Final Question 1

Thursday, May 13, 2021 12:18 PM

"I pledge my honor I have abided by the Stevens Honor system."

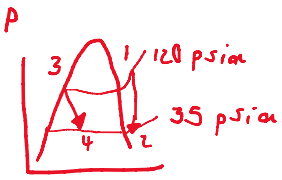
- Alex Jaskins

An ideal vapor compression refrigeration cycle operates using R134a with the evaporator at a pressure of 35 psia and the condenser at a pressure of 120 psia.

A. Derive the energy equation for the valve in this refrigeration system and show which terms in the equation can be neglected. You do not need to show derivations for the other components in the system.

$P_1 = 35$ psia $= P_4$

$P_2 = 120$ psia $= P_3$



Using table

$s_1 = 0.22324$ Btu/lbmR, $h_1 = 106.37$ Btu/lbm } @ 35 psia

$s_1 = s_2$

$h_3 = h_f = 41.791$ Btu/lbm, $h_2 = 117.59$ Btu/lbm } @ 120 psia

$h_3 = h_4$

A.) $E_{in} = E_{out}$

$\Delta\left(W + Q + \dot{m}\left(h + \frac{v^2}{2} + gz\right)\right) = 0$

$W_{in} + Q_{in} + \dot{m}(h_{in}) = Q_{out} + \dot{m}(h_{out})$

$h_{in} = h_{out}$

$h_3 = h_{in}$

$h_4 = h_{out}$

B.)

$$COP_R = \frac{\dot{m}(h_1 - h_4)}{\dot{m}(h_2 - h_1)}$$

$$= \frac{106.37 - 41.791}{117.59 - 106.37} = 5.76$$

C.)

$$COP_{HP} = \frac{Q_H}{W_{net,in}} = \frac{h_2 - h_3}{h_2 - h_1} = \frac{117.59 - 41.791}{117.59 - 106.37} = 6.76$$

D.) Refrigerator - cools external fluid (Removes heat)

Heat Pump - heats external fluid (Adds heat)