THE UNITED REPUBLIC OF TANZANIA
NATIONAL EXAMINATIONS COUNCIL OF TANZANIA
ADVANCED CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

132/2 **CHEMISTRY 2**
(For Both School and Private Candidates)

Time: 3 Hours **Year: 2020**

Instructions

1. This paper consists of a total of **six (6)** questions.
2. Answer **five (5)** questions.
3. Each question carries **twenty (20)** marks.
4. Mathematical tables and non-programmable calculators may be used.
5. Cellular phones and any unauthorised materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. For calculations you may use the following constants:

   Gas constant, R = 8.31 J mol^{-1} K^{-1} or 0.082 atm mol^{-1} K^{-1} dm^3

   GMV = 22.4 dm^3

   1 litre = 1 dm^3 = 1000 cm^3

   Standard temperature = 273 K

   Standard pressure = 760 mmHg = 1 atm = 1.0 x 10^{-5} NM^{-2}

   Velocity of light, c = 3.0 x 10^8 m/s

   1 Faraday = 96,500 $Cmol^{-1}$

Answer **five (5)** questions.

1. (a) Ethanol and water form an azeotropic mixture which boils at 78.01°C and contians 95.6% ethanol at standard pressure. If the boiling points of pure water and ethanol are 100°C and 78.4°C, respectively.
   (i) draw and label a temperature versus mole fraction phase-diagram of ethanol and water solution. **(4 marks)**
   (ii) what happens when a dilute ethanol solution of less than 50% is boiled and condensed several times? **(3 marks)**
   (iii) how would you increase the percentage of ethanol after obtaining a 95.6% ethanol-water mixture? **(3 marks)**

   (b) When 500 cm^3 of an aqueous solution containing 4 g of a solute G per litre was shaken with 100 cm^3 of pentan-1-ol, 1.5 g of the solute G was extracted. Assuming the molecular state of the solute remained the same in both solvents, calculate:
   (i) partition coefficient of the solute G between pentan-l-ol and water. **(4 marks)**
   (ii) mass of the solute G which remained in the aqueous solution after a further shaking with 100 cm^3 of pentan-l-ol. **(4 marks)**

   (c) Write two practical applications of the partition law. **(2 marks)**

2. (a) (i) What are the effects of a catalyst on the activation energy of a reaction? **(2 marks)**
   (ii) Describe how temperature, concentration, light, pressure and surface area can affect the rate of a chemical reaction. **(5 marks)**

   (b) The decomposition of a hydrogen peroxide at 25°C was studied by titrating portions of the reaction mixture with a standard potassium permanganate solution at different time intervals. The results obtained were tabulated as follows:

Volume of $KMnO_4$ (cm^3)	75	47	30	13	7.20
Time (min)	0	6	9	20	29

   (i) Show that the reaction is a first order.
   (ii) Without using a graph, calculate the rate constant at the given temperature. **(9 marks)**

   (c) The reaction, $NH_2NO_2(aq) \rightarrow N_2O(g) + H_2O(l)$ is a first order with $k = 2.2 \times 10^{-5} sec^{-1}$.
   (i) Find the percentage of NH_2NO_2 that would be decomposed on heating at 310°C for 90 minutes.
   (ii) If the rate of reaction triples when the temperature is raised from 20°C to 50°C, calculate the activation energy of the reaction in kJ/mol. **(4 marks)**

3. (a) Calculate the pH of a solution obtained when:
   (i) 1.0 cm^3 of 0.10 M NaOH is added to 100 cm of 0.001 M HCl.
   (ii) 1.0 cm^3 of 1.0 M HCl is added to 1000 cm^3 of a solution mixture prepared by dissolving 0.04 moles of CH_3COOH. Use $Ka(CH_3COOH) = 1.84 \times 10^{-5}$. **(10 marks)**

(b) How does Bronsted-Lowry concept account for the relative strength of acid-base conjugate pairs? **(4 marks)**

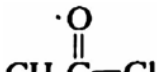
(c) Indicate the acid-base conjugate pairs in each of the following equilibria:
(i) $NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$
(ii) $H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$
(iii) $AH + H_2O \rightleftharpoons A^- + H_3O^+$ **(6 marks)**

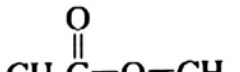
4. (a) Describe four characteristics of *s*-block elements. **(4 marks)**

(b) (i) What do you understand by the word electronegativity?
(ii) Explain three factors that affect the size of electronegativity. **(6 marks)**

(c) Briefly, explain how hydrides of period 2 react with water, acids and bases. Support your answers with reaction equations. **(10 marks)**

5. (a) With the aid of chemical equations, show how dimethylamine reacts with the following compounds:

(i) 

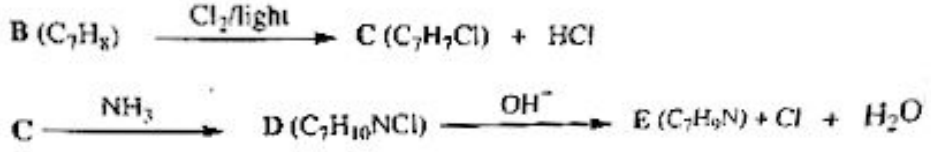
(ii) 

(3 marks)

(b) Give the structural formula of the following compounds:
(i) tripropylamine
(ii) dipentylamine
(iii) 2,4-dimethyl-3-hexanamine. **(3 marks)**

(c) (i) Show how you can carry out the conversion starting from propanoylchloride to dipropylamine.
(ii) Write the equation to show the reaction between benzaldehyde (C_7H_6O) and warm phenylamine.
(iii) Write the general formula and functional group of secondary amine and tertiary amine.
(iv) Write the equation for the equilibrium that exists when diethylamine dissolves in water.
(8 marks)

(d) Give the structural formula for compounds **B** through **E**, which undergo the following sequence of reactions:



(6 marks)

6. (a) Briefly, explain the following and give one example for each:
(i) Thermoplastic polymers
(ii) Thermosetting polymers
(iii) Natural polymers **(4 marks)**

(b) Write the monomers used in synthesis of the following polymers:
   (i) Polyvinylchloride (PVC)
   (ii) Teflon
   (iii) Bakelite **(3 marks)**

(c) (i) Why cationic polymerization is more favored than anionic polymerization when vinylic monomers contain an electron donating group?
   (ii) Why styrene undergo anionic polymerization easily? Briefly explain.
   (iii) Differentiate addition from condensation polymers basing on the mode of polymerization. Give one example for each type. **(7 marks)**

(d) With reasons, write down the use of each of the following polymers:
   (i) Butyl-rubber
   (ii) Polyacrylonitriles
   (iii) Polyhaloalkene **(6 marks)**