RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree
Second year – Semester I Examination – September / October 2013

PHY 2101 – THERMODYNAMICS AND RADIATION

Answer two questions only **Time: 1 hour**

Universal gas constant (R) = 8.314 J K^{-1} mol^{-1}

The use of a non-programmable electronic calculator is permitted.

1)

a) Write down the zeroth law and the first law of thermodynamics.

b) Prove that the work done on the system of a fixed gas mass is given by $-pdv$ for a small volume change dv, where "p" is the pressure and "v" is the volume.

c) Prove that the work done on a system consisting of ideal gas in a isothermal, and reversible expansion is given by; (a) $W = nRT \ln(V_1/V_2)$ and
(b) $W = nRT \ln (P_2/P_1)$. The symbols have their usual meanings.

d) One mole of an ideal gas having pressure, P_1, and volume, V_1, is compressed reversibly and isothermally till the pressure is doubled. Calculate;
i) the work done on the system,
ii) the internal energy change and
iii) the heat input to the system.

2)

a) Write down the second law of thermodynamics.

i) Prove that for an adiabatic and reversible process; PV^{γ} = constant , where $\frac{c_p}{c_v} = \gamma$, c_p is the molar heat capacity at constant pressure, c_v is the molar heat capacity at constant volume.

ii) Prove that $c_p - c_v = R$ for an ideal gas.

3) What is it meant by perfect black body?

a) Define absorptive power and emissive power of black body radiation.

b) Write down the Kirchoff's law for the black body radiation and prove it.

c) Write down Stefan-Boltzman law for the black body radiation.

d) An iron furnace radiates 2 x10^{-5} J h^{-1} through an opening of cross-section 1 cm^2. If the relative emittance of the furnace is 0.8, calculate the temperature of the furnace. (Stefan's constant, $\sigma = 5.67X10^{-8}$ W m^{-2} K^{-4})

End