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EASTERN UNIVERSITY, SRI LANKA
THIRD EXAMINATION IN SCIENCE - 2010/2011
FIRST SEMESTER (SPECIAL REPEAT)
(JUNE 2014)
PH 302 THERMODYNAMICS

Time: 01 hour.

Answer ALL Questions

1. Distinguish an isothermal and an adiabatic process. When a gas undergoes an adiabatic process the pressure and the volume change according to the relation $PV^\gamma = \text{constant}$, where $\gamma = \frac{C_P}{C_V}$. Prove that the work done in an adiabatic process is given by,

$$W = \frac{1}{(\gamma - 1)} [P_1 V_1 - P_2 V_2].$$

A diatomic gas ($\gamma = 1.4$) of volume 1.0 m^3 at a pressure of $1.01 \times 10^5 \text{ Nm}^{-2}$ is compressed adiabatically until the volume is reduced to 0.4 m^3 . Find the work done on the gas during the compression.

2. For a Carnot's engine, give an expression for its efficiency η in terms of the temperature T_1 and T_2 of the hot and cold operating reservoirs respectively.

(i) A Carnot's engine working between 27°C and 127°C takes up 800 J of heat from the reservoir in one cycle. What is the work done by the engine?

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

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

Hence derive the Maxwell's relation

$$\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T.$$