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**University Examinations 2016/2017**

THIRD YEAR, FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN CHEMISTRY

**SCH 3305: STATISTICAL THERMODYNAMICS**

**DATE: December, 2016 TIME: HOURS**



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

**QUESTION ONE - (30 MARKS)**

1. Define the following terms; (14 Marks)
2. System
3. Thermodynamics
4. Statistical Thermodynamics
5. Distribution
6. Degeneracy
7. Complexion
8. Most probable distribution
9. Outline three modes through which species absorb energy. (3 Marks)
10. Determine the molar entropy of neon gas at one atmosphere pressure and

C (R.A.M, Ne = 20.179) (3 Marks)

1. How many ways can 8 molecules be allocated to 4 energy levels such that each energy level occupies two molecules? (3 Marks)
2. The energy of the first electronically ground state of chlorine is 0.11ev. Calculate the contribution of partition function of this term at 1000K. (3 Marks)
3. Explain briefly an equilibrium state in terms of macrostate and microstate.(2 Marks)
4. What is a dominating configuration? (2 Marks)

**QUESTION TWO (20 MARKS)**

1. Define the following terms; (8 Marks)
2. Phase space
3. Partition function
4. Ensemble
5. Configuration
6. State the five conditions that make the Gibbs ensemble (Gp) valid. (5 Marks)
7. The vibration frequency of a species is Hz. Determine the vibrational contribution to the molar thermal energy of the species at (5 Marks)
8. What is entropy from a statistical thermodynamics point of view? (2 Marks)

**QUESTION THREE (20 MARKS)**

1. Distinguish between microcanonical ensemble and grand canonical ensemble.(4 Marks)
2. Determine the rotational contribution to the entropy of one mole of ideal nitrogen (II) oxide gas at when bond length is metres (R.A.M N = 14.0067, O = 15.9994) (6 Marks)
3. Consider the molecules A and B , each having only one allowed energy level. That for A consists of a level of multiplicity 2; that for B, multiplicity 3. The multiple energy level for b is higher than that for A. Determine the Gibb’s free energy difference, between A and B; and Keq for the system at . (4 Marks)
4. Given that the Helmholtz function A, the internal energy E, and Entropy, S of an ideal monoatomic gas are related to the absolute temperature, T by the equation;

how that the Suckers- Tetrode equation can be written as;

 (6 Marks)

**QUESTION FOUR (20 MARKS)**

1. The vibration energy levels of HCl consists of an evenly spaced set with a separation of . If there are 10,000 molecules in the ground state, determine the number in the first excited state. (4 Marks)
2. A typical vibrational state energy level separation is per . Determine the vibrational heat capacity, Cv of the species at . (4 Marks)
3. Determine the translational partition function for neon gas when enclosed in a cube at (R.A.M Ne = 20.179) (4 Marks)
4. Given that;

Show that the equation of state for a perfect gas is; (8 Marks)