

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Final Examination: Semester I

Academic year : 2010

Date : 9 October, 2010

Time : 13.30 – 16.30

Subject : 231-201 Material and Energy Balances

Room : A401

รายละเอียดการทำข้อสอบ

1. ห้ามนำข้อสอบบางส่วนหรือทั้งหมดออกจากห้องสอบ
2. สามารถนำหนังสือหรือเอกสารทุกชนิดเข้าห้องสอบได้
3. ใช้ดินสอหรือปากกาในการทำข้อสอบได้
4. ข้อสอบมีทั้งหมด 6 ข้อ มีจำนวนทั้งหมด 7 หน้า
5. อนุญาตให้ทำข้อสอบด้านหลังกระดาษคำตอบแต่ละข้อได้
6. กรอกชื่อและรหัสนักศึกษาด้านหน้าข้อสอบและกรอกรหัสในข้อสอบทุกหน้าของกระดาษ

ข้อที่	คะแนนเต็ม	คะแนนที่ได้
1	25	
2	20	
3	25	
4	25	
5	20	
6	15	
รวม	130	

อ.จันทิมา ชั่งศิริพร
ผู้ออกข้อสอบ

1. A stream of air in pressure vessel at 80°C with partial pressure of water in the air at 370 mmHg contains 8% water by volume. (25 marks)

- 1) Calculate total pressure of the air stream in the system.
- 2) What is the condition (superheated, saturation, or condensation) of this air stream?
- 3) Calculate the % of the vapor that condenses to get the new saturation condition.
- 4) The final temperature of the air stream if the system is heated to saturation condition at constant pressure.

2. An liquid mixture of n-hexane and toluene is in equilibrium with it vapor at 40°C . The content of n-hexane in the liquid mixture is 0.79 and the toluene content is 0.21. (20 marks)

- 1) What is the system pressure?
- 2) Calculate the composition of the vapor in the system.

3. Use the humidity chart (psychrometric chart) to estimate the condition of the humid air at 35°C and 30% relative humidity:

- 1) The wet-bulb temperature, moisture content, and specific enthalpy of humid air.
- 2) The mass flow rate of water in 25 kg/h of dry air flow at these conditions.
- 3) If the air is heated up to 45°C . How much enthalpy is required?

(25 marks)

4. Two streams of water are mixed and heated in the heat exchanger to form the saturated steam feed to a boiler. Process data are given here.

Feed stream 1: 150 kg/h at 50°C

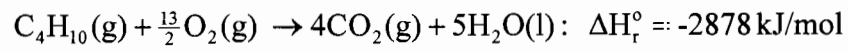
Feed stream 2: 275 kg/h at 74°C

- 1) Draw flow diagram of the heat exchanger.
- 2) Calculate the required heat input to the heat exchanger in kJ/h if the exiting steam is saturated steam at 100°C.

Neglect the kinetic energies of the liquid inlet streams. (25 marks)

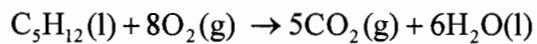
5. Calculation of heat of reaction. (20 marks)

1) The standard heat of the combustion of n-butane vapor : s



Calculate the rate of enthalpy change, $\Delta \dot{H}$ (kJ/h), if 1600 mol/h of CO_2 is produced in this reaction and the reactants and products are all at 25°C .

2) Determine the standard heat of reaction for the combustion of 20 mol/h liquid n-pentane, assuming $\text{H}_2\text{O}(\text{l})$ is a combustion product.



6. Calculate the heating rate required to raise 50 kg/h of Nitrous oxide (N_2O) from 100°C to 250°C in constant-volume vessel. The heat capacity of N_2O in this temperature range is given by the equation $C_p = (\text{kJ/kg}\cdot^\circ\text{C}) = 0.95 + 9.37 \times 10^{-4}T$, where T is in $^\circ\text{C}$
(15 marks)