The liquid fraction is obtained by the lever rule:

$$x_L = \frac{475.25 - 242.67}{1578.1 - 242.67} = 0.826,$$

and the entropy of stream 2 is

$$S_2 = (0.826)(1.0896) + (1 - 0.826)(6.4067) = 2.0148 \text{ kJ/kg K}.$$

Summary of streams. The complete table of streams is shown below:

	1	2	3	4
T (°C)	28	−22	−22	137.5
P (bar)	10.993	1.7379	1.7379	10.993
H (kJ/kg)	475.25	475.03	1578.1	1916.1
S (kJ/kg K)	1.9281	2.0148	6.4067	6.5764
Phase	sat L	($x_L = 0.826$)	sat V	s/h V

Having evaluated all streams, we proceed to calculate the energy and entropy balances.

Energy balances. The energy balances in the evaporator, condenser, and compressor are:

$$\begin{array}{lcccll} Q_E & = & H_3 - H_4 & = & 1103.07 & \text{kJ/kg} \\ Q_C & = & H_1 - H_2 & = & -1440.85 & \text{kJ/kg} \\ W_C & = & H_4 - H_3 & = & 338 & \text{kJ/kg} \\ \text{cop} & = & Q_E / W_C & = & 3.26 & - \end{array}$$

The maximum coefficient of performance is estimated using $T_E = -20$ C $= 253.15$ K, and $T_C = 25$ °C $= 299.15$ K, corresponding to the temperatures of the baths that exchange heat with the evaporator and condenser, respectively. We find,

$$\text{cop}\Big|_{\text{max}} = \frac{253.15}{299.15 - 253.15} = 5.50$$

Entropy balances. The entropy balances are:

Evaporator	S_{gen}	=	$S_3 - S_4 - Q_E/T_E$	=	0.034523	kJ/kg K	S3 - S2 - QE/TE
Condenser	S_{gen}	=	$S_2 - S_4 - Q_C/T_C$	=	0.16818	kJ/kg K	S4 - S1 - QC/TC
Compressor	S_{gen}	=	$S_4 - S_3$	=	0.1697	kJ/kg K	S4 - S3
Throttling	S_{gen}	=	$S_2 - S_1$	=	0.0867	kJ/kg K	
Total					0.459103		

The main contributions come from the compressor and the condenser. The throttling valve contributes relatively little, corresponding to lost work of (0.0867 kJ/kg K)(300 K) = 26 kJ/kg, or about 7% of the work in the compressor. The contribution from the evaporator is also small because of the small temperature differential between the refrigerant, whose temperature stays constant during evaporation, and the chilled stream, which has been assumed to be at −20 °C. By contrast, the condenser operates under a larger temperature difference, air at 25 °C and superheated ammonia vapor at 137.5 °C.