KABARAK UNIVERSITY

UNIVERSITY EXAMINATIONS

2008/2009 ACADEMIC YEAR

FOR THE DEGREE OF BACHELOR OF EDUCATION SCIENCE

COURSE CODE: **CHEM 311**

COURSE TITLE: **ORGANIC CHEMISTRY IV**

STREAM: **SESSION VI**

DAY: **THURSDAY**

TIME: **2.00 – 4.00 P.M.**

DATE: **13/08/2009**

INSTRUCTIONS TO CANDIDATES:

Attempt all questions

PLEASE TURN OVER

QUESTION ONE (20MARKS)

a) Define the following terms:

i. Internal energy

ii. Work

iii. Heat (6marks)

b) State and explain the different types of thermodynamic systems. (6marks)

c) Calculate the work done by an expansion of 1 mol of an ideal gas from V_2 $0.01m^3$ to $0.1m^3$ at 25^0C by the following processes;

i. Against a constant external pressure of 0.1 bar. (2marks)

ii. From $0.01m^3$ to $0.025m^3$ against a constant external pressure of 0.33bar, followed by a second expansion from $0.025m^3$ to $0.05m^3$ against a constant external pressure of 0.2bar, followed by a third expansion from $0.05m^3$ to $0.1m^3$ against a constant external pressure of 0.1 bar. (4marks)

iii. A reversible expansion. (2marks)

QUESTION TWO (20MARKS)

a) Show that the mean energy of an atom in three dimensional motion can be given by 3/2nRT. (4marks)

b) State the second law of thermodynamics and define all terms there in. (4marks)

c) What is entropy? Hence explain the effect of temperature change on the entropy of a system. (4marks)

d) A system at 25°C absorbed 6.2 x 10^6J from its surroundings without undergoing a temperature change. Calculate $\Delta S_{(system)}$. Is this an increase or a decrease in entropy for the system? (4marks)

e) Consider a reversible isothermal expansion of 1.00 mol of an ideal gas from $0.01m^3$ to $0.1m^3$ at 298K. Calculate $\Delta S_{(system)}$for this process. (4marks)

QUESTION THREE (15MARKS)

a) One of the first steps involved in refining sulfide ore is the process of roasting ZnS (sphalerite) as shown in the equation below.

$$ZnS_{(s)} + 3/2O_{(g)} \longrightarrow ZnO_{(s)} + SO_{2(g)}$$

Given that the $\Delta_f H°_{298}$ in kJ/mol of $ZnS_{(s)}$, $ZnO_{(s)}$ and $SO_{2(g)}$ are -205.98, -348.28 and -296.3 respectively. Calculate the $\Delta_f H°_{298}$ in kJ/mol for roasting sphalerite. (6marks)

b) Given that $\Delta S°$rxn in J/mol.K for $CO_{2(g)}$, $H_2O_{(l)}$, C_3H_8 and $O_{2(g)}$ are 21.7, 69.9, 26.99 and 205 respectively. Calculate $\Delta S°_{rxn}$ in J/mol.K for the combustion of propane. (6marks)

c) Given that $\Delta_f H°$ in kJ/mol of $Cl^-_{(g)}$ and $Na^+_{(g)}$ are -233.13 and 609.358 and respectively.

Calculate the lattice energy of $NaCl_{(s)}$. (3marks)

given $Na_{(s)} + 1/2Cl_2(g) \rightarrow NaCl_{(s)}$ $\Delta H° = -411.153$ kJ/mol

QUESTION FOUR (15MARKS)

a) Define the following terms:

i. Critical point (2marks)

ii. Triple point (2marks)

iii. Supercritical fluid (2marks)

iv. Phases (2marks)

v. Equilibrium (2marks)

b) Consider a process of water vapour condensation from vapour into liquid. What are the signs of ΔH and ΔS for this reaction? Give an explanation for each case, and hence comment on the spontaneity of this reaction. (5marks)