a) Anderson 8.16

Static $p = 0.1 \text{ atm}$, $P_{\text{pitot}} \frac{P_{\text{pitot}}}{p} = 1.13 \text{ atm}$

Since $\frac{P_{\text{pitot}}}{p} = 11.3 > \left[1 + \frac{\gamma - 1}{2} M_1^2 \right]^{\frac{\gamma}{\gamma - 1}} = 1.89$

the flow is clearly supersonic. $P_{\text{pitot}} = P_0$ behind bow shock.

From Anderson App. B,

\[
\frac{P_{\text{pitot}}}{P_1} = \frac{P_{\text{pitot}}}{p} = 11.3 \quad \text{occurs at} \quad M_1 = 2.9
\]

b) Anderson 8.17

Across a shock, $h_{0_1} = h_{0_2}$

\[
\frac{h_1}{c_p} \left[1 + \frac{\gamma - 1}{2} M_1^2 \right] = \frac{h_2}{c_p} \left[1 + \frac{\gamma - 1}{2} M_2^2 \right]
\]

\[
\frac{T_1}{T_1} \left[1 + \frac{\gamma - 1}{2} M_1^2 \right] = \frac{T_2}{T_2} \left[1 + \frac{\gamma - 1}{2} M_2^2 \right]
\]

From App. B for $M_1 = 36$:

\[
M_2 = 0.3787, \quad \frac{T_2}{T_1} = 252.9
\]

\[
T_{0_2} = T_2 \left[1 + \frac{\gamma - 1}{2} M_2^2 \right] = T_1 \cdot \frac{T_2}{T_1} \left[1 + \frac{\gamma - 1}{2} M_2^2 \right] = 300 \times 252.9 \left[1 + 0.2 \times 0.3787^2 \right]
\]

\[
T_{0_2} = 78046 \text{ K} \quad \text{toasty}
\]

This result is surely invalid, since air will no longer be a perfect gas at this temperature, due to ionization and/or chemical changes. So the shock relations used to get this result are not valid.