EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2008/2009

FIRST SEMESTER (PROPER)

(FEBRUARY 2010)

PH 302 THERMODYNAMICS

Time: 01 hour.

Answer ALL Questions

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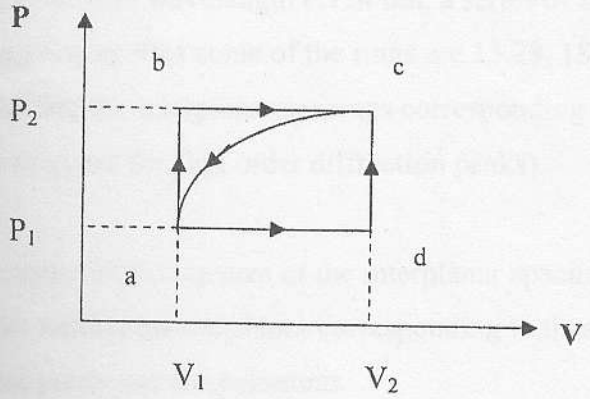
1. What do you mean by "external work done" in thermodynamics. Write down the mathematical equation for external work done and explain the external work done by using $P-V$ diagram.

i. Write down the mathematical form of the first law of thermodynamics.

The thermodynamic process for an ideal gas is shown in the $P-V$ diagram below. In path abc, the work done by the gas is $40kJ$, heat energy supplied to the system is $90kJ$. If the work done by the gas in path adc is $20kJ$ and the internal energy at point '***a***' is $40kJ$ $(ie, U_a = 40kJ)$, find:

(a) The value for the internal energy at point "***c***".

(b) The heat energy which is to be supplied to the process adc.



ii. Write down the relations for Helmholtz free energy (F), Enthalpy (H) and Gibb's function (G). Prove the Gibb's Helmholtz relation:

$$\left(\frac{\partial G}{\partial T}\right)_P = \frac{G-H}{T}.$$

2. What do you mean by heat engine? Write down the general expression for its efficiency. An ideal gas is expanded adiabatically, from (P_1, V_1) to (P_2, V_2). Then it is compressed isobarically to (P_2, V_1). Finally, the pressure is increased to P_1 at constant volume V_1.

a) Show these processes in a $P-V$ diagram.

b) Show that the efficiency of this cycle is:

$$\eta = 1 - \frac{\gamma\left(\frac{V_2}{V_1} - 1\right)}{\left(\frac{P_1}{P_2} - 1\right)}. \quad \text{Where, } \gamma = \frac{C_P}{C_V}.$$

c) A Carnot's engine working between $27^0 C$ and $127^0 C$ takes up $800J$ of heat from the reservoir in one cycle. Find the work done by the engine?