a)

part a requires F in terms of quantities that go through bypass stream

need

$$\frac{u_9}{u_0} = \sqrt{\frac{\gamma R T_9}{\gamma R T_0}} \frac{M_9}{M_0} = \sqrt{\frac{T_9}{T_0}} \frac{M_9}{M_0}$$

back up total temp:

$$\frac{T_{t9}}{T_9} = 1 + \frac{\gamma-1}{2} M_9^2 = \frac{T_{t9}}{T_{t4}}^{1} \underbrace{\frac{T_{t4}}{T_{t3}}}_{\tau_m} \underbrace{\frac{T_{t3}}{T_0}}_{\tau_\lambda} \frac{T_0}{T_9}$$

$$1 + \frac{\gamma-1}{2} M_9^2 = \tau_m \tau_\lambda \frac{T_0}{T_9}$$

$$\frac{T_9}{T_0} = \tau_m \tau_\lambda \left(1 + \frac{\gamma-1}{2} M_9^2\right)^{-1} \quad - \textcircled{1}$$

back up total pressure

$$\frac{P_{t9}}{P_9} = \left(\frac{T_{t9}}{T_9}\right)^{\frac{\gamma}{\gamma-1}} = \left(1 + \frac{\gamma-1}{2} M_9^2\right)^{\frac{\gamma}{\gamma-1}} = \frac{P_{t9}}{P_{t4}}^{1} \frac{P_{t4}}{P_{t3}}^{\pi_m} \frac{P_{t3}}{P_{t2}}^{1}$$

$$\times \frac{P_{t2}}{P_{t0}}^{1} \frac{P_{t0}}{P_0}^{\pi_r} \frac{P_0}{P_9}^{1}$$

$$\pi_r = \tau_r^{\frac{\gamma}{\gamma-1}}$$