

47.22 5lb_m of 80°F air is compressed at constant temperature from 15psia to 90psia . How much work is done on the closed system?

- A. 50Btu
- B. 110Btu
- C. 220Btu
- D. 330Btu

For a **Constant Temperature Process** in a **Closed System**, with the initial and final pressures known, select the equation below. Make sure to use absolute temperature. Look up the **Gas Constant** for air.

$$w = RT \ln \left(\frac{P_1}{P_2} \right)$$

$$w = \left(53.35 \frac{\text{ft} \cdot \text{lb}_f}{\text{lb}_m \cdot ^\circ\text{R}} \right) (540^\circ\text{R}) \ln \left(\frac{15\text{psia}}{90\text{psia}} \right) = -51,619 \frac{\text{ft} \cdot \text{lb}_f}{\text{lb}_m}$$

Convert units to $\frac{\text{Btu}}{\text{lb}_m}$. Search **Measurement Relationships** for relevant conversions.

$$w = \left(-51,619 \frac{\text{ft} \cdot \text{lb}_f}{\text{lb}_m} \right) \left(\frac{1\text{Btu}}{778\text{ft} \cdot \text{lb}_f} \right) = -66 \frac{\text{Btu}}{\text{lb}_m}$$

Note this result is the *specific* work i.e. the work per unit mass. Multiply by the mass to determine the total work. The negative sign implies work done *on the system* and may be omitted since the problem statement calls for the work on the system.

$$W = mw = (5\text{lb}_m) \left(66 \frac{\text{Btu}}{\text{lb}} \right) = 330\text{Btu}$$

Answer D

47.23 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 conditions 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.