



2. A weather balloon is filled to the volume of 150.0 L on a day when the temperature is 10.0°C. If no gases escaped, what would be the volume of the weather balloon after it rises to an altitude where the temperature is -8.00°C?

3. A fixed quantity of gas at 23.0°C has a volume of 10.3 L. Calculate the volume the gas will occupy if the temperature is increased to 145°C while the pressure is held constant.

4. A sample of gas occupies a volume of 7.50 L at 28.0°C. At what temperature is the volume of the gas 4.00 L if the pressure is kept constant.

5. A gas occupies a volume of 100.0 mL at 27.0°C. At what temperature would the volume be 50.0 mL?

**Gay-Lussac's Law:  $P_1T_2 = P_2T_1$  (or  $P_1/T_1 = P_2/T_2$ ) \*\*T must be in Kelvin ( $K = 273 + ^\circ C$ )\*\***

1. A sample of gas has a pressure of 100.0 torr and 27.0°C. Calculate the pressure if the temperature is changed to 127°C while the volume remains constant.

2. A gas initially at STP is changed to 248 K. Calculate the final pressure of the gas.

3. A gas occupies a volume of 50.0 mL at 27°C and 630 mmHg. At what temperature, in °C, would the pressure be 101.3 kPa if the volume remains constant?

4. A sample of gas has a pressure of 700. mmHg and 30.0°C. At what temperature would the pressure be 600. mmHg if the volume remains constant?

5. A sample of gas is initially at STP. What would the pressure be if the temperature were increased to 819°C?

**Moles and Volume Law:**  $V_1n_2 = V_2n_1$  (or  $V_1/n_1 = V_2/n_2$ ) **\*\*n = moles\*\***

1. A 5.50 mole sample of gas has a volume of 2.50L. What would be the volume if the amount increased to 11.0 moles?

2. 7.50 moles of nitrogen occupies 4.25 L. How many moles of nitrogen would be present if the volume were 12.5 L, assuming pressure and temperature remain constant?

3. 2.15 moles of oxygen occupies 650. mL. How many moles of oxygen would be present if the volume were 1300. mL, assuming pressure and temperature remain constant?

4. A 4.50 mole sample of gas has a volume of 300. mL. What would be the volume if the amount increased to 5.50 moles?

**Combined Gas Law:**  $P_1V_1T_2 = P_2V_2T_1$  (or  $V_1P_1/(n_1T_1) = V_2P_2/(n_2T_2)$ ) **\*\*T must be in Kelvin ( $K = 273 + ^\circ C$ )\*\***

1. A 280.0 mL sample of neon exerts a pressure of 660.0 torr at 26.0°C. At what temperature would it exert a pressure of 940. torr in a volume of 440. mL assuming the number of moles remains constant?

2. A certain gas has a volume of 500.0 mL at 77.0°C and 600.0 torr. Calculate the temperature if the volume decreased to 400.0 mL and the pressure is increased to 760. torr and assume the number of moles does not change.

3. A given sample of gas has a volume of 4.20 L at 60.°C and 1.00 atm pressure. Calculate its pressure if the volume is changed to 5.00 L and the temperature to 27°C (assume the amount of gas does not change).

4. A gas has a volume of 240.0mL at 25.0°C and 0.789 atm. Calculate its volume at STP and assume the number of moles does not change.

5. 4.50 moles of a certain gas occupies a volume of 550.0 mL at 5.000°C and 1.000 atm. What would the volume be if 10.50 moles are present at 27.00°C and 1.250 atm?

**Gas Law Worksheet #2 (Dalton's Law and Ideal Gas Law)****Dalton's Law:  $P_T = P_1 + P_2 + P_3 + \dots$** 

1. Determine the total pressure of a gas mixture that contains oxygen at a pressure of 150.mmHg, nitrogen at 350.mmHg pressure, and helium at a pressure of 200.mmHg.
  
2. A gas mixture containing oxygen, nitrogen, and carbon dioxide has a pressure of 250.mmHg. If the partial pressure of oxygen is 50.0mmHg and the partial pressure of nitrogen is 175mmHg, what is the partial pressure of the carbon dioxide?
  
3. Consider a mixture of two gases A and B, confined to a closed vessel. A quantity of a third gas, C, is added to the same vessel at the same temperature. How does the addition of gas C affect the total pressure in the vessel?
  
4. Determine the total pressure of a gas mixture that contains oxygen at a pressure of 1.00 atm, nitrogen at 1.25 atm, and helium at a pressure of 2.00 atm.

**Ideal Gas Law:  $PV = nRT$  (**R = .0821 when P has atm units, T is K, V is L, n is moles**)**

1. A chemist is preparing to carry out a reaction at high pressure that requires 36.0 moles of hydrogen gas. The chemist pumps the hydrogen into a 12.4 L rigid steel container at 25.0 °C. To what pressure, in atm, must the hydrogen be compressed?
  
  
  
  
  
  
  
  
  
  
2. To what temperature must 0.588 moles of NH<sub>3</sub> gas have to be heated in a 15.0 L container in order for it to exert a pressure of 3.50 atm?

3. If 0.00100 moles of hydrogen gas at 155 °C exert a pressure of 323 mmHg. What is the volume?
4. It is desired to obtain a volume of 1.00 L of nitrogen at 100.°C and 640. mmHg. How many moles of nitrogen would be required?
5. Some oxygen is collected in a 0.250 L container at 25.0°C and 720.mmHg. How many moles of oxygen is this?
6. A chemist is preparing to carry out a reaction at high pressure that requires 5.50 moles of hydrogen gas. The chemist pumps the hydrogen into a 12.4 L rigid steel container at 25.0 °C. To what pressure, in atm, must the hydrogen be compressed?
7. To what temperature must 6.50 moles of a gas have to be heated in a 15.0 L container in order for it to exert a pressure of 7.50 atm?

**Gas Worksheet #3 – Molar Volume and Gas Stoichiometry****Gas Stoichiometry: (1 mol of gas @STP = 22.4 L)**

1. Given the following reaction:  $\text{NH}_4\text{NO}_2 (\text{s}) \rightarrow \text{N}_2 (\text{g}) + 2\text{H}_2\text{O} (\text{g})$  How many liters of nitrogen gas is produced if 50.0L of water is produced at STP?
2. Given the following reaction:  $\text{CuO} (\text{s}) + \text{H}_2 (\text{g}) \rightarrow \text{Cu} (\text{s}) + \text{H}_2\text{O} (\text{g})$  If 250. L of hydrogen gas are used to reduce copper (II) oxide at STP, what mass of copper is to be expected?
3. Given the following reaction:  $\text{Li} (\text{s}) + 2\text{H}_2\text{O} (\text{l}) \rightarrow \text{H}_2 (\text{g}) + 2\text{LiOH} (\text{aq})$  How many grams of solid lithium must be added to liquid water in order to obtain 15.0 L of hydrogen gas at STP?
4. Given the following reaction:  $16\text{KNO}_3 (\text{s}) + 24\text{C} (\text{s}) + \text{S}_8 (\text{s}) \rightarrow 8\text{N}_2 (\text{g}) + 24\text{CO}_2 (\text{g}) + 8\text{K}_2\text{S} (\text{s})$  When black gunpowder explodes, solid potassium nitrate, solid carbon, and solid sulfur react with each other to form nitrogen gas, carbon dioxide gas, and solid potassium sulfide. If the original mixture contains 50.0 grams of potassium nitrate, what volume of carbon dioxide is produced in the reaction at STP?
5. Given the following reaction:  $\text{Mg} (\text{s}) + 2\text{HCl} (\text{aq}) \rightarrow \text{H}_2 (\text{g}) + \text{MgCl}_2 (\text{aq})$  Calculate the volume of hydrogen gas produced by the reaction of 0.52 grams of solid magnesium with excess hydrochloric acid.
6. Given the following reaction:  $\text{H}_2 (\text{g}) + \text{Cl}_2 (\text{g}) \rightarrow 2\text{HCl} (\text{g})$  How many liters of hydrogen gas are needed to react completely with 50.0 L of chlorine gas at STP? How many liters of hydrogen chloride gas is produced in the reaction?
7. Given the following reaction:  $2\text{NO} (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2\text{NO}_2 (\text{g})$  How many liters of gaseous oxygen are needed to produce 4.50 L of gaseous nitrogen dioxide, if both gases are being measured at STP?
8. Given the following reaction:  $\text{N}_2 (\text{g}) + 3\text{H}_2 (\text{g}) \rightarrow 2\text{NH}_3 (\text{g})$  If 200. L of ammonia are produced in the reaction between nitrogen and hydrogen at STP, how many liters of nitrogen and hydrogen gases are used up in this reaction?
9. Given the following reaction:  $\text{F}_2 (\text{g}) + \text{H}_2 (\text{g}) \rightarrow 2\text{HF} (\text{g})$  If 30.0 L of fluorine gas are exposed to 50.0 L of hydrogen gas at STP which is the limiting reactant? Which is the excess? How many liters of hydrogen fluoride are formed in this reaction?

**Solids, Liquids, and Gases**

Read over the notes and practice problems.

1. Be able to define and identify the 6 phase changes (freezing, melting, vaporization, condensation, sublimation, and deposition).
2. Gases have a definite volume. True or False?
3. Solids have a definite volume. True or False?
4. Liquids have a definite volume. True or False?
5. Gases have a definite shape. True or False?
6. Solids have a definite shape. True or False?
7. Liquids have a definite shape. True or False?
8. Solids are considered fluids. True or False?
9. Liquids are considered fluids. True or False?
10. Gases are considered fluids. True or False?
11. Draw a picture showing the structure of a solid, liquid, and gas:

12. Define compressibility: (use drawing from above if needed)

**Solve the following problems.**

1. A gas is heated from  $-20.0^{\circ}\text{C}$  to  $57.0^{\circ}\text{C}$  and the volume is increased from 2.00 L to 4.50 L. If the initial pressure is 0.125 atm, what is the final pressure (assume number of moles remains constant)?
2. The volume of a sample of gas is 650.mL at  $0.00^{\circ}\text{C}$ . What volume will the sample occupy at  $75.0^{\circ}\text{C}$ ?
3. A 0.100 moles of solid carbon dioxide is allowed to sublime in a balloon. The final volume of the balloon is 1.00 L at 300. K. What is the pressure, in atm, of the gas?
4. Determine the total pressure of a gas mixture that contains oxygen at a pressure of 150.mmHg, nitrogen at 350.mmHg pressure, and helium at a pressure of 200.mmHg.
5. A 5.50 mole sample of gas has a volume of 2.50L. What would be the volume if the amount increased to 11.0 moles?
6. A sample of gas has a pressure of 100.0 torr and  $27.0^{\circ}\text{C}$ . Calculate the pressure if the temperature is changed to  $127^{\circ}\text{C}$  while the volume remains constant.
7. A gas sample contained in a cylinder equipped with a moveable piston occupied 300.0 mL at a pressure of 2.00 atm. What would be the final pressure if the volume were increased to 500.0 mL at constant temperature?
8. Given the following reaction:  $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$  How many liters of gaseous oxygen are needed to produce 4.50 L of gaseous nitrogen dioxide, if both gases are being measured at STP?