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RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree
Second Year – Semester II Examination – October /Nonmember 2014

PHY 2101-THERMODYNAMICS AND RADIATION

Answer **Two** Questions Only Time allowed: Two hours

Stefan's constant, $\sigma = 1.36X10^{-8}$ J m^{-2} s^{-1} K^{-4}

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

1)

a) 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.

(30 marks)

b) An ideal gas contained in a vertical cylinder, with a piston of mass M at the top. Initially, no external force is applied to the piston, and it comes to some equilibrium height. If the atmospheric pressure is P_0 and cross sectionarea of the cylinder is A, what is the gas pressure in thecylinder?

(40 marks)

c) The gas is now heated quasi-statically at constant pressure until its volume is tripled. How much work does the gas do against the environment during this process?

(30 marks)

2)

a) Write down the second law of thermodynamics.

(15 marks)

i) Prove that,a) $C_p - C_v = P\left(\frac{\partial V}{\partial T}\right)_p$ for real gases and

b) $C_p - C_v = R$ for ideal gases.

(40 marks)

ii) An ideal gas undergoes an adiabatic and reversible process. Prove that;

$PV^{\gamma} = \text{constant}$, where $\frac{C_p}{C_v} = \gamma$,

(30 marks)

b) Gibbs free energy can be used to predict whether a reaction will spontaneously proceed or not. Explain?

(15 marks)

Symbolizes; C_p and C_v are the molar heat capacity at constant pressure and at constant volume respectively. P, V and T are pressure, volume and temperature.

3) Describe the operation of the Carnot ideal gas heat engine step by step with help of pressureversus volume diagrams.

(40 marks)

a) A heat engine is operating between two reservoirs, one contains steam at 100 ˚C and the other contains water at 30˚C. What is the maximum possible efficiency this engine can reach according to thermodynamic laws?

(30 marks)

b) Emissivity of a person is about 0.98 and the surface area of the human body is A = 1.07 m^2. At a body temperature of 37 °C, how much heat does a person radiatein eachsecond?

(30 marks)