c) \[ \dot{m} = p_1 A_1 V_1 = p_2 A_2 V_2 \quad \Rightarrow \quad \frac{A_2}{A_1} = \frac{p_1 V_1}{p_2 V_2} \left( \frac{v_2}{v_1} \right) \]

\[
\frac{p_1}{p_2} = \frac{V_2}{V_1} = \frac{\Phi_1 - \frac{RT_2}{p_2}}{\Phi_1 - \frac{RT_1}{p_1}} = \frac{150}{300} \cdot \frac{371}{323} = 0.574
\]

\[
A_0 \frac{A_2}{A_1} = \frac{310}{20} \cdot 0.574 = 8.90
\]

\[
A_2 = 8.90 \times 0.02 = 0.189 \text{ m}^2
\]

d) \[ \dot{m}_2 = \dot{m}_1 = \dot{m} \text{ for steady flow.} \]

4. a) nozzle shaper (diffusers have to expand slowly to avoid separation)

b) jet engine case smaller (power turbines want \( \frac{V_2}{V_1} \) as small as possible, for maximum energy extraction)

c) Supercritical fluids: density of a liquid, transport properties of a gas

d) True - in fact, part of the liquefying process for liquefying gases