T10 SOLUTIONS (WAIT≠)

a) $\frac{T_T}{T} = 1 + \frac{\gamma-1}{2}M^2 = 1 + 0.2(4) = 1.8$

$\therefore$ $\boxed{T_T = 390.6\ K,\ T = T_{atm} = 217\ K}$

$\frac{P_T}{P} = \left[\frac{T_T}{T}\right]^{\gamma/\gamma-1} = \left[1.8\right]^{1.4/.4} = 7.82$

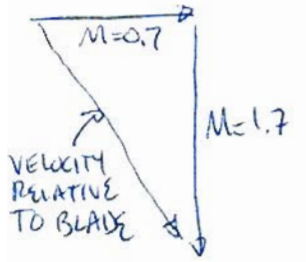
$\therefore$ $\boxed{P_T = 176.8\ kPa,\ P = p_{atm} = 22.6\ kPa}$

b) $\boxed{T_T \text{ & } P_T \text{ ARE THE SAME AS ABOVE}}$ INLET IS ADIABATIC AND Q-S SO STAG. QUANTITIES ARE CONSTANT AND WE HAVEN'T CHANGED REFERENCE FRAMES)

$T = \frac{T_T}{1 + \frac{\gamma-1}{2}M^2}$, $M = 0.7 \Rightarrow \boxed{T = 355.7\ K}$

$P = \frac{P_T}{\left[1 + \frac{\gamma-1}{2}M^2\right]^{\gamma/\gamma-1}}$, $M = 0.7 \Rightarrow \boxed{P = 127.5\ kPa}$

c) FLOW IN INLET IS $M = 0.7$ (AXIAL) WITH $\boxed{T = 355.7\ K.}$ BLADE MOVING AT $M = 0.7$ (TANGENTIALLY)



VELOCITY RELATIVE TO BLADE = 1.84 Mach

$T_T = T\left(1 + \frac{\gamma-1}{2}M^2\right)$ $T_T = ?$

$T_T = 355.7\left(1 + \frac{\gamma-1}{2}(1.84)^2\right) = \boxed{596\ K}$

$P_T = \underbrace{\boxed{127.5\ kPa}}_{P = ?}\left(1 + \frac{\gamma-1}{2}(1.84)^2\right)^{\gamma/\gamma-1} = \underbrace{\boxed{779\ kPa}}_{P_T = ?}$

d) $T_{vessel} = 300K$ ACCELERATE TO $M=2$

$$T_{\substack{test \\ section}} = \frac{T_T}{1 + \frac{\gamma-1}{2} M^2} = \frac{300}{1.8} = \boxed{166.7\,K = T_{test\ section}}$$

FOR $T_{test\ section} = 217K$ (flight temp)

AND MACH = 2, THEN MUST HEAT

VESSEL TO $1.8 \cdot 217K = \boxed{390.6\,K}$