Gas Laws

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Three Concepts

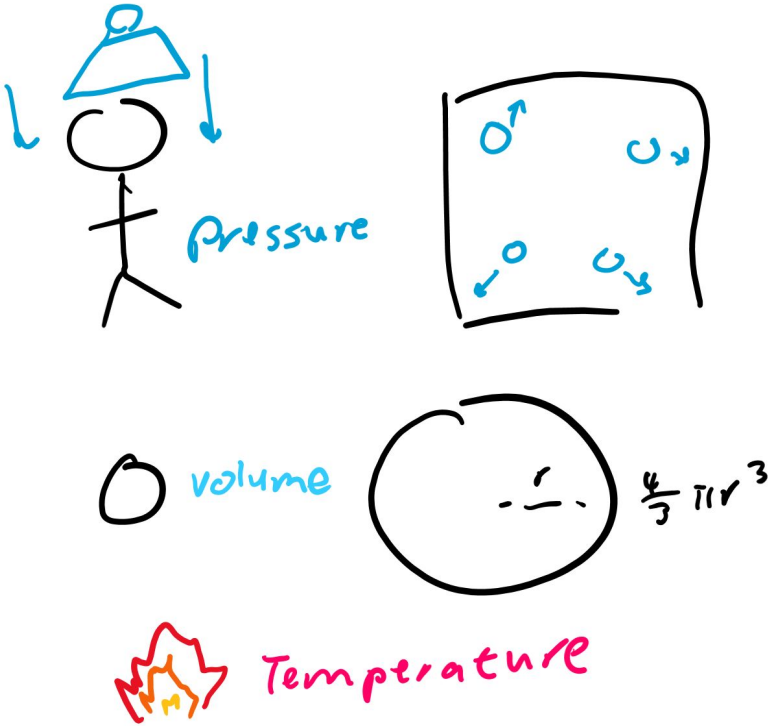
Review

What's pressure?

What's volume?

What's temperature?

Our first three laws will only deal with these three things.



Absolute values

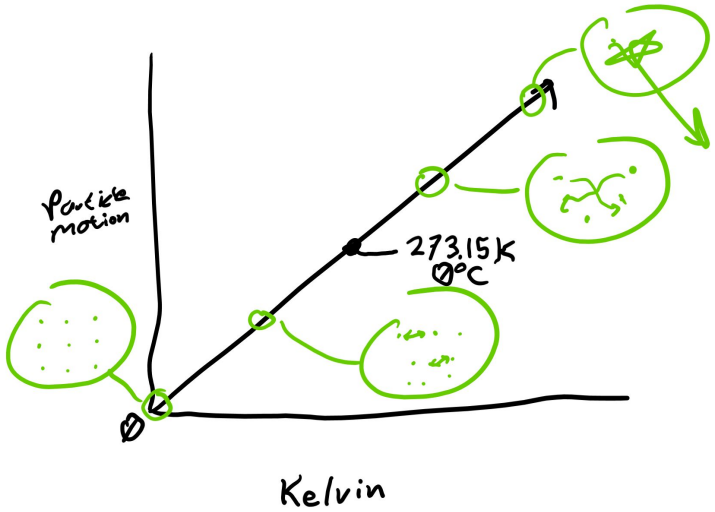
Absolute volume: 0 means nothing, none of it exists

0 volume means nothing. Liters does this because 0 liters is 0 volume

0 pressure means nothing. Atms does this because 0 atms is no pressure at all

0 temperature means nothing. Celsius doesn't do this because molecules are still moving (have temperature values at 0 degrees)

We have to use "Kelvin" which sets 0 to "absolute zero" where there is no temperature



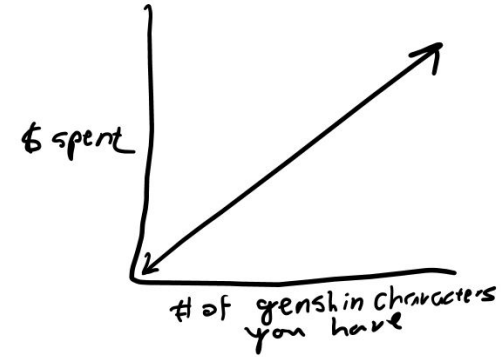
Proportional vs Inverse

Proportional: if two things are proportional, increasing one will increase the other; decreasing one will decrease another

Inversely proportional: if two things are inversely proportional, increasing one will decrease the other; decreasing one will increase the other

What are some things that are proportional?

Inversely proportional?

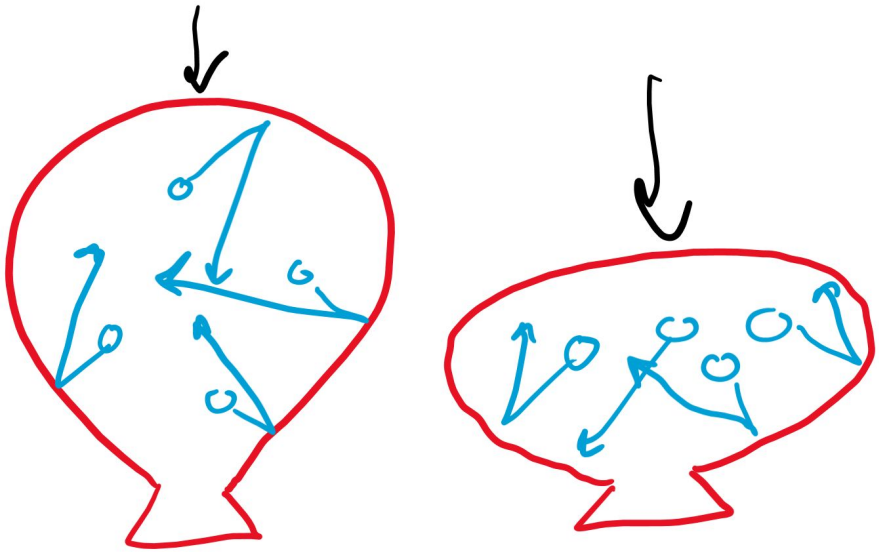


Boyle's Law

If you squeeze a balloon (decrease the volume), what happens to the size of the balloon?

If you stretch out a balloon (increase the volume) what happens to its pressure?

How to remember: boyle sounds like boil, like temperature, but this one has no temperature, ez dubskis



$$P_1 V_1 = P_2 V_2$$

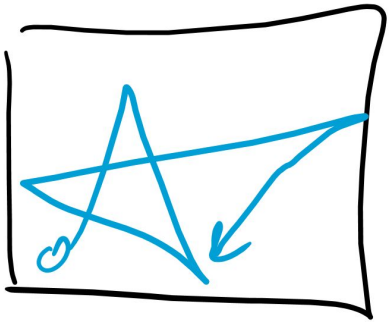
Gay Lussac's Law

If you increase the temperature of a gas, what happens to the speed at which the gasses move?

So what happens to the pressure?

If you decrease temperature, what should happen to pressure?

How to remember: he's French, and name a country under more heat (close enough to temperature) and pressure in WWII



$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Charles' Law

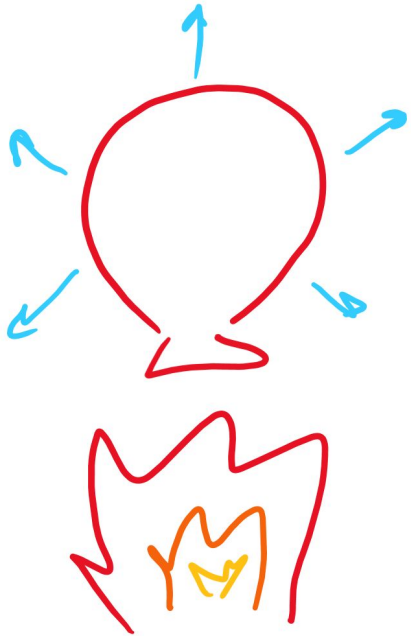
If you increase the temperature, what happens to particular motion?

What happens to the pushing against the walls of the container?

If the container can change size (like a balloon), what is going to happen to the size?

If you decrease temperature what happens to volume?

How to remember: Charles is "PR"etty basic and "PR"essure is held constant



$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Combined

Let’s talk relationships

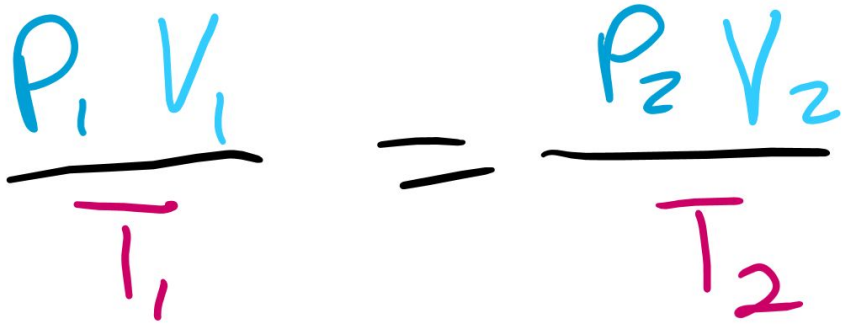
- If volume is increased, what can happen to
  - Temperature?
  - Pressure?
- If pressure is increased, what can happen to
  - Volume?
  - Temperature?
- If temperature is increased, what can happen to
  - Volume?
  - Pressure?

Combined gas law

V, P are multiplied (inverse)

V, T are divided (proportional)

P, T are divided (proportional)



Moles

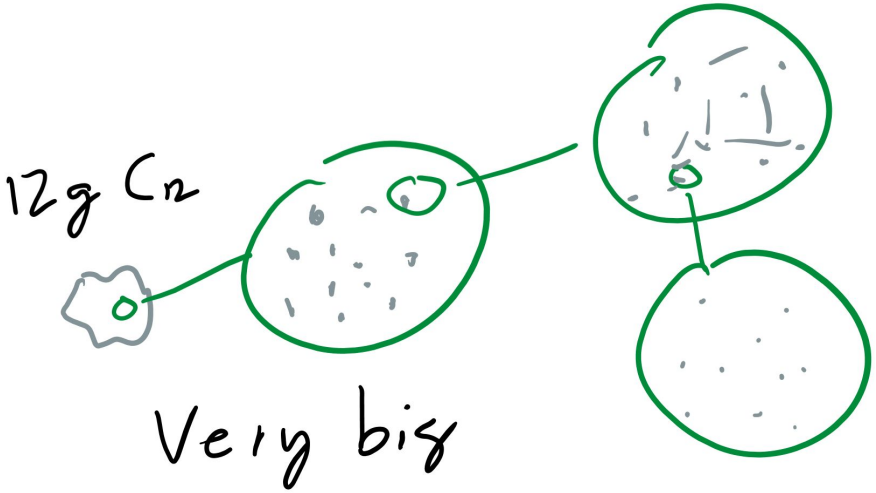
What is a mole?

Exact definition: the amount of Carbon-12 molecules in a 12 gram sample

Close enough definition: about 6.022 * 10^23 amount of an object

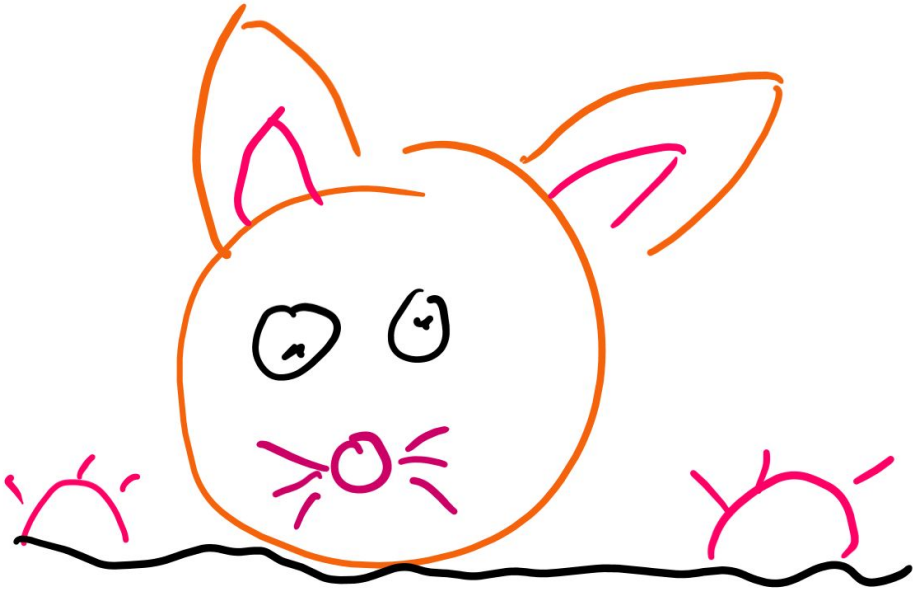
If I have a mole of cars, how many cars do I have?

Moles are just a measurement of quantity



Avagadro's Number

Yeah it's just the 6.022 * 10^23 number, but it has a fancy name for the guy that discovered it, here's a slide with a picture of a mole, though, for the funnies

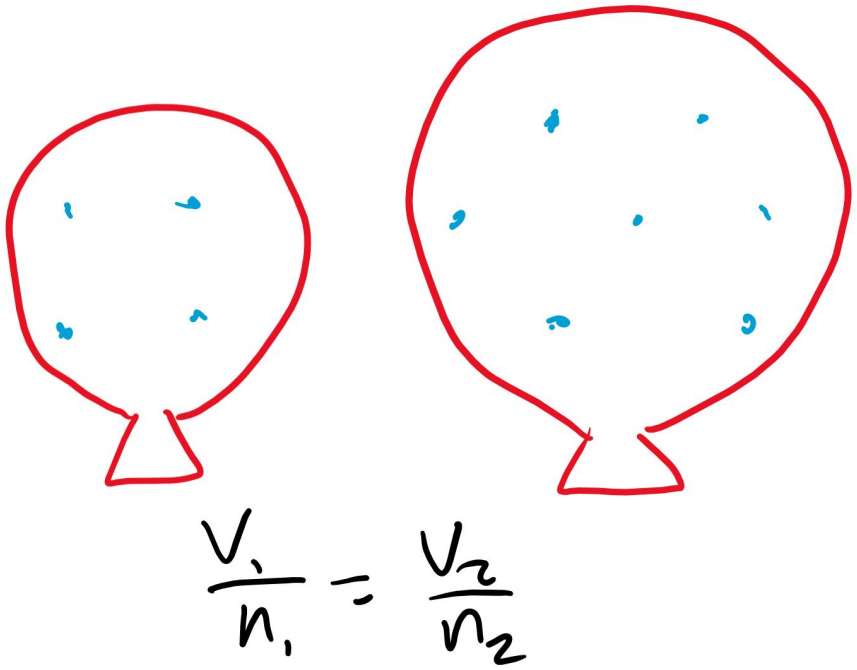


Avocado's Law

If you have more molecules in a container, what needs to happen to the volume of the container to fit all the molecules?

Yeah that's it, Avagadro's law is dumb

Way to remember: moles need to eat food, and avocados are close enough and he's also the mole guy, so he's gonna be the only law with moles



Ideal Gas Law

Avogadro's Law + Combined Law

Why are V and n divided?

Hard questions:

1. Why are P and n divided?
2. Why are T and n multiplied?

$$\frac{P_1 V_1}{T_1 n_1} = \frac{P_2 V_2}{T_2 n_2}$$

Constants

If PV/nT is always the same, what can we say about it?

We create a constant called R that's always going to be what PV/nT results in because it's the same for every gas according to these laws

Multiply both sides by nT and we get the law

Sometimes people call it PVnRT to remember it