DEPARTMENT OF CHEMISTRY
FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA
SECOND SEMESTER EXAMINATION 2018/2019 SESSION
COURSE CODE: CHM 322
UNITS: 2
COURSE TITLE: CHEMICAL KINETICS   **TIME ALLOWED: 2 HOURS**

INSTRUCTION: ANSWER ANY THREE (3) QUESTIONS

Q1 (a). Define the following terms:

(i) Chemical kinetics   (ii) Order of a reaction   (iii) Reaction rate

(iv) Molecularity of a reaction   (v) Homogeneous reaction (vi) Heterogeneous reaction **(6 marks)**

(b) Give a brief account of any four factors affecting the rates of chemical reactions

(8 marks)

(c) The decomposition reaction of reactant (A) which gives the product (P) is considered a first order reaction. Derive an expression for this reaction. **(6 marks)**

Q2. (a) Explain briefly any two (2) methods of determining the order of reaction

(6 marks)

(b) The inversion of sucrose in the presence of HCl gave the following values for the optical rotations

| Time (minutes)	0	15	30	45	63	∞
Optical rotation (degree)	+32.4	+28.8	+25.5	+22.4	+19.6	-11.6

Use the integration method only; show that the inversion of sucrose is a first order reaction and hence determine the half-life period of the reaction. **(10 marks)**

(c) The following mechanism has been proposed for a chemical reaction.

$(CH_3)3CCl \leftrightarrow (CH_3)3C^+ + Cl^-$…………………………………Slow

$(CH_3)3C^+ + OH \rightarrow (CH_3)3COH$………………………………Fast

Write the rate expression and the overall reaction **(4 marks)**

Q3. (a) Consider a bimolecular reaction of the type

$$P + Q \xrightarrow{k_2} Products$$
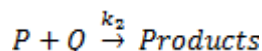
Derive an expression for second order reactions under the following conditions

(i) When the two reactants are same (ii) When the two reactants are different with different concentrations **(10 marks)**

(b) (i) When is a reaction considered "zero order reaction"? **(1 mark)**

(ii) Deduce a relationship between concentration and time for a given fractional change. **(3 marks)**

(c).(i) How is energy of activation of a reaction determined? **(3 marks)**

(ii) Trichloroacetic acid in aniline solvent decomposes to give chloroform and car dioxide. The rate constant for this first order reaction is 0.00004 per min at 25°C and 0.0008 at 45°C. Calculate the energy of activation for this reaction. Given that the gas constant R is 1.987 kcal/mol/deg **(3 marks)**

Q4. (a) (i) Give an account of collision theory and Transition State Theory of reaction.

(6 marks)

(ii)   List any two drawbacks of collision theory **(2 marks)**

(b) Account for the followings:

(i) Mono-molecular reactions   (ii) Bimolecular reaction (iii) Termolecular reaction using collision theory **(9 marks)**

(c) Explain the following observations:

(i) The rate constants for third order reactions are less than those for second order reactions

(ii) the velocity of molecules increases with the increase of temperature

(iii) the rate of termolecular reaction decreases with increase in temperature.

(3 marks)