所別：化學工程與材料工程學系碩士班 科目：化工熱力學及化學反應工程

所別：學習與教學研究所碩士班 不分組 科目：學習與教學理論

化工熱力學試題

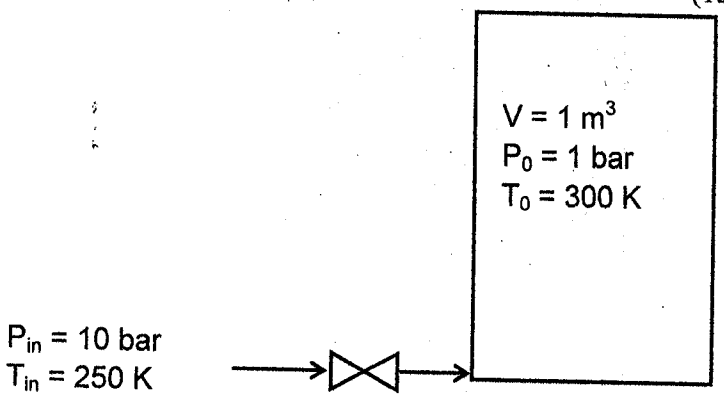
1. Derive the expression for $H_t - \sum n_i H_i^0$. (9%)

2. Show that the entropy of universe is increasing now and keeps increasing. (10%)

3. Write out the Boltzmann's postulation, the 3rd law and the expression for the 3rd law entropy. (6%)

4. Evaluate the value of the derivative: $\left[\frac{\partial V_m}{\partial T}\right]_S$ when the molar volume is 0.001 m^3 and the temperature is 500 K. Provided that the EOS of the nonideal gas is: $P = \frac{nRT}{V - nb} - \frac{n^2 a}{V^2}$, where $a = 0.134$ m^6 Pa mol^{-2}, $b =$ 0.0279×10^{-3} m^3 mol^{-1}. The constant volume heat capacity is $C_{V,m}^{ig} / R = \alpha + \beta T$, $\alpha = 2.387$, $\beta = 0.629 * 10^{-3}$ K^{-1}. (10%)

5. A methane storage tank has a capacity of 1 m^3. The initial methane in tank was kept at 1 bar and 300K. Mr. Lin decides to fill more methane into the tank from a supplier. The methane source has a pressure of 10 bars at a temperature of 250 K. What will be the temperature inside the tank when the pressure reaches 5 bars? You may treat methane as an ideal gas with a constant volume heat capacity of 20.785 $Jmol^{-1}K^{-1}$. (15%)



注意：背面有試題

化學反應工程試題:

6. The off gas from a boiling water nuclear power reactor contains a whole variety of radioactive trash, one of the most troublesome being Xe-133 (half life = 5.2 days). This off gas flows continuously through a large holdup tank in which its mean residence time is 60 days, and where we can assume that the contents are well mixed. Find the fraction of activity removed in the tank. **(7%)**

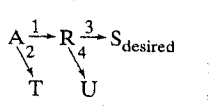
7. 100 liters/hr of radioactive fluid having a half-life of 20 hr is to be treated by passing it through two ideal stirred tanks in series, V = 20000 liters each. In passing through this system, how much will the activity decay? **(8%)**

8. Pure gaseous A at about 3 atm and 30 °C (120 mmol/liter) is fed into a 1-liter mixed flow reactor at various flow rates. There it decomposes (A→ 3R), and the exit concentration of A is measured for each flow rate. From the following data find a rate equaiton to represent the kinetics of the decomposition of A. Assume that reactant A alone affects the rate. **(10%)**

v_0, liter/min	0.06	0.48	1.5	8.1
C_A, mmol/liter	30	60	80	105

9. Sketch the relationship between conversion (X_A), temperature (T) and rate ($-r_A$) with **X_A vs. T** plots at various rates for a reversible exothermic reaction, and sketch the optimum temperature progression to obtain the maximum rate during the course of the reaction. (5%)
In general the operation of an exothermic reaction gives a rise temperature with conversion. How to approach the optimum temperature profile for mixed reactors in series or a plug reactor? (8%)

10. The first-order reactions



$$k_1 = 10^9 e^{-6000/T}$$
$$k_2 = 10^7 e^{-4000/T}$$
$$k_3 = 10^8 e^{-9000/T}$$
$$k_4 = 10^{12} e^{-12{,}000/T}$$

are to be run in two mixed flow reactors in series anywhere between 10 and 90 °C. If the reactors may be kept at different temperatures, what should these temperatures be for maximum fractional yield of S? (12%)