

**MERU UNIVERSITY OF SCIENCE AND TECHNOLOGY**

**P.O. Box 972-60200 – Meru-Kenya.**

**Tel: 020-2069349, 061-2309217. 064-30320 Cell phone: +254 712524293, +254 789151411**

**Fax: 064-30321**

**Website:** [**www.must.ac.ke**](http://www.must.ac.ke) **Email:** **info@must.ac.ke**

**University Examinations 2015/2016**

SECOND YEAR, FIRST SEMESTER EXAMINATION FOR BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

**SCH 3201 : PHYSICAL CHEMISTRY II**

**DATE: NOVEMBER, 2015 TIME:** $2 $**HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions.*

 ***Useful Constants***

***R= 8.314*** $JK^{-1}$***= 0.821 l atm*** $mol^{-1}K^{-1}$

***1 atm= 101325***$Nm^{-2}$***= 101325 Pa = 760mmHg***

**QUESTION ONE – (30 MARKS)**

1. Define the following terms; (2 Marks)
2. Heat capacity
3. Compressibility factor
4. Outline four properties of energy. (4 Marks)
5. State the first law of thermodynamics. (2 Marks)
6. Calculate the root mean square speed of < u > rms of Nitrogen gas at 298.15k given that M = 28.02g/mole (3 Marks)
7. Distinguish between the following processes; (6 Marks)
8. Isothermal and adiabatic process
9. Isobaric and isochoric process
10. Reversible and irreversible process
11. Calculate the work involved in the expansion of 3.2 g of oxygen gas from 25.0 litres to 40.0 litres in an isothermal process at 270c. Assume ideal gas behaviour (O = 16) (4 Marks)
12. State four postulates of the kinetic theory of gases. (4 Marks)
13. The standard enthalpy of formation of gaseous ammonia at 250C is -46.1 KJ$mol^{-1}$. Estimate its value at 400 k given the following molar heat capacities at constant pressure.

NH3(q) = 29.75J$k^{-1}mol^{-1}$

H2(q) = 27.28$Jk^{-1}mol^{-1}$

N2(q) = 28.58$ Jk^{-1}mol^{-1}$

**QUESTION TWO ( 20 MARKS)**

1. Distinguish between the following terms as used in physical chemistry. (6 Marks)
2. Closed and isolated system
3. Extensive and intensive properties
4. Surrounding and system
5. Show that the heat capacity at constant pressure, Cp and heat capacity at constant volume Cv are related as follows; (10 Marks)

Cp = Cv + nR from the first law of thermodynamics

1. State the Zeroth law. (2 Marks)
2. What is a cyclic process? (2 Marks)

**QUESTION THREE (20 MARKS)**

1. Calculate q, w, $∆$H and $∆$u for the adiabatic and reversible compression of 1.0 moles of a monoatomic ideal gas from 0.1m3 and 250C to 0.01 m3 (6 Marks)
2. The kinetic energy k is given as k = ½$ mu^{-2}$, show that k is dependent on temperature by the equation E=$\frac{3}{2} $RT (6 Marks)
3. Calculate the volume that 1.5 moles of (C2H5)2 S would occupy at 2750c and 12.5 bar pc = 39.6 bar, Tc = 283.80c and z = 0.87 for (C2H5)2S (4 Marks)
4. Distinguish between heat and energy. (2 Marks)
5. Define the term state function as used in physical chemistry. (2 Marks)

**QUESTION FOUR (20 MARKS)**

1. Calculate the change in internal energy when 2 moles of CO are converted to 2 moles of CO2 at 1 bar and 250C

2CO (q) + O2(q)$\rightarrow $2CO(q) $∆H= -566.0$kJ$mol^{-1}$ (3 Marks)

1. $∆u and ∆H$ for heating of 35.36g of krypton ($\overbar{C}$v = 12.47J$mol^{-1}k^{-1}$) from 300k to 400k. Assume ideal gas behavior and that heat capacities at constant pressure and constant volume are independent of temperature. (6 Marks)

 (Kr = 83.80g/mol)

1. Outline one major limitation of the first law of thermodynamics. (1 Mark)
2. Critical points data can be used to determine approximate values of the van der Waals constants. Derive these values. (6 Marks)
3. A sample of a gas expands in volume from 2.0L to 6.0L at constant temperature. Calculate the work (in joules) done by the gas if it expands.
4. Against a vacuum and (2 Marks)
5. Against a constant external pressure of 1.2 bar (2 Marks)