

EASTERN UNIVERSITY, SRI LANKA  
THIRD EXAMINATION IN SCIENCE - 2013/2014  
FIRST SEMESTER (PROPER/REPEAT)  
(May/June 2016)  
PH 302 THERMODYNAMICS

Time: 01 hour.

Answer ALL Questions

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(A)

- a. What is meant by thermodynamic system and thermodynamic process *(10 Points)*
- b. Briefly explain the term: thermodynamic work *(05 Points)*
- c. A piston-cylinder device initially contains  $0.4 \text{ m}^3$  of an ideal gas at 100 kPa and  $80^\circ\text{C}$ . The gas is now compressed to  $0.1 \text{ m}^3$  in such a way that the temperature inside the cylinder remains constant. Determine the work done during this process. *(25 Points)*

(B)

- a. State Carnot's theorem in the process of Carnot engine. *(10 Points)*
- b. Define thermal efficiency of a Carnot engine. *(10 Points)*
- c. An imaginary Carnot engine receives heat and does work on a slowly moving piston such that the cycle of operation of 1 kg working fluid can be represented as a circle 14 cm in diameter on a P-V diagram on which 1 cm = 300 kPa and 1 cm =  $0.1 \text{ m}^3/\text{kg}$ .

- i. How much work is done by each of working fluid for each operation? (1)
- ii. If the heat rejected by the engine in a cycle is 1000 kJ per kg of fluid, what would be its thermal efficiency? (2)

2.

- a. Distinguish between ideal and real gas. (1)
- b. Define volume expansivity ( $\beta$ ) and isothermal compressibility ( $K$ ) of a thermodynamic system. (1)
- c. Define the Helmholtz free energy (F), Enthalpy (H), Gibb's free energy (G) hence establish the Maxwell's equations in thermodynamics. (3)
- d. By using above equations and show that following relations, where the symbols have their usual meaning. (4)

$$i. \left(\frac{\partial T}{\partial V}\right)_P = \frac{T\beta}{K(C_P - C_V)}$$

$$ii. \left(\frac{\partial T}{\partial P}\right)_V = \frac{T\beta V}{(C_P - C_V)}$$