

EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2004/2005

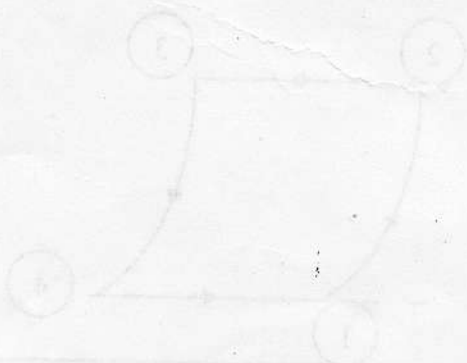
First Semester (January/February 2006)

THERMODYNAMICS - PH 302

Answer ALL questions.

Time: 1 hour

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Q(1). Formulate First Law of Thermodynamics and clearly identify each term involved in this law.

Derive Maxwell's relations

$$\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial V}\right)_T$$

and hence establish energy equation

$$\left(\frac{\partial U}{\partial V}\right)_T = T\left(\frac{\partial P}{\partial T}\right)_V - P$$

where the symbols have their usual meaning,

A gas obeying  $P(V-b) = RT$  has a heat capacity per mole, at constant volume, of  $C_v$ ,

- i. Show that the internal energy  $U$  is a function only of  $T$ ,
- ii. Show that for an adiabatic expansion  $P(V-b)^\gamma = \text{constant}$ , where  $\gamma$  is the ratio of principal heat capacities and  $C_p - c_v = R$ ,

Q(2). What do you mean by Heat engine? Obtain a general expression for its efficiency.

The jule cycle, shown in below figure consists of two constant-pressure steps connected by two adiabatics. Show that the thermal efficiency of a reversible heat engine operating on this cycle, with an ideal gas as the working medium is

$$\eta = 1 - r_p^{\frac{1-\gamma}{\gamma}}$$

$$\text{where } r_p = \frac{P_2}{P_1} = \frac{P_3}{P_4}$$

