

EASTERN UNIVERSITY, SRI LANKA

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

FIRST SEMESTER

PH 302 - THERMODYNAMICS

Time: 01 hour.

Answer ALL Questions.



1. Distinguish adiabatic and isothermal process. An ideal gas may be defined as one, whose 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 constant pressure and constant volume respectively.

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

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

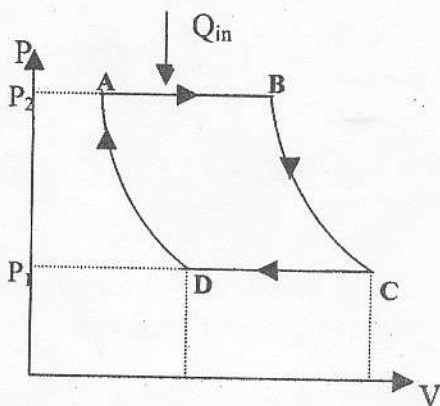
(iv) The work done in adiabatic expansion of the gas from (P_1, V_1) to (P_2, V_2) is, $\frac{1}{\gamma-1}(P_1V_1 - P_2V_2)$.

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 connected 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.