Example 11:

A water jet pump has a jet area of 0.010 m$^2$ and jet speed of 30.0 m/s. The jet is within a secondary stream of water having a speed of 3.00 m/s at section 1 as shown. The total area of the duct is 0.0750 m$^2$. The water is thoroughly mixed and leaves the jet pump in a uniform stream at section 2. The pressures of the jet and secondary stream are the same at the pump inlet. Determine the following:

(a) the velocity at the pump exit and  
(b) the pressure rise.

Known: Water jet pumped into flow, \( A_j = 0.010 \text{ m}^2 \), \( V_j = 30.0 \text{ m/s} \), \( V_s = 3.00 \text{ m/s} \), \( A = 0.0750 \text{ m}^2 \).

Assumptions: Steady flow, incompressible liquid, uniform flow at inlets and exit, uniform pressure at sections 1 and 2, negligible friction at walls, water at STP

Find: \( (a) \ V_2 \), \( (b) \ p_2 - p_1 \)

Solution:

Properties: \( \rho_{\text{water}} = 1000 \text{ kg/m}^3 \)

Answers: \( (a) \ 6.60 \text{ m/s} \) (b) 84.2 kPa