KISII UNIVERSITY

UNIVERSITY EXAMINATIONS

THIRD YEAR EXAMINATION FOR THE AWARD OF THE DEGREE OF BACHELOR OF EDUCATION [SCIENCE]
FIRST SEMESTER 2016/2017
(JANUARY - MAY, 2017)

CHEM 322: PHYSICAL CHEMISTRY III

STREAM: Y3S1 **TIME: 2 HOURS**

DAY: THURSDAY, 9:00-11:00 AM **DATE: 18/05/2017**

INSTRUCTIONS

1. ***Do not write anything on this question Paper.***
2. ***Answer question ONE and any other two questions.***

SECTION A: Answer all questions

1. a)Define the following terminologies

(i) Isolated sysystem

(ii) Entropy

(iii) isothermal process (3mks)

b) (i)state first law of thermodynamics and state its mathematical expesssion. (2mks)

(ii) A closed system performed work of 400 J, with 1000 J of energy in the form of heat supplied to it. How did the system's internal energy change? (3mks)

C (ii) with suitable examples, Define state properties. (3mks)

d) Find the amount of work done on the surroundings when 1 liter of an ideal gas, initially at a pressure of 10 atm, is allowed to expand at constant temperature to 10 liters by

i) reducing the external pressure to 1 atm in a single step,

ii) reducing P first to 5 atm, and then to 1 atm,

iii) allowing the gas to expand into an evacuated space so its total volume is 10 liters. (7mks)

e) Differentiate between the following;

(i) Adiabatic and isothermal processes

(ii) Open system and closed system

(iii) System and surrounding (6MKS)

f) .A system containing 5 moles of an ideal gas was heated from temperature T1 = 300 K to temperature T2 = 400 K. The internal energy of the gas increased by _U = 800 J. How did the enthalpy of the system change? (4mks)

(g) Categorize the processes below as spontaneous or non spontaneous (2mks)

(i) copper (ii) sulphate dissolves in water

(ii) a plant produces its own food by photosynthesis

(h) 2 moles of an ideal gas are held by a piston under 10 atms at 273.15 K. the pressure is suddenly released to 0.04 atm and then allowed to expand isothermally. Calculate ΔU, ΔH, W and q. (4mks)

(i) State Kirchoff's heat law (2mks)

(j) calculate the temperature of the cold sink in carnot engine having a hot source at 500 K with Q_H = 250j connected to cold sink at 120J. (4 mks)

SECTION B: Answer any two questions

2.a) Explain applications for thermodynamic laws. (5mks)

b) state the Carnot engine efficiency equation (2mks)

c)The Carnot heat engine received heat Q2 = 100 J from a heat reservoir of temperature T2 =600 K, performed work, delivered heat −Q1 to the cooler reservoir of temperature T1 = 300 K,and returned to the initial state. Calculate the engine's efficiency, the performed work and the supplied heat. (8mks)

3. (a) state the third law of thermodynamics and how does it differ from the second law (2mks)

b) Define Gibbs free energy and how is used to predict spontanseniority (3mks)

c) Calculate the standard enthalpy, its standard entropy of formation of $H_2O(l)$, its standard Gibb's energy of formation, and the equilibrium constant *K* for the reaction. (10mks)

$$\mathbf{H_2(g) + ½\ O_2(g) \rightarrow H_2O(l)}$$

Use data;

Substance	$\Box H_f^o$ kJ/mol	$\Box S^o$ J/(mol K)
$H_2(g)$	0	130.680
$O_2(g)$	0	205.152
$H_2O(l)$	-285.83	69.95

4. (a) The change in the Gibbs energy during the oxidation of one mole of glucose, according to the reaction; $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$; $\Delta G = -2870$ kJ mol^{-1}. How high can a person weighing 75 kg climb if he or she has eaten one mole (186 g) of glucose? The biological efficiency is 25%.

(4mks)

(b) state Clausius-Clapeyron equation (2mks)

c) The normal boiling temperature of butane is T = 272.7 K, its enthalpy of vaporization at this temperature is _vapH = 22.4 kJ mol−1. Find out whether butane would boil at Mount Everest at −30 _C, where the atmospheric pressure is 32 kPa. Assume that the enthalpy of vaporization does not depend on temperature. (4mks)

c) State two ways two can increase internal energy of your body (1mks)

d) Explain the following chemical phenomena; (4mks)

(i) Why is it more convenient for chemists to measure ΔH, than ΔE?

(ii) Could life exist in closed system? Explain.

END