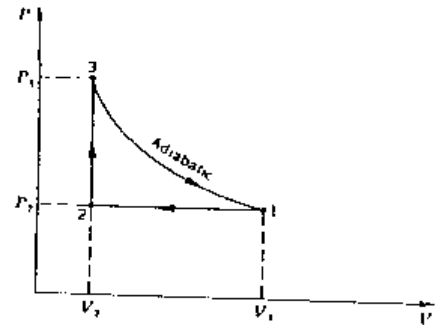(15%) 1. Figure below represents an imaginary ideal -gas engine cycle. Assuming constant heat capacities. Show that the thermal efficiency is

$$\eta = 1 - \gamma \frac{(V_1/V_2)-1}{(P_3/P_2)-1} , \quad \gamma = C_P/C_V$$

(15%) 2. (a) Describe a Carnot cycle engine.

(b) Which is the more effective way to increase the efficiency of a Carnot engine: to increase the temperature of the hot reservoir or to decrease the temperature of the cold reservoir?

(15%) 3. Prove the equivalence of Kelvin-Planck and Clausius statements of the second law of thermodynamics.

(15%) 4. (a) Derive Poisson's equation $TP^{-\kappa} = $ constant , for ideal gases under adiabatic processes, where T is temperature, P is pressure, R^* is universal gas constants, C_P is molar heat capacity at constant pressure, and $\kappa = R^*/C_P$.

(b) from (a) , if θ is the temperature at P=1000 mb, what is the meaning of θ

(c) Derive $dS = C_P d(\ln \theta)$ where S is the entropy.

(10%) 5. Make an example of the first law of thermodynamics in your ordinary life.

(20%) 6. Explain the following terms

(a) heat　(b) work　(c) internal energy　(d) exact differential

(e) conductivity　(f) radiation　(g) black body　(h) entropy

(10%) 7. Which thermodynamic property maintain constant during isobaric process?