Name ________ Date ________ 21

14 THE BEHAVIOR OF GASES

10

Vocabulary Review

Match the correct vocabulary term to each numbered statement. Write the letter of the correct term on the line.

Column A		Column B
G	1. At constant volume and temperature, the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures of the component gases.	a. combined gas law
I	2. The volume of a fixed mass of gas is directly proportional to its Kelvin temperature if the pressure is kept constant.	b. ideal gas constant (R)
J	3. The rate of effusion of a gas is inversely proportional to the square root of its molar mass.	c. diffusion
F	4. the contribution each gas in a mixture makes to the total pressure of that mixture	d. compressibility
D	5. a measure of how much the volume of matter decreases under pressure	e. Boyle's law
E	6. For a given mass of gas at constant temperature, the volume of the gas varies inversely with pressure.	f. partial pressure
C	7. the tendency of molecules to move toward areas of lower concentration until the concentration is uniform throughout	g. Dalton's law of partial pressures
A	8. $\frac{P_1 \times V_1}{T_1} = \frac{P_2 \times V_2}{T_2}$	h. effusion
H	9. the escape of a gas through a tiny hole in a container of gas	i. Charles's law
B	10. 8.31 (L·kPa)/(K·mol)	j. Graham's law of effusion

Name STURMAN KEY Date ________ Class ________

14 THE BEHAVIOR OF GASES

11 PV=nRT

Chapter Quiz

Fill in the word(s) that will make each statement true.

1. Adding more gas to a closed container increases the number of __1__ of particles with the walls of the container. 1. collisions 14.1
2. Doubling the number of particles of a gas in a container __2__ the pressure, assuming that the temperature is constant. 2. doubles 14.1
3. According to kinetic theory, the particles of a gas have a volume that is __3__ compared to the total volume of the gas. 3. small / fractional / proportional 14.1
4. One difference between real gases and ideal gases is that __4__ gases may be liquefied when they are cooled and pressure is applied to them. 4. real 14.3
5. The tendency of a gas to move toward areas of lower concentrations until the concentration is uniform throughout is __5__. 5. diffusion 14.4

Solve the following problems in the space provided.

6. A rigid container of O_2 has a pressure of 388 kPa at a temperature of 713 K. What is the pressure at 273 K? 14.2

$P_1 = 388\text{ kPa}$ $P_2 = ?$ $T_1 = 713\text{ K}$ $T_2 = 273\text{ K}$ $\frac{P_1}{T_1} = \frac{P_2}{T_2} \Rightarrow \frac{388}{713} = \frac{P_2}{273} \Rightarrow P_2 = 149\text{ kPa}$

7. A flexible gas storage container has a volume of $3.5 \times 10^5\ m^3$ when the temperature is 27°C and the pressure is 115 kPa. What is the new volume of the container if the temperature drops to −10°C and the pressure drops to 99 kPa? 14.2

$V_1 = 3.5 \times 10^5\ m^3$ $T_1 = 27° = 300\text{ K}$ $P_1 = 115\text{ kPa}$ $V_2 = ?$ $T_2 = 263\text{ K}$ $P_2 = 99\text{ kPa}$

$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2} \Rightarrow \frac{115(3.5\times10^5)}{300} = \frac{99V_2}{263}$

$V_2 = 356422$ or $3.6 \times 10^5\ m^3$

8. A mixture of gases at a total pressure of 145.0 kPa contains N_2, CO_2, and O_2. The partial pressure of the N_2 is 28.5 kPa, and the partial pressure of the CO_2 is 76.0 kPa. What is the partial pressure of the O_2? 14.4

$145.0\text{ kPa} = 28.5 + 76.0 + O_2$

$O_2 = 40.5\text{ kPa}$

Name STURMAN K. Date ________ Class ________

14 THE BEHAVIOR OF GASES

16 ≥ 11

Practice Problems

In your notebook, solve the following problems.

SECTION 14.1 THE PROPERTIES OF GASES

1. Using kinetic theory, explain why a tire is more likely to blow out during a trip in the summer than during one in the winter.
2. Use kinetic theory to explain why on a cold autumn morning a camper's air mattress may appear to be somewhat flatter than when it was blown up the afternoon before. Assume no leaks.

SECTION 14.2 THE GAS LAWS

1. The volume of a gas at 155.0 kPa changes from 22.0 L to 10.0 L. What is the new pressure if the temperature remains constant?
2. Is it possible for a balloon with an initial pressure of 200.0 kPa to naturally expand to four times its initial volume when the temperature remains constant and atmospheric pressure is 101.3 kPa?
3. Exactly 10.0 L of O_2 at −25°C is heated to 100.0°C. What is the new volume if the pressure is kept constant?
4. A gas at a pressure of 501 kPa and a temperature of 25°C occupies a volume of 5.2 L. When the gas is heated to 100.0°C the volume increases to 7.00 L. What is the new pressure?
5. A sample of O_2 with an initial temperature of 50.0°C and a volume of 105 L is cooled to −25°C. The new pressure is 105.4 kPa and the new volume is 55.0 L. What was the initial pressure of the sample?

14.1

① A tire is more likely to blow out in the summer than in the winter since the temp ... the pressure ... tires is higher. The pressure is ↑ because the molecules are moving faster and exerting more force per unit area, and hitting sides more frequently.

② When it's cold the molecules are moving more slowly & collide less frequently, thus exerting less pressure on the inside walls of mattress.

14.2

1) $V_1 = 22.0L$ $V_2 = 10.0L$ $P_1V_1 = P_2V_2$ $P_2 = 341 kPa$

$P_1 = 155.0 kPa$ $P_2 = ?$ $155.0(22.0) = P_2(10.0)$

2) $V_1 = 200.0 kPa$ Constant T + P - NO

3) $V_1 = 10.0L$ $V_2 = ?$ $\frac{10.0}{248} = \frac{V_2}{373}$ → $V_2 = 15L$ or 15.0L

$T_1 = -25° + 273 = 248$ $T_2 = 373$

4) $P_1 = 501 kPa$ $P_2 = ?$ $\frac{501(5.2)}{298} = \frac{P_2(7.00)}{373}$ $T_1 = 323k$ $\frac{P_1(105)}{323} = \frac{105.4(55.0)}{248}$

$T_1 = 298k$ $T_2 = 373k$ $V_1 = 105L$ $P_1 = 72 kPa$

$V_1 = 5.2L$ $V_2 = 7.00L$ $P_2 = 465.8$ $P_1 = ?$

$= 470 kPa$ $T_2 = 248$

$V_2 = 55.0L$

Name ________ Date ________ Class ________

SECTION 14.3 IDEAL GASES

1. A sample of argon gas is at a pressure of 1.24×10^4 kPa and a temperature of 24°C in a rigid 25-L tank. How many moles of argon does this tank contain?
2. A 35.0-L tank contains 7.00 mol of compressed air. If the pressure inside the tank is 500.0 kPa, what is the temperature of the compressed gas?
3. How many grams of helium does a 25.0-L balloon contain at 102.0 kPa and 24°C?
4. Calculate the volume that 2.25 mol of $O_2(g)$ will occupy at STP.
5. A sample of water vapor occupies a volume of 10.5 L at 200°C and 100.0 kPa. What volume will the water vapor occupy when it is cooled to 27°C if the pressure remains constant?
6. What is the volume occupied by 0.355 mole of nitrogen gas at STP?
7. What is the volume of a container that holds 25.0 g of carbon dioxide gas at STP?

SECTION 14.4 GASES: MIXTURES AND MOVEMENTS

1. A gaseous mixture consisting of nitrogen, argon, and oxygen is in a 3.5-L vessel at 25°C. Determine the number of moles of oxygen if the total pressure is 98.5 kPa and the partial pressures of nitrogen and argon are 22.0 kPa and 50.0 kPa, respectively.
2. Compare the effusion rates of O_2 (molar mass, 32.0 g/mol) and N_2 (molar mass, 28.0 g/mol).

14.3

1) $P_1 = 1.24 \times 10^4 kPa$ $T_1 = 297K$ $V_1 = 25L$ $(1.24 \times 10^4)(25) = n(8.31)(297)$ $n = 126 mol$ (130 mol)

2) $V_1 = 35.0L$ $n = 7.00 mol$ $P = 500.0 kPa$ $T = ?$ $500.0(35.0) = 7.00(8.31)(T)$

$T = 301 K$ (28°C)

3) m = ? $102.0(25.0) = n(8.31)(297)$ n = 1.03 mol · $\frac{4.00}{1 mol}$ = 4.0 or 4.1g

4) $101.3 V = 2.25(8.31)(273)$ → V = 50.4L

5) $V_1 = 10.5$ $V_2 = ?$ $\frac{10.5}{473} = \frac{V_2}{300}$ → V_2 = 6.7L or 6.66L

$T_1 = 473k$ $T_2 = 300$

6) $101.3 V = .355(8.31)(273)$ → V = 7.95L

7) $\frac{25.0g}{1} \cdot \frac{1 mol}{44.0g}$ = .568 mol $101.3 V = .568(8.31)(273)$ → V = 12.7L

14.4

1) $98.5 = 22.0 + 50.0 + O_2$ → $O_2 = 26.5 kPa$ $26.5(3.5) = n(8.31)(298)$

$n = .037 mol O_2$

2) The effusion rate of N_2 is faster

$\frac{effusion O_2}{effusion N_2} = \sqrt{\frac{28.0}{32.0}} = .935$ or N_2 is 1.07x faster effusion than O_2

since $.935^{-1} = 1.07$