1. Mass enters an open system with one inlet and one exit at a constant rate of 50 kg/min. At the exit, the mass flow rate is 60 kg/min. If the system initially contains 1000 kg of working fluid, determine:
   a) \( \frac{dm}{dt} \), treating the tank as a system
   b) the time when the system mass becomes 500 kg.

2. Steam enters an insulated tank through a valve. At a given instant, the mass of steam in the tank is found to be 10 kg, and the conditions at the inlet are measured as follows: \( A = 50 \text{ cm}^2 \), \( V = 31 \text{ m/s} \), and \( \rho = 0.6454 \text{ kg/m}^3 \). Determine:
   a) \( \frac{dm}{dt} \), treating the tank as a system
   b) assuming the inlet conditions and tank contents remain unchanged, determine the mass of steam in the tank after 10 s.

3. Steam enters a mixing chamber at 100 kPa, 20 m/s and a specific volume of 0.4 m\(^3\)/kg. Liquid water at 100 kPa and 25°C enters the chamber through a separate duct with a flow rate of 50 kg/s and a velocity of 5 m/s. If liquid water leaves the chamber at 100 kPa, 43°C, 5.58 m/s and a volumetric flow rate of 3.357 m\(^3\)/min. Assume liquid water density to be 1000 kg/m\(^3\) and steady state operation, then determine the port areas (in cm\(^2\)) at:
   a) the inlets
   b) the exit.