RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES, MIHINTALE

B.Sc. (General) Degree
Second year - Semester I Examination – February\March 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) Write down the first law of thermodynamics.
   a) Prove that the work done on a 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.
   b) Show that the work done (W) on a system for,
      i) an isobaric process, $W = P(V_1 - V_2)$
      ii) an isovolumetric process, $W = 0$
      iii) an isothermal process $W = nRT\ ln(V_1/V_2)$. The symbols have their usual meanings.
   c) One mole of an ideal gas at 25 °C is compressed isothermally and adiabatically until the pressure doubles , Calculate;
      i) the work done on the system,
      ii) the heat input to the system and
      iii) the internal energy change.
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 and C_v is the molar heat capacity at constant volume.
      ii) Derive equation, $C_p - C_v = R$ for an ideal gas.
   b) Determine the entropy change of the universe when 3.0 kg of water is boiled on a stove burner at 500 °C. (The latent heat of vaporization of water, $L_V = 2.26 \times 10^6$ J kg^{-1}).

3) What do you mean 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) A hot sphere with radius 1 cm radiates 1.3×10^{-5} J h^{-1}. Calculate the temperature of the sphere if the relative emittance of the sphere is 0.8. (Stefans constant, $\sigma = 5.67 \times 10^{-8}$ J m^{-2} s^{-1} K^{-4})