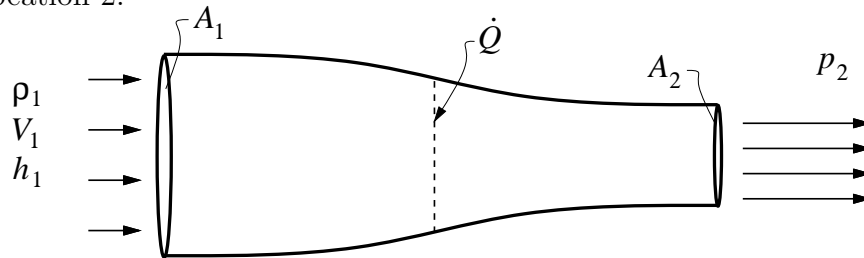


1. (50 %) Air flows into a constricting channel which has an electrical resistive heater in it. There is low speed flow throughout, which in this case means $V^2 \ll h$. All the quantities shown in the figure are known. The objective is to determine the remaining flow quantities at the exit location 2.



a) Draw a suitable control volume, and apply the integral mass and integral enthalpy equations to relate stations 1 and 2.

b) Determine the exit enthalpy h_2 .

c) Determine the exit density ρ_2 .

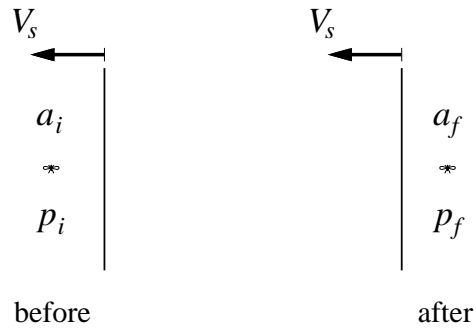
d) Determine the exit velocity V_2 .

2. (50 %) A mosquito is hovering in still air having the initial conditions

$$a_i = 350 \text{ m/s}$$

$$p_i = 100000 \text{ Pa}$$

A shock wave traveling at $V_s = 420 \text{ m/s}$ then passes the mosquito.



a) Sketch the air velocity distribution $V(x)$ in the mosquito's frame.

b) Sketch the air velocity distribution $V(x)$ in the steady shock frame.

c) Determine the final pressure p_f and speed of sound a_f the mosquito feels after it goes through the shock.