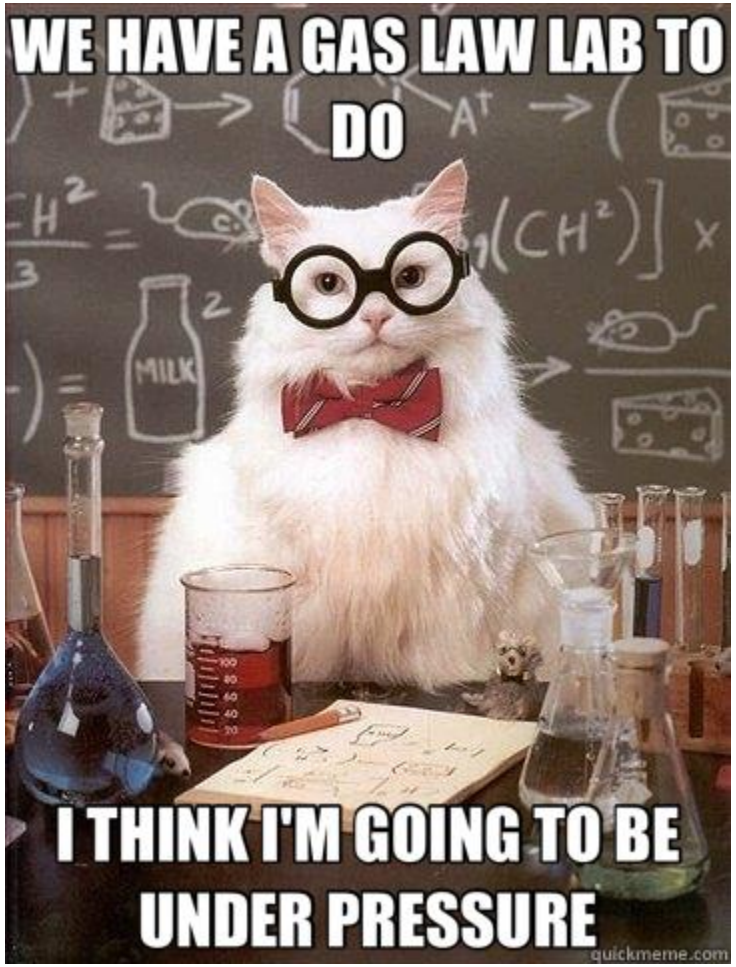
Combined Gas Law



Outcomes:

- *Solve problems involving the relationship among pressure, temperature and volume of a gas using dimensional analysis.*

The Combined Gas Law

So far we have the following gas laws:

1. Boyle's Law

$$P_1V_1 = P_2V_2$$

2. Charles' Law

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

3. Gay-Lussac's Law

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

The Combined Gas Law

We can combine the above formulas to derive the **COMBINED GAS LAW…**

Combine the laws together:

$$(P_1V_1)\left(\frac{V_1}{T_1}\right)\left(\frac{P_1}{T_1}\right) = (P_2V_2)\left(\frac{V_2}{T_2}\right)\left(\frac{P_2}{T_2}\right)$$

Multiply through:

$$\left(\frac{V_1^2P_1^2}{T_1^2}\right) = \left(\frac{V_2^2P_2^2}{T_2^2}\right)$$

Take the square root of both sides:

$$\frac{\sqrt{P_1^2V_1^2}}{\sqrt{T_1^2}} = \frac{\sqrt{P_2^2V_2^2}}{\sqrt{T_2^2}}$$

The Combined Gas Law

We end up with:

$$\left(\frac{P_1V_1}{T_1}\right)=\left(\frac{P_2V_2}{T_2}\right)$$

→ This is the ***combined gas law.***

We can use this law to solve **ANY** gas problem involving **PRESSURE**, **TEMPERATURE**, and **VOLUME**. (temperature **MUST** be in **KELVIN**)

It can also be used for any of the previous questions we have seen, since one of the variables were always **CONSTANT**, they would **CANCEL**.

Combined Gas Law Problems:

Examples:

If a gas occupies a volume of 25.0L at 25.0°C and 1.25atm, calculate the volume at 128°C and 0.750atm

Combined Gas Law Problems:

Examples:

A cylinder with fixed volume contains a gas at a pressure of 652kPa and a temperature of 25°C. If the cylinder is heated to 150°C, what will the new pressure be? (notice that volume is constant)

Combined Gas Law Problems:

Try these ones…

A gas has a volume of 125L at 325kPa and 58.0°C. Calculate the temperature (in °C) to produce a volume of 22.4L at 101.3kPa

Combined Gas Law Problems:

Try these ones…

Salvage divers often use lift bags to lift objects to the surface. A lift bag contains 145L of air at the bottom of the lake, at a temperature of 5.20°C and a pressure of 6.00atm. As the bag is released, it ascends to the surface, where the pressure is 1.00atm and 16.0°C. Calculate the volume of air in the bag at the surface. If the maximum volume of the bag is 750L, will the bag burst at the surface?