EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE 2005/06 (AUG-SEP. 2007)

FIRST SEMESTER

PH 302 - THERMODYNAMICS

Time: 01 hour.
Answer ALL Questions.

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1. Distinguish adiabatic and isothermal process. An ideal gas may be defined as one, wh equation of state is,

$$PV = nRT$$

and whose internal energy is only a function of temperature. Show that for an ideal gas,

(i) $C_P = C_V + R$, where C_P and C_V are the molar heat capacities at cons pressure and constant volume respectively.

(ii) The quantity PV^γ is constant during an adiabatic process (Assume that $\gamma =$ is constant).

(iii) The heat absorbed by one mole of gas in an isothermal expression from vol V_1 to volume V_2 is, $RT \ln\left(\frac{V_2}{V_1}\right)$.

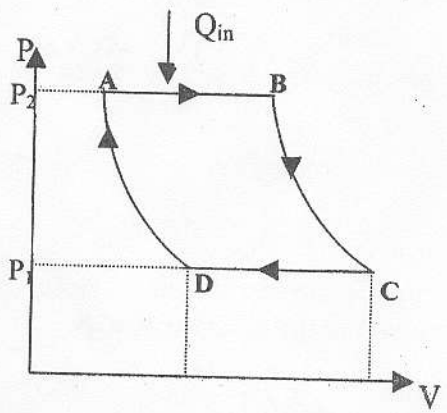
(iv) The work done in adiabatic expansion of the gas from (P_1, V_1) to $(P_2, V_2$ $\frac{1}{\gamma - 1}(P_1V_1 - P_2V_2)$.

2. Define the heat capacity at constant volume and show that,

$$C_v = \left(\frac{\partial U}{\partial T}\right)_v$$

The symbols have their usual meanings.

What is heat engine? Obtain a general expression for its efficiency.



$Point\ A \equiv (V_2, P_2)$

$Point\ B \equiv (V_3, P_2)$

$Point\ C \equiv (V_4, P_1)$

$Point\ D \equiv (V_1, P_1)$

The Joule cycle shown above consists of two constant-pressure (isobaric) steps conne by two adiabatic. Show that the Thermal efficiency of a reversible engine operating in cycle, with an ideal gas of constant heat capacities as the working medium is,

$$\eta = 1 - r_P^{\left(\frac{1-\gamma}{\gamma}\right)}$$

where the compression ratio $r_P = \frac{P_2}{P_1}$ and $\gamma = \frac{C_P}{C_V}$.

Where the symbols have their usual meanings.