FM: 70

PM: 28

Unit test

THERMAL SCIENCE

Attempt **all** question.

* Figure in the margin indicates **full marks.**
* Assume suitable data if necessary.

1. a. What is meant by thermodynamic system? How are these classified? Explain each with suitable sketch. [2+5]

b. Differentiate between absolute and gauge pressure. A new scale **N**  of temperature is devised in such a way that the ice point is 1000N and steam point of water is 4000N.What is the temperature reading on this new scale when the temperature reading is 1500N , 1000F and 2000K? At what temperature, both the Celsius and the new scale reading would be same? [2+6]

2. a. A tank has two rooms separated by a membrane. Room A has 1Kg of air and volume 0.5m3, room B has 0.75m3 air with density 0.8Kg/m3.The membrane is broken and the air comes to a uniform state. Find the final density. [7]

b. A frictionless piston cylinder device has a cross sectional area of 100cm2.Find the mass of piston such that absolute pressure in the cylinder is 10 bar. Take 1 atm equals 0.1Mpa. [8]

3. a. Derive the equation for work for Polytropic process. The 0.014 m3 volume gas at a pressure of 2070KPa expands to a pressure of 207 kPa, according to the law PV1.28=constant. Determine the work done by the gas during the process. [4+4]

b. A 1.8 m3 rigid tank contains steam at 220oC. One third of the volume is in the liquid phase and the rest is in the vapor form. Determine: (Refer attached Table of Properties for steam)

* The pressure of the steam
* The quality of the saturated mixture; and
* The specific volume [7]

4. a. Explain First law of thermodynamics for control volume and express for steady state steady flow process. [8]

b. Argon (100gm) is in the piston –cylinder device as shown in **Fig 4.b**.The initial pressure is 5MPa and temperature is 2000C.There is heat transfer to the argon, causing the piston to rise until it hits the stops. There is an additional heat transfer until the final pressure is 8MPa and temperature is 8000C .Find the total work done in the process. Draw P-V, T-V, P-T diagram. [7]

Ar

**Fig. 4.b**

5. Write short notes on (any two): [2 x 5]

* State and phase of thermodynamic system
* Transient and stored energy
* Heat and work as a path function

**Table: Property of steam for saturated vapor:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **T** | **P** | **vl** | **vlg** | **vg** | **ul** | **ulg** | **ug** | **hl** | **hlg** | **hg** |
| **0C** | **kPa** | **m3/kg** | **m3/kg** | **m3/kg** | **kJ/kg** | **kJ/kg** | **kJ/kg** | **kJ/kg** | **kJ/kg** | **kJ/kg** |
| 205 | 1722.9 | 0.001164 | 0.1140 | 0.1152 | 872.95 | 1723.9 | 2596.9 | 874.95 | 1920.4 | 2795.3 |
| 210 | 1906.2 | 0.001173 | 0.1032 | 0.1044 | 895.43 | 1703.3 | 2598.7 | 897.66 | 1900.0 | 2797.7 |
| 215 | 2104.2 | 0.001181 | 0.09357 | 0.09475 | 918.02 | 1682.3 | 2600.3 | 920.51 | 1879.2 | 2799.7 |
| 220 | 2317.8 | 0.001190 | 0.08497 | 0.08616 | 940.75 | 1660.9 | 2601.6 | 943.51 | 1857.8 | 2801.3 |
| 225 | 2547.9 | 0.001199 | 0.07726 | 0.07846 | 963.61 | 1638.9 | 2602.5 | 966.67 | 1835.7 | 2802.4 |