"Turbo"
"HW2 P1"
"Zhaoyi Jiang(.1364)"

"Inlet"
p1=7.8***convert**(bar,pa)
c1=3[m/s]

"Exit"
c2=6[m/s]
p2=1***convert**(bar,pa)
rho=1000[kg/m^3]
Q=0.148[m^3/s]
z1=0.8[m]
z2=0[m]
g=9.8[m/s^2]

p_dot=rho*Q*(p1/rho+0.5*c1^2+z1*g)-rho*Q*(p2/rho+0.5*c2^2+z2*g)

SOLUTION
Unit Settings: SI C Pa J mass deg

c1 = 3 [m/s]	c2 = 6 [m/s]	g = 9.8 [m/s^2]
p1 = 780000 [Pa]	p2 = 100000 [Pa]	$\dot{p}$ = 99802 [w]
Q = 0.148 [m^3/s]	ρ = 1000 [kg/m^3]	z1 = 0.8 [m]
z2 = 0 [m]		

No unit problems were detected.

"Turbo"
"HW2 P2"
"Zhaoyi Jiang(.1364)"

"Inlet"
p0=3.5[bar]
t0=600[k]
s0=**entropy**(***Air***,***P***=p0,***T***=t0)
h0=**enthalpy**(***Air***,***T***=t0)

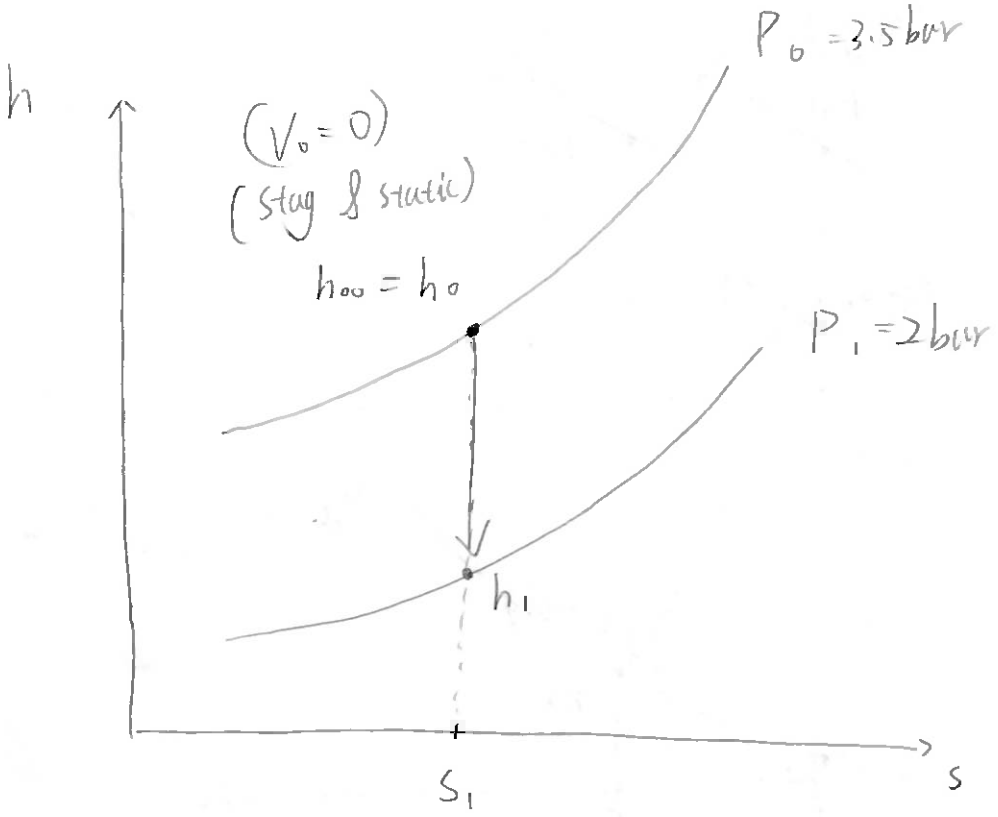
"Exit"
p1=2[bar]
h01=h0
s0=s1
t1=**temperature**(***Air***,***s***=s1,***P***=p1)
h1=**enthalpy**(***Air***,***T***=t1)
h01-h1=0.5*v1^2***convert**(m,km)

SOLUTION
Unit Settings: SI K bar kJ mass deg

h0 = 607.3 [kj/kg]	h01 = 607.3 [kj/kg]	h1 = 518 [kj/kg]
p0 = 3.5 [bar]	p1 = 2 [bar]	s0 = 6.053 [kj/kg-k]
s1 = 6.053 [kj/kg-k]	t0 = 600 [K]	t1 = 514.2 [k]
v1 = 422.8 [m/s]		

No unit problems were detected.

p2



"Turbo"
"HW2 P3"
"Zhaoyi Jiang(.1364)"

"Inlet"
p01=30[bar]
t01=400[c]
s1=**entropy**(***Steam***,***P***=p01,***T***=t01)
h01=**enthalpy**(***Steam***,***P***=p01,***T***=t01)

"Exit"
pd=10[bar]
s2s=s1
h01=h02
h2s=**enthalpy**(***Steam***,***s***=s2s,***P***=pd)
h01-h2s=0.5*v2s^2***convert**(m,km)
0.97=v2/v2s
h02-h2=0.5*v2^2***convert**(m,km)
t2=**temperature**(***Steam***,***P***=pd,***h***=h2)

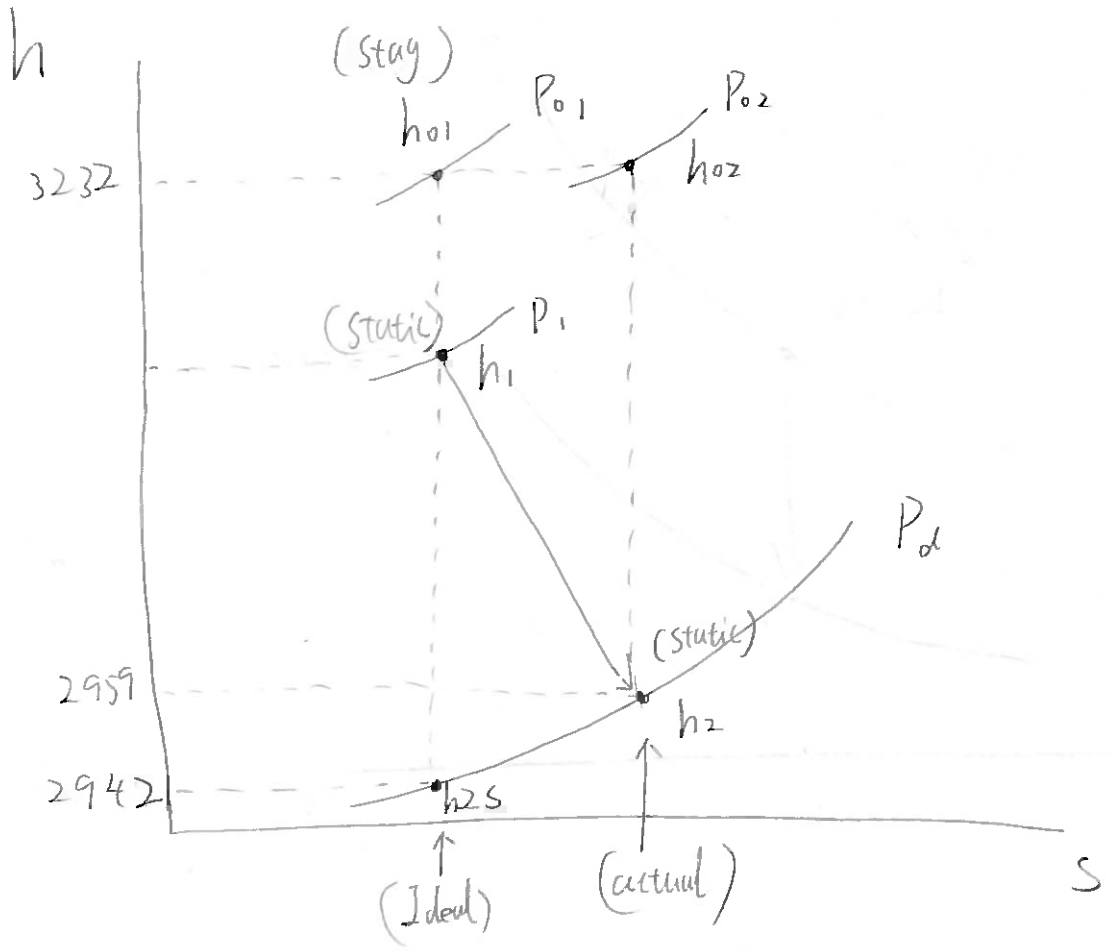
"Calculation"
zeta=(h2-h2s)/(h02-h2)
eta_s=1/(zeta+1)

SOLUTION
Unit Settings: SI C bar kJ mass deg

η_s = 0.9409	h01 = 3232 [kj/kg]	h02 = 3232 [kj/kg]
h2 = 2959 [kj/kg]	h2s = 2942 [kj/kg]	p01 = 30 [bar]
pd = 10 [bar]	s1 = 6.923 [kj/kg-k]	s2s = 6.923 [kj/kg-k]
t01 = 400 [C]	t2 = 257.1 [c]	v2 = 738.9 [m/s]
v2s = 761.8 [m/s]	ζ = 0.06281	

No unit problems were detected.

P3.


h
(stag)
h_{01}
P_{01}
P_{02}
h_{02}
3232
(static)
P_1
h_1
P_d
(static)
2959
h_2
2942
h_{2s}
(Ideal)
(actual)
s

"Turbo"
"HW2 P4"
"Zhaoyi Jiang(.1364)"

"Inlet"
p01=10[bar]
t01=450[c]
h01=**enthalpy**(***Steam***,***P***=p01,***T***=t01)
s01=**entropy**(***Steam***,***P***=p01,***T***=t01)

"Exit"
p2=6[bar]
v2=550[m/s]
h02=h01
h01-h2=0.5*v2^2***convert**(m,km)
h2s=**enthalpy**(***Steam***,***s***=s01,***P***=p2)
s2=**entropy**(***Steam***,***h***=h2,***P***=p2)
x=**quality**(***Steam***,***s***=s2,***h***=h2)
"x=100 means it is superheated"

"Mach Number"
c=**soundspeed**(***Steam***,***h***=h2,***s***=s2)
Mech=v2/c

"VLC"
h01-h2s=0.5*v2s^2***convert**(m,km)
phi=v2/v2s

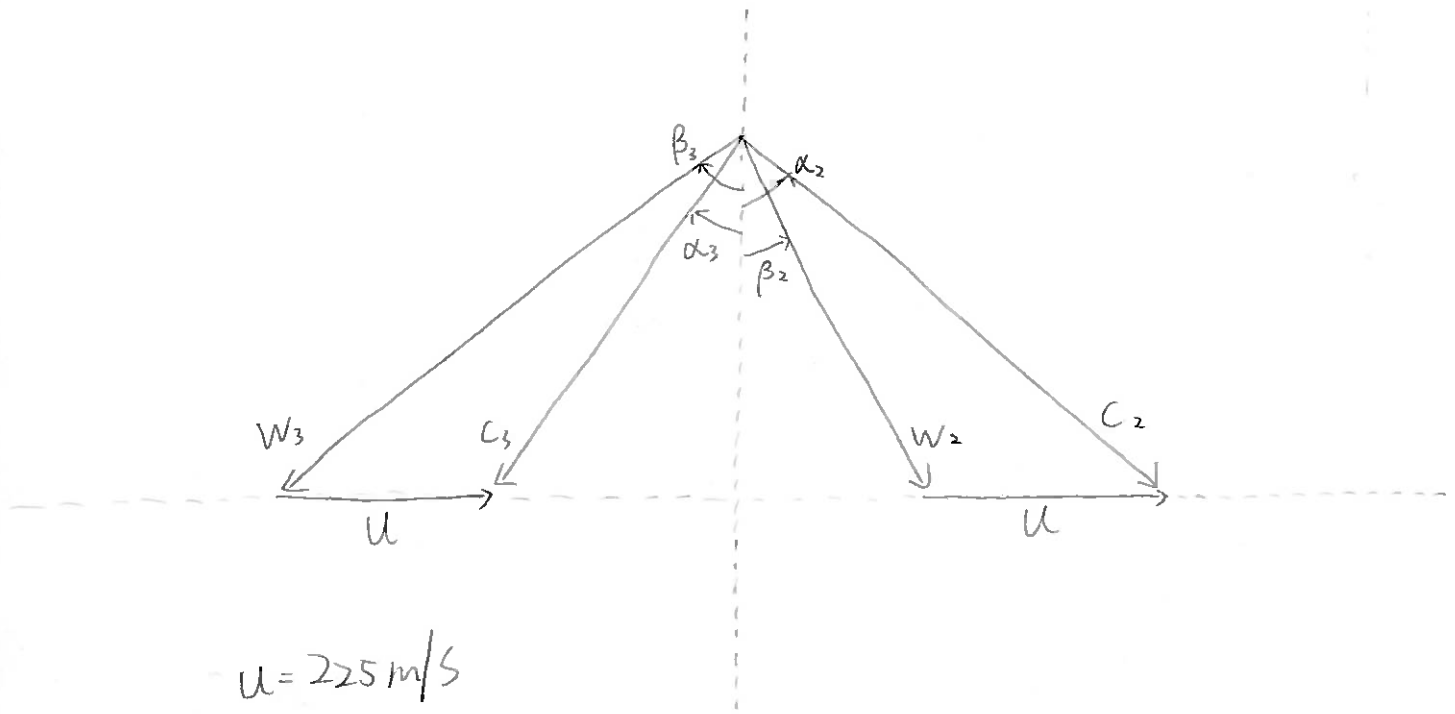
"Isen eff"
eta_s=phi^2

SOLUTION
Unit Settings: SI C bar kJ mass deg

c = 618.9 [m/s]	η_s = 0.9477	h01 = 3371 [kj/kg]
h02 = 3371 [kj/kg]	h2 = 3220 [kj/kg]	h2s = 3212 [kj/kg]
Mech = 0.8887	p01 = 10 [bar]	p2 = 6 [bar]
ϕ = 0.9735	s01 = 7.62 [kj/kg-c]	s2 = 7.633 [kj/kg-c]
t01 = 450 [C]	v2 = 550 [m/s]	v2s = 565 [m/s]
x = 100		

No unit problems were detected.

P5



$u = 225\ m/s$

$C_2 = 400\ m/s$

$\alpha_2 = 68°$

$\beta_3 = -58°$

$\omega = 18000\ rpm$

"Turbo"
"HW2 P5"
"Zhaoyi Jiang(.1364)"

"Given"
u=225[m/s]
c2=400[m/s]
alpha_2=68[degree]
beta_3=-58[degree]

"Mean R"
r=225/(18000*2*pi/60)

"The angle of the relative velocity entering the rotor"
cz2=c2***cos**(alpha_2)
cu2=c2***sin**(alpha_2)
wu2=cu2-u
wz2=cz2
beta_2=**arctan**(wu2/wz2)

"The magnitude of the relative velocity entering the rotor"
wz2=wz3
w3=wz3/**cos**(beta_3)

"The magnitude of the axial velocity leaving the rotor"
cz2=cz

"Work delivered"
cz2=cz3
wu3=w3***sin**(beta_3)
cu3=wu3+u
alpha_3=**arctan**(cu3/cz3)
c3=(cz3^2+cu3^2)^0.5
W=u*(c2***sin**(alpha_2)-c3***sin**(alpha_3))***convert**(m,km)

SOLUTION

Unit Settings: SI C bar kJ mass deg

α_2 = 68 [Degree]	α_3 = -5.64 [degree]	β_2 = 44.23 [degree]
β_3 = -58 [Degree]	c2 = 400 [m/s]	c3 = 150.6 [m/s]
cu2 = 370.9 [m/s]	cu3 = -14.8 [m/s]	cz = 149.8 [m/s]
cz2 = 149.8 [m/s]	cz3 = 149.8 [m/s]	r = 0.1194 [m]
u = 225 [m/s]	W = 86.78 [kj/kg]	w3 = 282.8 [m/s]
wu2 = 145.9 [m/s]	wu3 = -239.8 [m/s]	wz2 = 149.8 [m/s]
wz3 = 149.8 [m/s]		

No unit problems were detected.