Given: A process occurring in a rigid, insulated reactor

\[ \dot{W} + \sum m_i h_i - \sum m_i c_i h_i = 0 \]

\[ W_{elec} = \dot{m}_A h_A + \dot{m}_B h_B - \dot{m}_P h_P \]

The mass flow rate of chemical B is found from the conservation of mass.

\[ \dot{m}_A + \dot{m}_B - \dot{m}_P = 0 \]

\[ \dot{m}_B = \dot{m}_P - \dot{m}_A = (2 - 0.1) \, \frac{1}{hr} = 1.9 \, \frac{1}{hr} \]

Then,

\[ W_{elec} = (0.1 \, \frac{1}{hr}) (100 \, \frac{Btu}{lbm}) + (1.9 \, \frac{1}{hr}) (50 \, \frac{Btu}{lbm}) \]

\[ - (2 \, \frac{lbm}{hr}) (400 \, \frac{Btu}{lbm}) = -695 \, \frac{Btu}{hr} \]

\[ W_{elec} = -695 \, \frac{Btu}{hr} \times \frac{hr}{2545 \, \frac{Btu}{hr}} = -0.273 \, hp \]

Reflection:
- The power is negative, which means this is a power input to the reactor.
- This problem is a first exposure to some really neat engineering! A calculation like this is used to size the electrical heater used in the process.