EASTERN UNIVERSITY, SRI LANKA

THIRD EXAMINATION IN SCIENCE - 2004/2005

First Semester (January/February 2006)

THERMODYNAMICS - PH 302

Answer ALL questions.

Time: 1 hour

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

Derive Maxwell's relations

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

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 $P(V-b)^\gamma$ = constant, where γ 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

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

where $r_p = \frac{p_2}{p_1} = \frac{p_3}{p_4}$