



RAJARATA UNIVERSITY OF SRI LANKA
FACULTY OF APPLIED SCIENCES

B.Sc. (General) Degree in Applied Sciences
Second Year – Semester I Examination – July/August 2018

PHY 2101-THERMODYNAMICS AND RADIATION

Time: One hour

Answer All Questions.

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

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

1)

a) Write down the "First law of thermodynamics".

(10 marks)

b) Prove that, $C_p - C_v = P \left(\frac{\partial V}{\partial T} \right)_p$ for real gases where, C_p and C_v are molar heat capacities under constant pressure and volume respectively.

(30 marks)

c) Prove that $C_p - C_v = R$ for ideal gases, where R is the universal gas constant.

(20 marks)

d) Suppose that C_v of an ideal gas is given by $C_v = \frac{fR}{2}$, where f is the degree of freedom. Prove that, $C_p = (2 + f) \frac{R}{2}$.

(20 marks)

e) If the degree of freedom is $3n$ obtain equations for C_p and C_v in terms of n .

(20 marks)

2)

- a) Obtain an expression for the efficiency of a Carnot engine operating between two heat reservoirs at temperatures T_1 and T_2 .

(20 marks)

- b) A heat engine takes in 700 J of heat from the hot reservoir and emits 500 J of heat to the cold reservoir.

- i) Calculate the work done in a cycle.
- ii) Calculate the efficiency of the engine.
- iii) Calculate the temperature of the hot reservoir if the engine is a Carnot engine and the temperature of cold reservoir is 25°C .

(30 marks)

- c) Define the Absorptive Power (a_λ) and Emissive Power (e_λ) of a surface.

(20 marks)

- d) Write down the Stefan-Boltzmann law for black body radiation.

(15 marks)

- e) A bulb with power 60 W has area of 0.002 m^2 . If it has emissivity of 0.76, what is the temperature of the bulb?

(15 marks)

END.