KENYATTA UNIVERSITY

UNIVERSITY EXAMINATIONS 2010/2011

INSTITUTE OF OPEN, DISTANCE AND E-LEARNING

SECOND SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE AND BACHELOR OF EDUCATION

SCH 201 : CHEMICAL THERMODYNAMICS

DATE: Monday 4th July, 2011 **TIME:** 2.00 p.m. – 4.00 p.m.

Useful information:

$R = 8.314\ Jmole^{-1}K^{-1}$

$= 0.08206\ litre\text{-}atm\ mole^{-1}K^{-1}$

1 atm pressure = 760mmHg

$= 101\ 325\ Nm^{-2}$

$0^0C = 273.15\ K$

INSTRUCTIONS:

*Answer **ALL** questions.*

Q.1. (a) Define the term *system*, and distinguish between *open* , *closed* and *isolated* systems. (7 marks)

(b) Write to distinguish between *intensive* and *extensive* properties .Give one example of each type. (5 marks)

(c) Explain the term *state function*, giving an example. (4 marks)

(d) Express the *First law of thermodynamics* in mathematical form and explain the terms used (5 marks)

Q.2. (a) A sample of an ideal gas at 25^0C and 1 atm pressure is expanded isothermally from 2 litres to 5 litres . Determine q , ΔE and w for the process. (6 marks)

(b) A sample of helium at 1 atm pressure and 27^0C is expanded reversibly and adiabatically from 3 litres to 5 litres . Determine the final temperature, ΔE and the work done during the expansion .

(C_v(He) = 12.471 Jmole^{-1}K^{-1}) (7 marks)

(c) A sample of gaseous oxygen at 30^0C and 1 atm pressure is expanded isothermally from a volume of 5 litres to a volume of 8 litres. Determine the change in entropy of the process. (4 marks)

Q.3. (a) State Hess's law (3 marks)

(b) Given the following information :

$B_2H_{6(g)} + 3O_{2(g)} \rightarrow B_2O_{3(s)} + 3H_2O_{(g)}$, $\Delta H^0_{298} = -1941kJ$

$2B_{(s)} + \frac{3}{2}O_{2(g)} \rightarrow B_2O_{3(s)}$, $\Delta H^0_{298} = -2368kJ$

$H_{2(g)} + \frac{1}{2}O_{2(g)} \rightarrow H_2O_{(g)}$, $\Delta H^0_{298} = -241.8kJ$;

determine $\Delta H^0_{(f,298)}$ for diborane , $B_2H_{6(g)}$. (4 marks)

(c) A 1.8g sample of octane, C_8H_{18} , was combusted in a calorimeter (+ content) of heat capacity 11.66kJK^{-1} . The temperature of the calorimeter (+ content) increased from 21.36^0C to 28.78^0C . Determine the molar heat of combustion of octane.

(R.A.M (C = 12.011 , H = 1.008)) (4 marks)

Q.4. (a) Derive the Kirchhoff's equation (6 marks)

(b) The standard enthalpy of formation of gaseous water at 298K is -241.82kJmole^{-1}. Determine its value at 365K, given the following:

$C_P(H_2O_{(g)}) = 33.58Jmole^{-1}K^{-1}$

$C_P(H_{2(g)}) = 28.84Jmole^{-1}K^{-1}$

$C_P(O_{2(g)}) = 29.37Jmole^{-1}K^{-1}$

(5 marks)

(c) Given the following information:

Substance	$\Delta H^0_{f,298}(kJmole^{-1})$	$S^0(Jmole^{-1}K^{-1})$
$CH_{4(g)}$	-74.8	186.3
$C_2H_{2(g)}$	226.7	200.8
$C_4H_{10(g)}$	-124.73	310.0 :

for the system :

$$2CH_{4(g)} + C_2H_{2(g)} \rightarrow C_4H_{10(g)} \quad ,$$

(i) determine ΔS at 298K (4 marks)

(ii) determine ΔS_{surr} at 298K (4 marks)

(iii) determine ΔS of the universe , at 298K . Comment on this value. (2 marks)

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