```
"Given values"
Width = 20 [m]                                          "Room width"
Height = 2.5 [m]                                        "Room height"
T_1 = converttemp(C,K,25)                               "Initial room temperature"
P_1 = 100 [kPa]                                         "Initial room pressure"
P_in = 110 [kPa]                                        "Supply pressure"
T_in = converttemp(C,K,15)                              "Supply temperature"
V_dot = 2.78 [m^3/s]                                    "Supply volumetric flow rate"
P_atm = 100 [kPa]                                       "Hallway pressure"
K = 0.0157 [kg/(s*Pa^0.65)] * convert(kg/(s*Pa^0.65),kg/(s*kPa^0.65)) "Orifice constant"
Q_dot = 3.5 [kW]                                        "Energy in"
h_conv = 15 [W/(m^2*K)] * convert(W/(m^2*K), kW/(m^2*K))     "Heat transfer coefficient"
t_start = 0 [min] * convert(min,s)                      "Start time"
t_stop = 1 [min] * convert(min,s)                       "Stop time"

"Derived values"
V_room = Width * Width * Height                         "Volume of the room"
A_walls = (2 * Width * Width) + (4 * Width * Height)    "Surface area of walls/floors/ceiling"
rho_supply = density(Air,T=T_in,P=P_in)                 "Supply air density"
m_dot_in = V_dot * rho_supply                           "Supply mass flow rate"
s_in=entropy(Air,T=T_in,P=P_in)                         "Supply air entropy"
h_in=enthalpy(Air,T=T_in)                               "Supply air enthalpy"
h_1=enthalpy(Air,T=T_1)                                 "Initial enthalpy of room"
MW_air=molarmass(Air)                                   "Molar mass of air"
rho_1=density(Air,T=T_1,P=P_1)                          "Density of air at t=0"
m_1 = rho_1 * V_room                                    "Mass of air at t=0"
n_1 = m_1/MW_air                                        "Number of moles of air at t=0"
R_air = (P_1*V_room)/(n_1*T_1)                          "Specific gas constant of air"
u_1 = intenergy(Air,T=T_1)                              "Internal energy of gas in room initially"

"Equations for Part A"
m_dot_2 = K * DELTA_P_2^0.65                            "Given equation for orifice"
DELTA_P_2 = P_2 - P_atm                                 "Differential pressure at given time"
DELTA_T_2 = T_2 - T_1                                   "Temperature difference between the room and the surrounding rooms"
W_2 = h_conv * A_walls * DELTA_T_2                      "Energy lost through the walls"
h_2=enthalpy(Air,T=T_2)                                 "Enthalpy of air leaving room"
u_2=intenergy(Air,T=T_2)                                "Internal energy of the room"
Q_dot - W_2 - (m_dot_2  * h_2) + (m_dot_in * h_in) = dEdt     "Energy balance equation"
P_2 * V_room = (m_2 / MW_air) * R_air * T_2             "Ideal gas law"
m_dot_net = m_dot_in - m_dot_2                          "Net mass flow rate into room"
m_2 = m_1 + integral(m_dot_net, time)                   "Mass balance of the air in the room"
m_2*u_2 - m_1*u_1 = integral(dEdt, time)                "Net change in internal energy of the room"

"Equations for Part B"
m_dot_3 = m_dot_in                                      "Conservation of mass at equilibrium"
DELTA_P_3 = P_3 - P_atm                                 "Differential pressure at equilibrium"
m_dot_3 = K * DELTA_P_3^0.65                            "Given equation for orifice"
DELTA_T_3 = T_3 - T_1                                   "Temperature difference between the room and the surrounding rooms"
W_3 = h_conv * A_walls * DELTA_T_3                      "Energy lost through the walls"
h_3=enthalpy(Air,T=T_3)                                 "Enthalpy of air leaving room"
Q_dot - W_3 = (m_dot_3  * h_3) - (m_dot_in * h_in)      "Energy balance equation"
```

Given values

$Width = 20$ [m] *Room width*

$Height = 2.5$ [m] *Room height*

$T_1 = \textbf{ConvertTemp}[C, K, 25]$ *Initial room temperature*

$P_1 = 100$ [kPa] *Initial room pressure*

$P_{in} = 110$ [kPa] *Supply pressure*

$T_{in} = \textbf{ConvertTemp}[C, K, 15]$ *Supply temperature*

$\dot{V} = 2.78$ [m^3/s] *Supply volumetric flow rate*

$P_{atm} = 100$ [kPa] *Hallway pressure*

$K = 0.0157 \; [kg/(s*Pa^{0.65})] \cdot \left| 89.13 \cdot \frac{kg/(s*kPa^{0.65})}{kg/(s*Pa^{0.65})} \right|$ *Orifice constant*

$\dot{Q} = 3.5$ [kW] *Energy in*

$h_{conv} = 15 \; [W/(m^2*K)] \cdot \left| 0.001 \cdot \frac{kW/(m^2*K)}{W/(m^2*K)} \right|$ *Heat transfer coefficient*

$t_{start} = 0 \; [min] \cdot \left| 60 \cdot \frac{s}{min} \right|$ *Start time*

$t_{stop} = 1 \; [min] \cdot \left| 60 \cdot \frac{s}{min} \right|$ *Stop time*

Derived values

$V_{room} = Width \cdot Width \cdot Height$ *Volume of the room*

$A_{walls} = 2 \cdot Width \cdot Width + 4 \cdot Width \cdot Height$ *Surface area of walls/floors/ceiling*

$\rho_{supply} = \rho[Air, T = T_{in}, P = P_{in}]$ *Supply air density*

$\dot{m}_{in} = \dot{V} \cdot \rho_{supply}$ *Supply mass flow rate*

$s_{in} = \textbf{s}[Air, T = T_{in}, P = P_{in}]$ *Supply air entropy*

$h_{in} = \textbf{h}[Air, T = T_{in}]$ *Supply air enthalpy*

$h_1 = \textbf{h}[Air, T = T_1]$ *Initial enthalpy of room*

$MW_{air} = \textbf{MolarMass}[Air]$ *Molar mass of air*

$\rho_1 = \rho[Air, T = T_1, P = P_1]$ *Density of air at t=0*

$m_1 = \rho_1 \cdot V_{room}$ *Mass of air at t=0*

$n_1 = \frac{m_1}{MW_{air}}$ *Number of moles of air at t=0*

$R_{air} = \dfrac{P_1 \cdot V_{room}}{n_1 \cdot T_1}$ *Specific gas constant of air*

$u_1 = \mathbf{u}[Air, T = T_1]$ *Internal energy of gas in room initially*

Equations for Part A

$\dot{m}_2 = K \cdot \Delta_{P,2}^{0.65}$ *Given equation for orifice*

$\Delta_{P,2} = P_2 - P_{atm}$ *Differential pressure at given time*

$\Delta_{T,2} = T_2 - T_1$

Temperature difference between the room and the surrounding rooms

$W_2 = h_{conv} \cdot A_{walls} \cdot \Delta_{T,2}$ *Energy lost through the walls*

$h_2 = \mathbf{h}[Air, T = T_2]$ *Enthalpy of air leaving room*

$u_2 = \mathbf{u}[Air, T = T_2]$ *Internal energy of the room*

$\dot{Q} - W_2 - \dot{m}_2 \cdot h_2 + \dot{m}_{in} \cdot h_{in} = dEdt$ *Energy balance equation*

$P_2 \cdot V_{room} = \dfrac{m_2}{MW_{air}} \cdot R_{air} \cdot T_2$ *Ideal gas law*

$\dot{m}_{net} = \dot{m}_{in} - \dot{m}_2$ *Net mass flow rate into room*

$m_2 = m_1 + \int [\dot{m}_{net}] \, d\,time$ *Mass balance of the air in the room*

$m_2 \cdot u_2 - m_1 \cdot u_1 = \int [dEdt] \, d\,time$ *Net change in internal energy of the room*

Equations for Part B

$\dot{m}_3 = \dot{m}_{in}$ *Conservation of mass at equilibrium*

$\Delta_{P,3} = P_3 - P_{atm}$ *Differential pressure at equilibrium*

$\dot{m}_3 = K \cdot \Delta_{P,3}^{0.65}$ *Given equation for orifice*

$\Delta_{T,3} = T_3 - T_1$

Temperature difference between the room and the surrounding rooms

$W_3 = h_{conv} \cdot A_{walls} \cdot \Delta_{T,3}$ *Energy lost through the walls*

$h_3 = \mathbf{h}[Air, T = T_3]$ *Enthalpy of air leaving room*

$\dot{Q} - W_3 = \dot{m}_3 \cdot h_3 - \dot{m}_{in} \cdot h_{in}$ *Energy balance equation*