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
$P_{H2O,\ 27^oC}$		=	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 fucntions

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 ^oC, 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 priciples. (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 ^{o}C and 1 atm, be adiabatically compressed in order to raise its temperature to 300 ^{o}C? (4 marks)

e) Calculate ΔH for the following reaction: (4 marks)

8 Al(s) + 3 Fe_3O_4(s) --> 4 Al_2O_3(s) + 9 Fe(s) (Hint: use data in the table below)

COMPOUND	ΔH_f (Kj mol^{-1})
Al_2O_3	-1669.8
CuO	-155.2
Fe_2O_3	-822.2
Al_2S_3	-860.1
Fe_3O_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)

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