Do Now

- Take out notebook, calculator, and writing implement.
- Consider the formula PV=nRT
- Use algebra to isolate the variable:
- T, n, P, and R.

Algebra Answers:

P= $\frac{nRT}{V}$

R= $\frac{PV}{nT}$

n= $\frac{PV}{RT}$

T= $\frac{PV}{nR}$

Do now:

Convert 813 torr into kPa

Remember:
1atm=101.3kPa=14.7psi=760mmHg=760torr

Ch. 14

The Behavior of Gases

Gasses

- Very, very small particles with an insignificant volume.
- Particles in the gaseous state are relatively far apart.
- The motion of gas particles are rapid, constant, and random.
- Ex: O_2 at 20 degrees C travels at 1700 km/hr.

Nature of Gases

- Compressible - Unlike solids or liquids, gases can be squeezed into a smaller volume.
- This is because there is so much room between particles.

Nature of Gases

- Fluid - Gases change shape to fill their container.
- Gases will move into a place of lower pressure of an open container.
- Gas moves into the container. The lower pressure area **does not** suck the air in.

Describing Gas

- P- Pressure - [kPa] The measure of gas particles pushing on one another.
- V - Volume - [L] How much space it occupies.
- T - Temperature - [K] The measure of kinetic energy (directly related to heat)
- n - number of moles of gas.

(more to come on this later)

Changes in Pressure

in a closed container

- Volume decrease - pressure increase.
- Push on a plastic bottle. The more you push, the higher the pressure and the more the bottle resists your pushing.

Boyle's Law

- When volume decreases, pressure increases.
- When volume increases, pressure decreases.
- ~~Recall solutions: McVc=MdVd~~
- Boyle's Law: P1V1=P2V2

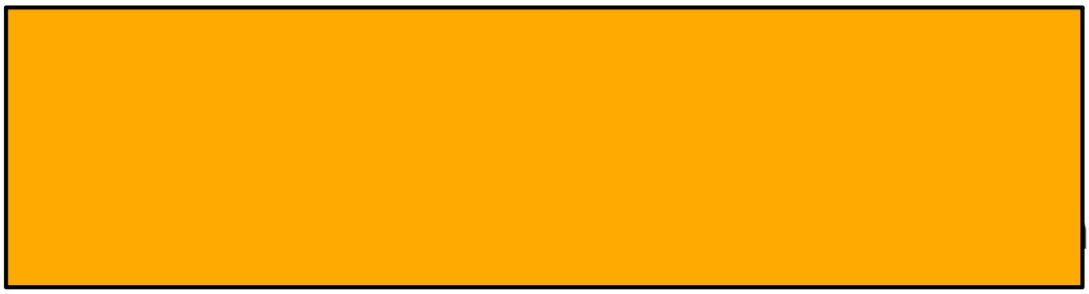
Boyle's Law

- Pressure and Volume are inversely proportional.
- This formula can be used with any form of pressure and volume, so long as it's consistent.
- If you are given pressure (or volume) in two different units, you must convert them to the same units.

Example: The volume of a closed, empty water bottle is decreased from 500 ml to 400 ml. If the original pressure inside the bottle was 1.02 atm, what is the new pressure?

answer in kPa

- P1=1.02 atm, V1=0.50L, V2=0.40L
- P2=?



The pressure of a 3.4L balloon is 920 torr. The pressure is increase to 1040 torr. What is the new volume of the balloon?

$P1 = 920$ torr

$V1 = 3.4\,L$

$P2 = 1040$ torr

$\frac{P1V1}{P2} = \frac{P2V2}{P2}$

$V2 = \frac{P1\,V1}{P2} = \frac{920\,\text{torr}\ 3.4\,L}{1040\,\text{torr}} = 3.0\ L$

Your body needs oxygen to breathe. Just before you breath in, your lungs are about 1L. Your diaphragm lowers, and your lungs expand to a volume of about 4.5 liters. If the air in the room is about 747 torr, what is the pressure in your expanded lungs before the air rushes in to fill them?


OXYGEN
MUSCLES CONTRACT
CANT SEE
GASES
WE CANNOT OBSERVE GASES WITH OUR EYES
YouTube

Gas Laws

Charles' Law

- Temperature affects volume.
- As temperature increases, so does volume. They are proportional to one another.

Charles's Law

- As temperature increases, so does volume.
- V1/T1 = V2/T2
- Pressure in kPa and T in kelvin.

Temperature in Kelvin:

Kelvin will never be negative.

0 degrees Kelvin is the lowest temp possible.

From Celsius to Kelvin: add 273

From Kelvin to Celsius: subtract 273

A mylar balloon in inflate to 6 L in a store that is 25°C. When the balloon is taken outside, where it is -10°C, what is the its new volume?

$V1 = 6L$

$T1 = 25^{\circ}C + 273^{\circ} = 298^{\circ}K$

$T2 = -10^{\circ}C + 273 = 263^{\circ}K$

$V2 =$

cbreview154

A 3L balloon is on the dark side of the moon where the temperature is -233 degrees C. What is the temp when the sun comes out and the volume increases to 29.7L? Answer in degrees C.

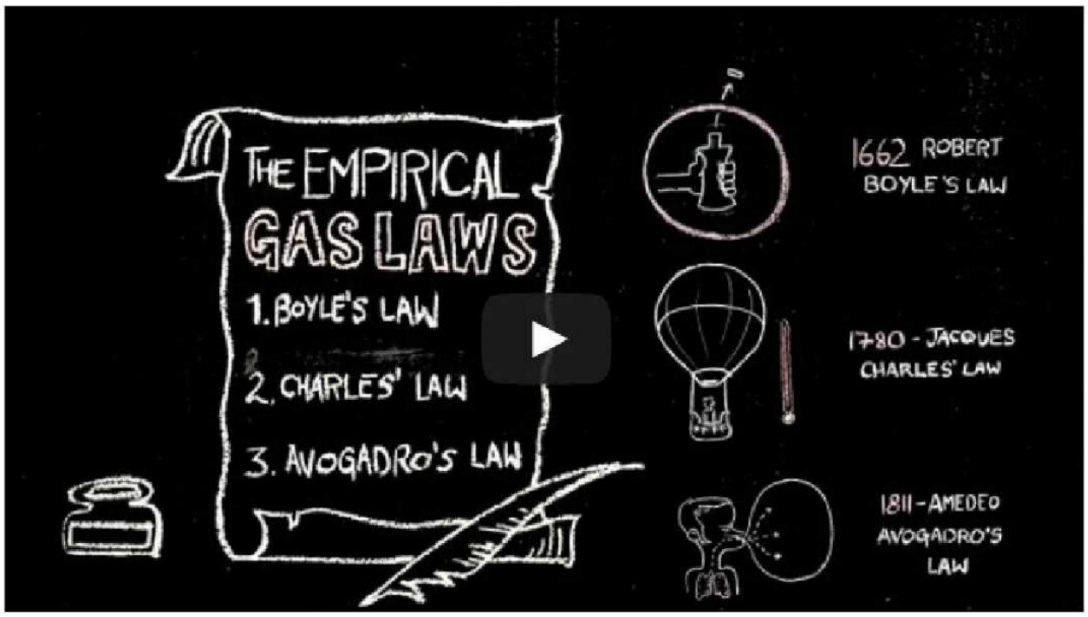
$V1 = 3L$

$T1 = -233^{\circ}C + 273 = 40^{\circ}K$

$V2 = 29.7L$

$T2$

A 3L ball sits on the dark side of the moon where the temperature is 40°K. When the sun hits the surface it heats up to 396°K. What is the new volume of the ball?


THE EMPIRICAL GAS LAWS
1. BOYLE'S LAW
2. CHARLES' LAW
3. AVOGADRO'S LAW
1662 ROBERT BOYLE'S LAW
1780 - JACQUES CHARLES' LAW
1811 - AMEDEO AVOGADRO'S LAW

Gas Laws

Scientific notation: the way that scientists easily handle very large numbers or very small numbers.

For example, instead of writing 5,600,000,000 we write 5.6×10^9

$10^2=100$

$200 = 2 \times 10 \times 10 = 2 \times 10^2$

$43{,}210{,}000 = 4.321 \times 10^7$

Very small numbers:

$1/10 = 10^{-1} = 0.1$

$0.2 = 2/10 = 2 \times 1/10 = 2 \times 10^{-1}$

$1/100 = 1/10 \times 1/10 = (1/10)^2 = 10^{-2}$

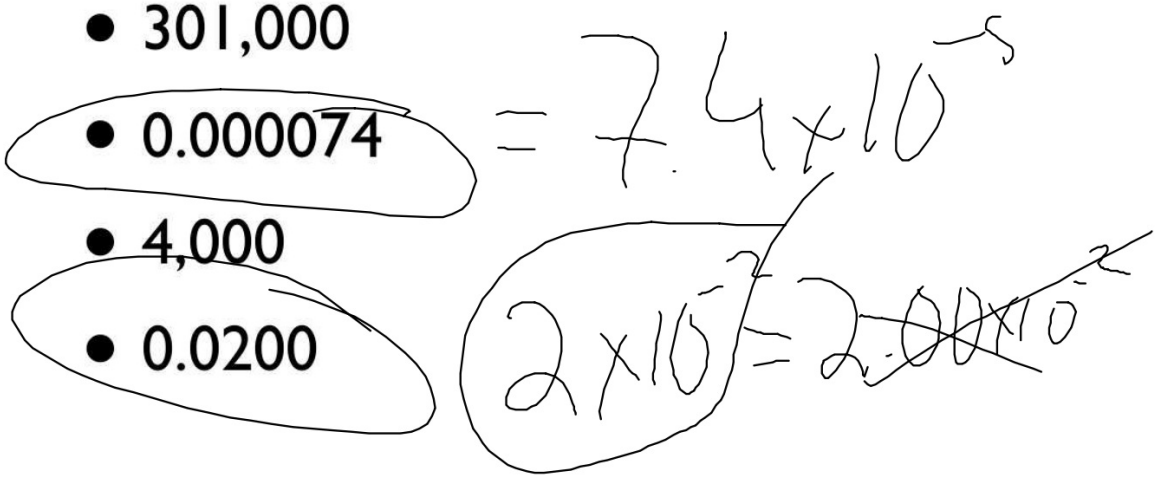
$0.05 = 5 \times 10^{-2}$

$0.000067 = 6.7 \times 10^{-5}$

Convert into Scientific Notation

On a whiteboard

- 301,000
- 0.000074
- 4,000
- 0.0200



Scientific Notation and Quest

Quest accepts scientific notation that looks like a graphing calculator.

23,000,000 becomes 2.3 e7

2.3×10^{7}

0.0000000765 becomes 7.65 e-9

7.65×10^{-9}

The Dangers of Science Denial

B2: 12:00

B3: 8:00

B4: 0:00

Happy Monday!

Solve for the following:
The ballist (like a balloon) on a submarine has a volume of 1.2x10^(6)L at a pressure of 6.5 atm. When the submarine surfaces the pressure is 1atm. What is the volume of the ballist?

$V1 = 1.2 \times 10^6 L$

$P1 = 6.5 atm$

$V2 = \star$

$P2 = 1 atm$

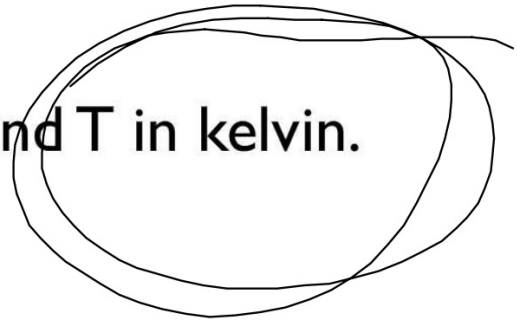
$$\frac{P1V1}{P2} = \frac{P2V2}{P2}$$

Boyle's Law

- When volume decreases, pressure increases.
- When volume increases, pressure decreases.
- Recall solutions: McVc=MdVd
- Boyle's Law: P1V1=P2V2

Charles's Law

- As temperature increases, so does volume.
- V1/T1 = V2/T2
- Pressure in kPa and T in kelvin.



Gay-Lussac's Law

- Pressure and temperature are directly proportional. As one increases, so does the other.
- P1/T1 = P2/T2
- Pressure is in kPa. Temperature in °K.

An engine piston is about 320°K at 100 kPa. Fuel ignites and measures about 800°K. What is the new pressure in the piston?

$T_1 = 320°K$

$P_1 = 100 kPa$

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

$T_2 = 800°K$

$P_2 = ? = \frac{T_2 P_1}{T_1} = \frac{800°K \cdot 100 kPa}{320°K} = 250 kPa$

A car tire is increased from 14.7 psi to 3800 torr. If the tire was 298°K before inflation, what was its final temperature?

$P1 = \frac{14.7\ \text{psi}}{1} \cdot \frac{1\ \text{atm}}{14.7\ \text{psi}} = 1\ \text{atm}$

$T1 = 298°K$

$P2 = \frac{3800\ \text{torr}}{1} \cdot \frac{1\ \text{atm}}{760\ \text{torr}} = 5\ \text{atm}$

$T2 = ?$

Core 3

Out if 10 points

Second chance learning offered Mon-Fri of this week after school.

Must arrive by 2:45 to be eligable.

The Ideal Gas Law: Crash Course Chemistry #12

0:00-4:00

~~Combined~~ Dan's Gas Law

- P1V1=P2V2 & V1/T1 =V2/T2
- P1/T1 = P2/T2
- Combine all of these formulae to get (P1V1)/T1=(P2V2)/T2

- $(P_1V_1)/T_1=(P_2V_2)/T_2$

  - Stay organized. Write your knowns in two columns.
  - Make all conversions needed.
  - Manipulate the algebra to isolate the unknown.
  - Plug and chug.

A gas occupies a volume of 458 ml at a pressure of 1.01kPa and temperature of 295°K. When the pressure is changed, the volume becomes 477 mL. If there has been no temp change, what is the new pressure?

$P_1 = 1.01\,kPa$

$V_1 = 458\,mL$

$T_1 = 295^\circ K$

$V_2 = 477\,mL$

$T_2 = 295^\circ K$

A balloon increases in temperature from ~~300~~°K to ~~350°K~~. The pressure increases by 50%. ~~If~~ the balloon was initially ~~2.3L,~~ what is the volume after the temp and ~~volume~~ pressure change?

$P1 = 50$ ~~mmHg~~

$V1 = 2.3\ L$

$T1 = 300°K$

75 ~~mmHg~~ $= P2$

$= V2$

$350°K = T2$

A gas sample at 83°C occupies a volume of 1400L. At what temperature will it occupy 1200L?

A 1.5L bag of methane is at room temp (295 degrees K) and 103kPa. If it ignites at 537 degrees C and the volume is expands to 3.1L. What is the pressure inside of the bag?

Thermochem Quiz:

Out of 48 points

I will take general and then specific questions once I have handed back the quizzes.

Quest:

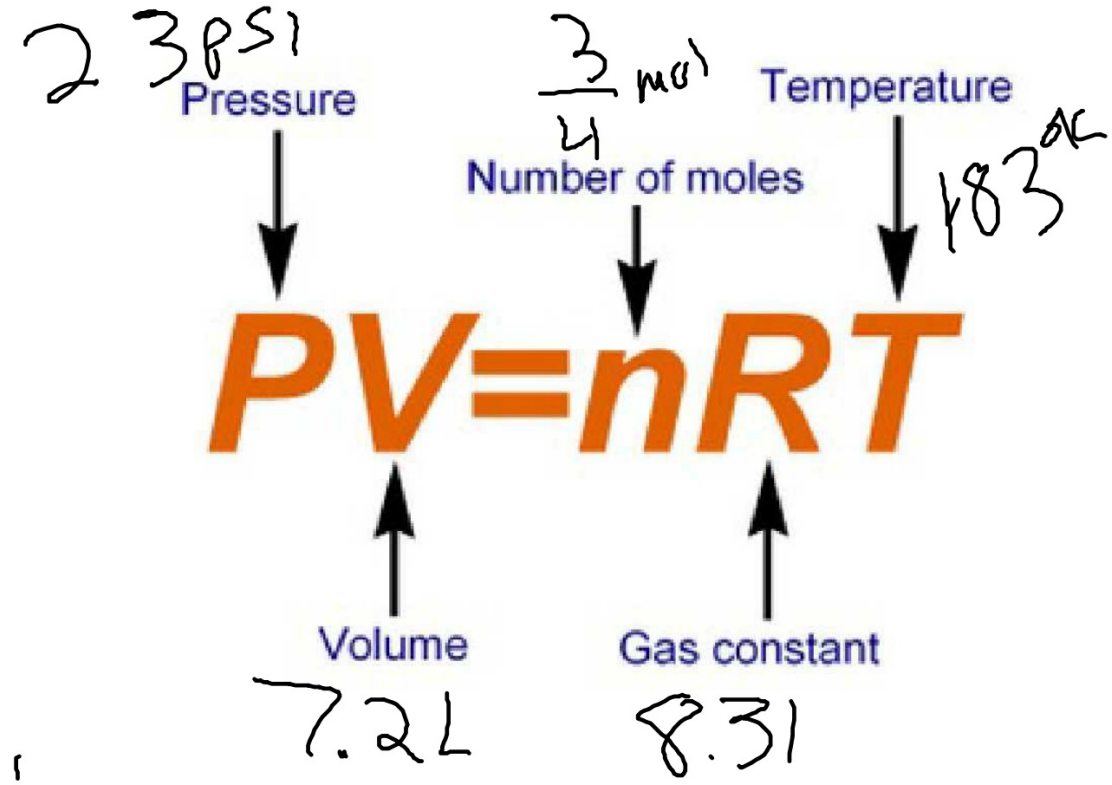
Gas Laws Part 1 due tonight.

Gas Laws Part 2 due tomorrow night.
You have the knowledge to do the first 5 problems in Part 2.

Powerpoint: Ch. 14-Bahavior of gasses.

Avagadro

- 1 mole of a gas at STP is 22.4L.
- At this point, we have used STP (273°K and 101.3kPa) to relate volume of a mole of gas.



Ideal Gas Law

At STP

- P = 101.3 kPa, V = 22.4L, T = 273°K, n = 1mol.
- PV=nRT. R is the ideal gas constant. Solve for R.

Volume of a gas lab:

-You will combine 3.0M HCl and Mg(s) in a eudiometer.
-Like a burrett, it has the numbered in the opposite way that a graduated cylinder is.
-Pay close attention to the set up and the variables that will be on the board.

Set up:

-Obtain a stand (pole), test tube clamp, 400ml beaker, eudiometer, test tube plug and copper wire 100ml or larger graduated cylinder (glass).
-Wrap the copper wire around a pencil so that there are 2-3 loops in it.
-Insert the straight end into the smaller side of the plug.
-Obtain 2-3cm of Magnesium ribbon. Record the value with 3 sig figs.

-Write the balanced chemical equation:
$HCl(aq) + Mg(s) \rightarrow MgC_2(aq)$ and $H_2(g)$
-The Mg is the limiting reactant.
-Position the test tube clamp on the stand so that the beaker can fit beneath it.
-Record the temp (in kelvin) and pressure (in kPa) in the room.
-Get the water vapor pressure for the temperature of the room (given).
-Add 10ml of 3.0M HCl to the eudiometer.
-Use the beaker to fill it to the top with room temp water.

-Fill the beaker with 200ml of water.
-Wrap the Mg around the copper wire.
-Place the stopper (with the wire facing in) into the eudiometer. The solution may overflow a bit. This is okay.
-**Gently** invert the eudiometer and place it into the GC.
-Secure the eudiometer with the ring stand. It should be snug, but it is glass. Careful.
-The reaction should be fairly rapid. Once it is finished wait another 5 min to be sure.
-Begin calculations while you are waiting.

-Once 5 min are up, flick (gently) the side of the eudiometer to let all gas rise to the top.
-Carfully loosen the eudiometer. Be careful that it does not fall.
-Hold the plug in the euidiometer and place it into the GC.
-Raise the eudiometer in the GC so that the water level of the eudiometer is the same as the GC.
-Measure the volume of gas in the eudiometer. Record.
-Rinse down the drain with ample water.