

**W1-2-60-1-6**

**JOMO KENYATTA UNIVERSITY**

**OF**

**AGRICULTURE AND TECHNOLOGY**

**UNIVERSITY EXAMINATIONS 2015/2016**

**SECOND YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN BIOCHEMISTRY AND MOLECULAR BIOLOGY/ INDUSTRIAL BIOTECHNOLOGY/MEDICAL BIOCHEMISTRY/**

**APPLIED BIO-ENGINEERING/CONTROL AND INSTRUMENTATION**

**SCH 2201: PHYSICAL CHEMISTRY II**

**DATE: DECEMBER 2015 TIME: 2 HOURS**

**INSTRUCTIONS: ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS**

**USEFUL DATA:**

R = 8.314 Jmol-1K-1 or 1.987 cal or 8.314 x 10-7 erg molecule K or 0.082 l atm

mol-1K-1, Na = 6.022 x 1023, 1 atm = 760 MMHg = 760 torv = 101325 NM2 = 24.218

Cal, O0C = 273K, RA.M of C =12, O = 16, Ar = 40, H = 1

**QUESTION ONE (30 MARKS)**

1. With suitable examples, distinguish between: [4 marks]
2. Extensive and intensive properties of a homogenous system
3. System and surrounding
4. State TWO limitations of thermodynamics. [2 marks]
5. Calculate the mean free path for oxygen molecule at 300 K and

101.325 KPa. The collision diameter of oxygen molecule is

0.362 nM. [3 marks]

1. Calculate the root mean square speed of molecules of the gas whose

density at 273 K and 1.05 x 105 NM-2 is 1.52 Kgm-3. [3 marks]

1. Prove that the change in enthalpy of a system is equal to the heat

transferred to it at constant pressure. [3 marks]

1. i) What is inversion temperature? [1 mark]

ii) Calculate the Inversion temperature of CO2 for which Van der

Waals constants  = 363.7 KPadm6 mol-2 and

 = 0.0427 dm3 mol-1 [3 marks]

1. Write the equations of:

i) Corresponding states [1 mark]

ii) Kirchhoff’s equation [1 mark]

1. i) What is meant by the term process of a system? [1 mark]

ii) Explain the following types of processes: [3 marks]

a) Isochoric process

b) Cyclic process

c) Reversible process

1. i) What is Internal energy? [1 mark]

ii) Two moles of an ideal gas at 2 atm and 270C is compressed

isothermally to half its volume by an external pressure of 4 atm.

Calculate work done on the system. [4 marks]

**QUESTION TWO (20 MARKS)**

1. State Joules-Thomson effect. [2 marks]
2. One mole of an ideal gas at 10 atm pressure is contained in a vessel

at 300 K. The gas is expanded till the pressure becomes 2 atm and

the temperature reaches 400 K. Calculate the work done on the

system and heat absorbed by it if the change is brought about by: [11 marks]

i) The gas expanded isothermally against a constant external

pressure of 2 atm

ii) Then heated to the desired temperatures at constant volume.

iii) And finally expanded till the final state is reached.

1. i) Define the term viscosity. [1 mark]

ii) Calculate the coefficient of viscosity of CO2 at 270C using

the kinetic theory of gases; d for CO2 is 3.64 x 10-10M. [4 marks]

1. State TWO importance of viscosity. [2 marks]

**QUESTION THREE (20 MARKS)**

1. i) Write the Van der Waals equation. [1 mark]

ii) Discuss the applicability of Van der Waals equation in

explaining a graph between compressibility factor against pressure. [8 marks]

1. One mole of argon gas is expanded reversibly and adiabatically from

2.5 M3 at 300 K to 5 M3. The Cvm for argon is 12.55JK-1 mol-1.

Calculate (assuming ideal behavior)

1. The final temperature experiments [2 marks]
2. The final pressure [2 marks]
3. W, q and D U for the process [3 marks]
4. The Van der Waals constant for CH4 are  = 2.25 atm l2 mol-2 and

 = 0.043 l mol-1. Calculate its critical constants. [3 marks]

**QUESTION FOUR (20 MARKS)**

1. i) State Hoss’s law [2 marks]

ii) A person takes 15 breaths/min. The amount of air inhaled in

each breath is about 450 ml and contains 21% oxygen by volume,

while the exhaled air contains 16.1% oxygen by volume. If all

the oxygen is used for converting sugar into CO2 and H2O ( i)

how much sucrose is burnt in the body in one day. [3 marks]

iii) Write the thermochemical equation for burning sucrose. [1 mark]

iv) What is heat evolved? (Enthalpy of combustion of sucrose

is -5645 KJ) . [3 marks]

1. i) State the first law of thermodynamics. [1 mark]

ii) A given sample of nitrogen gas weigh 2.8g at 270C and 20 atm

pressure was allowed to expand isothermally against a constant

external pressure of 1 atm. Calculate D U, q and w, assuming

ideal behavior of the gas. [4 marks]

1. i) What is heat capacity? [1 mark]

ii) Calculate the thermal conductivity of argon 270C, given that

the molar heat capacity at constant volume = 12.5 JK-1mol-1

and collision diameter 5.6 x 10-10 M. [3 marks]

1. Distinguish between an isolated and open system. [2 marks]