Solution to Problem 301A:

1. The temperature at the stagnation point of the flow around the airplane, T_S, is related to the temperature far from the plane, T_∞, by

$$\frac{T_S}{T_\infty} \;=\; 1 + \frac{U_\infty^2}{2c_p T_\infty} \tag{1}$$

where $U_\infty = 400m/s$ is the velocity of the airplane and c_p is the specific heat at constant pressure which is given by $c_p = \gamma\mathcal{R}/(\gamma-1)$ where $\mathcal{R}$ is the gas constant for air ($280m^2/s^2\ {}^\circ K$) and γ is the ratio of specific heats (1.4). This yields $T_S = 295^\circ K$.

2. The ratio of the pressure at the stagnation point, p_S, to that far from the airplane, p_∞, assuming isentropic flow is given by

$$\frac{p_S}{p_\infty} \;=\; \left(\frac{T_S}{T_\infty}\right)^{\frac{\gamma}{(\gamma-1)}} \;=\; 3.11 \tag{2}$$

3. If the speed of the airplane is $1000m/s$, the stagnation temperature will be given by the first equation with $U_\infty = 1000m/s$ so

$$T_S \;=\; 723^\circ K \tag{3}$$