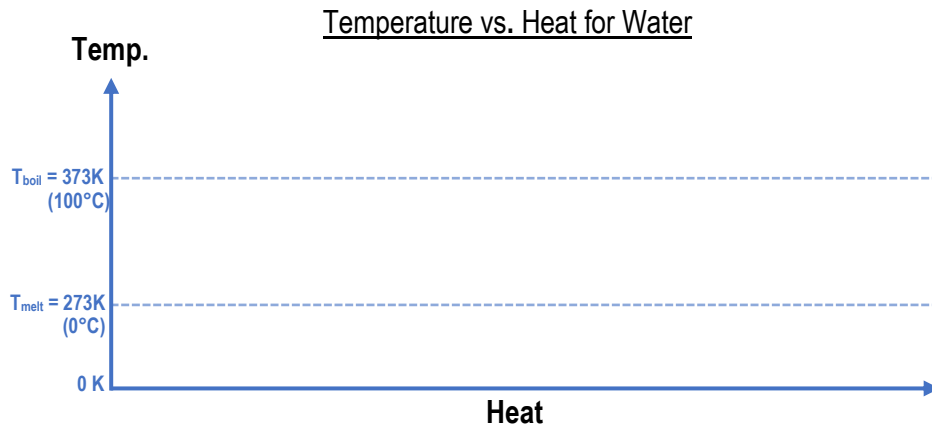


CONCEPT: LATENT HEAT & PHASE CHANGE

- **Phase** of a material = state of matter (e.g. *Ice* = solid; *Water* = liquid; *Steam* = gas), usually depends on temperature.
 - **Remember:** When a material *absorbs* or *loses* heat, it changes Temperature OR _____, but not BOTH.



Temperature Change

$Q = mc\Delta T$

- Temperature: [changing | constant]
- Phase: [changing | constant]

PHASE Change

$Q = \text{_____}$

- Temperature: [changing | constant]
- Phase: [changing | constant]

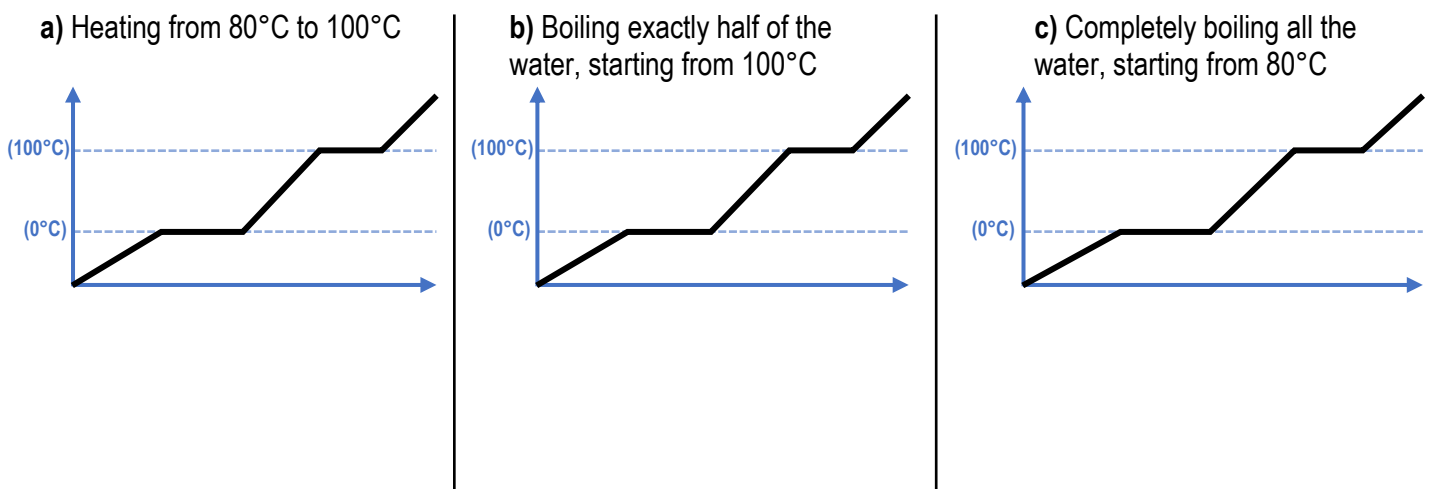
- **L = Latent Heat** or **Heat of Transformation**, depends on material (per kilogram) AND phase change [$\frac{J}{kg}$]

SPECIFIC & LATENT HEAT PROBLEMS

- 1) Draw T vs. Q graph, identify T_i & T_f
- 2) Draw "path" from $T_i \rightarrow T_f$
- 3) Write Q_{TOTAL} EQ
- 4) Plug in values & solve

Substance	Heat of Fusion (L_f) (solid $\leftrightarrow$ liquid)	Heat of Vaporization (L_v) (liquid $\leftrightarrow$ gas)
Hydrogen	5.86×10^4	4.52×10^5
Water	3.34×10^5	2.256×10^6
Lead	2.45×10^4	8.71×10^5

EXAMPLE: Calculate the heat required for the following heating processes for 400g of water. Use $c_{water} = 4186 \frac{J}{K \cdot kg}$



- In problems where T_i isn't the melting/boiling temp, TOTAL Heat = heat required to change **1) temperature** AND **2) phase**.

PROBLEM: How much heat must be removed from 0.7 kg of water at 23°C to cool it to 0°C and completely freeze it?

- A) -5.31×10^6 J
- B) 1.67×10^5 J
- C) -1.65×10^6 J
- D) -3.01×10^5 J



SPECIFIC & LATENT HEAT	
$Q = mc\Delta T$	(temp change)
$Q = mL$	(phase change)
$c_{\text{water}} = 4186$	J/(kg·K)
$L_f(\text{water}) = 3.34 \times 10^5$	J/kg
$L_v(\text{water}) = 2.256 \times 10^6$	J/kg

PROBLEM: If you add 5.89×10^5 J of heat to 0.6kg of liquid water initially at 90°C, how much of the water vaporizes?



SPECIFIC & LATENT HEAT	
$Q = mc\Delta T$	(temp change)
$Q = mL$	(phase change)
$c_{\text{water}} = 4186$	J/(kg·K)
$L_f(\text{water}) = 3.34 \times 10^5$	J/kg
$L_v(\text{water}) = 2.256 \times 10^6$	J/kg