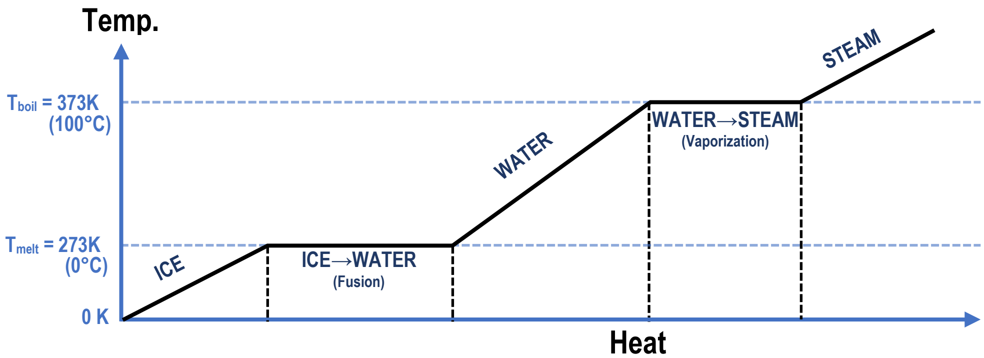
CONCEPT: CALORIMETRY WITH TEMPERATURE AND PHASE CHANGES

● You'll need to know to solve calorimetry problems where a material changes temperature AND phase.

- Heat *always* flows hot→cold, so only __________ obj's can change both. Hotter obj's *never* cool & change phase.
- **Recall:** In T vs. Q graphs, use Q=mcΔT for **[diagonal | horizontal]** lines, Q=mL for **[diagonal | horizontal]** lines

EXAMPLE: An insulated cup contains 0.25kg of water initially at 15°C. Calculate the amount of ice (in kg), initially at –20°C, you should add to the water in order for ***exactly half*** the ice to melt and the final temperature of the mixture to be 0°C.



CALORIMETRY
0) Draw **T** vs. **Q** diagram, **T_i's** & **T_f**
1) Write **$Q_A = –Q_B$,** 1 Q per change
Only colder materials may have >1 Q
2) Replace Q's with mcΔT OR ΔmL
Write Q=mcΔT for diagonal parts
Write Q=ΔmL for horizontal parts
3) Solve for Target

SPECIFIC & LATENT HEATS
$Q = mc\Delta T$
$Q = mL$
c_{ice} = **2100 J/(kg·K)**
c_{water} = **4186 J/(kg·K)**
$L_{f,water}$ = **3.34×10^5 J/kg** (sol→liq)
$L_{v,water}$ = **2.26×10^6 J/kg** (liq→gas)

● If not *all* the material changes phase, use ***Δm*** for _________ mass in Q=***Δm***L and ***m*** for _______ mass in Q=***m***cΔT

PROBLEM: You're a metalworker trying to cool a 1.6 kg chunk of iron initially at 600°C. To do this, you drip water at 20°C over it. If the chunk of iron cools down to 130°C and all of the water boils, how much (in kg) water did you drip over the iron?

CALORIMETRY
0) Draw **T** vs. **Q** diagram, **T_i's** & **T_f**
1) Write **$Q_A = -Q_B$,** 1 Q per change
Only colder materials may have >1 Q
2) Replace Q's with $mc\Delta T$ OR ΔmL
Write $Q=mc\Delta T$ for diagonal parts
Write $Q=\Delta mL$ for horizontal parts
3) Solve for Target

SPECIFIC/LATENT HEAT & CALORIMETRY
$Q = mc\Delta T$ (temp change)
$Q = mL$ (phase change)
c_{water} **= 4186 J/(kg·K)**
c_{iron} **= 470 J/(kg·K)**
$L_{f\ (water)}$ **= 3.34×10^5 J/kg**
$L_{v\ (water)}$ **= 2.256×10^6 J/kg**