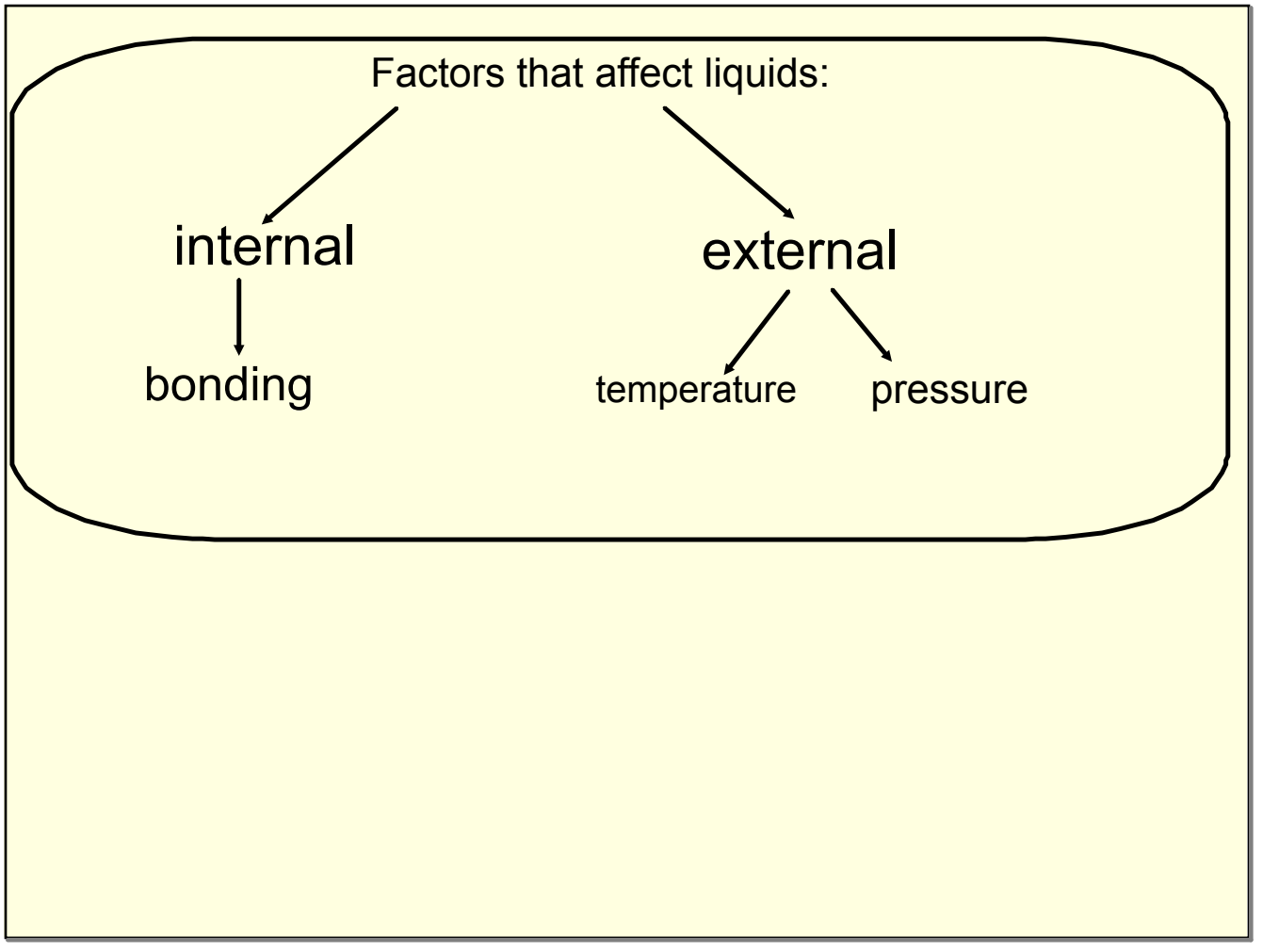
Why is a liquid a liquid?

What factors affect change in state of a liquid?

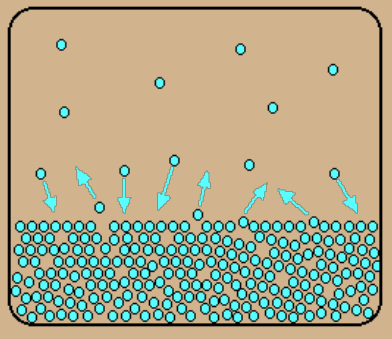
- Internal and external factors
- Vapor Pressure
- Triple phase diagrams

https://www.youtube.com/watch?v=im7DzMr8Ygs

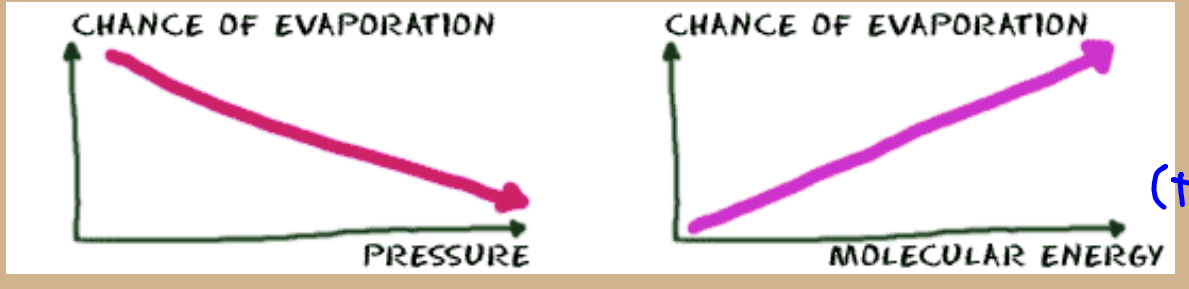

Factors that affect liquids:
internal
bonding
external
temperature
pressure

Vapor Pressure

The **pressure** exerted by the gas in equilibrium with a solid or liquid in a closed container at a given temperature.



Evaporation changes with pressure and temperature:

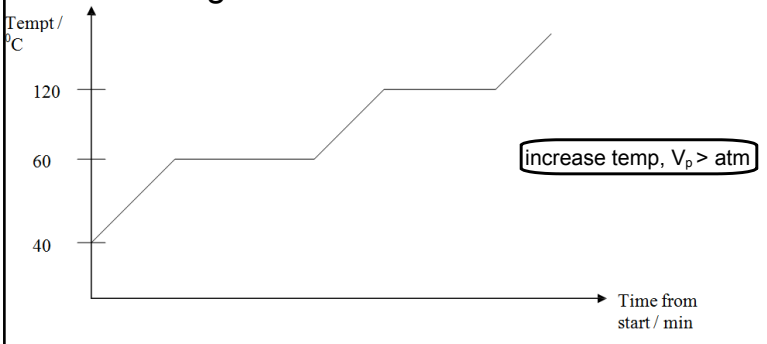


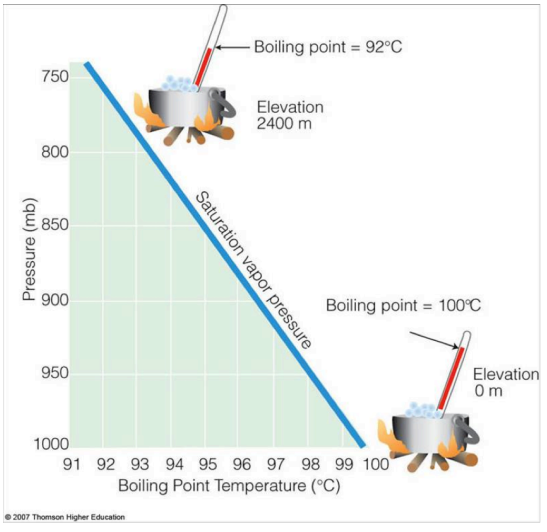
External factors

There are two ways to boil water.

1. Raise the water's Vapor pressure above the atmospheres pressure. (Vapor pressure > Atmospheric pressure.)
2. Find a way to lower the atmospheric pressure

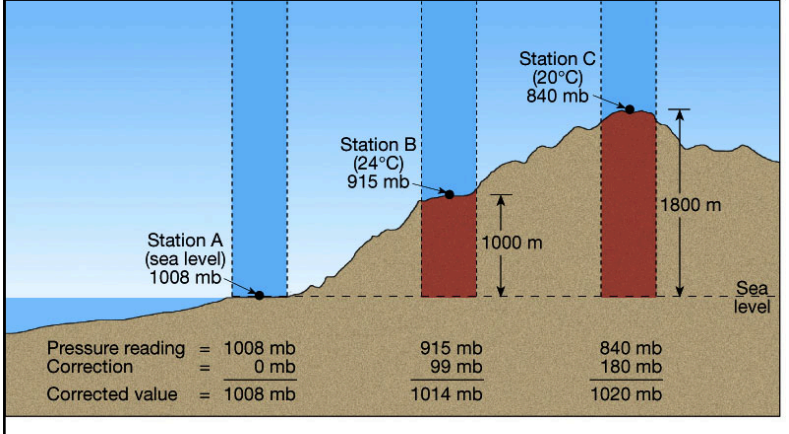
Heating Curve





decrease atm
V_p > Atm P

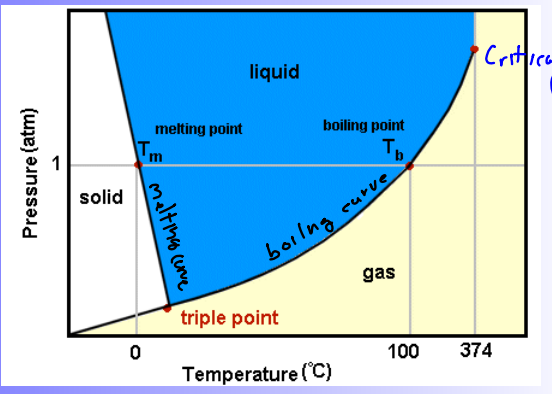
elevation vs pressure



Consider temperature and pressure at the same time:

Use a

Phase Diagram:



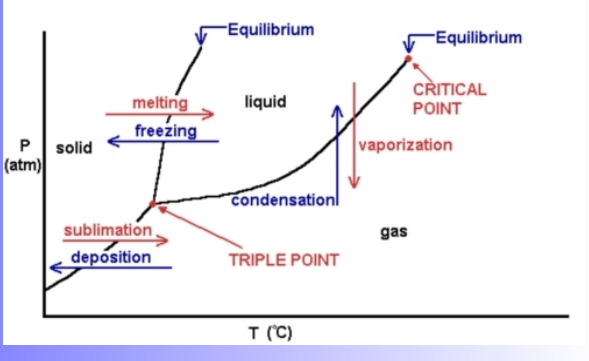
What happens when you cross a "line" into a different phase?

triple point --all 3 phases exist at one temp and pressure

critical point:temperature is so high liquid can no longer be sustained

//www.youtube.com/watch?v=r3zP9Rj7Inc

//www.youtube.com/watch?v=BLRqpJN9zeA



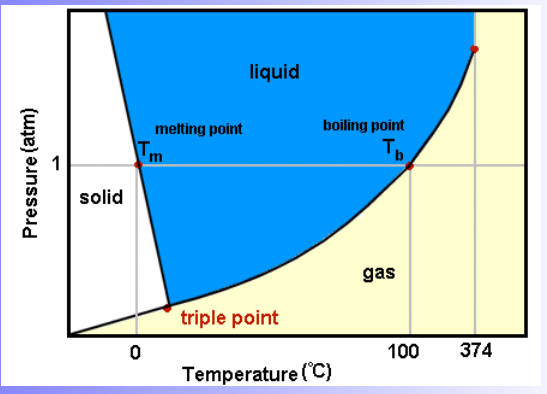
Increasing temperature pushes a substance toward being a gas.

Increasing the atmospheric pressure pushes or compresses the substance more toward being a solid.

Consider temperature and pressure at the same time:

Use a

Phase Diagram:



At 1 atm of pressure, what is the melting and freezing point?

What is the approximate melting and freezing point at 0.5 atm?

What phase change occurs if the sample starts at 50°C and 0.75 atm and the pressure is dropped to 0.25 atm?

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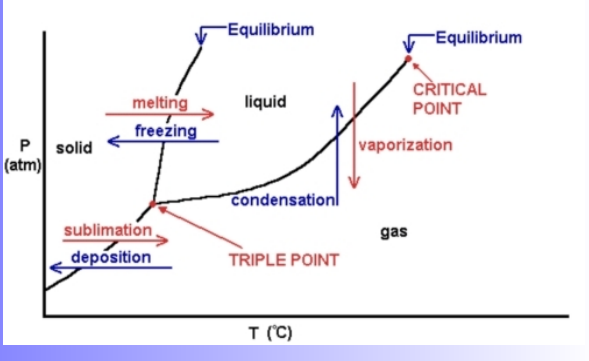
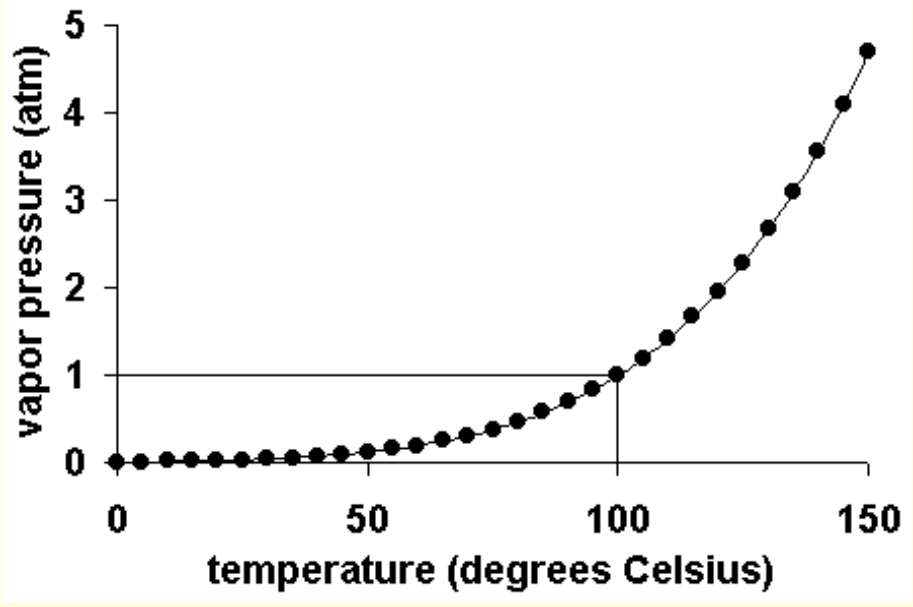


Vapor pressure varies with temperature



vapor pressure of H_2O vs. temperature

Vapor pressure varies with substance

substance	vapor pressure at 25^{0}C
diethyl ether	0.7 atm
bromine	0.3 atm
ethyl alcohol	0.08 atm
water	0.03 atm

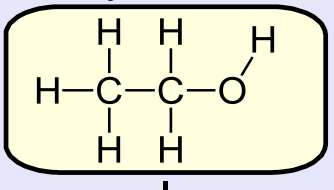
Factors that affect vapor pressure:

type of molecule

intermolecular forces:

- if strong: VP low

ethyl alcohol



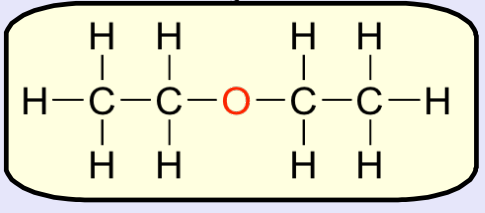
polar

will have H bonds

more intermolecular bonds

- if weak: VP high

diethyl ether

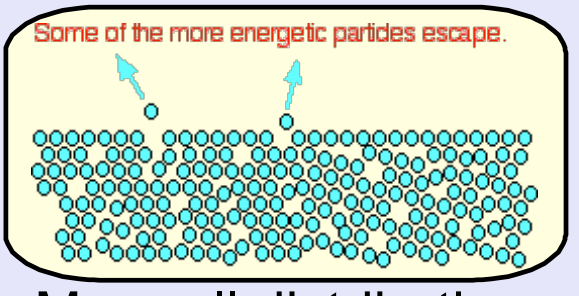


nonpolar

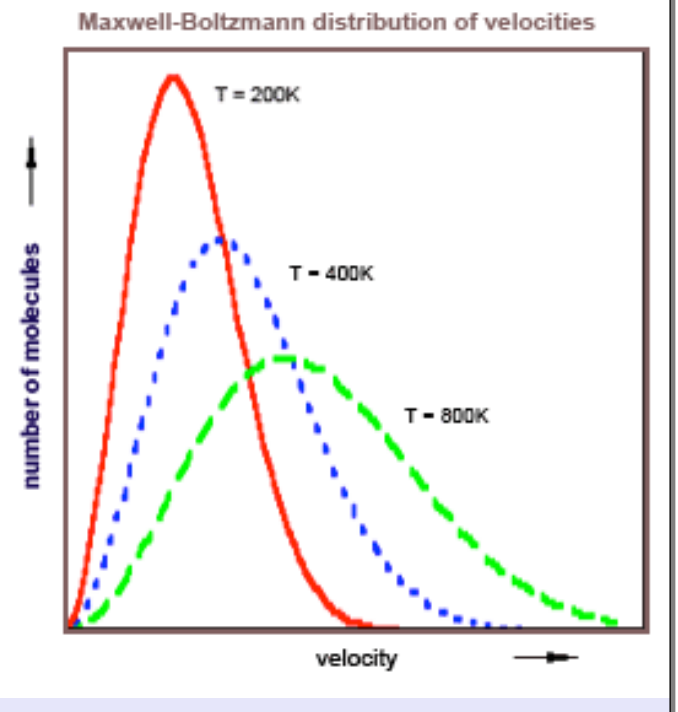
less intermolecular bonds

temperature

if high, more molecules have enough energy to escape the liquid



Maxwell distribution



$$\text{Mole Fraction} = \frac{\text{moles of X}}{\text{Total moles}}$$

If you mix 39.0g NH_4NO_3 in 200mL of water, what is the mole fraction of water?

mole fraction of water:

$$\frac{39.0\text{g } NH_4NO_3 \mid 1\text{ mol}}{80\text{ g}} = 0.49\text{ mol } NH_4NO_3$$

$$\frac{200\text{g } H_2O \mid 1\text{ mol}}{18\text{ g}} = 11.1\text{ mol } H_2O$$

$$X_{H_2O} = \frac{11.1}{11.1+0.49} = 0.96$$

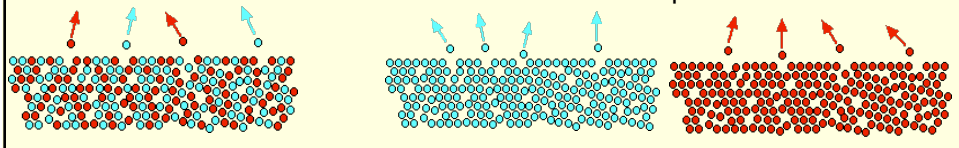
Raolt's Law

The partial vapour pressure of a component in a mixture
is equal to the vapour pressure of the pure component at that temperature multiplied by its mole fraction in the mixture.

mole fraction

$$\text{Vapor pressure} = X_X V_X + X_Y V_Y + \ldots$$

partial vapor pressure
of volitile liquid



Commonly mixed solutions
- hexane and heptane
- benzene and methylbenzene
- propan-1-ol and propan-2-ol

We can use this when we mix a non-volitile salt in water:

$$\text{Vapor pressure} = X_X V_X$$

mole fraction

mole fraction:

$$\frac{39.0\text{g } NH_4NO_3 \mid 1\text{ mol}}{80\text{ g}} = 0.49\text{ mol } NH_4NO_3$$

$$\frac{200\text{g } H_2O \mid 1\text{ mol}}{18\text{ g}} = 11.1\text{ mol } H_2O$$

$$X_{H_2O} = \frac{11.1}{11.1+0.49} = 0.96$$

$$P_{vap} = (0.96)(23.76) = 22.8\text{ mmHg}$$