



**JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE &
TECHNOLOGY UNIVERSITY EXAMINATIONS 2012/2013**

**2ND YEAR 1ST SEMESTER EXAMINATION OF BACHELOR OF
EDUCATION (SCIENCE)**

REGULAR

COURSE CODE: SCH 201

COURSE TITLE: PHYSICAL CHEMISTRY I

DATE: 12/8/13

TIME: 2.00 -4.00 PM

DURATION: 2 HOURS

INSTRUCTIONS

- 1. This paper contains five (5) questions.**
- 2. Answer question 1 (compulsory) and ANY other TWO questions.**
- 3. Write all answer in the booklet provided.**

Physical data constants

Molar gas constant;	R	=	8.314 J.K ⁻¹ .Mol ⁻¹
	R	=	0.0821 Latm.K ⁻¹ mol ⁻¹
Avogadro constant,	N _A	=	6.023 X 10 ²³ Mol ⁻¹
Boltzmann constant,	K	=	1.381 X 10 ⁻²³ J.K ⁻¹
Planck constant,	h	=	6.624 X 10 ⁻³⁴ J.s
P _{H2O, 27°C}		=	25 mmHg
Cp for NH ₃		=	33.1 JK ⁻¹ Mol ⁻¹ .
1 Cal		=	4.184 Joules
1 Faraday	F	=	96500 coulomb
Molar gas volume	V	=	22.4 dm ³ = 22400 cm ³

QUESTION1 (30 MARKS)

- a) With reference to any **FIVE** schools of thought, define the term 'Thermodynamics.' (5 marks)
- b) Distinguish between each of the following terms: (4 marks)
- (i) Isobaric and isochoric process
 - (ii) Reversible and irreversible work
- c) Explain each of the following observations; (3 marks)
- (i) Internal energy (U) is a state function.
 - (ii) Heat (q) and work (w) are path functions
- d) Derive the Van der Waals equation from first principles. (5 marks)
- e) Discuss the principles underlying thermometric titration. (4 marks)
- f) With examples where possible, define each of the following: (4 marks)
- i) An equation of state
 - ii) Principles of corresponding states
 - iii) Dalton's law of partial pressures
 - iv) Hess's law of constant heat summation
- g) What would be the Volume of hydrogen (2 gMol⁻¹) needed in a balloon to lift a 50 kg man? Assume that the temperature is 27 °C, the pressure is 1.0 atm, air has an average molar mass of 29.0 gMol⁻¹, and that both gases behave ideally. (5 marks)

SECTION B (40 MARKS): ANSWER ANY TWO QUESTIONS FROM THIS SECTION

EACH QUESTION CARRIES 20 MARKS

QUESTION 2 (20 MARKS)

- a) Give the expression for Kirchoff's law. (2 marks)
- b) Calculate the root mean square velocity of one mole of nitrogen gas at 298 K. (4 marks)
- c) Sketch the distribution of molecular velocities of nitrogen gas at two temperatures; 273 K and 298 K. (3 marks)
- d) (i) State **TWO** applications of Hess's Law. (2 marks)
(ii) Distinguish between enthalpy of formation and enthalpy of neutralization. (2 marks)
- e) Explain the difference between Berthelot's and Dieterici equations. (3 marks)
- f) A balloon contains 4 moles of an ideal gas with a volume of 5.0 L. If an additional 8 moles of the gas is added at constant pressure and temperature, what will be the final volume of the balloon? (4 marks)

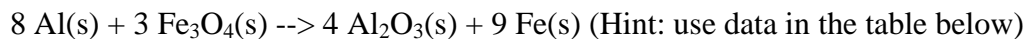
QUESTION 3 (20 MARKS)

- a) (i) Describe the dual nature of matter. (2 marks)
(ii) Distinguish between an ideal and real gas. (2 marks)
- b) Explain briefly each of the following terms as applied in thermodynamics: (4 marks)
(i) System (ii) Surrounding
(iii) Adiabatic system (iv) Diathermic system
- c) Derive the fundamental kinetic equation from first principles. (5 marks)
- d) One mole of an ideal gas occupies 12 litres at 25°C. What is the pressure of the gas? (4 marks)
- e) The Van der Waals equation was derived to correct some fundamental shortcomings failures of earlier gas law(s). Which law(s) was/were it supposed to correct and what were their shortcomings? (3 marks)

QUESTION 4 (20 MARKS)

- a) Explain the following terms: (4 marks)
(i) Heat
(ii) Enthalpy
(iii) Entropy
(iv) Internal energy
- b) (i) Give the Maxwell-Boltzmann distribution Law and define its terms. (4 marks)

- c) Describe an experiment you would carry out to investigate Boyles, Law. (4 marks)
- d) To what pressure must a gas of a given volume of nitrogen, originally at 200 °C and 1 atm, be adiabatically compressed in order to raise its temperature to 300 °C? (4 marks)
- e) Calculate ΔH for the following reaction: (4 marks)



COMPOUND	ΔH_f (Kj mol ⁻¹)
Al ₂ O ₃	-1669.8
CuO	-155.2
Fe ₂ O ₃	-822.2
Al ₂ S ₃	-860.1
Fe ₃ O ₄	-1120.9

QUESTION 5 (20 MARKS)

- a) Write brief notes on the following: (4 marks)
- (i) Collision frequency
- (ii) Distribution of molecular velocities
- b) Discuss the principles underlying thermometric titration. (5 marks)
- c) State and explain two limitations of the first Law of thermodynamics. (4 marks)
- d) A balloon with a volume of 2.0 L is filled with a gas at 3 atmospheres. If the pressure is reduced to 0.5 atmospheres without a change in temperature, what would be the volume of the balloon? (4 marks)
- e) Derive Charles' law from the fundamental kinetic equation. (3 marks)

E***N*****D**