**Chemistry**

**Packet#14**

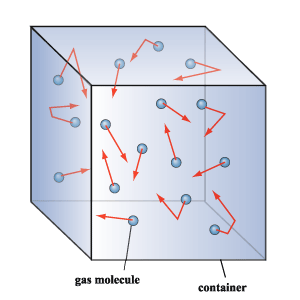
***The Gas Laws***

***Edmodo Group Code:*** *ozm60q* (http://www.edmodo.com)

***Class Website:*** http://mrgchem.weebly.com

***Mr. Gutierrez’s email:*** gutierrez.br@elizabeth.k12.nj.us

Text Messaging Reminders: Text @aofchem to 235559



*Note: You are expected to work on this packet during the allotted class practice time.*

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| --- | --- |
| **Packet Points** | |
| / | Completed Class Notes |
| / | Writing Name on Every Page |
| / | Handed Packet in on Time |
| / | Homework |
| / | Followed Classroom Policies |
| / | Classwork Participation |
| / | TOTAL POINTS |

Name of Chemist:

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Period: \_\_\_\_\_\_\_\_\_\_\_

***DUE \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_***

*\*All Classnotes + Questions MUST be finished for HOMEWORK if not done in class.*

**Unit#11: The Gas Laws**

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**Packet Grading:**

Remember you get TWO types of grades for your packet:

1. Packet participation grade (getting stamps at the end of the period)
2. Each “Class Work” section gets a separate grade

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT state the kinetic-molecular theory of matter and list the five assumptions of the kinetic-molecular theory of gases.** |
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Class Notes:

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| **The Kinetic-Molecular Theory of Gases**  **(Textbook Pages 329-332)**   |  |  | | --- | --- | | **Five Postulates (Assumptions)** | **Summary** (reword in your own words) | | 1. Gases consist of large numbers of tiny particles that are far apart relative to their size.  2. Collisions between gas particles and between particles and container walls are elastic collisions.  3. Gas particles are in continuous, rapid, random motion. They therefore possess kinetic energy, which is energy of motion.  4. There are no forces of attraction or repulsion between gas particles.  5. The average kinetic energy of gas particles depends on the temperature.  Kinetic energy = mv2 |  |   **Nature of Gases**  Summarize the information from the textbook about the nature of gases. Make sure to use your own words. Feel free to draw images or diagrams.  1. *Expansion*  2. *Fluidity*  3. *Low Density*  4. *Compressibility*  5. *Diffusion and Effusion* |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT define pressure and convert from one unit of pressure to another.** |
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**Pressure**

**(Textbook pages 361 – 365)**

Class Notes:

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| ***Pressure*** is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  Mathematically:  Pressure = force/area or P = F/A  The units of pressure:   * Atmosphere (atm) * Millimeters of mercury (mmHg) * Torr (torr)     A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a device that measures pressure.  **Standard Temperature and Pressure** has been agreed to be \_\_\_\_\_\_\_\_\_ atm pressure and \_\_\_\_\_ degrees Celsius.  **Pressure Unit Conversions**  1 atm = 760 mmHg  1 atm = 760 torr  1 torr = 1 mmHg  *Example#1*: Express 500 atmosphere in millimeters of Mercury. (atm to mmHg)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  |   *Example#2*: Express 876 mmHg in atm. (mmHg to atm)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  |   *Example#3*: How many torr are there in 980 atm?   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  | |

**You Try! Pressure Conversions**

Convert 500 mmHg to atmosphere.

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT define pressure and convert from one unit of pressure to another.** |
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**Pressure Conversions**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

Remember:

1 atm = 760 mmHg

1 atm = 760 torr

1 torr = 1 mmHg

1. Convert 1000 mmHg to atm.

2. How many torr are there in 8 x 1023 mmHg?

3. Express 9000 mmHg in atmosphere.

4. How many atmospheres are there in 6,900 mmHg?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Boyles’ law to calculate volume-pressure changes at constant temperature.** |
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**Boyle’s Law**

**(Textbook pages 369 – 370)**

Class Notes:

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| ***Boyle’s Law*** states that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Mathematically:  ***Volume*** is the amount of space that a substance occupies.   * Some units of volume include:   Based on the graph below, you can conclude that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Boyle’s Law Calculations**  *Example#1*. A sample of oxygen gas has a volume of 150.0 mL when its pressure is 0.947 atm. What will the volume of the gas be at a pressure of 0.987 atm if the temperature remains constant?   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | | When working with formulas follow “FLIPS.”  1. **Formula**  2. **List** information from question  3. **Isolate** the unknown variable  4. **Plug In** the numbers from your list.  5. **Solve** the equation and do the math. |  |   *Example#2*. A sample of oxygen gas has a volume of 300.0 mL when its pressure is 0.80 atm. What will the pressure of the gas be if its final volume is 250.0 mL if the temperature remains constant?   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | | When working with formulas follow “FLIPS.”  1. **Formula**  2. **List** information from question  3. **Plug In** the numbers from your list.  4. **Solve** the equation and do the math. |  |   *In your own words, summarize Boyle’s Law:* |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Boyles’ law to calculate volume-pressure changes at constant temperature.** |
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**BOYLES’ LAW CALCULATIONS**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

The formula for Boyle’s Law is:

1) 1.00 L of a gas at standard temperature and pressure is compressed to 473 mL. (Refer to your notes for the values of standard temperature and pressure.) What is the new pressure of the gas?

2) In a thermonuclear device, the pressure of 0.050 liters of gas within the bomb casing reaches 4.0 x 106 atm. When the bomb casing is destroyed by the explosion, the gas is released into the atmosphere where it reaches a pressure of 1.00 atm. What is the volume of the gas after the explosion?

3) Synthetic diamonds can be manufactured at pressures of 6.00 x 104 atm. If we took 2.00 liters of gas at 1.00 atm and compressed it to a pressure of 6.00 x 104 atm, what would the volume of that gas be?

4) The highest pressure ever produced in a laboratory setting was about 2.0 x 106 atm. If we have a 1.0 x 10-5 liter sample of a gas at that pressure, then release the pressure until it is equal to 0.275 atm, what would the new volume of that gas be?

5) Atmospheric pressure on the peak of Mt. Everest can be as low as 150 mm Hg, which is why climbers need to bring oxygen tanks for the last part of the climb. If the climbers carry 10.0 liter tanks with an internal gas pressure of 3.04 x 104 mm Hg, what will be the volume of the gas when it is released from the tanks?

6) Part of the reason that conventional explosives cause so much damage is that their detonation produces a strong shock wave that can knock things down. While using explosives to knock down a building, the shock wave can be so strong that 12 liters of gas will reach a pressure of 3.8 x 104 mm Hg. When the shock wave passes and the gas returns to a pressure of 760 mm Hg, what will the volume of that gas be?

7) Submarines need to be extremely strong to withstand the extremely high pressure of water pushing down on them. An experimental research submarine with a volume of 15,000 liters has an internal pressure of 1.2 atm. If the pressure of the ocean breaks the submarine forming a bubble with a pressure of 250 atm pushing on it, how big will that bubble be (volume)?

8) Divers get “the bends” if they come up too fast because gas in their blood expands, forming bubbles in their blood. If a diver has 0.05 L of gas in his blood under a pressure of 250 atm, then rises instantaneously to a depth where his blood has a pressure of 50.0 atm, what will the volume of gas in his blood be?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Charles’ law to calculate volume-temperatures changes at constant pressure.** |
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**Charles’ Law**

**(Textbook Pages 371 - 372)**

*Class Notes:*

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| ***Charles’ Law states*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  Mathematically:  Based on the graph below, you can conclude that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Charles’ Law Calculations**  *Example#1*. A sample of neon gas occupies a volume of 752 mL at 25 degrees Celsius.  What volume will the gas occupy at 50 degrees Celsius if the pressure remains constant?  IMPORTANT: When doing calculations using ANY of the gas laws, you must use Kelvin as your unit for temperature!!!  Celsius 🡪 Kelvin = 273 + degrees Celsius (e.g. 25 degrees Celsius is 273 + 25 = 298 K)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | | When working with formulas follow “FLIPS.”  1. **Formula**  2. **List** information from question  3. **Plug In** the numbers from your list.  4. **Solve** the equation and do the math. |  |   *Example#2*. A sample of nitrogen gas is contained in a piston with a freely moving cylinder. At 0 degrees Celsius, the volume of the gas is 375 mL. To what temperature must the gas be heated to occupy a volume of 500 mL?  IMPORTANT: When doing calculations using ANY of the gas laws, you must use Kelvin as your unit for temperature!!!  Celsius 🡪 Kelvin = 273 + degrees Celsius  (e.g. 25 degrees Celsius is 273 + 25 = 298 K)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | | When working with formulas follow “FLIPS.”  1. **Formula**  2. **List** information from question  3. **Plug In** the numbers from your list.  4. **Solve** the equation and do the math. |  | | |
| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Charles’ law to calculate volume-temperatures changes at constant pressure.** |
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**Charles’ Law Calculations**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

1) The temperature inside my refrigerator is about 40 Celsius. If I place a balloon in my fridge that initially has a temperature of 220 C and a volume of 0.5 liters, what will be the volume of the balloon when it is fully cooled by my refrigerator?

2) A man heats a balloon in the oven. If the balloon initially has a volume of 0.4 liters and a temperature of 20 0C, what will the volume of the balloon be after he heats it to a temperature of 250 0C?

3) On hot days, you may have noticed that potato chip bags seem to “inflate”, even though they have not been opened. If I have a 250 mL bag at a temperature of 19 0C, and I leave it in my car which has a temperature of 600 C, what will the new volume of the bag be?

4) A soda bottle is flexible enough that the volume of the bottle can change even without opening it. If you have an empty soda bottle (volume of 2 L) at room temperature (25 0C), what will the new volume be if you put it in your freezer (-4 0C)?

5) Some students believe that teachers are full of hot air. If I inhale 2.2 liters of gas at a temperature of 180 C and it heats to a temperature of 380 C in my lungs, what is the new volume of the gas?

6) How hot will a 2.3 L balloon have to get to expand to a volume of 400 L? Assume that the initial temperature of the balloon is 25 0C.

7) I have made a thermometer which measures temperature by the compressing and expanding of gas in a piston. I have measured that at 1000 C the volume of the piston is 20 L. What is the temperature outside if the piston has a volume of 15 L? What would be appropriate clothing for the weather?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Gay-Lussac’s law to calculate pressure-temperature changes at constant volume.** |
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**Gay-Lussac’s Law**

**(Textbook Pages 373-374)**

Class Notes:

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| ***Gay-Lussac’s Law states*** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  Mathematically:  Based on the graph below, you can conclude that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Gay-Lussacs’ Law Calculations**  *Example#1*. The gas in a container is at a pressure of 3.00 atm at 25 degrees Celsius. Directions on the container warn the user not to keep it in a place where the temperature exceeds 52 degrees Celsius. What would the gas pressure in the container be at 52 degrees Celsius?  IMPORTANT: When doing calculations using ANY of the gas laws, you must use Kelvin as your unit for temperature!!!  Celsius 🡪 Kelvin = 273 + degrees Celsius  (e.g. 25 degrees Celsius is 273 + 25 = 298 K)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  |   *Example#2*. A sample of helium gas has a pressure of 1.20 atm at 22 degrees Celsius. At what Celsius temperature, will the helium reach a pressure of 2.00 atm, assuming constant volume? (Because this asks for temperature in Celsius, you do not need to convert the given temperature to Kelvin.)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  |   *In your own words, summarize Gay-Lussac’s Law:* |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use Gay-Lussac’s law to calculate pressure-temperature changes at constant volume.** |
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**Gay-Lussac’s Law Calculations**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

1. Determine the pressure change when a constant volume of gas at 1.00 atm is heated from 20.0 ˚C to 30.0 ˚C.

2. A container of gas is initially at 0.500 atm and 25 ˚C. What will the pressure be at 125 ˚C?

3. A gas container is initially at 47 mm Hg and 77 K (liquid nitrogen temperature.) What will the pressure be when the container warms up to room temperature of 25 ˚C?

4. A gas thermometer measures temperature by measuring the pressure of a gas inside the fixed volume container. A thermometer reads a pressure of 248 Torr at 0 ˚C. What is the temperature when the thermometer reads a pressure of 345 Torr?

5. A gas is collected at 22.0 ˚C and 745.0 mm Hg. When the temperature is changed to 0 ˚C, what is the resulting pressure?

6. A gas has a pressure of 699.0 mm Hg at 40.0 ˚C. What is the temperature at

standard pressure?

7. If a gas is cooled from 323.0 K to 273.15 K and volume is kept constant what final pressure would result if the original pressure was 750.0 mm Hg?

1. The temperature of a sample of gas in a steel tank at 30.0 kPa is increased

from –100.0 ˚ to 1.00 x 103 ˚C to 25.0 ˚. What is the final pressure inside the tank?

1. Calculate the final pressure inside a scuba tank after it cools from 1.00 x 103 ˚C to 25.0 ˚C. The initial pressure in the tank is 130.0 atm.
2. A 30.0 L sample of nitrogen inside a rigid, metal container at 20.0 ˚C is placed

inside an oven whose temperature is 50.0 ˚C. The pressure inside the container at 20.0 ˚C was at 3.00 atm. What is the pressure of the nitrogen after its temperature is increased?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the Combined Gas Law to calculate pressure-temperature-volume changes.** |
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**Combined Gas Law**

**(Textbook Pages 374 – 375)**

Class Notes:

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| Mathematically, the combined gas law is:  **Combined Gas Law Calculations**  *Example#1*. A helium-filled balloon has a volume of 50.0 L at 25 degrees Celsius and 1.08 atm. What volume will it have at 0.855 atm and 10.0 degrees Celsius?  IMPORTANT: When doing calculations using ANY of the gas laws, you must use Kelvin as your unit!!!  Celsius 🡪 Kelvin = 273 + degrees Celsius  (e.g. 25 degrees Celsius is 273 + 25 = 298 K)   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | |  |  | |

*Example#2.* The volume of a gas is 27.5 mL at 22.0 degrees Celsius and 0.974 atm. What will the volume be at 15.0 degrees Celsius and 0.993 atm?

IMPORTANT: When doing calculations using ANY of the gas laws, you must use Kelvin as your unit!!!

Celsius 🡪 Kelvin = 273 + degrees Celsius

(e.g. 25 degrees Celsius is 273 + 25 = 298 K)

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| **Description of Steps** | **Calculations** |
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**YOU TRY! COMBINED GAS LAW CALCULATION!**

*Combined Gas Law Formula:*

The volume of a gas is 100 mL at 50.0 degrees Celsius and 0.954 atm. What will the temperature be at 190 mL and 0.999 atm?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the Combined Gas Law to calculate pressure-temperature-volume changes.** |
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**Combined Gas Law Calculations**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

*Combined Gas Law Formula (Look at your notes):*

1) If I initially have a gas at a pressure of 12 atm, a volume of 23 liters, and a temperature of 200 K, and then I raise the pressure to 14 atm and increase the temperature to 300 K, what is the new volume of the gas?

2) A gas takes up a volume of 17 liters, has a pressure of 2.3 atm, and a temperature of 299 K. If I raise the temperature to 350 K and lower the pressure to 1.5 atm, what is the new volume of the gas?

3) A gas that has a volume of 28 liters, a temperature of 45 0C, and an unknown pressure has its volume increased to 34 liters and its temperature decreased to 35 0C. If I measure the pressure after the change to be 2.0 atm, what was the original pressure of the gas?

4) A gas has a temperature of 14 0C, and a volume of 4.5 liters. If the temperature is raised to 29 0C and the pressure is not changed, what is the new volume of the gas?

5) If I have 17 liters of gas at a temperature of 67 0C and a pressure of 88.89 atm, what will be the pressure of the gas if I raise the temperature to 94 0C and decrease the volume to 12 liters?

6) I have an unknown volume of gas at a pressure of 0.5 atm and a temperature of 325 K. If I raise the pressure to 1.2 atm, decrease the temperature to 320 K, and measure the final volume to be 48 liters, what was the initial volume of the gas?

7) If I have 21 liters of gas held at a pressure of 78 atm and a temperature of 900 K, what will be the volume of the gas if I decrease the pressure to 45 atm and decrease the temperature to 750 K?

8) If I have 2.9 L of gas at a pressure of 5 atm and a temperature of 50 0C, what will be the temperature of the gas if I decrease the volume of the gas to 2.4 L and decrease the pressure to 3 atm?

9) I have an unknown volume of gas held at a temperature of 115 K in a container with a pressure of 60 atm. If by increasing the temperature to 225 K and decreasing the pressure to 30 atm causes the volume of the gas to be 29 liters, how many liters of gas did I start with?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the standard molar value to calculate amounts in moles and volumes.** |
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**Standard Molar Volume**

**(Textbook Pages 380-381)**

Class Notes:

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| ***The standard molar volume*** of a gas is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  STP stands for \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The value of the ***standard molar volume*** is equal to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  **Standard Molar Volume Calculations**  *Example#1*. What volume does 0.0685 mol of gas occupy at STP?  Solution:  *Example#2.* What quantity of gas in moles is contained in 2.21 L at STP?  Solution: |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the standard molar value to calculate amounts in moles and volumes.** |
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**Standard Molar Volume Calculations**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work.

1. At STP, what is the volume of 7.08 mol of nitrogen gas (N2)?

2. A sample of hydrogen gas occupies 14.1 L at STP. How many moles of the gas are present?

3. Extension. A sample of oxygen gas has a mass of 98 grams at STP. What is the volume that this gas occupies? (Hint: Convert grams to moles first.)

4. Extension. A small component of “fart gas”, methane gas which has a chemical formula of CH4, occupies a volume of 3.5 L at STP. What is its mass at this volume? (Hint: Find moles first and then convert to grams.)

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the Ideal Gas Law equation to determine pressure, volume, number of moles, and temperature when the value of three quantities are known.** |
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**The Ideal Gas Law**

**(Textbook Pages 383 – 385)**

Class Notes:

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| A constant is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The Gas Constant, R, has a value of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  The Ideal Gas Law Equation:  PV = nRT  Where:  P = pressure in **atmosphere (atm)**  V = volume in **liters (L)**  n = number of **moles** of gas  R = gas constant: 0.0821 **L \* atm/mol \* K**  T = temperature in **Kelvin**  Note: The units of each quantity are in **bold.** |

**Finding P, V, n, R, or T from the Ideal Gas Law Equation**

*Example*#1: What is the pressure in atmospheres exerted by a 0.500 mol sample of Nitrogen gas in a

10.0 L container at 298 K?

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| **Description of Steps** | **Calculations** |
| 1. **Formula**  2. **List** information from question  3. **Plug** in numbers  4. **Solve** for unknown |  |

*Example*#2: A gas occupies 8.77 L at 20 degrees Celsius. How many moles of gas are present if the pressure was measured to be 0.953 atm?

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| **Description of Steps** | **Calculations** |
| 1. **Formula**  2. **List** information from question  3. **Plug** in numbers  4. **Solve** for unknown |  |

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| --- |
| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT use the Ideal Gas Law equation to determine pressure, volume, number of moles, and temperature when the value of three quantities are known.** |
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**The Ideal Gas Law Calculations**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework. Show ALL your work. **Box your final answers.**

1) If I have 4 moles of a gas at a pressure of 5.6 atm and a volume of 12 liters, what is the temperature?

2) If I have an unknown quantity of gas at a pressure of 1.2 atm, a volume of 31 liters, and a temperature of 87 0C, how many moles of gas do I have?

3) If I contain 3 moles of gas in a container with a volume of 60 liters and at a temperature of 400 K, what is the pressure inside the container?

4) If I have 7.7 moles of gas at a pressure of 0.09 atm and at a temperature of 56 0C, what is the volume of the container that the gas is in?

5) If I have 17 moles of gas at a temperature of 67 0C, and a volume of 88.89 liters, what is the pressure of the gas?

6) If I have an unknown quantity of gas at a pressure of 0.5 atm, a volume of 25 liters, and a temperature of 300 K, how many moles of gas do I have?

7) If I have 21 moles of gas held at a pressure of 78 atm and a temperature of 900 K, what is the volume of the gas?

8) If I have 1.9 moles of gas held at a pressure of 5 atm and in a container with a volume of 50 liters, what is the temperature of the gas?

9) If I have 2.4 moles of gas held at a temperature of 97 0C and in a container with a volume of 45 liters, what is the pressure of the gas?

10) If I have an unknown quantity of gas held at a temperature of 1195 K in a container with a volume of 25 liters and a pressure of 560 atm, how many moles of gas do I have?

11) If I have 0.275 moles of gas at a temperature of 75 K and a pressure of 1.75 atmospheres, what is the volume of the gas?

12) If I have 72 liters of gas held at a pressure of 3.4 atm and a temperature of 225 K, how many moles of gas do I have?

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT compare and contrast effusion and diffusion. SWBAT use Graham’s law to determine the relative rate of effusion of two gases of known molar masses.** |
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**Effusion and Diffusion**

**(Textbook Pages 386 – 388)**

Class Notes:

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| **Effusion**  Effusion is defined as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  **Diffusion**  Diffusion is defined as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.  **Graham’s Law of Effusion**  *Review:*  Kinetic energy = where m is the mass of the gas and v is the velocity (speed with a direction) at which the gas travels.  For two different gases A and B, the following equation is true:  Where mA is the molar mass of gas A and mB is the molar mass of gas B; and vA is the velocity of gas A and vB is the velocity of gas B.  From this equation, you can derive Graham’s Law of Effusion which state the rates of effusion of gases at the same temperature and pressure can be calculated by using the following mathematical relationship:   |  | | --- | | **Graham’s Law of Effusion** |   WARNING!!! WARNING!!! When using this equation, be careful where MB and MA go. As you can see, MB and Rate of Effusion A are on top while MA and Rate of Effusion of B are at the bottom.  **Graham’s Law of Effusion Calculations**  *Example#1*. Compare the rates of effusion of hydrogen and oxygen gas at the same temperature and pressure. Remember that oxygen is found as O2 and hydrogen as H2.   |  |  | | --- | --- | | **Description of Steps** | **Calculations** | | When working with formulas follow “FLIPS.”  1. **Formula**  2. **List** information from question  3. **Plug In** the numbers from your list.  4. **Solve** the equation and do the math. |  | |

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| **Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**  **Objective: SWBAT compare and contrast effusion and diffusion. SWBAT use Graham’s law to determine the relative rate of effusion of two gases of known molar masses.** |
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**Effusion and Diffusion Questions**

***Class Work (Independent Practice):*** Finish as many questions as you can during class. Refer to your notes and ask at least three classmates before asking me for help. If you do not finish these questions in class, you must finish them for homework.

1. Compare the rate of effusion of carbon dioxide with that of hydrogen chloride at the same temperature and pressure.

2. Compare the rate of effusion of bromine gas (Br2) and nitrogen gas (N­­2) at the same temperature and pressure.

3. A sample of hydrogen gas (H­­2) effuses through a porous container about 9 times faster than an unknown gas x. Estimate the molar mass of the unknown gas.

Make sure Mr. Gutierrez stamps/signs this by the end of the period. You CANNOT get the stamp/signature for a day later on. It is your responsibility to remind Mr. Gutierrez. You will NOT receive a stamp if you did not follow all classroom policies or actively work on the practice problems during the allotted class time.A stamp means you received all 10 points. No stamps means you’ve received zero points. If you completed some work, I may give you partial credit based on my discretion. ***If you are absent, write the date on the day you were absent and write the word “Absent.” DO NOT LOSE THIS SHEET!!!*** (If you lose this sheet, you will lose all of your participation points. NO EXCEPTIONS.)

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| **Day of Week** | **Followed All Classroom Policies** (Respectful, on time, prepared, engaged…) | **Class work Participation** | **Homework** |
| *Monday* | /10 | /10 | /10 |
| *Tuesday* | /10 | /10 | /10 |
| *Wednesday* | /10 | /10 | /10 |
| *Thursday* | /10 | /10 | /10 |
| *Friday* | /10 | /10 | /10 |

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| **Classroom Policy Violation Codes**  P = Phone  C = Cursing  T = Talking  L = Late to class  O.T. = Off Task  H.D. = Head Down  N.iP = Did not bring iPad  Unp = Unprepared (no pencil, no iPad, no emergency passes, no periodic table, etc.) |

**Teacher Comments:**