"ME-5427 Introduction to Turbomachinery"
"Zhaoyi Jiang(.1364)"

"HW1 P2"

"Exit"
p=1.5[bar]
t=195[c]
v2=350*cos(70)
rho=density(steam,p=p,t=t)
A=(40-2.1)*25
m_dot=rho*v2*A*convert(mm^2,m^2)

SOLUTION
Unit Settings: SI C bar kJ mass deg

A = 947.5 [mm^2]	$\dot{m}$ = 0.07939 [kg/s]	p = 1.5 [bar]
ρ = 0.6999 [kg/m^3]	t = 195 [C]	v2 = 119.7 [m/s]

No unit problems were detected.

"ME-5427 Introduction to Turbomachinery"
"Zhaoyi Jiang(.1364)"

"HW1 P3"

"Inlet"
p1=84[bar]
t1=532[c]
v1=266[m/s]
h1=enthalpy(steam,p=p1,t=t1)
h01=h1+0.5*v1^2*convert(j,kj)
s1=entropy(steam,p=p1,t=t1)

"Exit"
p2=0.4[bar]
t2=82[c]
v2=50[m/s]
h2=enthalpy(steam,p=p2,t=t2)
h02=h2+0.5*v2^2*convert(j,kj)
s2s=s1
h2s=enthalpy(steam,p=p2,s=s2s)

"Work"
w_dot=h01-h02

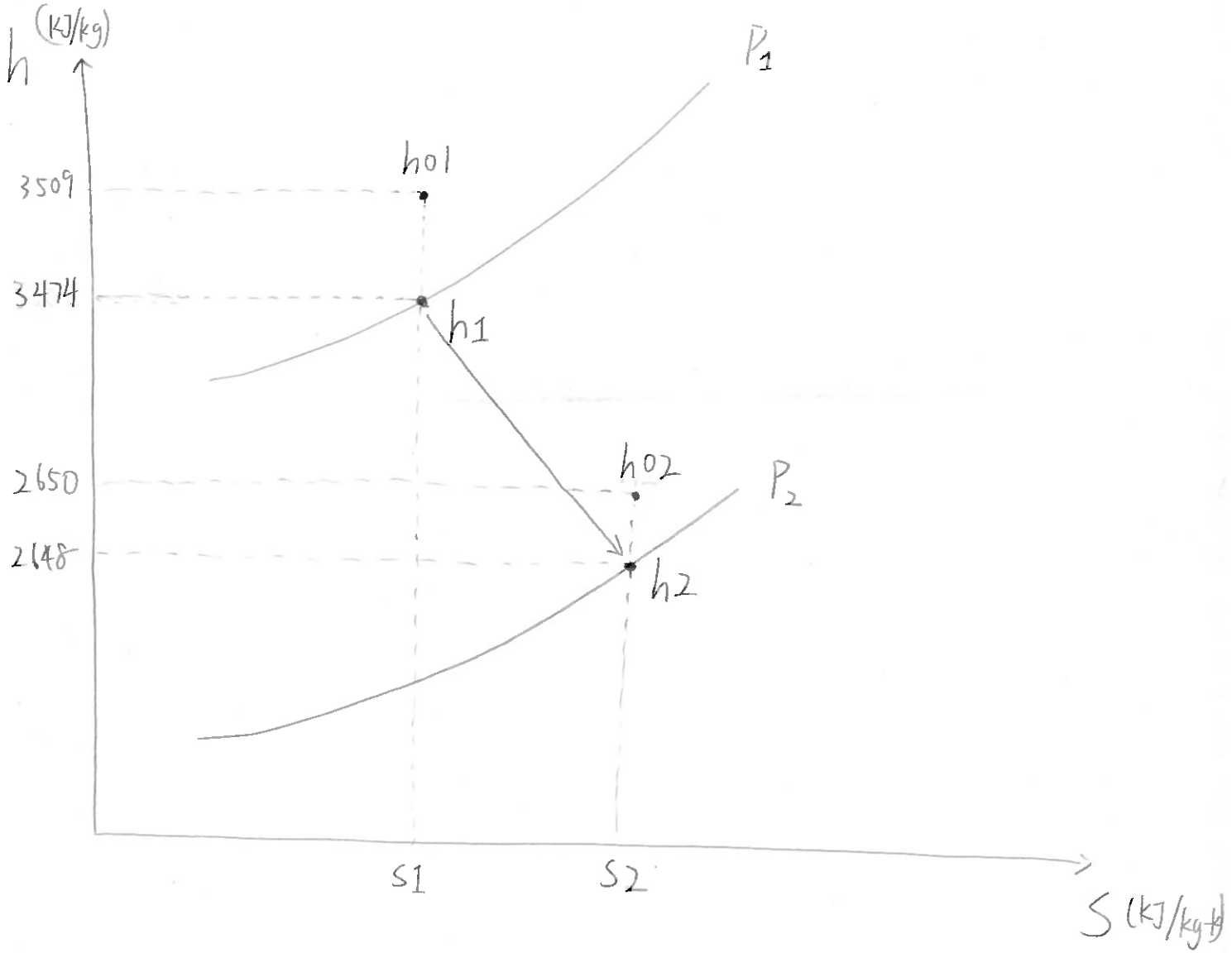
"Efficiency"
eta=(h1-h2)/(h1-h2s)

SOLUTION
Unit Settings: SI C bar kJ mass deg

η = 0.7234	h01 = 3509 [kj/kg]	h02 = 2650 [kj/kg]
h1 = 3474 [kj/kg]	h2 = 2648 [kj/kg]	h2s = 2333 [kj/kg]
p1 = 84 [bar]	p2 = 0.4 [bar]	s1 = 6.8 [kj/kg-k]
s2s = 6.8 [kj/kg-k]	t1 = 532 [C]	t2 = 82 [C]
v1 = 266 [m/s]	v2 = 50 [m/s]	$\dot{w}$ = 859.7 [kj/kg]

No unit problems were detected.

Problem 3



"ME-5427 Introduction to Turbomachinery"
"Zhaoyi Jiang(.1364)"

"HW1 P4"

"Inlet"
t1=293[k]
p1=1[bar]
v1=50[m/s]
h1=enthalpy(air,t=t1)
h01=h1+0.5*v1^2*convert(j,kj)
s1=entropy(air,h=h1,p=p1)
t01=temperature(air,h=h01)
p01=pressure(air,h=h01,s=s1)

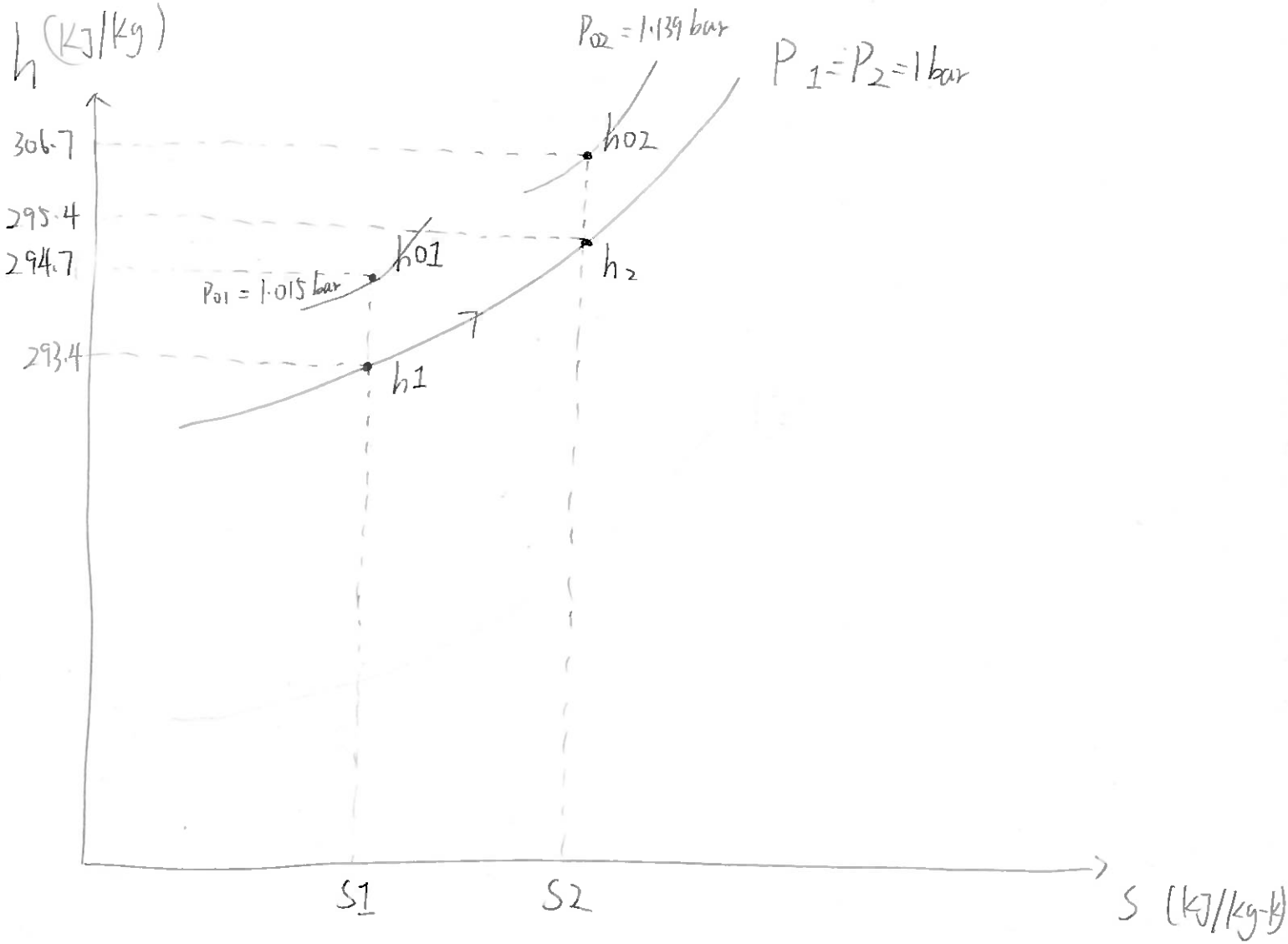
"Exit"
t2=295[k]
p2=1[bar]
v2=150[m/s]
h2=enthalpy(air,t=t2)
s2=entropy(air,h=h2,p=p2)
h02=h2+0.5*v2^2*convert(j,kj)
t_02=temperature(air,h=h02)
p02=pressure(air,h=h02,s=s2)

SOLUTION
Unit Settings: SI K bar kJ mass deg

h01 = 294.7 [kj/kg]	h02 = 306.7 [kj/kg]	h1 = 293.4 [kj/kg]
h2 = 295.4 [kj/kg]	p01 = 1.015 [bar]	p02 = 1.139 [bar]
p1 = 1 [bar]	p2 = 1 [bar]	s1 = 5.682 [kj/kg-k]
s2 = 5.689 [kj/kg-k]	t01 = 294.2 [c]	t1 = 293 [K]
t2 = 295 [K]	t_{02} = 306.2 [c]	v1 = 50 [m/s]
v2 = 150 [m/s]		

No unit problems were detected.

Problem 4


h (KJ/Kg)
306.7
295.4
294.7
293.4
$P_{02} = 1.139$ bar
$P_1 = P_2 = 1$ bar
h_{02}
h_{01}
h_2
$P_{01} = 1.015$ bar
h_1
S1
S2
S (KJ/Kg-K)

"ME-5427 Introduction to Turbomachinery"
"Zhaoyi Jiang(.1364)"

"HW1 P5"

"Inlet"
p01=2.5[bar]
t01=500[k]
h01=enthalpy(air,t=t01)
s01=entropy(air,p=p01,t=t01)
s01=s1

"Exit"
p2=1.5[bar]
s1=s2
h02=h01
h2=enthalpy(air,s=s2,p=p2)
v2=(2*(h02-h2)*convert(kj,j))^(0.5)
t2=temperature(air,h=h2)

"Speed"
M=v2/soundspeed(air,t=t2)
"Subsonic"

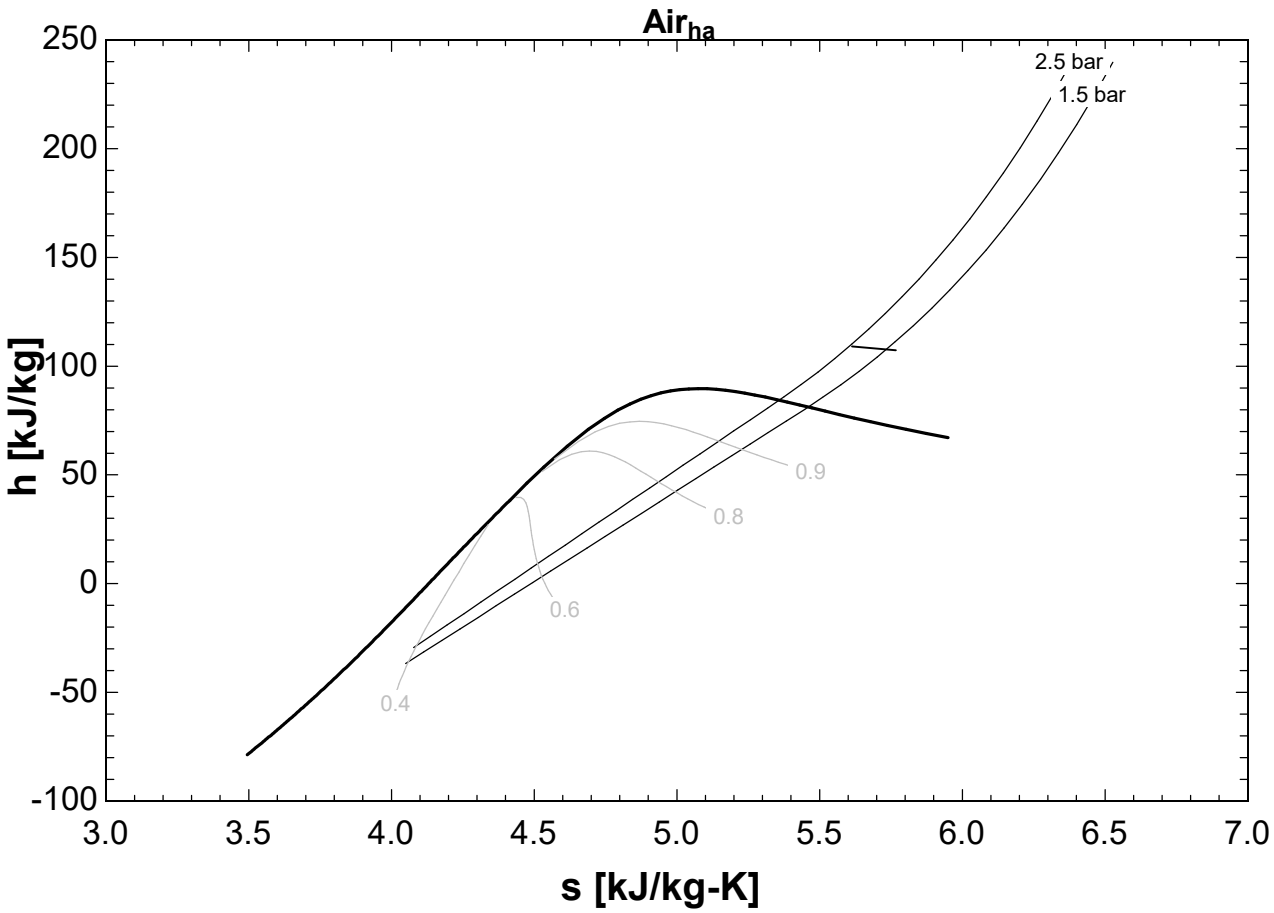
"M dot"
omega=15*convert(cm^2,m^2)
rho=density(air,p=p2,t=t2)
m_dot=omega*rho*v2

SOLUTION

Unit Settings: SI K bar kJ mass deg

h01 = 503.4 [kj/kg]	h02 = 503.4 [kj/kg]	h2 = 434.9 [kj/kg]
M = 0.889	$\dot{m}$ = 0.6695 [kg/s]	ω = 0.0015 [m^2]
p01 = 2.5 [bar]	p2 = 1.5 [bar]	ρ = 1.206 [kg/m^3]
s01 = 5.96 [kj/kg-k]	s1 = 5.96 [kj/kg-k]	s2 = 5.96 [kj/kg-k]
t01 = 500 [K]	t2 = 433.1 [k]	v2 = 369.9 [m/s]

No unit problems were detected.


Air$_{ha}$
2.5 bar
1.5 bar
0.9
0.8
0.6
0.4
h [kJ/kg]
s [kJ/kg-K]
250
200
150
100
50
0
-50
-100
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0

Problem 5