八十九學年度 資格考

化工熱力學

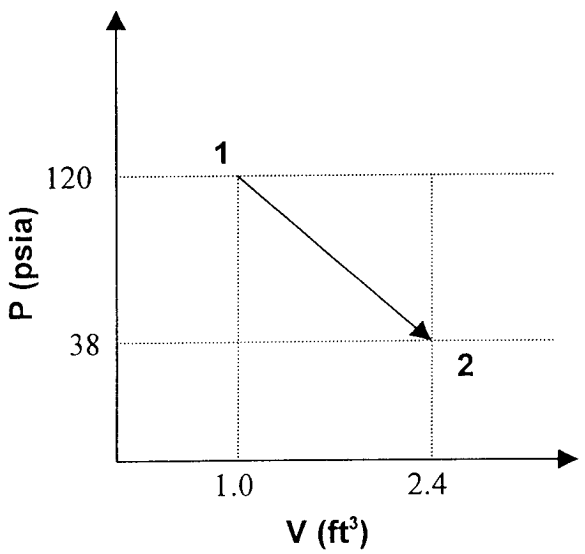
1. Complete the following Table for the cycle 1 → 2 → 3 → 4.

	Q (kJ)	W (kJ)	ΔU (kJ)
1 → 2	27	-15	
2 → 3	-8		
3 → 4	9	-3	

where Q, W and U are heat, work and internal energy, respectively. (15%)

2. The following expressions relate to a particular gaseous mass: $pv = 85\ T$, $H = 135 + 0.9\ T$ where p is in lb_f/ft^2, v in ft^3/lb_m, T in °R and H in BTU/lb_m. If the specific heats are temperature dependent only, find c_P and c_V. (Note: 1 BTU = 778 ft-lb_f) (15%)

3. The decrease in internal energy of 0.30 pounds of dry air assumed to be an ideal gas is 13.24 BTU when the air pressure decreases from 120 psia to 38 psia and the volume increases from 1 cubic foot to 2.4 cubic feet. C_V for air is 0.17 BTU/lb °F. Calculate the change in enthalpy and the initial and final temperatures. (Note: 1 ft = 12 in) (15%)



4. The coefficient of thermal expansion $\alpha = (1/V)(\partial V/\partial T)_P$, of isothermal compressibility $\beta = -(1/V)(\partial V/\partial P)_T$, and of thermal pressure $\gamma = (\partial P/\partial T)_V$ are interrelated. When any two of them are known for a system, the third can be calculated. Derive the equation for the relationship by using the Jacobian of transformation. (10%)

5. (a) List all types of intermolecular forces, which may include in the following mixtures:
   (M1) water + ethanol
   (M2) n-octane + n-decane
   (M3) benzene + tetrahydrofuran (THF) (10%)
   (b) Based on your knowledge of intermolecular forces, compare qualitatively the magnitudes of enthalpy change of mixing of the above three mixtures through an equal molar mixing. (10%)

6. Describe the reasons why a two-parameter corresponding-states model is inadequate for strongly polar fluids.
   (a) Based on microscopic concepts. (5%)
   (b) Based on macroscopic concepts. (5%)

7. The partition function of a canonical ensemble Q is given by

$$Q = \sum_{i=1}^{M} e^{(-\beta\varepsilon_i)}$$

where ε_i is the total energy of a phase point in the cell i and M is the number of cells in the phase space.
   (a) Show that $\beta = 1/(kT)$
   (b) Derive the relation between Q and macroscopic thermodynamic property.
   Note that: $H = U + PV$, $A = U - TS$, $G = H - TS$. (15%)