DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

UNIVERSITY EXAMINATIONS 2021/2022

YEAR TWO SEMESTER ONE EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN POLYMER CHEMISTRY

SCP 2101 CHEMICAL THERMODYNAMICS AND POLYMER CHEMISTRY

DATE: NOVEMBER 2021   **TIME: 2 HOURS**

INSTRUCTIONS: ANSWER ALL QUESTIONS

$R = 8.314 \text{ J K mol}^{-1} = 0.0821 \text{ l atm mol}^{-1} K^{-1}$ $G = G^o - RT\ln K_p$

$$-\frac{R}{C_v} \ln \frac{V_2}{V_1} = \ln \frac{T_2}{T_1} \ldots\ldots$$

QUESTION ONE [25 MARKS]

a) Define the following:
   i.   System
   ii. State function
   iii. Path function

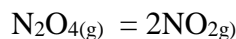   (6 marks)

b)   (i) $G = H - TS$, Explain how this equation can be utilized to determine the state
       of equilibrium at different temperature ranges based on H and S accompanying the
       change   (5 marks)

       ii)   The standard Free energy of formation of $NO_{2(g)}$ and $N_2O_{4(g)}$ are 51.30 and 102 Kj
               mol^{-1} respectively

       For the reaction

                           $N_2O_{4(g)} = 2NO_{2g)}$

       At 298 K, Calculate G^o and K_p for this   (4 marks)

c)   1 mole of an ideal gas occupying a volume of 1litre expands isothermally, in a reversible
       process to a volume of 5 litres at 298 K.

               (i)   Determine w, q and ΔE for this process   (6 marks)

(ii)   If the expansion was done irreversibly against an external pressure of 1 atm. what would be the value of w.   (4 marks)

QUESTION TWO [15 MARKS]

(a)   Define heat capacity   (2 marks)

(b)   Explain why the temperature of a gas falls in the adiabatic expansion of an ideal gas   (2 marks)

(c)   Given that $H=E+PV$

Show that $C_p = C_v + R$ (5 marks)

(d)   2 moles of an ideal gas at 25 $^\circ$C, and a pressure of is 2 litres is expanded adiabatically to a volume of 5 litres.
Calculate the final Temperature and work done by the gas   (6 marks)

QUESTION THREE [15 MARKS]
3) a)   i)   Define a spontaneous reaction and comment on their reversibility (2 marks)

ii)   Explain why during a phase transition the Temperature remains constant

(2 marks)
iii)   Define entropy and hence state the second law of thermodynamics   (4 marks)

b)   Given the following reactions at 298 K

$2C + 3H_2 = C_2H_6$ H = -84.68 Kj/mol

And S° for C = 5.9, H_2 =130.5, and C_2H_6 = 229.7 j $K^{-1}mol^{-1}$

i)   Calculate   G and hence determine if the reactions are thermodynamically feasible
(7 marks)

QUESTION FOUR [15 MARKS]

a) Differentiate between
   i.   Homogeneous and a heterogeneous polymer so
   ii.   Ideal and a regular solution   (4 marks)
b)   Define Viscosity   (2 marks)
c)   What is Osmotic pressure   (3 marks)
d)   Calculate the molar mass of a substance if at 27 ^{0}C its solution containing 6.0 g/l has an osmotic pressure of 3 mm Hg   (6 marks)