Thermo

Recitation #12 (05/09/23)

→ Problems using Preos excel sheet.

Q1

Steam turbine

$$W_S = \Delta H = H_2 - H_1$$

$T_1 = 500°C$

$P_1 = 3.5 \, MPa$

$T_2 = ?$

$P_2 = 1.2 \, MPa$
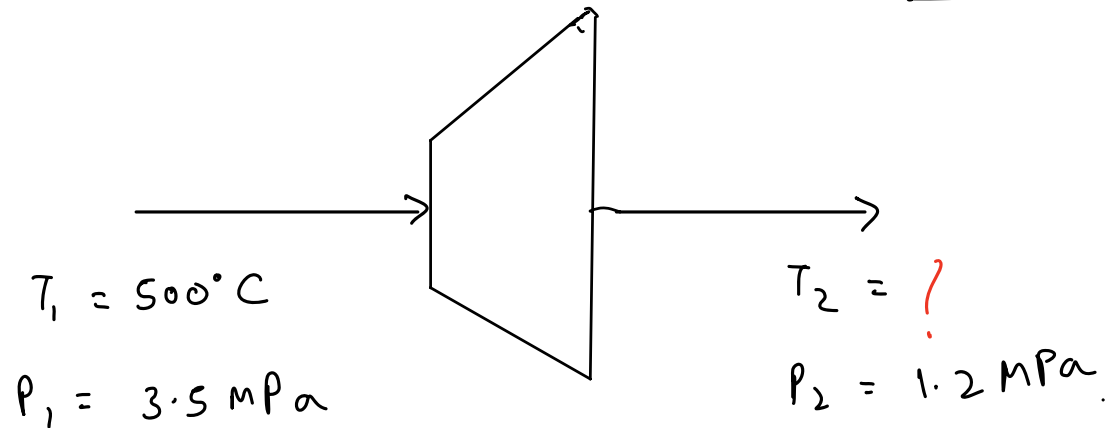
Aim is to fill this table:

①	steam table	$T_2 = 334.867°C$ $S_1 = S_2 =$ $7.159 \, kJ/kgK$	$H_1 = 3451.6 \quad kJ/kg$ $H_2 = 3121.55 \quad kJ/kg$ $\Delta H = 5.941 \, kJ/mol$	$= 62.129 \, kJ/mol$ $= 56.188 \quad kJ/mol$
②	Pre os Ref : triple point of water.	$T_2 = 604.707 k$ $S_1 = S_2 = 133.87$ $J/mol K$	$H_1 = 63.996 \, kJ/mol$ $H_2 = 58.066 \quad kJ/mol$ $\Delta H = 5.93 \quad kJ/mol$	

③	Preos Ref: $P = 1$ MPa $\quad\quad T = 100°C$	$T_2 = 604.81 K$ $S_1 = S_2 =$ 108.456 J/molk	$H_1 = 55.822$ kJ/mol $H_2 = 49.897$ kJ/mol $\Delta H = 5.925$ kJ/mol

$$S_1 = 7.1593 \ \text{kJ/kg-k}$$

$$S_2 = S_1$$

interpolation for T_2

for 1.2 MPa

	S (kJ/kgk)	T (°C)	
x_1	7.0335	300	y_1
x	7.1593	y	
x_2	7.2139	350	y_2

interpolation formula :

$$y = \frac{y_2 - y_1}{x_2 - x_1} (x - x_2) + y_2$$

$$y = \boxed{334.87\,°C = T_2 = 608.02\,K}$$
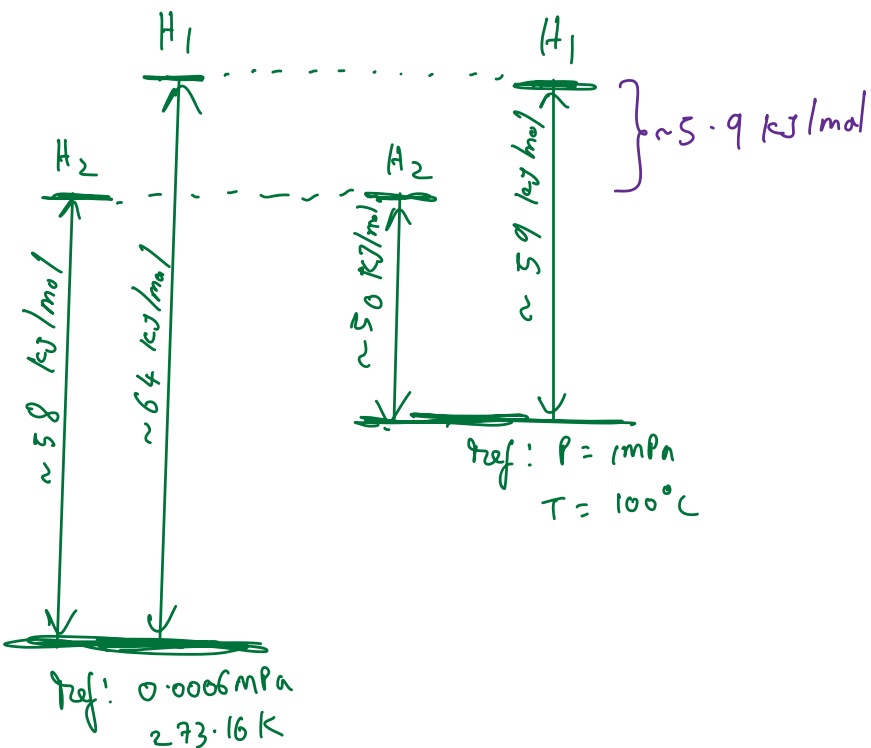
interpolation for H_2

at 0.5 MPa.

	T (°C)	H (kJ/kg)	
x_1	300	3046.3	y_1
x	334.87	y	
x_2	350	3154.2	y_2

$$y = \frac{y_2 - y_1}{x_2 - x_1}(x - x_2) + y_2$$

$$y = \boxed{3121.55 \qquad kJ/kg = H_2}$$

$$\boxed{H_2 = 56.188 \qquad kJ/mol}$$

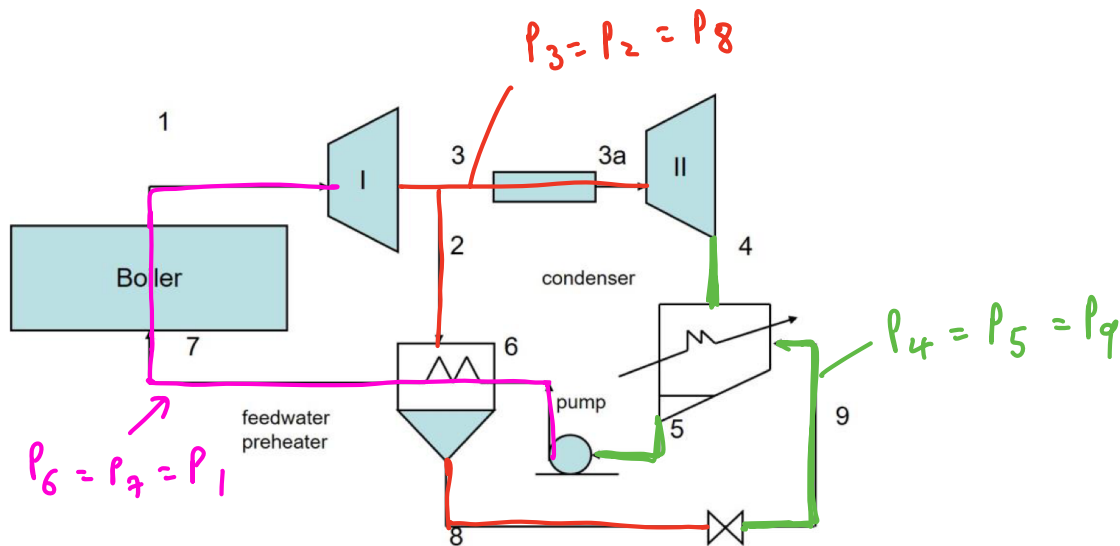## Overview :

$$\Big\} \sim 5.9 \, kJ/mol \implies$$

Conclusion : irrespective of the reference the delta(Δ) of the thermodynamic state property is the same. Having different reference give us different value of the state property.

H_1

H_1

H_2

H_2

$\sim 58 \, kJ/mol$

$\sim 64 \, kJ/mol$

$\sim 50 \, kJ/mol$

$\sim 59 \, kJ/mol$

Ref: $P = 1mPa$
$T = 100°C$

Ref: $0.0006 mPa$
$273.16 \, K$

Recitation #8

↳ Q5.4

$P_3 = P_2 = P_8$

$P_4 = P_5 = P_9$

$P_6 = P_7 = P_1$

Filling the table with H & S values?!

SH

SH ?

SH

?

Sat. liq.

Compressed liq {

Sat. liq ←

			(J/mol)	(J/mol/k)
Stream	T [°C]	P [Mpa]	H [kJ/kg]	S [kJ/kgK]
1	500 °C	4	63882.092	132.658
2/3	616.85 k	0.8 1.5	58422.63	132.65
3a	500 °C	0.8	64602.84	146.724
4	620.85 k	0.01 0.3	58972.11	146.720
5	134.32 °C	0.01 0.3		
6		4		
7	T8-5	4		
8	T8 443.8 k	0.8	14174.75	40.14

$P_1 = P_6 = P_7$

$P_2 = P_3 = P_8$

$P_4 = P_5 = P_9$

$T_7 = T_8 - 5°C$

Values reported at ref: $P = 0.0006$ mpa   Triple point of
T = 273.16 k   water.

Recitation #4 : Q4

① $T_1 = 200\,°C$ →→ [valve] →→ $T_2 = ?$ ②

$P_1 = 550\,kPa$

$\dot{m} = 15\,kg/min$

(superheated)

$P_2 = 200\,kPa$

(super heated)

valve
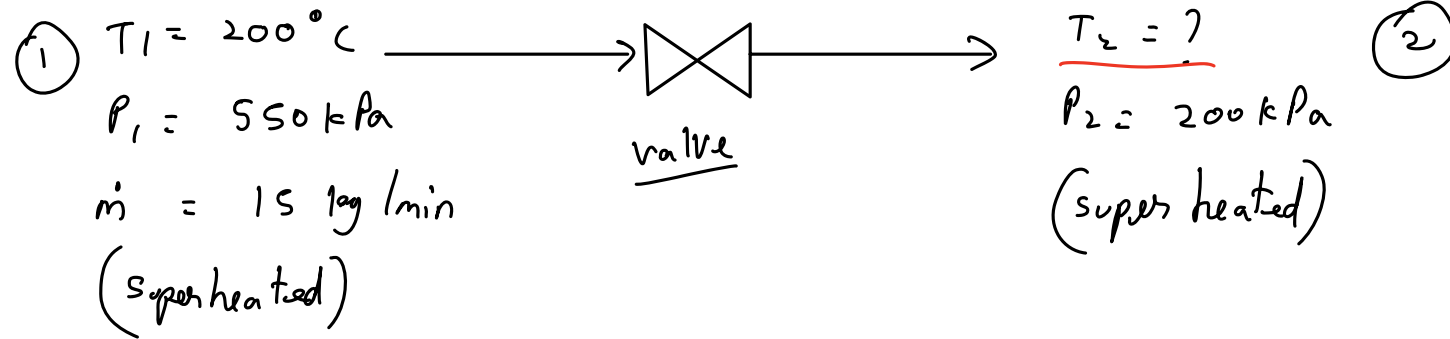
(works at 6.5MPa)

Assumption: steady-state

throttle → $\Delta H = 0$

from PREOS → $H^V = 53\,492.944\ J/mol$

$$T_2 = 468.113\ K$$

$$= 194.963\,°C$$

‡ often times the PREOS excel function will give results in 3-root region even though the stream is in 1-root region actually. we can proceed with the vapor or liq values as per the Steam table.