Why is a gas a gas?

- **external factors**
  - Temp
  - Pressure
- **Internal factors**
  - No interactions → Ideal
  - small interactions → Non-ideal

These were already covered in previous areas. You should know and easily be able to describe and answer the following concepts/questions.

- Average Kinetic energy verses molecular velocity → $KE = \frac{1}{2}mv^2$
  temp
- Pressure, what is it and how is it produced.
  ↳ when particles hit the inside wall of a container

Internal Factors

- **Ideal gas**
  - No interactions due to
    - distance between particles
    - speed of particles
    } Passed
  - All gases can be ideal if conditions are right
  - Temp ↑ fast
  - Pressure ↓ lots of space
  - $PV = nRT$ + $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ → working well
- **Non-ideal gas**
  - Coulombic attraction exists
  - Charges are attracting due to strong charges or they are close enough
  - $PV = nRT$ + $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ } Not working very good

How can these variables be affected to cause a coulombic attraction between two gaseous particles?

Substance has ability to attract due to Charges (IMF)

$$F = \frac{q\ q}{d^2}$$

F is larger due to close distance

Ideal verses Non-ideas: How does AP structure questions about this particular topic? There are 2 basic types. See below.

$XeCl_6(g)$ and $CO_2(g)$ (2 gas samples)

If cooled, which will condense first?

$XeCl_6$, more LDF

Which is most likely exhibit ideal gas properties?

$XeCl_6$ gas is in a container, Circle the conditions that would most likely ensure no attraction between the particles?

1000°C	100°C	100atm	0.01 atm

Ideal Gases?

- Are all gases either Ideal or non- ideal? NO, depends on conditions
- Are there specific gases that considered to just be non-ideal or ideal? NO.
- Why is are these gas laws below called non- ideal? Same.

$$PV = nRT \qquad \frac{P1V1}{T1} = \frac{P2VT2}{T2}$$

- For ideals gases, one property that just does NOT affects its properties? (except density)

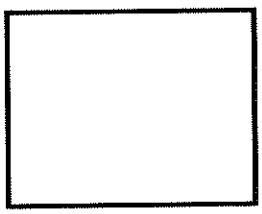
Identity of Particles does not matter

Kinetic Molecular Theory

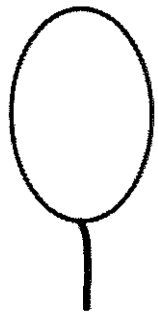
Gases must be able to be described both physically and mathematically.

3 types of containers

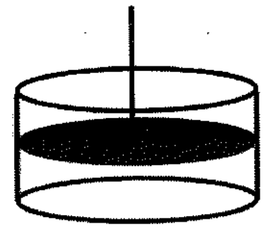
Rigid container
Constant volume



Balloon
Constant pressure



Piston
- Hold temperature constant?



Number of particles remains constant!

In each container indicate which will increase or decrease or stay the same given arrow below.

Volume —
Pressure ↑
Temperature ↑
moles —

In each container indicate which will increase or decrease or stay the same given arrow below.

Volume ↑
Pressure —
Temperature ↑
moles —

In each container indicate which will increase or decrease or stay the same given arrow below.

Volume ↓
Pressure ↑
Temperature —
moles —

How does AP phrase these questions?
Describe each of these scenarios in terms of collisions of particles with the inside container of the wall.

↑ Pressure = ↑ Collisions ↑ T = ↑ velocity

Math Scenarios

Need to know!

PV = nRT

unit specific
T = Kelvin
proportional
- moles constant

$\frac{P1V1}{T1} = \frac{P2VT2}{T2}$

- Very proportional
- moles constant
- Same units
- T = Kelvin

A rigid 2L container at 1 atm has its temperature increases from 10C to 20C.
-- Using the kinetic molecular theory describe how is the pressure affected?

↑T = ↑ collisions, more pressure

collisions are more forceful, faster particle velocity

-- Calculate the actual pressure?

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{1}{283} = \frac{x}{293}$ ← x = 1.03 atm Not doubled

Balloon

A 2L container at 1 atm has its temperature increases from 10C to 20C.
-- Using the kinetic molecular theory describe how is the pressure affected?

More collisions, But Balloon expands giving more area so same Ratio of $\frac{\text{Collisions}}{\text{area}}$

-- Calculate the actual pressure?

same pressure

A 2L piston has its volume decreased to 0.5L at a constant temperature, Using the principles of the kinetic molecular theory. Explain how they system will change.

↑ Collisions, same velocity But smaller area

-- Calculate the actual pressure?

Pressure is doubled

A sample of oxygen at 24.0°C and 745 torr was found to have a volume of 455mL. How many grams of O_2 were in the sample?

PV=nRT

$n = \frac{PV}{RT} = \frac{745 \cdot 0.455L}{62.4 \cdot 297} = 0.0182 \text{ mol} \cdot \frac{32g}{1 \text{ mol}} = 0.58g$

What is the density of carbon tetrachloride vapor at 714torr at 125°C.

- Little more complicated version of PV = nRT. Try it.

$d = \frac{mass}{vol}$ ← Solve for; vol ← set to 1L

$= \frac{4.4g}{1L}$

$n = \frac{PV}{RT} = \frac{714 \cdot 1L}{62.4 \cdot 398} = 0.0287 \text{ mol}$

CCl_4 → 12 + (35.4(4)) = 153.4

$0.0287 \cdot \frac{153.5}{1 m} = 4.4 g$

Partial pressure: Portion of total pressure contributed by a specific substance.

$n_{total} = n_1 + n_2 + n_3 \ldots\ldots$

PV = nRT If V and T are constant

P proportional to n

$P_{total} = P_1 + P_2 + P_3 \ldots$

$n_{total} = n_1 + n_2 + n_3 \ldots$

Partial pressures, ~~as~~ are used in chemistry, are most often used as a way to describe the concentration of a gas!

A balloon has a pressure of 1.2atm. It contains 0.2 moles of He, 1.0mol of O_2 and 0.5 moles of N_2.

Q: What is the partial pressure of Nitrogen in the sample?

total mol = 1.7 $\frac{.5}{1.7}$ = 29.4% of Pressure

.294 · 1.2 = 0.35 Atm

Stoichiometry of gases
- particulate representations of gases

A container of acetylene (C_2H_2) is ignited inside of a rigid container. Explain, using the principles of the kinetic molecular theory, how and why does the pressure change as the reaction is completed and returned to original temperature.

$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$ — 7 → 6 → Pressure decrease Less particles

Common example of a stoichiometric problem.

100 g/mol $CaCO_3$

A student needs to prepare some CO_2 and intends to use the following reaction in which $CaCO_3$ is strongly heated. $CaCO_{3(s)} \rightarrow CO_2 + CaO_{(s)}$ The question concerns the size of the balloon needed to accept the gas. How large will the balloon be if 1.25g of $CaCO_3$ is used? The pressure of the CO_2 is to be 740torr, and its final temperature is to be 25.0°C.

$1.25g \cdot \frac{1\ mol}{100\ g} \cdot \frac{1\ CO_2}{1\ CaCO_3} = 0.0125\ mol\ CO_2$

PV = nRT

$V = \frac{nRT}{P}$ $\frac{0.0125 \cdot 62.4 \cdot 298}{740}$ = 0.314 L