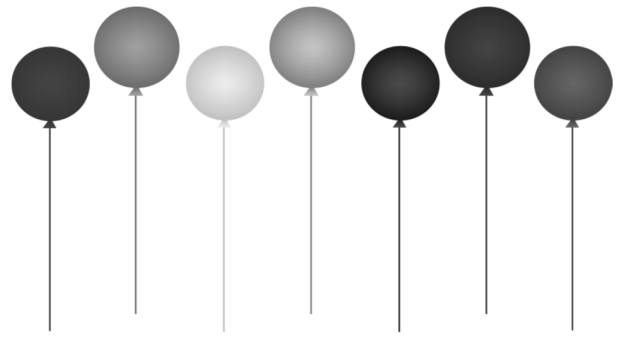# Gas Notes

1. Write the Combined Gas Law Formula

$$=$$

2. Which we say like this:

_____

3. And THAT MEANS: that if you know the ORIGINAL CONDITIONS of _____, _____,

    and _____, you can…

4. The pressure units I could use are:_____

5. The volume units I could use are:_____

6. Units for temperature are always _____ (no matter what)

7. Your balloon is filled on the ground. It's 45.6 liters in size, it is filled with helium gas to a pressure of 1.20 atm, and the temperature of the gas is 293 K (20.0°C). The balloon rises into the atmosphere, and the temperature drops to 278 K (5.00°C); the pressure drops to 1.05 atm.   What's the new volume of your balloon?

8. A weather balloon has been filled with helium to a volume of 65.5 liters, at 1.50 atm, and the gas temperature is 295 K. At a height of twelve hundred meters, the balloon cools to 265 K, and the volume drops to 62.0 Liters. What is the pressure in this balloon under these new conditions?

9. At constant temperature, a sample of (H_2S) dihydrogen monosulfide *(stink gas)* of 50.0 cm^3 and 125 kPa is put into a much larger container and it expands to 595 cm^3. What is the new pressure of this gas?

10. At constant pressure, a 12.0 liter sample of CO_2 gas is at 24.0°C. If the sample is cooled to -15.0°C, what's the new gas volume?

11. At a constant volume of 450.0 mL, a sample of carbon dioxide gas is at 165 kPa, and standard temperature. If it is heated up to 349 Kelvin, what is the new pressure on this gas?

12. Fill in this chart

Review Guide	formula	Show a simple graph of this relationship	Name this relationship as *inversely or directly* proportional. Or both.
The combined gas law:			
The combined gas law with constant temp:			
The combined gas law with constant pressure:			
The combined gas law with constant volume:			

The combined gas law is the starting point for every single gas problem in our course.
Sometimes one of the three variables is a constant, and we can cancel it out before the math.

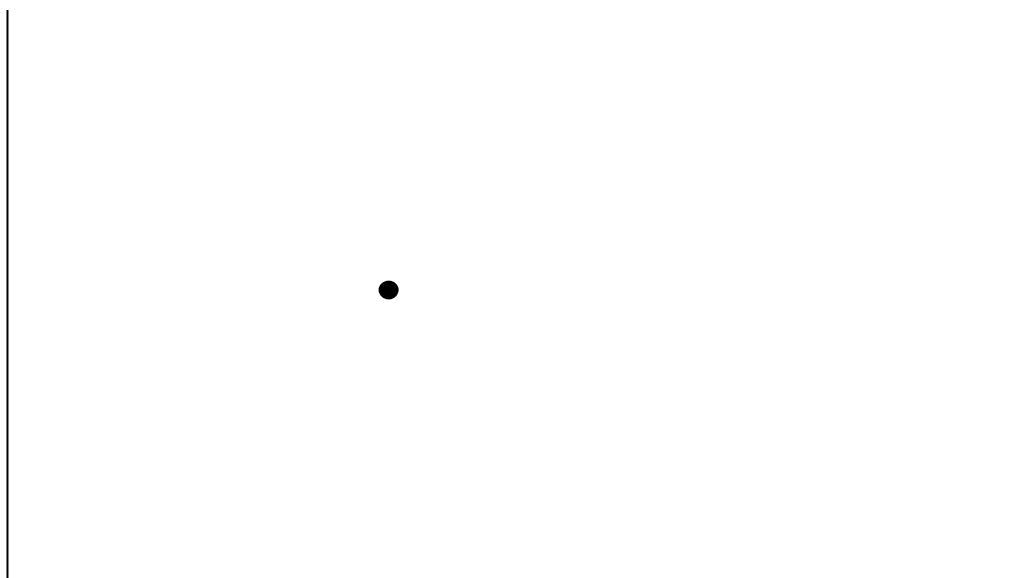The temperature MUST BE KELVIN. WHY?

14. With CONSTANT TEMPERATURE we can change this formula to… (Boyle's Law)

15. DRAW Charlie's CO_2 Balloon	16. Draw squished balloon with smaller volume.
P and Vol for this balloon? _____ _____	17. As volume decreased, _____

18. The Pressure and Volume _____

19. If the balloon was stretched into a LARGER VOLUME? The Volume _____ and the Pressure _____

20. Draw this graph…

Fill in the rest of the dots. Use both of the balloons in the slide show to "show" you why the first and last dot are where they are.

21. _____

22. P x V = C, that means that the _____ X _____ = _____

23. For this gas sample, every single point, every P x V = _____

24. *Your* $N_{2(G)}$ sample has volume of 3.75 Liters. It is at a pressure of 125 kPa.   What is the gas constant for this gas?

25. What if we change the conditions of your nitrogen gas sample, to 9.75 Liters. Calculate the new volume?

26. For any sample of gas, the pressure and volume are inversely proportional and equal to a constant, so…

27. Boyle's Law: For any sample of gas, the pressure + volume are inversely proportional & equal to a constant, so…

28. A sample of neon gas is at standard pressure and 45.8 liters volume. If you double the pressure, what is the new volume?

Do the math with kPa here   Do the math with atm here

29. A thick rubber balloon has 16.3 liters of oxygen gas inside at 1.25 atm. If the balloon can be squished (when some boys stand on it) to a volume of just 12.8 L, what's the new balloon pressure?

30. There are 4 variables in which to measure gases. (you already know these) They are:

_____   _____   _____   _____

31. Let's imagine what happens to the balloon size (volume) when we put these 2 balloons into hot water, and into cold water. What do you think? _____

Into HOT water

44B. WHAT ACTUALLY HAPPENED?

Into COLD water
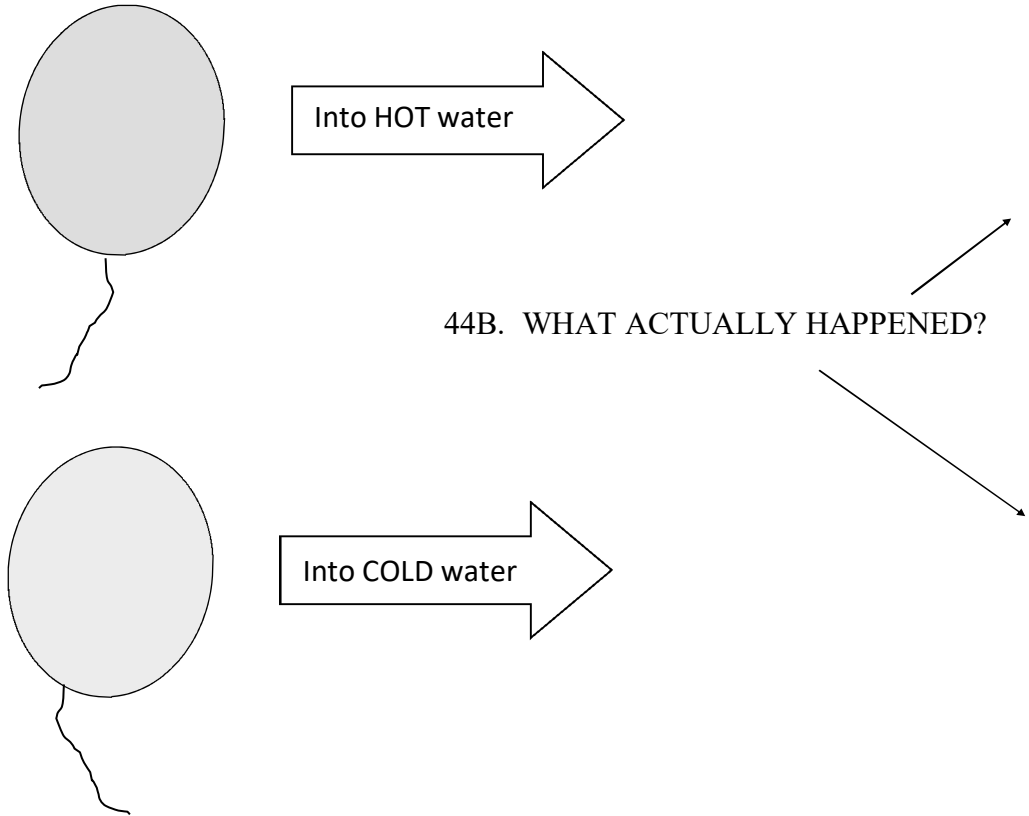
32. When both variables move in the same direction (both increase, or both decrease) this is called:

_____

Draw this graph.
(title, axis labels)

Time for a story about little girls and balloons and the Oakdale mall and being a stay home father, etc.
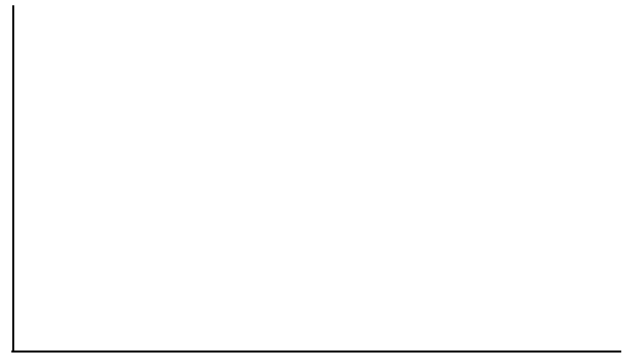
33. Volume and Temperature of a gas are _____

34. Draw these 2 graphs carefully - Note the TITLE wording and the axis labels. (Y is a function of X)

Temperature as a function of Volume   Volume as a function of Temperature

35. Directly proportional does not mean that the slope have to be 1, it can slope any direction… like these

Ideal vs. Real Gases

This will be out there, but you are smart enough to grasp this. To teach we discuss "ideal gases", which are not real. They are the theoretical concept of gases. There are NO examples of ideal gases, any more than there is a Superman or Wonder Woman. We understand them, but we know they are fake.

They are used to help kids learn what gases are, how gases remain gases, etc. There are NO examples of ideal gases. There are many examples of real gases, and you know lots of them, like: oxygen, nitrogen, carbon dioxide, helium, etc.

36. Ideal vs. Real Gases

A.

B.

C.

D.

E

37. Real gases act most ideally under these two conditions:

Because:

38.

39.

40. If you had 2.45 liters of neon, of carbon dioxide, and propane (C_3H_8) gases, all at STP, which gas would act the MOST IDEAL ? Fill in the chart.

Name	Symbol	Number of atoms	ranking
Neon			
Carbon Dioxide			
Propane			

41. _____

42. Convert 1.06 atm into millimeters of mercury

43. Change 844 mm of Hg into kilopascals

44. When a rigid cylinder containing methane gas at 273 Kelvin and is at 125 kPa is warmed up to 295 Kelvin, the pressure changes. What is the new pressure of this gas? VOLUME IS CONSTANT HERE

45. Avogadro's Hypothesis (this is really important)

46. Fill in	He	CO$_2$	NH$_3$	ANY GAS
volume				
Temp				
Pressure				
moles				
particles				

If you have 5.48 liters of He$_{(G)}$ and CO$_{2(G)}$ and NH$_{3(G)}$ all at STP, how many moles of each gas, and how many particles of each gas are present?

You could do the math, or copy it now...

47. Under which conditions of temperature and pressure does carbon dioxide gas behave most like an ideal gas?
   1. low temperature + low pressure   2. low temperature + high pressure
   3. high temperature + low pressure   4. high temperature + high pressure

48. Which gas sample at STP has the same total number of molecules as 2.0 liters of $CO_{2(G)}$ at STP?
   1. 5.0 L of $CO_{2(G)}$ 2. 2.0 L of $Cl_{2(G)}$ 3. 3.0 L of $H_2S_{(G)}$ 4. 6.0 L of $He_{(G)}$

Time for another demo, this one is about Pressure and Temperature (the can crush)

49. Pressure as a function of Temperature

as temperature _____ pressure _____

Temperature and Pressure are

_____

Does the can "suck in" or does air pressure crush it from the outside?

CHEM NEVER _____

Now, more demos, meet you in the back of the room

50	51, 52, 53
54, 55, 56	57, 58, 59

60. The KINETIC MOLECULAR THEORY   AKA _____ (make flash cards, or else)
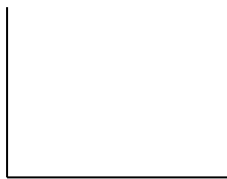
A.

B.

C.

D.

E.

F.

G.

61. Draw these three graphs (careful title to axis label placement!)

62. According to the kinetic molecular theory, the particles of an ideal gas
   1. have no potential energy   2. are separated by great distances, compared to their size
   3. have strong intermolecular forces   4. are arranged in a regular, repeated geometric pattern

63. Which temperature change would cause a sample of an ideal gas to double in volume while the pressure
   is held constant?
   1. from 400. K to 200. K   2. from 200. K to 400. K
   3. from 400.°C to 200.°C   4. from 200.°C to 400.°C

64. A sample of gas confined in a cylinder with a movable piston is kept at constant pressure.
   The volume of the gas doubles when the temperature of the gas is changed from
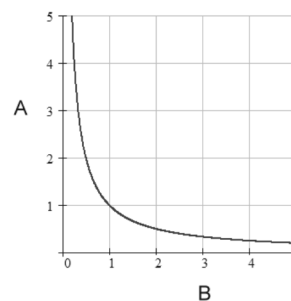   1. 400. K to 200. K   2. 200. K to 400. K   3. 400.°C to 200.°C   4. 200.°C to 400.°C

65. Under which conditions of temperature and pressure would a 1-liter sample of a real gas behave most like
   an ideal gas?
   1. 100 K and 0.1 atm   2. 100 K and 10 atm   3. 500 K and 0.1 atm   4. 500 K and 10 atm

66. Here is a graph from gas chemistry. What relationship can it represent?

   1. Pressure as a function of Volume
   2. Pressure as a function of Temperature
   3. Volume as a function of Temperature
   4. Temperature as a function of Kinetic Energy

67. What is the volume of a gas at 2.00 atm, and 360. Kelvin, if it's original volume was 307 Liters at 385 Kelvin and 0.250 atm?

68. Under which conditions of temperature and pressure would a 1-liter sample of a real gas behave LEAST like an ideal gas?

  1. 356 K & 1.2 atm   2. 356 K & 4.0 atm   3. 459 K & 1.2 atm   4. 500 K & 4.0 atm

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When we celebrate gases. Here's how to do well:

1   You will be able to understand all points of the KMT, including being able to describe the difference between real and ideal gases.

2   You will be able to draw 3 graphs that show the relationships between: Pressure + Volume, Pressure + Temperature, and Volume + Temperature. You will know which of these are directly proportional, and which is inversely proportional.   Your graphs will match the titles to the axis labels as well.

3   You will be able to state and explain Avogadro's Hypothesis

4   You will be able to calculate any pressure conversions

5   You will be able to calculate any type of combined gas law problems

6   You will have read the BASICS twice.