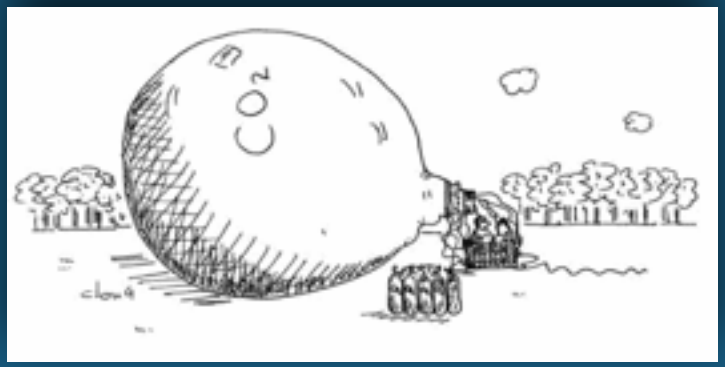
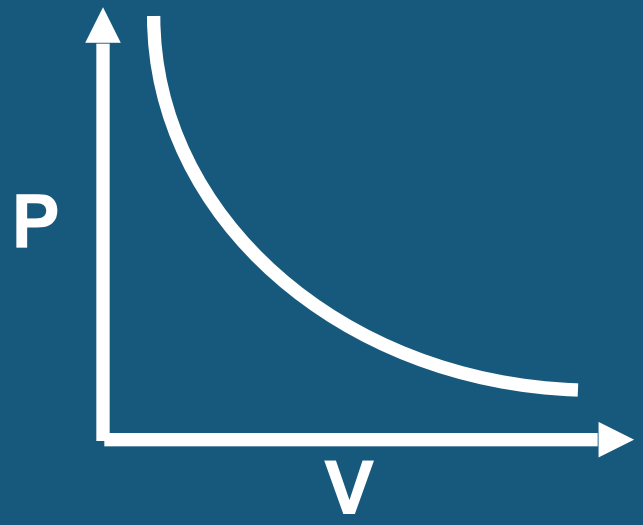
Warm Up 4/13/2015

- Why can four tires support the weight of your car?
- Write 3 properties of gases.



A. Boyle's Law

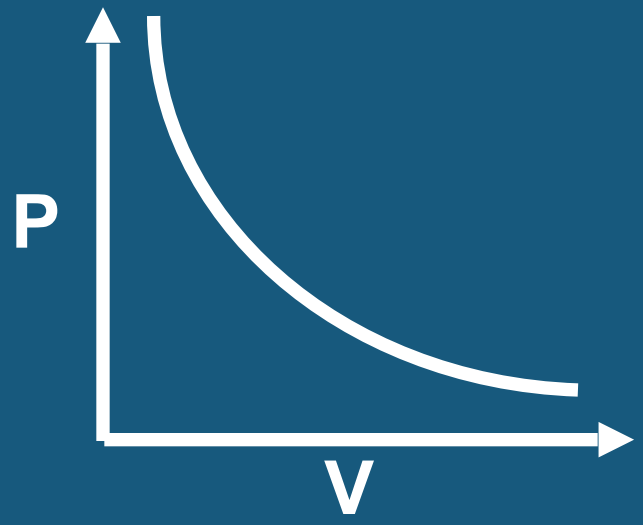
Volume (mL)	Pressure (torr)	P·V (mL·torr)
10.0	760.0	7.60×10^3
20.0	379.6	7.59×10^3
30.0	253.2	7.60×10^3
40.0	191.0	7.64×10^3



$$PV = k$$

A. Boyle's Law

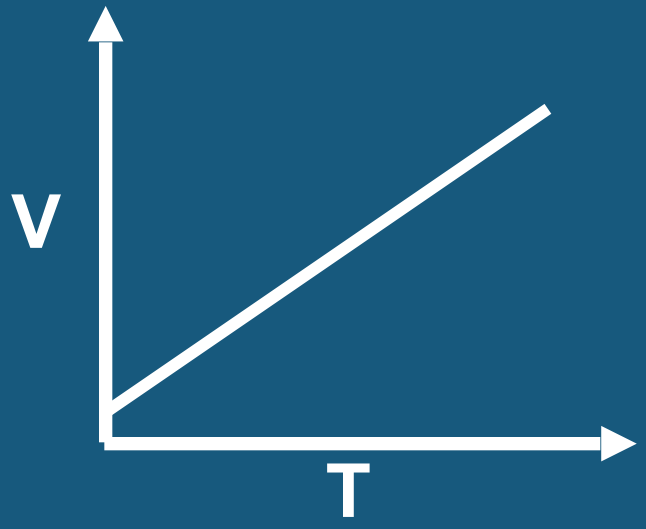
- The pressure and volume of a gas are inversely related
  - at constant mass & temp



$$PV = k$$

B. Charles' Law

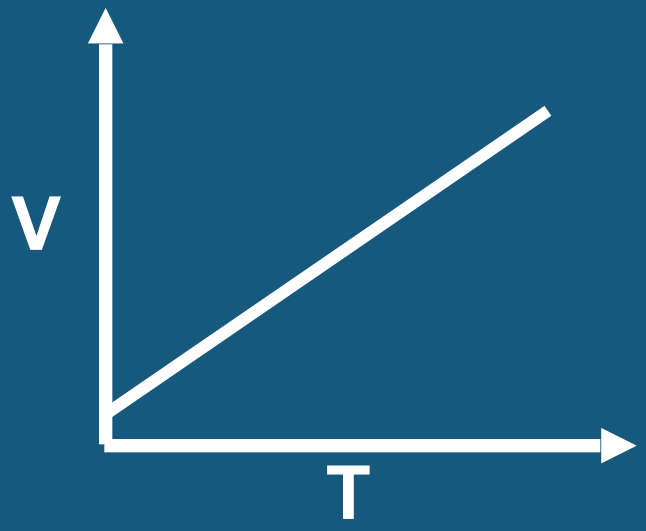
Volume (mL)	Temperature (K)	V/T (mL/K)
40.0	273.2	0.146
44.0	298.2	0.148
47.7	323.2	0.148
51.3	348.2	0.147



$$\frac{V}{T} = k$$

B. Charles' Law

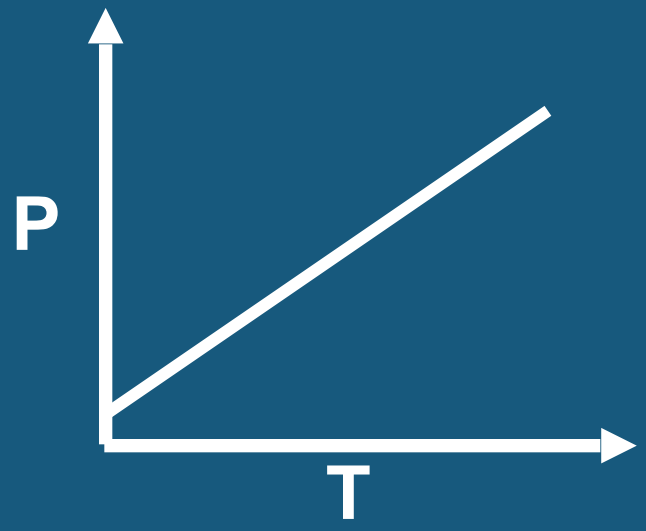
- The volume and absolute temperature (K) of a gas are directly related
  - at constant mass & pressure



$$\frac{V}{T} = k$$

C. Gay-Lussac's Law

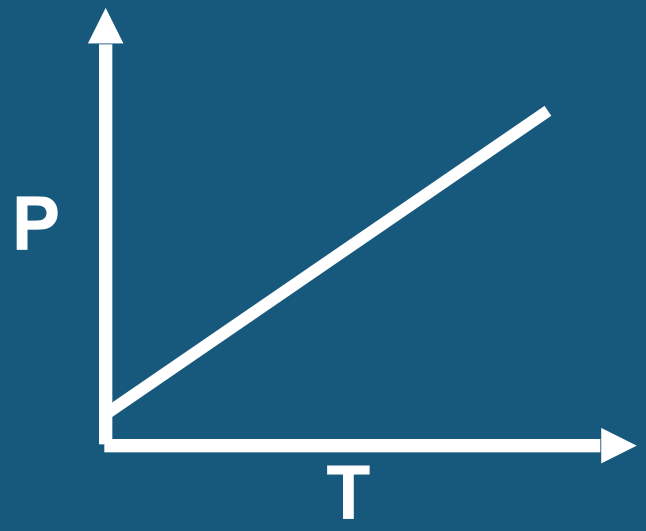
Temperature (K)	Pressure (torr)	P/T (torr/K)
248	691.6	2.79
273	760.0	2.78
298	828.4	2.78
373	1,041.2	2.79



$$\frac{P}{T} = k$$

C. Gay-Lussac's Law

- The pressure and absolute temperature (K) of a gas are directly related
  - at constant mass & volume



$$\frac{P}{T} = k$$

Equations for the three Gas Laws

- Charles's Law

$$V_1/T_1 = V_2/T_2$$

- Boyle's Law

$$P_1V_1 = P_2V_2$$

- Gay-Lussac's Law

$$P_1/T_1 = P_2/T_2$$

C. Gay-Lussac's Law

- Gay-Lussac's Law

B. Charles' Law

Charles' Law

D. Combined Gas Law

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

F. STP

Standard Temperature & Pressure

0°C -OR- 273 K

1 atm 101.325 kPa

E. Gas Law Problems

- A gas occupies 473 L at 36°C. Find its volume at 94°C.

CHARLES' LAW

GIVEN: $T\uparrow$ $V\uparrow$	WORK:
$V_1 = 473$ L $T_1 = 36°C = 309K$ $V_2 = ?$ $T_2 = 94°C = 367K$	$V_1/T_1 = V_2/T_2$ $(473\ L)(367\ K) = V_2(309\ K)$ **$V_2 = 562$ L**

E. Gas Law Problems

- A gas occupies 100. mL at 1.5 atm. Find its volume at 2 atm.

BOYLE'S LAW

GIVEN: $P\uparrow$ $V\downarrow$	WORK:
V_1 = 100. mL P_1 = 1.5 atm V_2 = ? P_2 = 2 atm	$P_1V_1 = P_2V_2$ (1.5 atm)(100.mL)=(2 atm)V_2 **V_2 = 75.0 mL**

E. Gas Law Problems

- A gas' pressure is 1 atm at 23°C. At what temperature will the pressure be 0.737 atm?

GAY-LUSSAC'S LAW

GIVEN: $P\downarrow$ $T\downarrow$	WORK:
P_1 = 1 atm T_1 = 23°C = 296K P_2 = 0.737 atm T_2 = ?	$P_1/T_1 = P_2/T_2$ $(1atm)T_2 = (0.737\ atm)(296K)$ **T_2 = 218 K = -55°C**

E. Gas Law Problems

- A gas occupies 7.84 cm^3 at 0.71 atm & 25°C. Find its volume at STP.

COMBINED GAS LAW

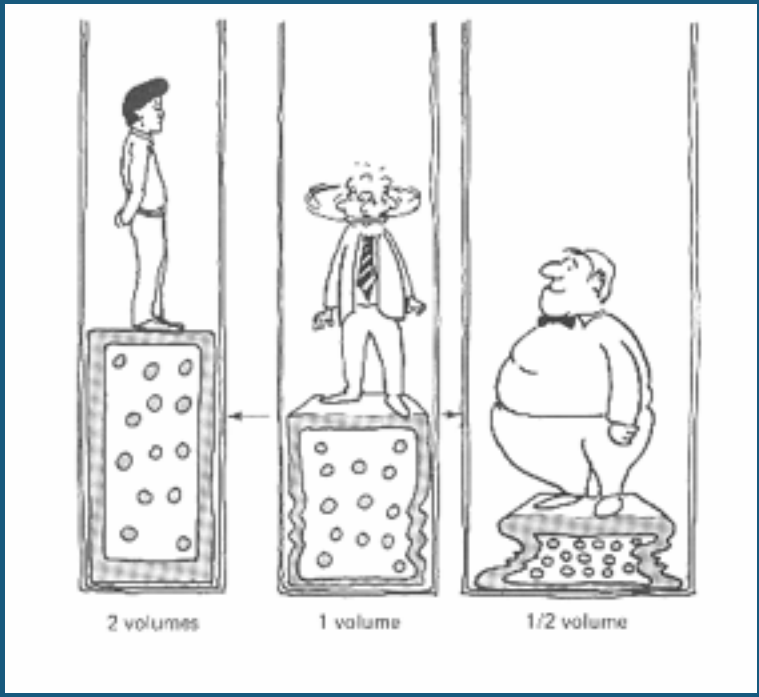
GIVEN: **P↑ T↓ V↓**	WORK:
V_1 = 7.84 mL P_1 = 0.71 atm T_1 = 25°C = 298 K V_2 = ? P_2 = 1 atm T_2 = 273 K	$P_1V_1T_2 = P_2V_2T_1$ (0.71 atm)(7.84 mL)(273 K = (1 atm) V_2 (298 K) **V_2 = 5.09 mL**

Warm Up 4/15/2015

A teacher places 15 mL of shaving cream into a vacuum. If we assume the atmospheric pressure in CO is 0.852 atm, and any change in volume results from the gas molecules, what is the pressure in the vacuum when the shaving cream reaches a volume of 500 mL?

Are the assumptions realistic? Explain why or why not.

STP = 0°C and 1 atm



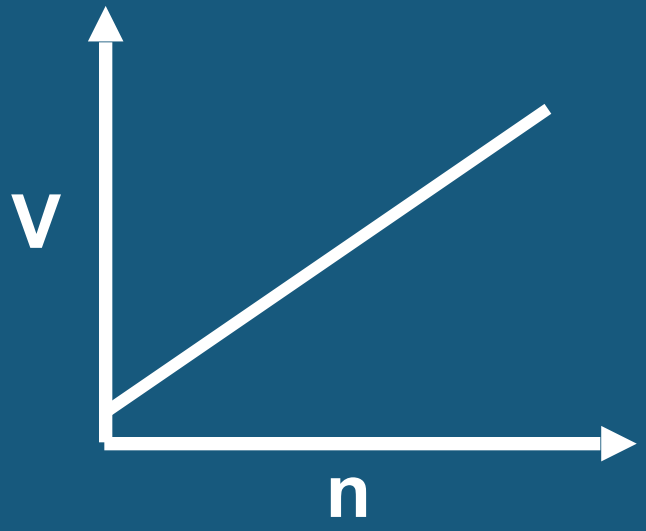
20 minutes for front of worksheet - Gas Law Problems

Ch. 14 - Gases

III. Ideal Gas Law

A. Avogadro's Principle

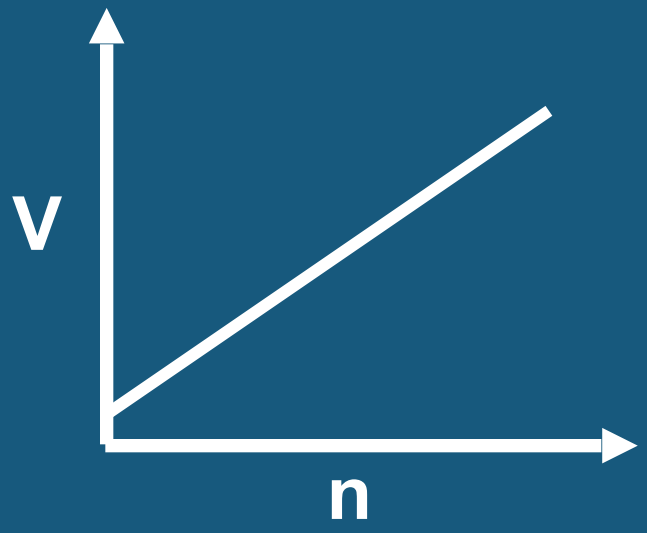
Gas	Volume (mL)	Mass (g)	Moles, n	V/n (L/mol)
O_2	100.0	0.122	3.81×10^{-3}	26.2
N_2	100.0	0.110	3.93×10^{-3}	25.5
CO_2	100.0	0.176	4.00×10^{-3}	25.0



$$\frac{V}{n} = k$$

A. Avogadro's Principle

- Equal volumes of gases contain equal numbers of moles
  - at constant temp & pressure
  - true for any gas



$$\frac{V}{n} = k$$

B. Ideal Gas Law

$$\frac{V}{n}\frac{PV}{T} = R$$

UNIVERSAL GAS CONSTANT

R=0.0821 L·atm/mol·K

R=8.315 dm^3·kPa/mol·K

B. Ideal Gas Law

$$PV=nRT$$

UNIVERSAL GAS CONSTANT

$R=0.0821\ L\cdot atm/mol\cdot K$

$R=8.315\ dm^3\cdot kPa/mol\cdot K$

A. Ideal Gases

- Particles in an ideal gas…
  - have no volume.
  - have elastic collisions.
  - are in constant, random, straight-line motion.
  - don’t attract or repel each other.
  - have an avg. KE directly related to Kelvin temperature.

B. Real Gases

- Particles in a REAL gas…
  - have their own volume
  - attract each other
- Gas behavior is most ideal…
  - at low pressures
  - at high temperatures
  - just like students (think summer!

B. Ideal Gas Law

- Calculate the pressure in atmospheres of 0.412 mol of He at 16°C & occupying 3.25 L.

GIVEN:	WORK:
P = ? atm n = 0.412 mol T = 16°C = 289 K V = 3.25 L R = 0.0821 $\frac{L \cdot atm}{mol \cdot K}$	PV = nRT P(3.25)=(0.412)(0.0821)(289) L mol L·atm/mol·K K P = 3.01 atm

B. Ideal Gas Law

- Find the volume of 85 g of O_2 at 25°C and 1 atm.

GIVEN:	WORK:
V = ? n = T = 25°C = 298 K P = 1 atm R = 0.0821L·atm/mol·K	$\frac{85\ g \mid 1\ mol}{\mid 32.00\ g} = 2.7\ mol$ PV = nRT (1) V=(2.7mol) (8.315) (298) V = 64 L

Warm Up 4/17/2015

- **A 1.89 L pressure cooker increases atmospheric pressure by 1 atm, which increases the temperature of boiling to 121°C when heated thereby making cooking food faster.**
  - What two factors result in the increase in pressure?
  - In a closed pressure cooker at sea level, how many moles of gas are present at room temperature 25°C?
  - How many moles of gas are present in the pressure cooker when it reaches maximum pressure and temperature?
  - Bonus: Two ways of removing pressure are: running cold water along the side of the pressure cooker, or opening a valve. What mechanisms are responsible for each method?

Challenge Question

- If you complete the challenge question correctly, your name could be drawn to write a test question for the unit 7 test. 1-2 test students will be selected depending on number of entries.

- A sample of methane gas having a volume of 2.80 L at 25°C and 1.65 atm was mixed with a sample of oxygen gas having a volume of 35.0 L at 31°C and 1.25 atm. The mixture was then ignited to form carbon dioxide and water. Calculate the volume of CO_2 formed at a pressure of 2.50 atm and a temperature of 125°C.

  - Hint: This is an AP problem that combines all the material we have worked with this semester.