



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:

$$R = 8.314 \text{ Jmole}^{-1}\text{K}^{-1}$$
$$= 0.08206 \text{ litre-atm mole}^{-1}\text{K}^{-1}$$

$$1 \text{ atm pressure} = 760\text{mmHg}$$
$$= 101\,325 \text{ Nm}^{-2}$$

$$0^{\circ}\text{C} = 273.15 \text{ K}$$

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^oC and 1 atm pressure is expanded isothermally from 2 litres to 5 litres. Determine *q*, ΔE and *w* for the process. (6 marks)

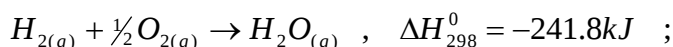
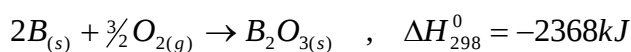
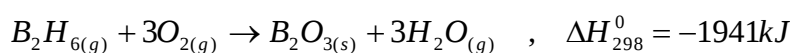
- (b) A sample of helium at 1 atm pressure and 27⁰C is expanded reversibly and adiabatically from 3 litres to 5 litres . Determine the final temperature, ΔE and the work done during the expansion .

$$(C_v(\text{He}) = 12.471 \text{ Jmole}^{-1}\text{K}^{-1}) \quad (7 \text{ marks})$$

- (c) A sample of gaseous oxygen at 30⁰C 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 :



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

- (c) A 1.8g sample of octane, C₈H₁₈ , was combusted in a calorimeter (+ content) of heat capacity 11.66kJK⁻¹ . The temperature of the calorimeter (+ content) increased from 21.36⁰C to 28.78⁰C . 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:

$$C_p(H_2O_{(g)}) = 33.58 \text{ Jmole}^{-1}\text{K}^{-1}$$

$$C_p(H_{2(g)}) = 28.84 \text{ Jmole}^{-1}\text{K}^{-1}$$

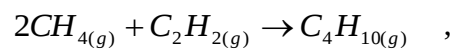
$$C_p(O_{2(g)}) = 29.37 \text{ Jmole}^{-1}\text{K}^{-1}$$

(5 marks)

- (c) Given the following information:

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

for the system :



- (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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