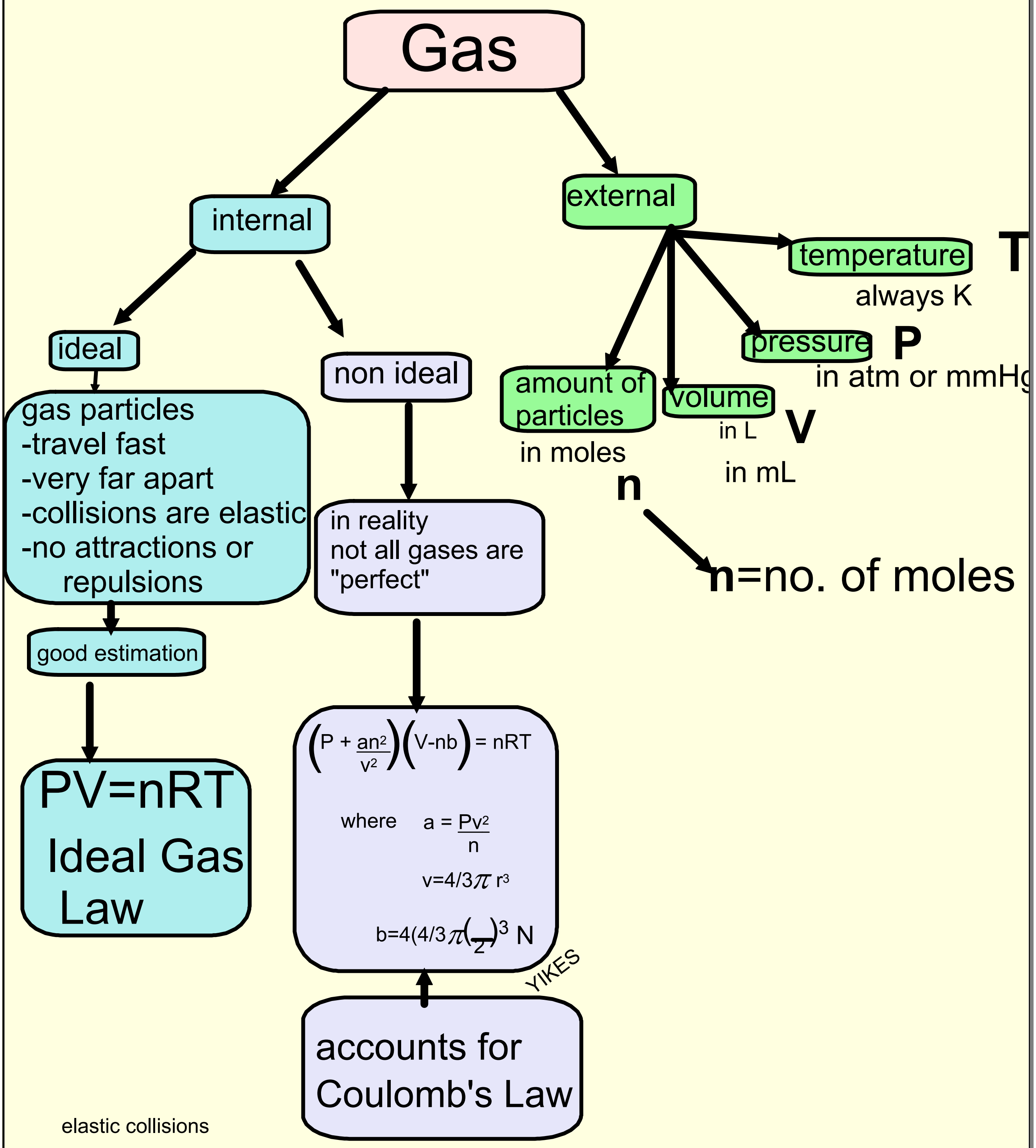
Gas Laws



elastic collisions

http://sci-culture.com/advancedpoll/GCSE/collisions.htm

$$\text{pressure} = \frac{\text{force}}{\text{area}} = \frac{\text{collisions}}{\text{area}}$$

Gas-- external factors

Pressure $= \frac{\text{force}}{\text{area}} = \frac{\text{collisions}}{\text{area}}$

Temperature = **speed of particles**

Volume

no. of particles (moles)

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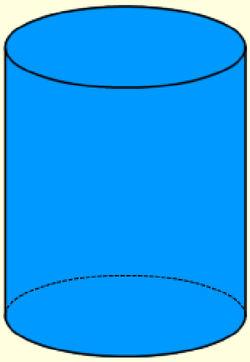
rigid container

Volume-constant
n -Mass/moles-constant



if ↑ T
then ↑ P

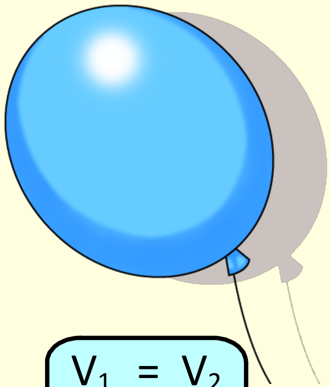
if ↓ T
then ↓ P

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

↑ T, ↑ $\frac{\text{collisions}}{\text{area}}$ **(P)**

flexible container

Pressure is constant
n - Mass/moles-constant



$P_{in} = P_{out}$

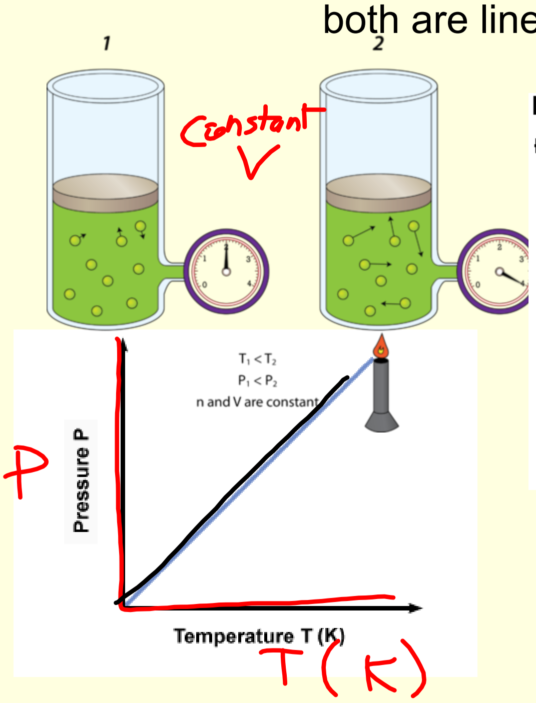
if ↑ T
then ↑ V

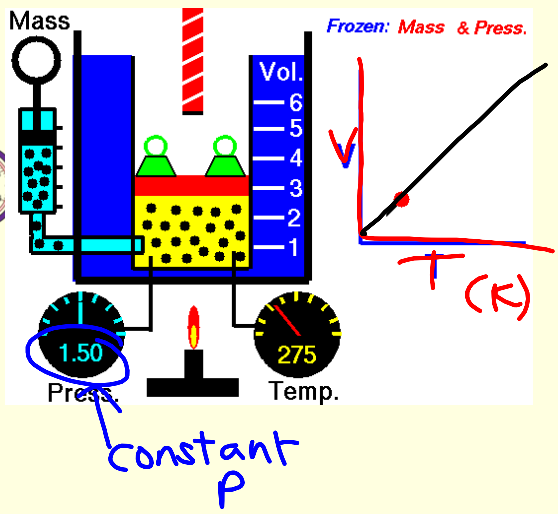
if ↓ T
then ↓ V

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

↑ T, ↑ $\frac{\text{collisions}}{\text{area}}$ **(P)**, ↑ V

both are linear relationships





Temperature constant
n -Mass/moles-constant

if ↑ V
then ↓ P

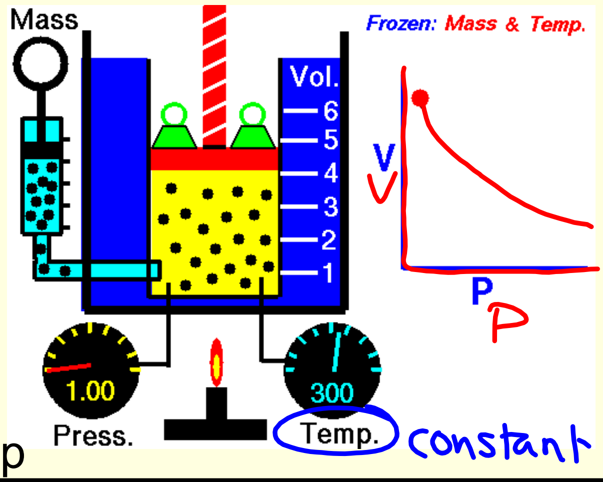
if ↓ V (more collisions)
then ↑ P

inverse

$P_1V_1 = P_2V_2$

reciprocal relationship

use a piston to demonstrate:



Put all 3 together:

Guy-Lussacs Law

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

Charles Law

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

Boyles Law

$$P_1V_1 = P_2V_2$$

Combined Gas Law

$$\frac{V_1P_1}{T_1} = \frac{V_2P_2}{T_2}$$

6 variables: solve for one

Temperature must be in Kelvin for all gas laws

$$^{o}C + 273 = K$$

Convert 25°C to K

Convert 300K to °C

A gas had an initial pressure of 2.4 atm and a volume of 5.6 L.

If the pressure of the gas changes to 1.7 atm, what is the new volume?

Held constant: T

Variables:

$P_1 = 2.4\,atm$

$V_1 = 5.6\,L$

$P_2 = 1.7\,atm$

$V_2 = ?$

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

Plug into equation:

$$P_1 \cdot V_1 = P_2 \cdot V_2$$

$$\frac{(2.4\,atm)(5.6\,L)}{1.7\,atm} = \frac{(1.7\,atm) \cdot V_2}{1.7\,atm}$$

$$V_2 = 7.9\,L$$

Mar 14-1:52 PM

A balloon has a volume of 3.4 L at 213 K.

If the temperature drops to 197 K, what is the volume of the balloon?

Held constant:

Variables:

$V_1 = 3.4\text{L}$

$T_1 = 213\text{K}$

$T_2 = 197\text{K}$

$V_2 = ?$

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

Plug into equation:

$$\frac{3.4\text{L}}{213\text{K}} = \frac{V_2}{197\text{K}}$$

$$\frac{(3.4\text{L})(197\text{K})}{213\text{K}} = \frac{(213\text{K})V_2}{213\text{K}}$$

$V_2 = 3.14\text{ L}$

A balloon has a volume of 1.2 L at a temperature of 253 K.
The temperature changes to 305 K. What is the new volume of the balloon?

The pressure inside a container is 770 mm Hg at a temp of 57 degrees Celsius.

What would the pressure be at 75 degrees Celsius?

$P_1 = 770\ mmHg$

$T_1 = 57°C + 273 = 330K$

$P_2 = ?$

$T_2 = 75°C + 273 = 348K$

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

$(348K)\frac{770\ mmHg}{330K} = \frac{P_2}{348K}(348K)$

$P_2 = 812\ mmHg$

p. 6 + 7

1, 2, 5, 6, 9, 10

A gas filled balloon has a temp of 42 degrees C at a pressure of 0.75 atm.
The pressure changes to 1.02 atm.
What is the new temperature of the gas in the balloon?

Mar 14-1:57 PM