EXERCISE 4

1 Temperature-enthalpy rate diagram

a)

Consider the simple case where one stream needs to be cooled and one stream needs to be heated. In the table below the stream data is listed. Draw the two streams in a temperature-enthalpy rate diagram. The minimal temperature difference, ΔT_{min}, is 25 $^\circ C$.

type	*cp* $[kJ/kg \cdot K]$	$\dot{m}$ $[kg/s]$	$cp \cdot \dot{m}$ $[kJ/K \cdot s]$	T_{start} $[^\circ C]$	T_{target} $[^\circ C]$
hot	4.2	1.91	8.0	90	40
cold	4.2	1.43	6.0	30	80

Read the approximate theoretical minimum hot- and cold utility consumption from the figure.

b)

The hot utility that is available is steam at 133 $^\circ C$ and 3 bar. How does the steam consumption vary with ΔT_{min}? Draw the result in a diagram.

2 Composite curves

a) composite curves

We want to heat integrate the following streams:

stream #	*type*	$cp \cdot \dot{m}$ $[kJ/K \cdot s]$	T_{start} $[^\circ C]$	T_{target} $[^\circ C]$
1	hot	3.5	180	60
2	hot	1.5	140	30
3	cold	2.0	45	115
4	cold	5.0	70	160

Draw the composite curves in a temperature-enthalpy rate diagram when $\Delta T_{min} = 10\ ^\circ C$ and answer the following questions:

- What is the theoretical minumum hot- and cold utility consumption?
- What is the pinch temperature?