國立雲林科技大學 115 學年度
碩士班招生考試試題

系所：化材系
科目：化工熱力學

1. (15% = (a)8%+(b)7%)

(a) What is the ideal gas law? (b) And explain its equation representation in different procedures.

2. (20% = (a)15%+(b)5%)

(a) A detailed explanation of the four laws of thermodynamics? (b) Entropy balance and equivalent equations expressed in terms of rate?

3. (15% = (a)7%+(b)8%)

In a closed system, air at 1 bar and 298.15 K is compressed to 3 bar and 298.15 K using two different mechanically reversible procedures: (a) cooling at constant pressure followed by heating at constant volume; (b) heating at constant volume followed by cooling at constant pressure. Calculate the heat and work done for each path, as well as the ΔU and ΔH of the air. Assume that the heat capacity of air is independent of temperature: $Cv = 20.78$ and $Cp = 29.1$ $J \cdot mol^{-1} \cdot K^{-1}$. Also assume that air remains a gas with a constant PV/T regardless of the changes. At 298.15 K and 1 bar, the molar volume of air is 0.0248 $m^3 \cdot mol^{-1}$.

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4. (5%)

Please describe what the Raout's law is and how to obtain it.

5. (20% = (a)10%+(b)10%)

The binary system, compound (1) and compound (2), obeys the Raoult's law. And, the Antoine equations can provide vapor pressures:

$$lnP_1^{sat} = 14.27 - \frac{2945.5}{T - 49.15}, \qquad lnP_2^{sat} = 14.20 - \frac{2972.6}{T - 64.15}$$

where T is in Kelvins and the vapor pressure are in KPa.

(a) Prepare a graph showing P vs x_1 and P vs y_1 for a temperature of 80°C. And, please label bubble line and dew line on the graph, respectively.

(b) Prepare a graph showing T vs x_1 and T vs y_1 for a pressure of 60 kPa. And, please label bubble line and dew line on the graph, respectively.

6. (15% = (a)10%+(b)5%)

For thermodynamic property M in binary solutions, one has obtained a plot of M vs. x_1 (mole fraction of solution 1). (a) Please describe how to obtain the partial molar properties $\overline{M_1}$, and $\overline{M_2}$ from the plot and (b) explain your reason.

7. (10% = (a)5%+(b)5%)

(a)What is the excess Gibbs energy and partial excess Gibbs energy, respectively? Please explain their difference. (b)Please show how to obtain the relationship between the partial excess Gibbs-energy and activity coefficient.