1. Let the gases flowing through the nozzle control volume 0s be perfect with $c_p = 1.004 \frac{kJ}{kg \cdot K}$.
Determine V_9, if $T_5 = 1000K$, $T_9 = 670K$ and $V_5 = 120ms^{-1}$ (See Mattingly Fig 2.4a)
Ans: 822.8m/s

Steady Flow Equation

$\dot{Q} - \dot{W}_{x} = \dot{m}(h + \frac{V^2}{2g_c} + \frac{gz}{g_c})_{out} - \dot{m}(h + \frac{V^2}{2g_c} + \frac{gz}{g_c})_{in}$

$\div \dot{m}$) $q - w_x = (h + \frac{V^2}{2g_c} + \frac{gz}{g_c})_{out} - (h + \frac{V^2}{2g_c} + \frac{gz}{g_c})_{in}$.

$\frac{gz}{g_c}out - \frac{gz}{g_c}in = 0$

$q - w_x$ is negligable, and will therefore be considered as zero.

$0 = (h + \frac{V^2}{2g_c})_{out} - (h + \frac{V^2}{2g_c})_{in}$

$h_9 + \frac{V_9^2}{2g_c} = h_5 + \frac{V_5^2}{2g_c} \rightarrow V_9 = \sqrt{2g_c(h_5 - h_9) + V_5^2}$

$h_2 - h_1 = c_p(T_2 - T_1) \rightarrow 1.004(1000 - 670) = 331.32 \rightarrow V_9 = \sqrt{2g_c(331.32) + 120^2}$

$g_c = 6.67 \times 10^{-11}$ (from research, is this correct?)

$2 \times (6.67 \times 10^{-11}) \times 331.32 + 120^2 = 14400$

$\sqrt{14400} = 120$