3-14-1

九十八學年度四年制二、三年級轉學生招生考試

四技三年級　化學工程與生物科技系

第三節　專業科目（二）物理化學　試題

注意事項：

1.本試題共 6 題，配分共 100 分。
2.請標明大題、子題編號作答，不必抄題。
3.全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. Determine the Boyle temperature in terms of constants for the equation of state:

$$PV_m = RT\left[1+\frac{8PT_c}{57P_cT}\left(1-4\frac{T_c^2}{T^2}\right)\right]$$

R, P_c, and T_c are constants. (15%)

2. Two moles of oxygen gas, which can regarded as ideal with C_p = 29.4 J K^{-1} mol^{-1} (independent of temperature), are maintained at 273 K in a volume of 11.35 dm^3.
   a. What is the pressure of the gas? (6%)
   b. What is PV? (6%)
   c. What is C_v? (6%)

3. The temperature of a building maintained at 22℃ by means of a heat pump, and on a particular day the external temperature is 11℃. The work is supplied to the heat pump by a heat engine that burns fuel at 900℃ and operates at 22℃. Calculate the performance factor for the system (i.e. the ratio of the heat delivered to the building to the heat produced by the fuel in the heat engine). Assume perfect efficiencies of the pump and the engine. (15%)

4. At 25℃ 3 moles of an ideal gas is expanded isothermally from 5 to 50 dm^3. Calculate internal energy change (ΔU), enthalpy change (ΔH), entropy change (ΔS), Helmholtz energy change (ΔA), and Gibbs energy change (ΔG). Do the values depend on whether the process is reversible or irreversible? (17%)

5. Liquid reactant A decomposes as follows:

$$A \xrightarrow{k_1} R, \quad r_R = k_1 C_A^{\,2}$$
$$A \xrightarrow{k_2} S, \quad r_S = k_2 C_A$$

A feed of initial concentrations, C_{A0} = 1 mol L^{-1}, C_{R0} = 0, C_{S0} = 0.3 mol L^{-1}, enters two mixed flow reactors (CSTR) in series where the space times of the first and the second reactors are 2.5 min. and 10 min., respectively. The composition in the first reactor is C_{A1} = 0.4 mol L^{-1}, C_{R1} = 0.4 mol L^{-1}, C_{S1} = 0.5 mol L^{-1}. Find the composition of the stream leaving the second reactor. (20%)

6. Please describe the energy balance for steady-state flow process for the control volume system. (15%)