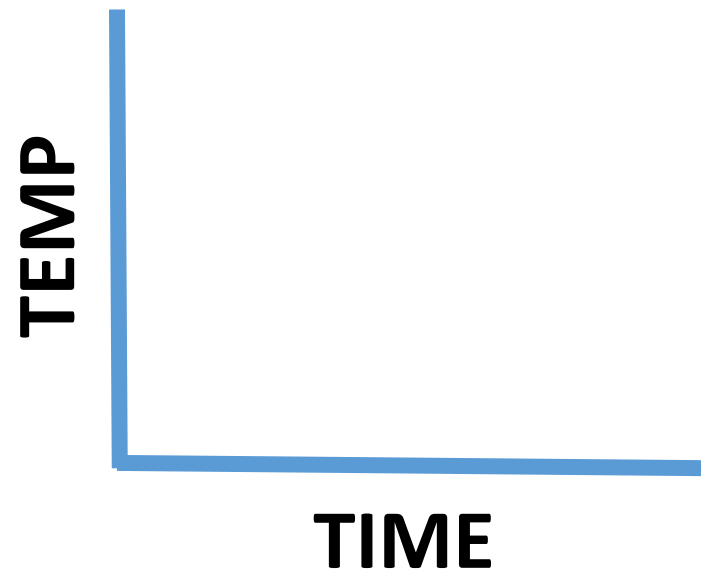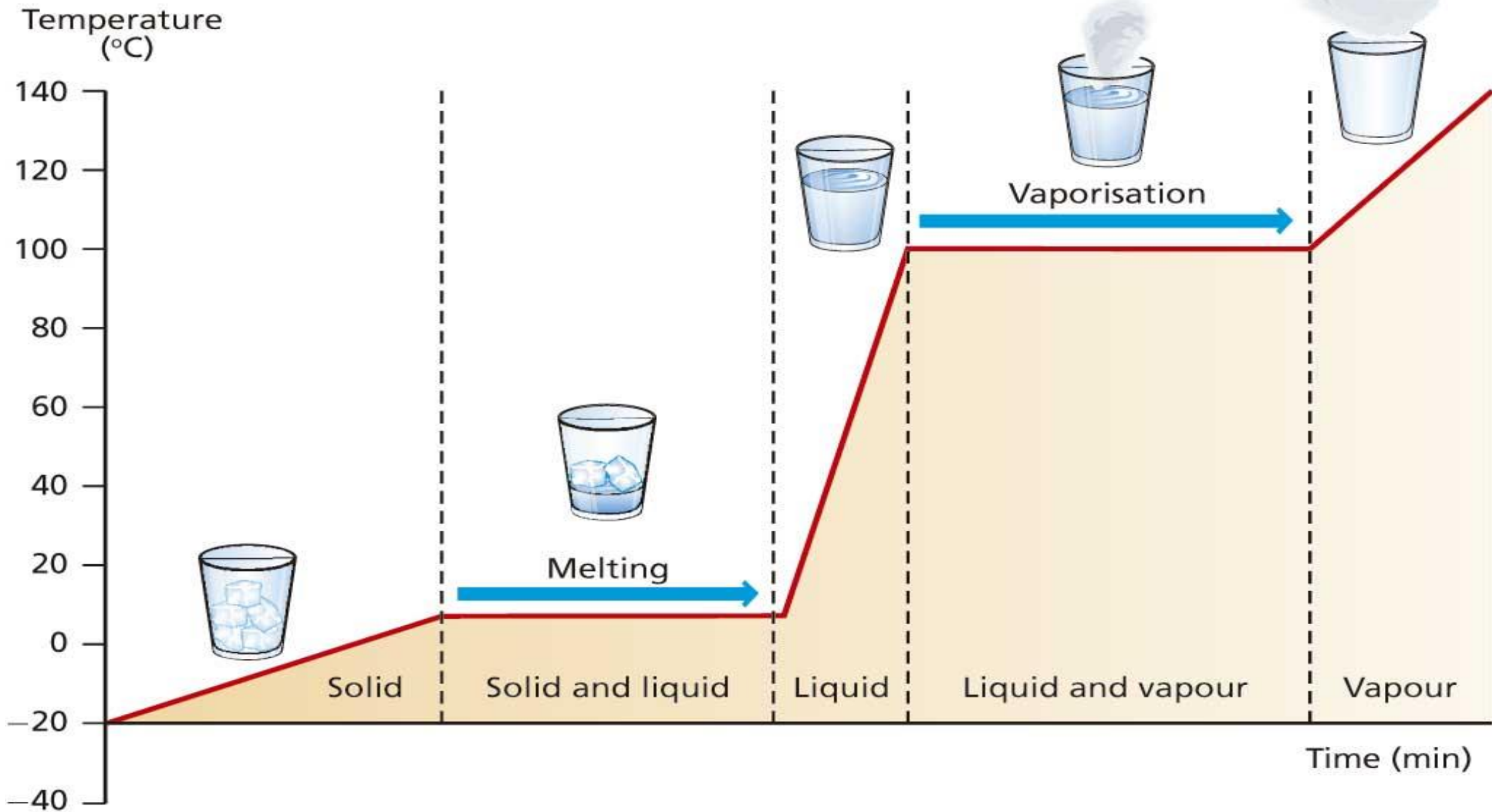# KCQ - Heating and Cooling Curves

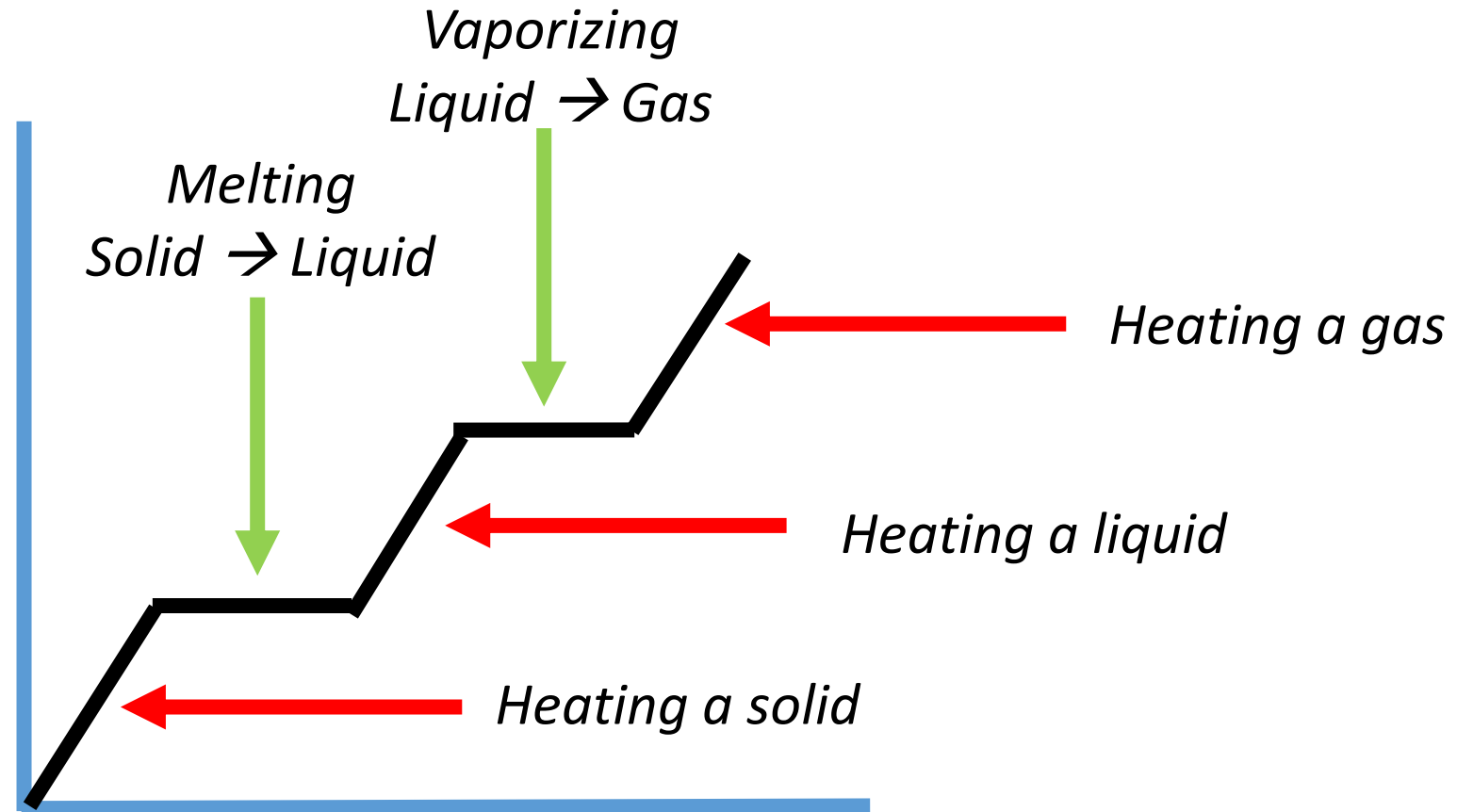**I can use heating and cooling curves to help calculate the energy changes during phase changes**

What do they show us?

- Heating or cooling → *the sloped parts of graph*
- Phase changes → *the flat parts of graph*

Temperature (°C)

140

120

100

80

60

40

20

0

−20

−40

Vaporisation

Melting

Solid

Solid and liquid

Liquid

Liquid and vapour

Vapour

Time (min)

Heating Curve

Cooling Curve
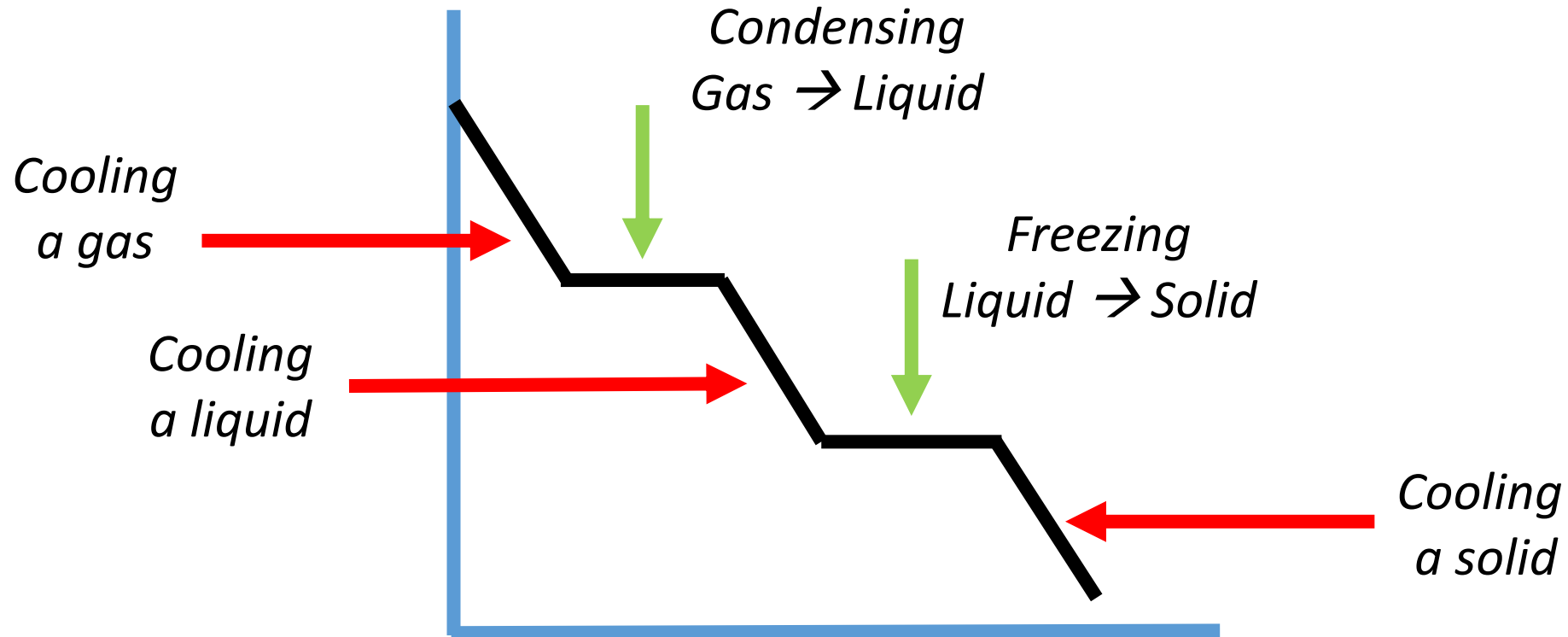
Why are some areas sloped and some flat?

	Heating	Phase Changes

(Cooling would just be the opposite of these things!)

Why are some areas sloped and some flat?

Heating	Phase Changes
Issue: **SPEED**	Issue: **POSITION**
All the energy is going towards **SPEEDING UP** the molecules	All the energy is going towards **SPREADING OUT** the molecules
Results in a temperature change	Results in **NO** temperature change

(Cooling would just be the opposite of these things!)

How is our math changed by NO ΔT?

HEATING/COOLING

- Q = mCΔT

- C = J/g°C → Has a temperature component.

- So…. Cant use it for phase changes

PHASE CHANGES

- ΔT = 0   BUT   Q ≠ 0

- Get rid of ΔT, and replace C with something else

- ## Q = mL

- L = "Latent Heat" → J/g
  The energy required to phase change one gram of substance

Specific Heat and Latent Heat Labels

HEATING/COOLING

- C_{solid}
- C_{liquid}
- C_{gas}
- Always positive values

PHASE CHANGES

- L_{fusion}
- $L_{vaporization}$
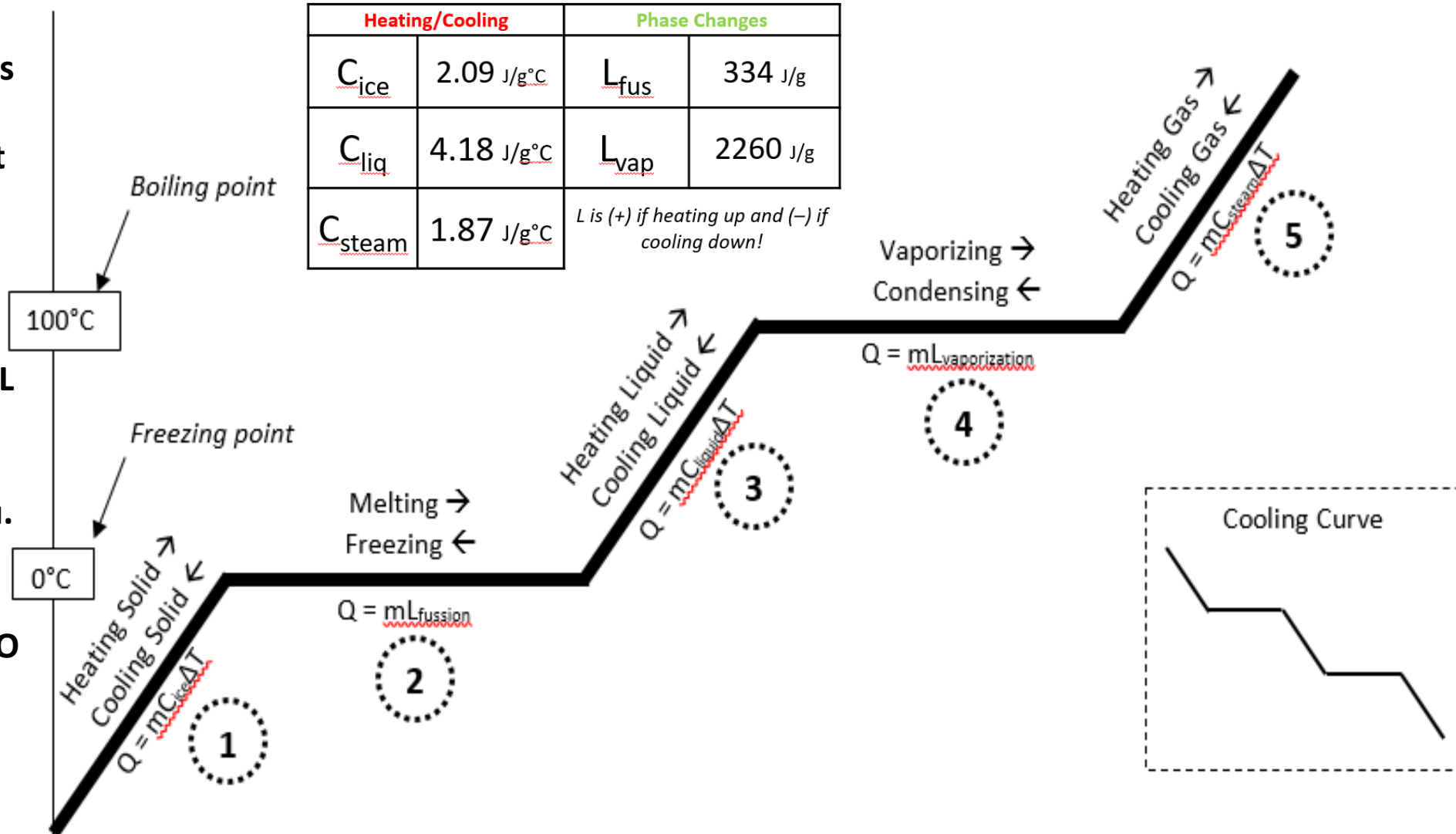- ***Positive if endothermic process (melting/vaporizing)***
- ***Negative if exothermic process (condensing/freezing)***

Values to Memorize for Water

Heating/Cooling		Phase Changes	
C_{ice}	2.09 J/g°C	L_{fus}	334 J/g
C_{liq}	4.18 J/g°C	L_{vap}	2260 J/g
C_{steam}	1.87 J/g°C	*L is (+) if heating up and (−) if cooling down!*	

Completely Labeled Heating Curve

*These numbers are specific for H$_2$O. A different chemical would have different melting/boiling temperatures, different C and L values. I would give those numbers to you. You should know the numbers for H$_2$O

Heating/Cooling		Phase Changes	
C_{ice}	2.09 J/g°C	L_{fus}	334 J/g
C_{liq}	4.18 J/g°C	L_{vap}	2260 J/g
C_{steam}	1.87 J/g°C	*L is (+) if heating up and (−) if cooling down!*	

Boiling point

100°C

Freezing point

0°C

Heating Solid ↗
Cooling Solid ↙

$Q = mC_{ice}\Delta T$

1

Melting →
Freezing ←

$Q = mL_{fussion}$

2

Heating Liquid ↗
Cooling Liquid ↙

$Q = mC_{liquid}\Delta T$

3

Vaporizing →
Condensing ←

$Q = mL_{vaporization}$

4

Heating Gas ↗
Cooling Gas ↙

$Q = mC_{steam}\Delta T$

5

Cooling Curve

YouTube Link to Presentation

- https://youtu.be/5EIksSZfU_M