{Question 4.009}

$UnitSystem ENG
T_1=40[F]
P_1=80[psi]
T_2=160[F]
P_2=200[psi]
T_3=90[F]
P_3=200[psi]

T_air_1=1[F]
P_air_1=14.7[psi]
Vdot_air=1[ft^3/min] {Vdot[ft^3/min] = VA[ft^3/min]}
T_air_2=110[F]

{Part A}
{Use first law equation to solve for Vdot_ref. We are observing the condensor so we can neglect heat transfer, work, kinetic energy and potential energy}
0=mdot_air*(h_air_1-h_air_2)+mdot_ref*(h_2-h_3)
{Alternate Method => mdot_air*cp(Air,T=T_air_1)*(converttemp(F,R,T_air_2)-converttemp(F,R,T_air_1))=mdot_ref*(h_2-h_3)}

{We need mdot_air in order to find mdot_ref, mdot_air = VA*rho, so we need to find density}
mdot_air=Vdot_air***density**(***Air***, ***T***=T_air_1, ***P***=P_air_1)
h_air_1=**enthalpy**(***Air***, ***T***=T_air_1)
h_air_2=**enthalpy**(***Air***, ***T***=T_air_2)
h_2=**enthalpy**(***R22***, ***T***=T_2, ***P***=P_2)
h_3=**enthalpy**(***R22***, ***T***=T_3, ***P***=P_3)
{Solving the first law equation with the values we gathered we can calculate mdot_ref}
{Mass Flow Rate of Refrigerant: mdot_ref = 0.02531 lb/min}

{Part B}
{To find the work of the compressor we need to use the first law equation for only the refrigerant between states 1 and 2. We neglect heat loss, kinetic energy, and potential energy. WE DO NOT NEGLECT WORK}
0=Wdot+(mdot_ref*(h_1-h_2)***convert**(Btu/min, hp))
h_1=**enthalpy**(***R22***, ***T***=T_1, ***P***=P_1)
{Solve the first law equation to find work}
{Compressor Power: Wdot = 0.01012 hp}

SOLUTION
Unit Settings: Eng F psia mass deg

$h_1 = 175$ [Btu/lb$_m$]
$h_2 = 192$ [Btu/lb$_m$]
$h_3 = 103$ [Btu/lb$_m$]
$h_{air,1} = 110.1$ [Btu/lb$_m$]
$h_{air,2} = 136.3$ [Btu/lb$_m$]
$mdot_{air} = 0.08613$ [lb$_m$/min]
$mdot_{ref} = 0.02531$ [lb$_m$/min]
$P_1 = 80$ [psi]
$P_2 = 200$ [psi]
$P_3 = 200$ [psi]
$P_{air,1} = 14.7$ [psi]
$T_1 = 40$ [F]
$T_2 = 160$ [F]
$T_3 = 90$ [F]
$T_{air,1} = 1$ [F]
$T_{air,2} = 110$ [F]
$Vdot_{air} = 1$ [ft^3/min]
$Wdot = 0.01012$ [hp]

No unit problems were detected.