Name FITCH Date 3/15/16 Class CHEM

CHAPTER STUDY GUIDE FOR CONTENT MASTERY

Gases

The Gas Laws

In your textbook, read about the basic concepts of the three gas laws.

Use each of the terms below to complete the passage. Each term may be used more than once.

pressure	temperature	volume

Boyle's law relates **(1)** PRESSURE and **(2)** VOLUME if **(3)** TEMPERATURE and amount of gas are held constant. Charles's law relates **(4)** VOL and **(5)** TEMP if **(6)** PRESS and amount of gas are held constant. Gay-Lussac's law relates **(7)** PRESS and **(8)** TEMP if **(9)** VOL and amount of gas are held constant.

In your textbook, read about the effects of changing conditions on a sample of gas.

For each question below, write *increases*, *decreases*, or *stays the same*.

INCREASES **10.** The room temperature increases from 20°C to 24°C. What happens to the pressure inside a cylinder of oxygen contained in the room?

STAY THE SAME **11.** What happens to the pressure of the gas in an inflated expandable balloon if the temperature is increased? – VOL. INCREASES, THOUGH

DECREASES OR STAYS THE SAME **12.** An aerosol can of air freshener is sprayed into a room. What happens to the pressure of the gas if its temperature stays constant? DEPENDS ON HOW YOU INTERPRET QUESTION

INCREASES **13.** The volume of air in human lungs increases before it is exhaled. What happens to the temperature of the air in the lungs to cause this change, assuming pressure stays constant?

DECREASES **14.** A leftover hamburger patty is sealed in a plastic bag and placed in the refrigerator. What happens to the volume of the air in the bag?

INCREASES **15.** What happens to the pressure of a gas in a lightbulb a few minutes after the light is turned on?

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Name _____ Date _____ Class _____

CHAPTER STUDY GUIDE FOR CONTENT MASTERY

The Combined Gas Law and Avogadro's Principle

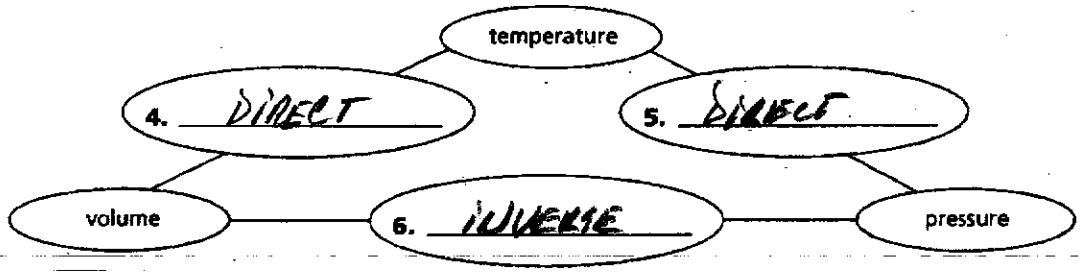
In your textbook, read about the combined gas law.

Fill in the following table. State what gas law is derived from the combined gas law when the variable listed in the first column stays constant and the variables in the second column change.

Derivations from the Combined Gas Law		
Stays constant	**Change**	**Becomes this law**
Volume	Temperature, pressure	1. $P_1/T_1 = P_2/T_2$ GAY-LUSSAC
Temperature	Pressure, volume	2. $P_1V_1 = P_2V_2$ BOYLE
Pressure	Temperature, volume	3. $V_1/T_1 = V_2/T_2$ CHARLES

In your textbook, read about the relationships among temperature, pressure, and volume of a sample of gas.

Fill in the blanks between the variables in the following concept map to show whether the variables are directly or inversely proportional to each other. Write *direct* or *inverse* between the variables.



In your textbook, read about the combined gas law and Avogadro's principle.

Circle the letter of the choice that best completes the statement or answers the question.

7. The variable that stays constant when using the combined gas law is
   a. amount of gas. **b.** pressure. **c.** temperature. **d.** volume.
8. The equation for the combined gas law can be used instead of which of the following equations?
   a. Boyle's law **b.** Charles's law **c.** Gay-Lussac's law **d.** all of these
9. Which of the following expresses Avogadro's principle?
   a. Equal volumes of gases at the same temperature and pressure contain equal numbers of particles.
   b. One mole of any gas will occupy a certain volume at STP.
   c. STP stands for standard temperature and pressure.
   d. The molar volume of a gas is the volume that one mole occupies at STP.

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Name _____ Date _____ Class _____

CHAPTER

STUDY GUIDE FOR CONTENT MASTERY

Answer the following questions.

10. What is standard temperature and pressure (STP)?

0°C/273 K 1 ATM/760 mmHg

11. What is the molar volume of a gas equal to at STP?

22.4 L

In your textbook, read about how to solve problems using the combined gas law and Avogadro's principle.

Each problem below needs more information to determine the answer. List as many letters as are needed to solve the problem.

a. molar volume of the gas
b. molar mass of the gas
c. temperature of the gas
d. pressure of the gas
e. volume of the gas
f. No further information is needed.

F **12.** What volume will 1.0 g N_2 gas occupy at STP? – USING IDEAL GAS LAW

F **13.** What volume will 2.4 mol He occupy at STP? – "

D (P_2) C (T_2) **14.** A gas sample occupies 3.7 L at 4.0 atm and 25°C. What volume will the sample occupy at 27°C? – COMBINED

E (V_1) **15.** A sample of carbon dioxide is at 273 K and 244 kPa. What will its volume be at 400 kPa? – COMBINED

C (T_1) **16.** A sample of oxygen occupies 10.0 L at 4.00 atm pressure. At what temperature will the pressure equal 3.00 atm if the final volume is 8.00 L? – COMBINED

F **17.** At what pressure will a sample of gas occupy 5.0 L at 25°C if it occupies 3.2 L at 1.3 atm pressure and 20°C? – COMBINED

F **18.** How many grams of helium are in a 2-L balloon at STP? – IDEAL + MOL TO MASS

F **19.** One mole of hydrogen gas occupies 22.4 L. What volume will the sample occupy if the temperature is 290 K and the pressure is 2.0 atm? – IDEAL

T P

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Name _____ Date _____ Class _____

CHAPTER 13 STUDY GUIDE FOR CONTENT MASTERY

The Ideal Gas Law

In your textbook, read about the ideal gas law.

Answer the following questions.

1. Why is the mathematical relationship among the amount, volume, temperature, and pressure of a gas sample called the ideal gas law?
   THIS IS THE RELATIONSHIP FOR GASES UNDER MOST NORMAL (IDEAL) CONDITIONS

2. Define the ideal gas constant, R.
   .0821 L·ATM/mol K

3. In Table 13-4 in your textbook, why does R have different numerical values?
   BECAUSE PRESSURE IS IN DIFFERENT UNITS.

4. What variable is considered in the ideal gas law that is not considered in the combined gas law?
   n. THE NUMBER OF MOLS

In your textbook, read about real versus ideal gases. pp. 444-445

For each statement below, write *true* or *false*.

T 5. An ideal gas is one whose particles take up space.

T 6. At low temperatures, ideal gases liquefy.

F 7. In the real world, gases consisting of small molecules are the only gases that are truly ideal.

T 8. Most gases behave like ideal gases at many temperatures and pressures.

T 9. No intermolecular attractive forces exist in an ideal gas.

F 10. Nonpolar gas molecules behave more like ideal gases than do gas molecules that are polar.

T 11. Real gases deviate most from ideal gas behavior at high pressures and low temperatures.

F 12. The smaller the gas molecule, the more the gas behaves like an ideal gas.

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Name _____ Date _____ Class _____

CHAPTER

STUDY GUIDE FOR CONTENT MASTERY

In your textbook, read about applying the ideal gas law.

Rearrange the ideal gas law, $PV = nRT$, to solve for each of the following variables. Write your answers in the table.

Rearranging the Ideal Gas Law Equation	
Variable to Find	**Rearranged Ideal Gas Law Equation**
n	**13.** $\frac{PV}{RT} = n$
P	**14.** $P = \frac{nRT}{V}$
T	**15.** $\frac{PV}{nR} = T$
V	**16.** $V = \frac{nRT}{P}$

In your textbook, read about using the ideal gas law to solve for molar mass, mass, or density.

Use the following terms below to complete the statements. Each term may be used more than once.

mass = m	molar mass = M	volume

The number of moles of a gas is equal to the **(17)** MASS divided by the **(18)** MOLAR MASS.

Density is defined as **(19)** MASS per unit **(20)** VOLUME.

To solve for M in the equation $M = \frac{mRT}{PV}$, the **(21)** VOLUME and the **(22)** MASS of the gas must be known. ?

According to the equation $D = \frac{MP}{RT}$, the **(23)** VOLUME of the gas must be known when calculating density. ?

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Name _____ Date _____ Class _____

Gas Stoichiometry

In your textbook, read about gas stoichiometry.

Balance the following chemical equation. Then use the balanced equation to answer the questions.

1. 2 $H_2(g)$ + ____ $O_2(g) \rightarrow$ 2 $H_2O(g)$

2. List at least two types of information provided by the coefficients in the equation.
   # OF MOLS ; RATIOS OF MOLS REACTED AND PRODUCED; MASSES (IF USE MOLAR MASS)

3. If 4.0 L of water vapor is produced, what volume of hydrogen reacted? What volume of oxygen? IF P,T&N CONSTANT, CAN USE MOL RATIOS
   4 L H_2 2 L O_2

4. If it is known that 2 mol of hydrogen reacts, what additional information would you need to know to find the volume of oxygen that would react with it?
   TEMP & PRESSURE (PLUS BALANCED EQTN, OBVIOUSLY)

5. List the steps you would use to find the mass of oxygen that would react with a known number of moles of hydrogen.
   1. WRITE & BALANCE EQTN. 2. CALCULATE MOLS O_2 USING GIVEN MOLS H_2. 3. USE MOLAR MASS OF O_2 TO CALCULATE MASS

6. Find the mass of water produced from 4.00 L H_2 at STP if all of it reacts. Show your work.

$$\frac{(4\,L\,H_2)(1\,mol)}{(22.4\,L)} = .1787\,mol\,H_2$$

$$\frac{(.1787\,mol\,H_2)(2\,mol\,H_2O)}{(2\,mol\,H_2)} = .1787\,mol\,H_2O$$

$$\frac{(.1787\,mol\,H_2O)(18.02\,g)}{(1\,mol)} = 3.22\,g\,H_2O$$

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