5.6

a)

$$\frac{F}{\dot{m}_a} = a_0 \left\{ \left[\frac{2}{\gamma - 1} \frac{\tau_{\lambda AB}}{\tau_r \tau_t \tau_c} \left(\tau_r \tau_t \tau_c - 1 \right) \right]^{\frac{1}{2}} - M_0 \right\}$$

$$\tau_t = 1 - \frac{\tau_r}{\tau_\lambda} \left(\tau_c - 1 \right)$$

$$\tau_c = \pi_c^{\frac{\gamma-1}{\gamma}} \qquad \pi_c = 10 \quad \gamma = 1.4$$

$$\tau_r = 1 + \frac{\gamma - 1}{2} M_0^2 \qquad \gamma = 1.4 \quad 0 \le M_0 \le 3.5$$

$$a_0 = \sqrt{\gamma R T_0} = \sqrt{(\gamma - 1) c_p T_0} \qquad \gamma = 1.4 \quad c_p = 1005 \frac{J}{kg K}$$

$$T_0 = 210 \, K$$

also have $\tau_\lambda = 7$ and $\tau_{\lambda AB} = 8$

Also

$$f_{tot} = \frac{c_p T_0}{h} \left(\tau_{\lambda AB} - \tau_r \right) \qquad h = 4.42 \times 10^7 \frac{J}{kg}$$

$$S = \frac{f_{tot}}{F/\dot{m}_a}$$

Plot above in the range $0 \le M_0 \le 3.5$

b) Maximum M_0 is when $F/\dot{m}_a = 0$

Plot shows that $(M_0)_{max} \approx$