37.23 $300psia$ **superheated steam enters an isentropic turbine and exits at** $170°F$ **with 10% moisture content. What is the temperature of the entering steam?**

A. $420°F$

B. $690°F$

C. $960°F$

D. $1230°F$

Consider the entering consitions to be State 1, and exit conditions to be State 2. Since there is some moisture content at State 2, it can be inferred that the steam is a saturated mixture. 10% moisture content implies a quality of $\chi_2 = 0.9$. Use the Properties of Saturated Water and Steam table to look up the entropies s_f and s_{fg}. Calculate the entropy at State 2.

$$T_2 = 170°F$$

$$\chi_2 = 0.9$$

$$s_f = 0.2474\frac{Btu}{lb°F}$$

$$s_{fg} = 1.5816\frac{Btu}{lb°F}$$

$$s_2 = 0.2474\frac{Btu}{lb°F} + 0.9\left(1.5816\frac{Btu}{lb°F}\right) = 1.671\frac{Btu}{lb°F}$$

Since the turbine is isentropic, the entropy for State 1 is the same as the entropy for State 2. The pressure at State 1 has been given. Use the Properties of Superheated Steam table to determine the temperature at State 1. Interpolate or estimate as appropriate.

$$s_1 = s_2 = 1.671\frac{Btu}{lb°F}$$

$$P_1 = 300psia$$

$$T_1 = 690°F$$

Answer B