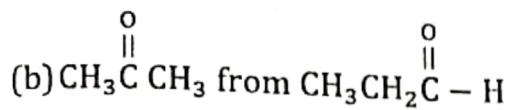
(ii) By the use of equations only, show how T can be synthesized from bromoethane. (1 ½)

(1 ½ mark)

11. Write equations to show how the following conversions can be carried out. In each case indicate the reagents and conditions for the reaction.

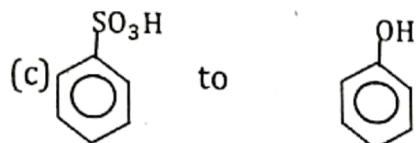
(a) $\text{CH}_3\text{CH}_2\text{OH}$ to $\text{CH}_3\overset{\text{OH}}{\underset{|}{\text{C}}} \text{HCOOH}$

(3 ½ marks)



(3 ½ marks)

.....
.....
.....
.....
.....
.....
.....
.....



.....
.....
.....
.....
.....
.....
.....
.....

12. State the conditions under which beryllium and magnesium react with the following substances and where applicable write equation(s) for the reaction

(a) Water

(4 marks)

.....
.....
.....
.....
.....
.....
.....
.....

(b) Concentrated sodium hydroxide solution

(2 ½ marks)

.....
.....
.....
.....
.....
.....
.....
.....

(c) Concentrated nitric acid

(2 ½ marks)

.....
.....
.....
.....
.....
.....
.....
.....

13.(a) (i) Write down the electronic configuration of copper.

(01 mark)

(ii) State two properties which show copper as a transition element (01 marks)

(b) Excess ammonia was shaken with an equal volume of chloroform and a 0.04 M aqueous solution of copper(II) Sulphate and allowed to stand. Some of the aqueous ammonia reacted with copper (II) ions to form the complex $[\text{Cu}(\text{NH}_3)_n]^{2+}$. After equilibrium was established, the concentration of ammonia in the Chloroform and aqueous layers were $0.017 \text{ mol dm}^{-3}$ and $0.580 \text{ mol dm}^{-3}$ respectively. (The partition coefficient, K_D of ammonia between water and chloroform is 25.0). Calculate the

(i) Concentration of free ammonia in the aqueous layer. (2 marks)

(ii) Concentration of ammonia that complexed with copper (II) ions. (2 marks)

(iii) Value of n in $[\text{Cu}(\text{NH}_3)_n]^{2+}$

(3 marks)

14. In the extraction of Zinc from its ores, the ores are first concentrated and then roasted in air. The roasted material is mixed with coke and limestone and heated by hot air in the blast furnace producing zinc.

(a) Write the name and formula of the ore from which zinc can be extracted.

(1 mark)

.....
.....

(b) Describe the process by which the ore named in (a) above can be concentrated.

(2 marks)

.....
.....
.....
.....
.....
.....
.....
.....

(c) Write the equations for the reaction.

(i) that takes place when the ore is roasted in air.

(1 ½ marks)

.....
.....
.....
.....

(ii) that lead to the formation of zinc in the blast furnace.

(1 ½ marks)

.....
.....
.....

(d) State what would be observed and write equation for the reaction when zinc metal is added to;

(i) Copper (II) Sulphate solution

(1 ½ mark)

.....
.....
.....

(ii) Aqueous sodium hydroxide solution.

(1 ½ mark)

.....
.....
.....

15. (a) Explain what is meant by the term common ion effect. (01 mark)

(b) Silver chromate is sparingly soluble in water.

Write

- (i) The equation for solubility of silver chromate in water. (1 ½ mark)

- (ii) The expression for solubility product, K_{sp} for Silver chromate. (1 ½ mark)

- (iii) A solution of silver nitrate was added to a saturated solution of Silver Chromate. State and explain how the solubility of silver chromate was affected. (2 marks)

- (c) (i) A saturated solution of silver chromate contains $2.4 \times 10^{-2} \text{ g l}^{-1}$ at 20 °C. Calculate the value for the solubility product, K_{sp} for silver chromate at 20°C.

(2 marks)

- (iii) State **two** applications of solubility product. (1 mark)

16.(a) Explain the following observations.

- (i) Lead(II) chloride is more soluble in silver nitrate solution than in water

(3 marks)

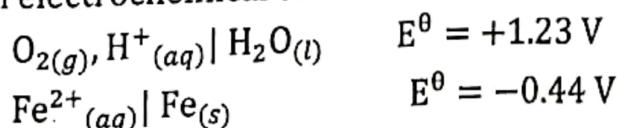
(ii) Carbon dioxide is a gas at room temperature whereas silicon(IV) oxide is a solid. (3 marks)

(iii) Lead(IV) chloride exists whereas lead(IV) bromide does not (3 marks)

17.(a) (i) Define the term standard electrode potential (01 mark)

(ii) State any **three** factors that determine the magnitude of electrode potential
(1 ½ mark)

(b) An electrochemical cell consists of the following electrodes



(i) Write the half equations at the Anode (01 mark)

Cathode

(01 mark)

(ii) Write down the overall cell reaction

(1 ½ marks)

(c) (i) Write the cell notation for the reaction

(01 mark)

(ii) Calculate the standard electrode potential for the reaction and state if it is
possible/feasible.

(1 ½ mark)

(iii) State **one** effect of the above reaction on metals.

(½ marks)

END