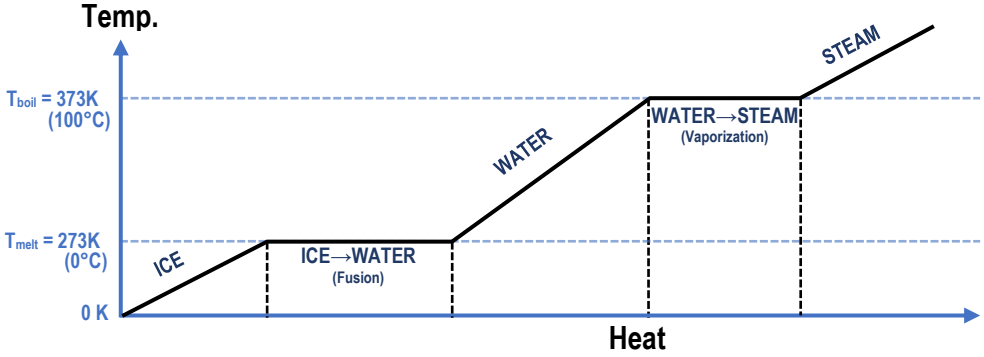
CONCEPT: CALORIMETRY WITH TEMPERATURE AND PHASE CHANGES

- 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)
$L_{f,water}$ = 3.34×10⁵ J/kg (sol→liq)
$L_{v,water}$ = 2.26×10⁶ 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 mcΔT OR ΔmL

Write Q=mcΔT for diagonal parts
Write Q=ΔmL 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