



ELIZADE UNIVERSITY, ILARA-MOKIN, ONDO STATE

FACULTY: BASIC AND APPLIED SCIENCES

DEPARTMENT: PHYSICAL AND CHEMICAL SCIENCES

SECOND SEMESTER EXAMINATIONS: 2015/2016 ACADEMIC SESSION

COURSE CODE: CHM 204 COURSE TITLE: PHYSICAL CHEMISTRY I

DURATION: 2.5 HOURS

HOD's SIGNATURE

m. O. O. O.

TABLE OF CONSTANTS:

Speed of light c , $2.997 \times 10^8 \text{ m/s}$

Elementary charge e , $1.602 \times 10^{-19} \text{ C}$

Faraday constant F , 96500 C/mol

Boltzmann constant k , $1.38 \times 10^{-23} \text{ J/K}$

Gas constant R , $8.314 \text{ JK}^{-1} \text{ mol}^{-1}$

Planck's constant h , $6.626 \times 10^{-34} \text{ Js}$,

Gas constant R , $8.314 \times 10^{-2} \text{ Lbar K}^{-1} \text{ mol}^{-1}$

Avogadro's constant N_A , $6.022 \times 10^{23} \text{ mol}^{-1}$

Atomic mass unit u , $1,661 \times 10^{-27} \text{ kg}$

INSTRUCTIONS: ATTEMPT QUESTION ONE AND ANY OTHER THREE QUESTIONS

QUESTION ONE IS COMPULSORY

1. QUESTION ONE

- a. State the van der Waals equation for pressure and explain the physical meaning of the parameters in terms of the pressure and volume of a gas. [4marks]
- b. Define the following thermodynamic quantities [6marks]
 - i. Open, Isolated, and Closed Systems
 - ii. Surrounding
 - iii. Reversible and irreversible changes
- c. Explain concisely how the body utilizes its internal energy [3marks]
- d. State the Zeroth, first and second laws of thermodynamics. [3marks]
- e. Calculate the diffusion coefficient of haemoglobin in water at 298K (approximated as spherical), of viscosity η is $0.891 \text{ kgm}^{-1} \text{ s}^{-1}$ and radius 3.55nm. [3marks]
- f. State the Ostwald dilution law [2marks]
- g. State the assumptions of the kinetic theory of gases [3marks]
- h. State the conditions under which ΔH and ΔU for a reaction involving gases and/or liquids or solids identical [3marks]
- i. State the factors that affect rates of reaction [3marks]
- j. Given the table below, Determine with respect to A and B the order of reaction and the rate constant of the reaction. [3marks]

[A]m	[B]M	Initial rate Ms^{-1}
2.30×10^{-4}	3.10×10^{-5}	5.25×10^{-4}
4.60×10^{-4}	6.20×10^{-5}	4.20×10^{-3}
9.20×10^{-4}	6.20×10^{-5}	1.70×10^{-2}

2. QUESTION TWO

- a. Explain why the heat capacity a body at constant pressure is greater than its heat capacity at constant volume. [1mark]
- b. Predict the following heat changes
 - i. Isothermal heat [1mark]
 - ii. Isobaric heat [1mark]
 - iii. Isochoric heat [1mark]

- iv. Adiabatic heat [1 mark]
- c. Calculate the change in entropy of the surrounding, total entropy and entropy of the system for one mole of an ideal gas isothermally compressed at 300K from a volume of 25L to 10L. [5marks]

3. QUESTION THREE

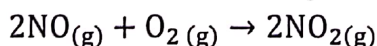
The evolution of life requires the organization of a very large number of molecules into biological cells. Does THE FORMATION OF LIVING ORGANISMS violate the second law of thermodynamics? Present detailed arguments to support your clearly stated conclusions. [10marks]

4. QUESTION FOUR

- a. Calculate the work each of the processes when 3.00mol an ideal gas expands isothermally along three different paths, [6marks]
- Reversible expansion from $P_i = 35.0\text{bar}$, $V_i = 6.50\text{L}$ to $P_f = 10.50\text{bar}$
 - A single-step expansion against a constant external pressure of 10.50bar
 - A two-step expansion consisting initially of an expansion against constant external pressure of 22.0bar, $P=P_{\text{external}}$, followed by an expansion against a constant external pressure of 10.50 until $P=P_{\text{external}}$
- b. For which of the irreversible process in (a) is the magnitude of work greater [1mark]
- c. Discuss the molecular interpretation of Trouton's rules. [3marks]

5. QUESTION FIVE

- a. The standard reduction potential of cytochrome c which carries an electron from Q – cytochrome c oxidoreductase to cytochrome c oxidase is 0.15V and free energy of the reducing oxygen to carbondioxide is -30kJ/mol. If the overall equation of this redox reaction is written as [4marks]
- $$\text{QH}_2 + \text{Fe}^{3+}(\text{Cyt c}) \rightarrow \text{Q} + \text{Fe}^{2+}(\text{Cyt c}) + \text{H}^+$$
- how many electrons are involved in the redox reaction
 - balance the equation for the reaction
 - Write a shorthand notation for the cell reaction
- b. The half-life of decomposition of N_2O_5 is $4.05 \times 10^{-4}\text{s}$. How long will it take for N_2O_5 to decay to 75% of its initial value? [3marks]
- c. Define the following
- quantum yield for a photochemical reaction [1mark]
 - enzyme turnover number [1mark]
- d. Write an expression for the rate of the shown in the equation below [1mark]



6. QUESTION SIX

- a. Explain with equations the different steps involved in this photochemical reaction. $\text{HI} + h\nu \rightarrow \text{H}\cdot + \text{I}\cdot$ and deduce its stoichiometric quantum yield. [4marks]
- b. The kinetic data of an enzyme catalysed reaction is given in the table below. Determine Michaelis constant ' K_m ', catalytic constant K_2 and the catalytic efficiency ϵ for the enzyme at 0.5°C given that the initial enzyme concentration is 2 nM. [6marks]

Rate($\text{mmoldm}^{-3}\text{s}^{-1}$)	2.78×10^{-5}	5.00×10^{-5}	8.33×10^{-5}	1.67×10^{-5}
[S] (mmoldm^{-3})	1.25	2.5	5.0	20.0