```
"Scenario 5 - Constant temperature Pressure rise"

F$ = 'Steam_IAPWS'                                      "water"

"Initial state - case A subcooled liquid"

P[1] = 101.325[kPa]                                     "initial pressure same as external"
T[1] = 25[c]                                            "initial temperature inside and outside"
vol[1] = 1e-3[m3]                                       "1 liter volume"

vA[1] = volume(F$, T=T[1], P=P[1])                      "specific volume at state 1"
hA[1] = enthalpy(F$, T=T[1], P=P[1])                    "specific enthalpy at state 1"
uA[1] = intenergy(F$, T=T[1], P=P[1])                   "specific internal energy at state 1"
sA[1] = entropy(F$, T=T[1], P=P[1])                     "specific entropy at state 1"
mass_A = vol[1]/vA[1]                                   "mass of H2O"

{delta_P = m2*g#/A_P*convert(Pa, kPa)                   "added pressure from mass m2"}

A_P = pi*dia^2/4                                        "cross sectional area of the piston"
m2 = 100[kg]                                            "added mass"
dia = 0.1[m]                                            "piston diameter"

"state 2A"

P[2] = P[1] + delta_P                                   "final pressure"
T[2] = T[1]                                             "isothermal process"

vA[2] = volume(F$, T=T[2], P=P[2])                      "specific volume at state 2"
hA[2] = enthalpy(F$, T=T[2], P=P[2])                    "specific enthalpy at state 2"
uA[2] = intenergy(F$, T=T[2], P=P[2])                   "specific internal energy at state 2"
sA[2] = entropy(F$, T=T[2], P=P[2])                     "specific entropy at state 2"

Q_12A/mass_A = (uA[2] - uA[1]) + P[1]*vA[1]*ln(vA[2]/vA[1]) "determine heat transfer from 1st law - not sure about this
eq"

"Case B - two phase"

xB[1] = 0.25                                            "quality at state 1B"

vB[1] = volume(F$, T=T[1], x=xB[1])                     "specific volume at state 1"
hB[1] = enthalpy(F$, T=T[1], x=xB[1])                   "specific enthalpy at state 1"
uB[1] = intenergy(F$, T=T[1], x=xB[1])                  "specific internal energy at state 1"
sB[1] = entropy(F$, T=T[1], x=xB[1])                    "specific entropy at state 1"
mass_B = vol[1]/vB[1]                                   "mass of H2O"
PB[1] = pressure(F$, T=T[1], x=xB[1])                   "pressure at state 1"

PB[2] = PB[1] + delta_P                                 "final pressure"

"since PB[1] is the saturation pressure associated with T[1], PB[2] will bring the state into the subcooled liquid range"

vB[2] = volume(F$, T=T[2], P=PB[2])                     "specific volume at state 2"
hB[2] = enthalpy(F$, T=T[2], P=PB[2])                   "specific enthalpy at state 2"
uB[2] = intenergy(F$, T=T[2], P=PB[2])                  "specific internal energy at state 2"
sB[2] = entropy(F$, T=T[2], P=PB[2])                    "specific entropy at state 2"

vBck[2] = PB[1]*vB[1]/PB[2]                             "specific volume at state 2? - no, polytropic relation only
applies to ideal gas regime"

Q_12B/mass_B = (uB[2] - uB[1]) + PB[1]*vB[1]*ln(vB[2]/vB[1]) "determine heat transfer from 1st law - not sure about this
eq"
```

"Case C - superheated vapor"

```
vC[1] = volume(F$, T=TC[1], P=PC[1])        "specific volume at state 1"
hC[1] = enthalpy(F$, T=TC[1], P=PC[1])      "specific enthalpy at state 1"
uC[1] = intenergy(F$, T=TC[1], P=PC[1])     "specific internal energy at state 1"
sC[1] = entropy(F$, T=TC[1], P=PC[1])       "specific entropy at state 1"
mass_C = vol[1]/vC[1]                       "mass of H2O"

PC[1] = 1[kpa]                              "pressure at state 1"
TC[1] = 150[c]                              "temperature at state 1"

"initial conditions chosen so that final state will still be in the superheated regime"

PC[2] = PC[1] + delta_P                     "final pressure"
TC[2] = TC[1]                               "constant temperature"

vC[2] = volume(F$, T=TC[2], P=PC[2])        "specific volume at state 2"
hC[2] = enthalpy(F$, T=TC[2], P=PC[2])      "specific enthalpy at state 2"
uC[2] = intenergy(F$, T=TC[2], P=PC[2])     "specific internal energy at state 2"
sC[2] = entropy(F$, T=TC[2], P=PC[2])       "specific entropy at state 2"

Q_12C/mass_C = (uC[2] - uC[1]) + PC[1]*vC[1]*ln(vC[2]/vC[1]) "determine heat transfer from 1st law"
```

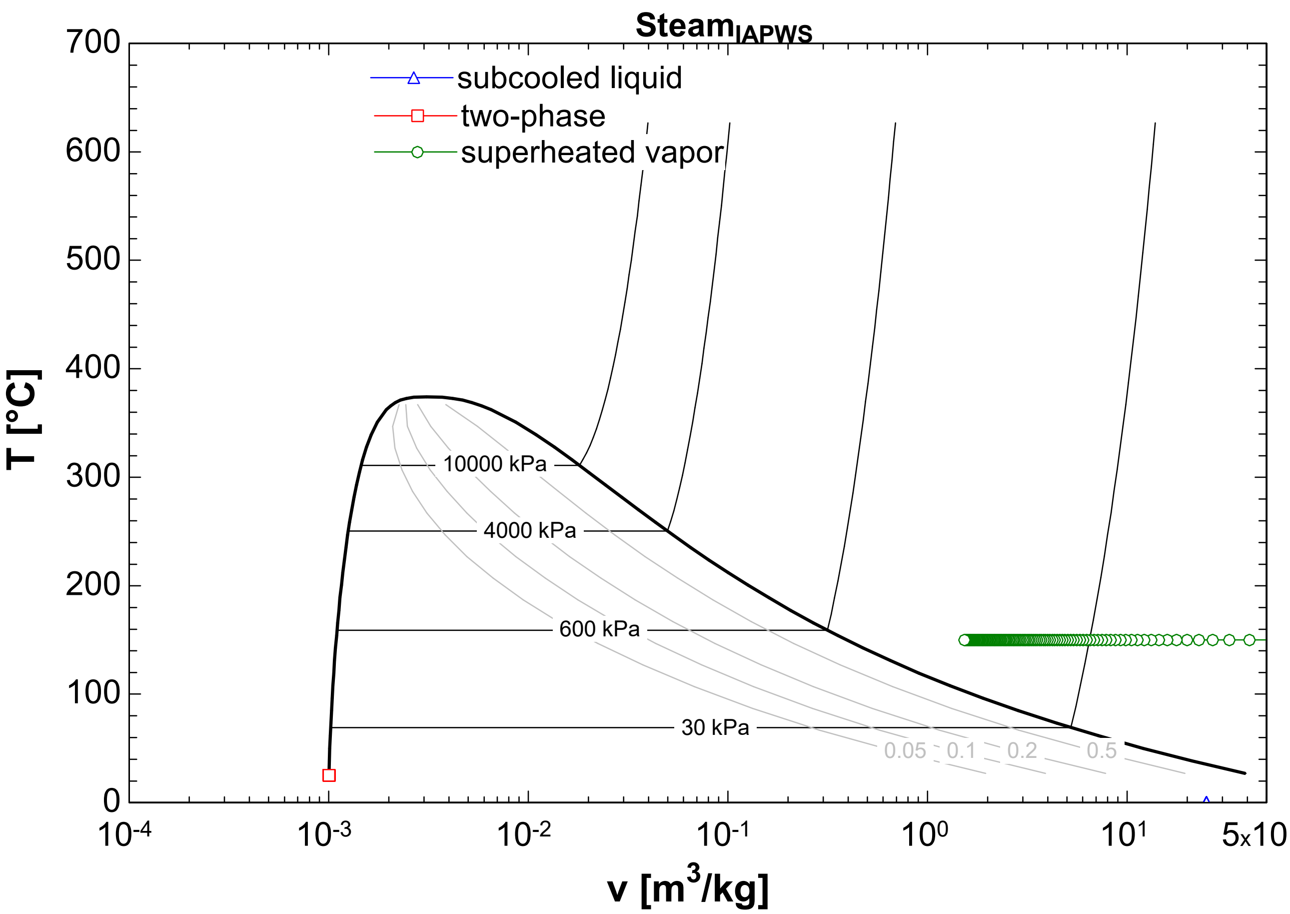
SOLUTION

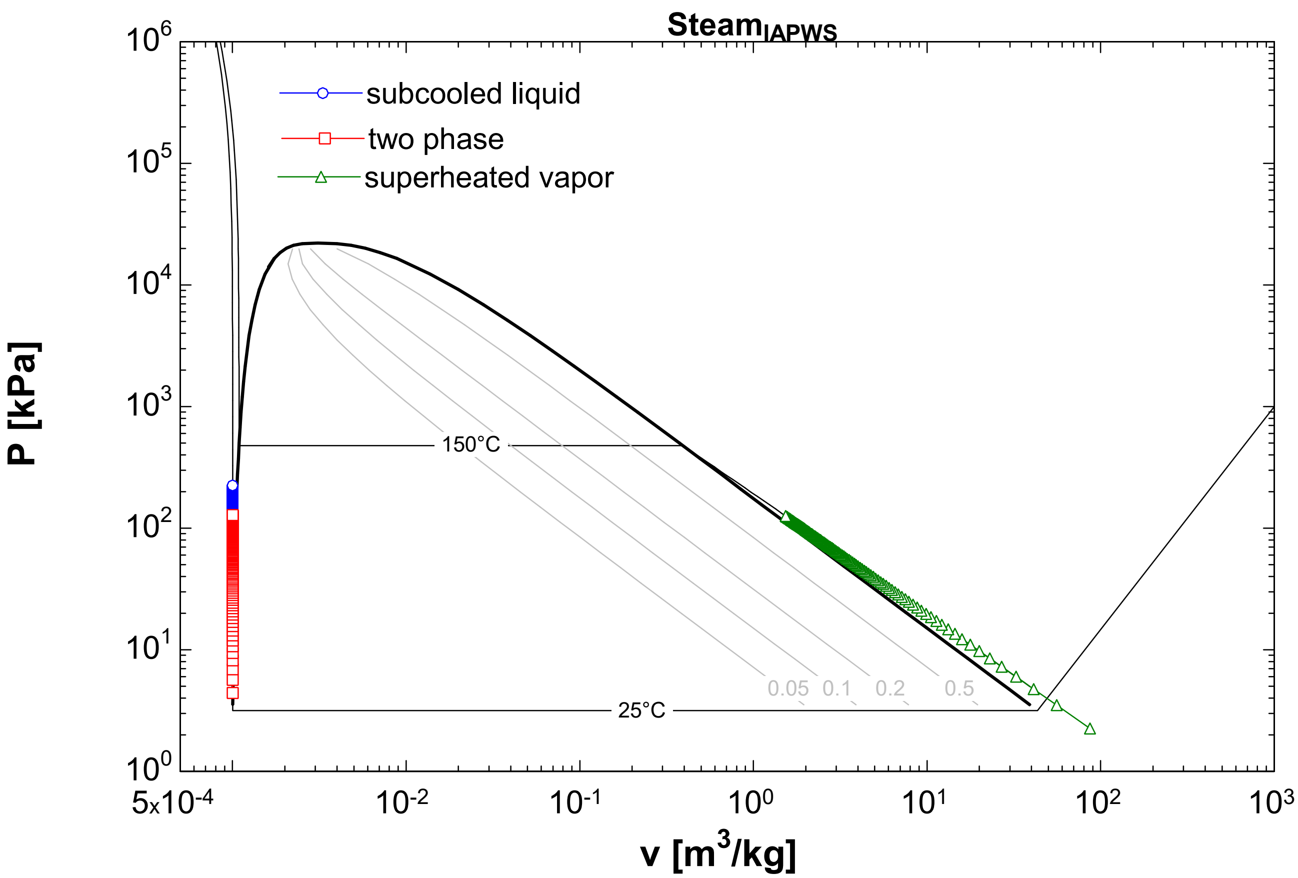
Unit Settings: SI C kPa kJ mass deg

(Case C, Run 100)

A_P = 0.007854 [m^2]	δ_P = 125 [kPa]
dia = 0.1 [m]	F$ = 'steam_iapws'
m2 = 100 [kg]	$mass_A$ = 0.997 [kg]
$mass_B$ = 0.00009229 [kg]	$mass_C$ = 0.000005121 [kg]
Q_{12A} = -0.009588 [kJ]	Q_{12B} = -0.08261 [kJ]
Q_{12C} = -0.004882 [kJ]	

No unit problems were detected.


Steam$_{IAPWS}$
subcooled liquid
two-phase
superheated vapor
10000 kPa
4000 kPa
600 kPa
30 kPa
0.05
0.1
0.2
0.5
T [°C]
v [m^3/kg]
0
100
200
300
400
500
600
700
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
5×10^{1}


Steam$_{IAPWS}$
subcooled liquid
two phase
superheated vapor
150°C
25°C
0.05
0.1
0.2
0.5
P [kPa]
v [m^3/kg]
10^0
10^1
10^2
10^3
10^4
10^5
10^6
5×10^{-4}
10^{-2}
10^{-1}
10^0
10^1
10^2
10^3