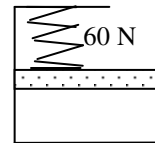


ME 209 Basic Thermodynamics

Assignment -1

1. A 75 kg astronaut carried a bathroom scale (working on spring balance principle) and a beam balance to moon where the acceleration due to gravity is 1.67 m/s^2 . Determine how much will he weigh in the bathroom scale and in beam scale. (Ans. 12.8 kg, 75 kg)
2. Determine the pressure exerted on the surface of a submarine cruising 100 m below the free surface. Assume that the barometric pressure on the free surface is 101 kPa and the specific gravity of sea water is 1.03. (Ans. 1111.4 kPa)
3. A gas is contained in a vertical frictionless cylinder-piston assembly as shown in the figure. The piston weighs 4 kg, and a compression spring resting on the piston exerts a force of 60 N. If the atmospheric pressure is 95 kPa, and the cross sectional area of the cylinder is 35 cm^2 , determine the absolute pressure inside the cylinder. (Ans. 123.4 kPa)



4. The pressure inside a chamber is equal to 80 kPa and is connected to a mercury differential manometer. If the ambient pressure is 98 kPa, how much will be the deflection in the mercury column. (Ans. 13.5 cm)
5. A platinum resistance thermometer had 75 ohms at steam point and 63 ohms at ice point. The same thermometer had 64.992 ohms at room temperature. Compute the room temperature on the centigrade scale. (Ans. 16.6 °C)
6. The value of a property X of a certain substance is given by the expression,
$$X_T = X_0 + 0.5T + 2 \times 10^{-4} T^2$$
where, T is the temperature in degrees Celsius on gas thermometer scale (correct temperature). What would be the temperature measured by the thermometer following centigrade scale (two-point scale), if the system was at 50 °C. (Ans. 49.0 °C)
7. A particular physical property X of a substance changes in magnitude on heating. Its variation with the absolute temperature T is given by
$$X = a/(T-223), \text{ where } T > 223 \text{ K.}$$
Derive an expression for the centigrade temperature scale, t based on this scale and establish a relation between t and T. What is the value of t when T is equivalent to 423 K (Ans. 112.5 °C)
8. The pressure recorded in a constant volume gas thermometer at triple point of water and at a boiling point of liquid were 600 mm and 800 mm of Hg respectively. What is the apparent temperature of the boiling point. If it were subsequently found that the volume of thermometer had increased by 1% between the two temperatures, obtain a more accurate value of the boiling point. (Ans. 364.2 K, 367.9 K)
9. A pressure cooker cooks a lot faster due to maintenance of high pressure (consequently higher temperature) inside. If the pressure has to be maintained at 100 kPa gauge and the atmospheric pressure is 101 kPa, determine the mass of the petcock assuming that the area of the opening is 4 mm^2 (Ans 40.8 g)
10. What is the temperature in °R, if the same in Celsius scale is 50°C.
11. A nuclear reactor operates at 8 MPa. What is the operating pressure in psi, kgf/cm^2 (Ans. 81.54 kgf/cm^2 , 1160 psi)