Chemistry 10: Gases (getting legal about gases).

April 27- May 1

Time Allotment: 40 minutes per day

Student Name: _____

Teacher Name: _____

Academic Honesty

I certify that I completed this assignment independently in accordance with the GHNO Academy Honor Code.

Student signature:

_____

I certify that my student completed this assignment independently in accordance with the GHNO Academy Honor Code.

Parent signature:

_____

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Packet Overview

Date	Objective(s)	Page Number
Monday, April 27	*Characteristics of gases*	3
Tuesday, April 28	*Pressure*	6
Wednesday, April 29	*Charles and Boyle*	10
Thursday, April 30	*Avogadro; review for quiz*	13
Friday, May 1	*Quiz on days 1-4 and the "ideal gas" equation*	17

.

Additional Notes:

Hi all,

Some advice this week:

1) You'll be memorizing some equations
    a. Using terms like "direct relationship", "inverse relationship", "increase", and "decrease" will be very helpful.

2) You'll be thinking about physical variables (pressure, volume, temperature, mass) and how they are all related as it pertains to gases.

My advice: Buy a bag of balloons. There are some very useful experiments in this week's packet that can help you think about these relationships (and there are more experiments you can think of that are not in this packet!). If you don't have or can't buy balloons, then you'll have to use your imagination. But (obviously) it's better to touch things. In few other places do you get to see the relationship between reality and equations that you'll experience in this unit. So enjoy.

Mr. Luke

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Monday, April 27

Chemistry Unit: Gases (getting legal about gases)
Lesson 1: Physical properties of gases

Unit Overview

A Question for Lesson 1: What are some words I can use to describe the movement and properties of gas(es)?

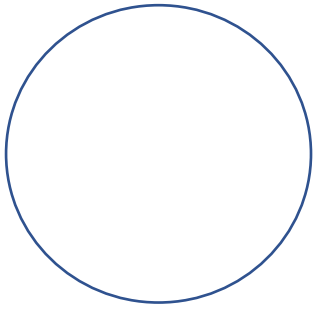
Objective

Be able to answer all questions below.

Introduction to Lesson 1

Read and take short notes on Section 10.1 in your textbook (pages 399 to 402). Then answer the questions below.

What gases compose air? Write the relative percentages. Fill in a pie chart:



What is the difference between a **mono**atomic and **di**atomic gases?

Name 1 element that tends to be a monotatomic gas: _____ and one element that tends to be a diatomic gas: _____.

Note the common molecular compound gases in Table 10.1 (page 400). What similarities do you notice about them?

Hints: what kind of compound are they (ionic, molecular, organic, etc)? What kind of elements are they made of (metal, nonmetal, metalloid)?

H_2O can exist as a solid, liquid, or a gas. However, when water is in the gaseous form, we call it **water vapor**, *not* **water gas** or **gaseous water**. Why is that?

_____

Summarize the three primary differences gases show when compared to liquids or solids, as far as their behavior and movement goes:

_____

_____

_____

You release 1 Liter of pure O_2 into a 100-liter container. You wait 5 minutes. What is the volume of the O_2 gas? (how much space does the O_2 take up?): _____

You release 1 Liter of pure water into a 100-liter container. You wait 5 minutes. What is the volume of the H_2O liquid? (how much space does the H_2O take up?): _____

You mix 2 tablespoons of oil and 2 tablespoons of water in a sealed container. Do they mix?

Now, you heat the oil and water in a sealed container until they both have turned into gas and are floating around the container. **Are they mixing?** _____

How is this possible? What trait or state of gas molecules allows them to do this?

_____

If you were to take a 100-Liter tank filled with O_2 gas, collect all the O_2 molecules and pack them all together, how much space would the ball of O_2 molecules take up?

a. 100 L
b. 10 L
c. 1 L
d. 100 mL (0.1 L)

The molecules of a gas take up about 0.1% of the total volume, whereas in liquids the individual molecules take up about ____% of the liquid's volume.

For example, if you were to compress 100 mL of water until all the H_2O molecules were packed tightly together, it would take up _____mL of space.

(Thinking outside the reading) What else do you think might happen if you were to pack a lot of O_2 or H_2O molecules so tightly together that they formed a clump or a sort of ball?

Nice work today! Keep this in mind—things are about to change.

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Tuesday, April 28

Chemistry Unit: Gases (getting legal about gases)
Lesson 2: Pressure and quantifying it (mathematically)

Unit Overview

Two Questions for Lesson 2: What is pressure? How can I measure and quantify it?

Objective:

Be able to answer all questions below.

Introduction to Lesson 2

Read and take short notes on Section 10.2 (pages 401 and 402, then answer the questions below.

1. What two variables can be used to calculate a quantity of pressure?
2. Write an equation for finding pressure, using three variables:
3. **Show your work below.** If a man presses with 20. N of force onto a plastic board with area 2.0 m^2, how much pressure is he applying? **Make sure you write units, or your number will not be meaningful.**
4. What is the SI unit of pressure? What base SI units is it composed of? Write the compound unit and the base units below.

   ☐ = ☐

   compound unit base units
5. All the most common units of pressure are given below. Fill in the blanks.

   1 atm = _____ mm Hg = _____ torr = _____ kPa = _____ Pa
6. Using a diagram and 2-3 sentences, explain how a barometer is able to tell you the amount of pressure in a room.

Diagram:

Explanation:

_____
_____
_____
_____

7. A woman goes to a nurse. Her blood pressure at the time is 130 torr / 70 torr.

   Using dimensional analysis and conversion factors from the units equation above, write her blood pressure in Pascals. **Show your work!**

Answer: _____ Pa
Pa

Today's Optional Review Problems
Found in your textbook at the end of Chapter 10 (pages 423-440).

10.10 **10.13**

10.11 **10.14**

10.18a b **10.21**

c d

10.20

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Wednesday, April 29

Chemistry Unit: Gases (getting legal about gases)
Lesson 3: Boyles' and Charles' gas laws

Unit Overview

Objective:

Be able to answer all questions below.

Two Questions for Lesson 3: What kind of relationship do pressure and volume have?
Temperature and volume?

Introduction to Lesson 3

Experiment of the Day
Blow up a balloon to about the size of your fist. Tie it off. In both hands, squeeze the balloon. If you can, try to make it pop.

What is happening inside the balloon to the pressure? What is happening to the air/gas molecules? Try to explain in a physically descriptive fashion. **Use 2+ sentences (one for each question).**

_____
_____
_____

Read the first two sections of Chapter 10.3 ("The Pressure-Volume Relationship" and "The Temperature-Volume Relationship" on pages 405 to 407). Then answer the questions below.

Boyle's Law

1. In a sentence, summarize Boyle's Law:

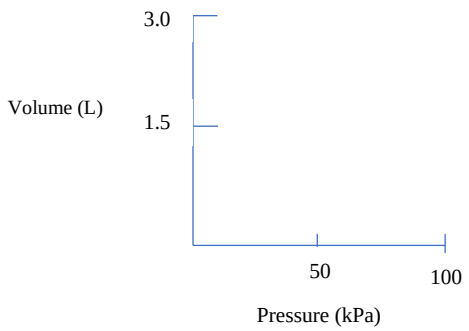
_____

   a. Express it as an equation, using the variables P (pressure), V (volume), and c (constant).

   _____

Given the pressure values below and the equation above, calculate the volume at each pressure if PV = 39. Then, graph the values on the chart to the right.

Pressure (kPa)	Volume (L)
100	
80	
50	
10	



To sum up, as the volume increases, the pressure _____;
as the volume decreases, the pressure _____;
as the pressure increases, the volume _____,
and as the pressure decreases, the volume _____.

Chrales' Law

1. In a sentence, summarize Jacques Charles' law :

---

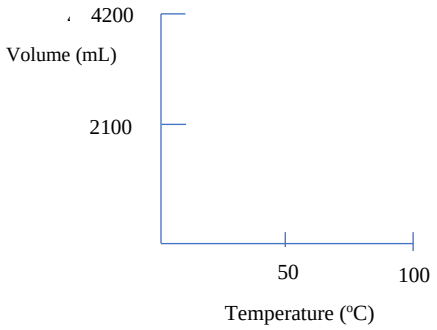
a. Express it as an equation, using the variables P (pressure), T (temperature), and c (constant).

_____

b. In this equation, T and V have a (direct/inverse) relationship.
c. In Boyles' equation from yesterday, V and P have a (direct/inverse) relationship.

Given the sample temperatures below and the equation above, calculate the volume at each temperature if V/T = 42. Then, graph the values on the chart to the right.

Temperature (°C)	Volume (mL)
100	
80	
50	
10	



To sum up, as the temperature increases, the volume _____;
as the temperature decreases, the volume _____;
as the volume increases, the temperature _____, and
as the volume decreases, the temperature _____.

Today's Optional Review Problems

10.23 a

b

10.24 a

b

(Go back and do yesterday's optional review problems if you have 5+ minutes left. Nice work!)

Thursday, April 30

Chemistry Unit: Gases (getting legal about gases)
Lesson 4: Avogadro's law and review for tomorrow's quiz

Unit Overview

Lesson 4 Socratic Question: What is the relationship between temperature and volume?

Objective:

Be able to answer all questions below.
See note at the end of today's work for tips on reviewing for tomorrow's (short) quiz.

Introduction to Lesson 4

Experiment of the Day
Blow up a balloon to about the size of your fist. Tie it off. Safely heat some water in a pot, then place the balloon in. What is happening inside the balloon to the pressure? The volume? What is happening to the air/gas molecules? Try to explain in a physically descriptive fashion. **Use 2+ sentences in your answer.**

_____

_____

_____

Read and take notes on Joseph Louis Gay-Lussac and Amadeo Avogadro's hyoptheses on page 407. Then, read on to the next page (408) and stop at the Sample Exercise.

Answer the questions below.

Avogadro's Law

1. In a sentence, summarize Amadeo Avogadro's law :

_____

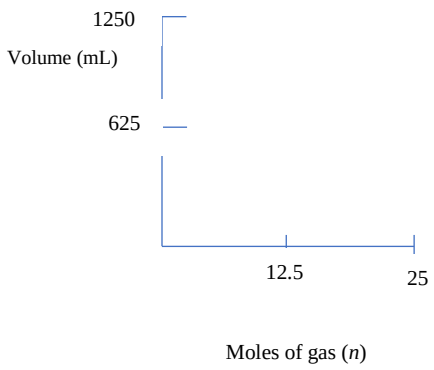
   a. Express it as an equation, using the variables V (volume), *n* (number of moles of gas), and c (constant).

      _____

   b. In this equation, *n* and V have a (direct/inverse) relationship.
   c. In Charles' equation from yesterday, V and T have a (direct/inverse) relationship.

Given the sample temperatures below and the equation above, calculate the volume at each temperature if $n/V = 50$. Then, graph the values on the chart to the right.

Moles of gas (*n*)	Volume (mL)
25	
24	
12.5	
2	



To sum up, as the amount of gas increases, the volume _____;
as the amount of gas decreases, the volume _____;

Today's Mandatory Review Problems
Show all work.

1) A sample of helium has a volume of 3 liters when the pressure is 500 torr. What volume does the gas occupy at 300 torr?

Tip: You'll need to 1) decide which of the three law equations (Boyles', Charles', or Avogadro's) you'll need, then 2) calculate the value of the constant *c* in the equation. Then you can 3) set up a new equation with the second variable, then use *c* to solve for the unknown.

2) At a pressure of 100 kPa, a sample of a gas has a volume of 50 liters. What pressure does it exert when the gas is compressed to 40 liters?

3) When a 375 mL sample of nitrogen is kept at constant temperature, it has a pressure of 1.2 atmospheres. What pressure does it exert when compressed to 125 mL?

4) When a sample of hydrogen is compressed to 240 mL, its pressure changes from 0.8 atmospheres to 2 atmospheres. What was the original volume of the sample?

5) At constant pressure, a sample of gas occupies 420 mL at 210 K. What volume does the gas occupy at 250 K?

6) A sample of argon gas has a volume of 6 liters at a temperature of 7 °C. What volume does the gas occupy at 147 °C?

7) At what **Kelvin** temperature will a sample of gas occupy 12 liters if the same sample occupies 8 liters at 27 °C?

Note for Review

The quiz tomorrow, which consists of 7 short questions, will require knowledge of the four variables: pressure, volume, temperature, and amount of gas in moles (*n*). Know each of the three gas laws (Charles', Boyles', and Avogadro's) and be comfortable solving for pressure, volume, and temperature, using those three equations. The questions above are a good measure of the types of questions you'll see on the quiz.

Friday, May 1

Chemistry Unit: Application of knowledge to elements, periodic trends
Lesson 4: A quiz and the "Ideal Gas" Equation

Unit Overview

Lesson 5 Socratic Question: What can ionization energy and context tell me about these specific elements?

Objective: Be able to do this by the end of this lesson.

Take the quiz.
Be able to answer any of the questions below.

If you are signed up for Google Classroom, please take the quiz under Week 6 ("Minor Assessment Submission: The gas laws". You do not need to submit the last page of this packet.

If you are not signed up for Google Classroom, use the quiz on the last page of this packet. When finished, submit the attached quiz as usual.

You may start the lesson below before or after completing the quiz.

Introduction to Lesson 5

Read and take notes on pages 408 to 412. Then answer the questions below.

In the gas equations, P stands for _____, V stands for _____, T stands for _____, and *c* stands for "_____".

If $\frac{V}{P} = c$
$VT = c$, and
$Vn = c$,

then $\frac{VnT}{p} = c$, or $PV = ncT$ (there are a number of ways it could be expressed)

This equation is often phrased with *R* for *c* (they both still mean "constant", however).[1]

$$PV = nRT$$

[1] Chemists and physicists often call this equation the "pivnert" equation as a mnemonic device.

A word on the constant (*c* or *R*, in this case). It can be calculated by plugging in the values V, *n*, T, and P for any given experimental situation—maybe you're calculating gas variables for helium in a standard party balloon; maybe you're calculating gas variables for the air in the piston of a car engine—it doesn't really matter what kind of gas-based situation you're dealing with. Each situation will have its own unique constant (*c* or *R*, in this case) that can be determined by knowing P, V, *n*, and T.

Temperature must be expressed in Kelvins for these equations to work.

1. "Standard Temperature and Pressure" or "STP" is a way of saying "we're doing this experiment in normal conditions". Write down the values for T and P for an experiment being done at STP:

   Standard T: _____ Kelvin = _____ °C
   Standard P: _____ atm = _____ kPa

2. How many Liters of space does 1 mole of gas take up at standard temperature and pressure?

3. Why is the PV = *n*RT law called the "ideal" gas law (and not simply "the gas law")?

   I. Why is it useful, even though it technically doesn't predict the P, V, T, or *n* of any real gas in actuality?
   _____

4. Using the box (STRATEGIES IN CHEMISTRY) on page 411, write down the four main strategies you can use when solving PV = *n*RT problems.

   I. _____

   II. _____

   III. _____

   IV. _____

Comprehension Check

5. How is it that an equation (PV = *n*RT) is a *law*? How can an equation express a truth or a rule?

6. Re-phrase the ideal gas equation in words, using terms like "is proportional to" or "is equal to".

When an you're given a situation where the pressure, volume, and/or temperature change from 1 second to the next, how would we set up an equation to solve it? Write that equation below (page 412).

initial condition	final condition

Mandatory Practice Problems: The "Ideal Gas" Law

10.32 a b c

10.34 10.35 (remember 6.022×10^{23} molecules in a moles)

10.36 (remember 6.022×10^{23} molecules in a moles)

10.37 a b c

10.33 (solve for **moles** of H_2, then convert to grams)

The quiz is on the next page.

For this quiz, you may use a calculator, a pencil, and scratch paper. You may not use a periodic table (not needed).

Quiz: The Gas Laws

A review of basic topics in preparation for advanced gas law work.

1. A sample of neon gas exerts a pressure of 120 kPa when the temperature is 400 K. What pressure is produced when the temperature is raised to 600 K?
    a. 80 kPa
    b. 180 kPa
    c. .00005 kPa

2. Assuming all other variables remain constant, as the temperature of a gas inside a chamber decreases, its volume would
    a. increase
    b. decrease

3. What pressure will a gas sample exert at 300 K if the same sample has a pressure of 4 atmospheres at 120 K?
    a. 6atm
    b. 10 atm
    c. 1×10^{-4} atm

4. Assuming all other variables remain constant, as the amount of a gas inside a chamber increases, its volume would
    a. increase
    b. decrease

5. A chemist produces 460 mL of oxygen gas at 230.15 K and constant pressure. To what temperature, in Kelvins, must the oxygen be warmed in order for it to have a volume of 600 mL?
    a. 300 K
    b. 176 K
    c. 273.15 K

6. Assuming all other variables remain constant, as the volume inside a chamber decreases, the pressure would
    a. increase
    b. decrease

7. Some gas is held in a rigid container (e.g. not a balloon). If the pressure at 100 K is 52 kPa, at what Kelvin temperature would the pressure be doubled?
    a. 50 K
    b. 100 K
    c. 150 K
    d. 200 K