School of Mechanical & Aerospace Engineering
MA3010 – Thermodynamics & Heat Transfer
Tutorial 5: Ideal Gas Mixtures and Gas-Vapour Mixtures

1. The volumetric analysis of mixture of gases is 30% oxygen, 40% nitrogen, 10% carbon dioxide, and 20% methane. This mixture is heated from 20°C to 200°C while flowing through a tube in which the pressure is maintained at 150 kPa. Determine the heat transfer to the mixture per unit mass of the mixture. Use specific heat values at T = 300K.

[Ans: 199 kJ/kg]

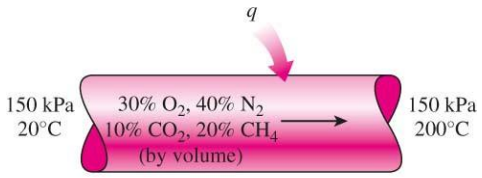
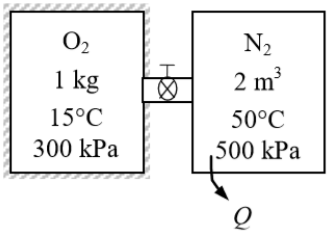


FIGURE P13–50

2. An insulated tank that contains 1 kg of O_2 at 15°C and 300 kPa is connected to a 2-m^3 uninsulated tank that contains N_2 at 50°C and 500 kPa. The valve connecting the two tanks is opened, and the two gases form a homogeneous mixture at 25°C. Determine (a) the final pressure in the tank, (b) the heat transfer to the surroundings, and (c) the entropy generated during this process. Assume the surrounding temperature to be T_o = 25°C.

[Ans: 444.6 kPa; 187.2 kJ; 0.962 kJ/K]



3. A tank contains 15 kg of dry air and 0.17 kg of water vapour at 30°C and 100 kPa total pressure. Determine (a) the specific humidity, (b) the relative humidity, and (c) the volume of the tank.

[Ans: a) 0.01133, b) 0.421, c) 13.3 m^3]

4. After a long walk in the 12°C outdoor, a person wearing glasses enters a room at 25°C and 55% relative humidity. Determine whether the glasses will become fogged.

[Ans: Yes]

5. Atmospheric air at a pressure of 1 atm and dry-bulb temperature of 28°C has a wet-bulb temperature of 20°C. Using the psychrometric chart, determine (a) the relative humidity, (b) the humidity ratio, (c) the enthalpy, (d) the dew-point temperature, (e) the water vapour pressure.

[Ans: a) 48%, b) 0.0113, c) 57.1 kJ/kg dry air, d) 16°C, e) 1.82 kPa]