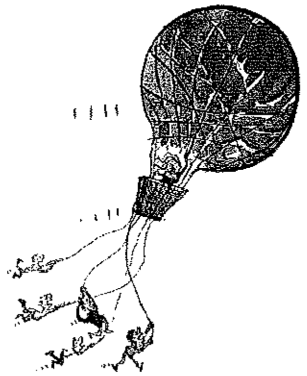

The Gases

Unit Review?

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Date S2016

Essential Questions

1. *How do gases make our daily lives better?*

Objectives

1. Properties of Gases
2. Define Ideal Gas and how it relates to KMT
3. Calculate for pressure, volume, temperature, or moles using the gas laws
4. Solve for the amount of a substance using gas stoich
5. Determine the limiting reactant

UNIT 4 REVIEW - Gases

1. Gases are distinguished from other states of matter by which of the following?

a. Expansion

b. Compressibility

c. Homogeneity

d. Space between atoms/molecules

e. Constant and random motion

f. All of the above

2. Which statement is not part of the Kinetic Molecular Theory of Gases?

a. Gas atoms/molecules travel in straight-line motion and obey Newton's Laws

b. Collision between gas atoms/molecules are perfectly elastic (no energy gained or lost)

c. Gases are composed of atoms/molecules of very small volume

d. There are no attractive or repulsive forces between gas atoms/molecules

3. Define the differences between an **Ideal Gas** and a **Real Gas**. Why does this distinction need to be made?

Ideal gas conforms to postulates of KMT where as real gases deviate from these (have volume & forces of attraction).

4. Gases behave most ideally when?

At low pressures & high temperatures... the molecules are moving rapidly & are far apart.

5. The average kinetic energy of the particles of a gas:

a. Is not affected by the temperature of the gas

b. Increases as the temperature of the gas increases

c. Decreases as the temperature of the gas increases

d. Is equal to the total thermal energy absorbed by the substance

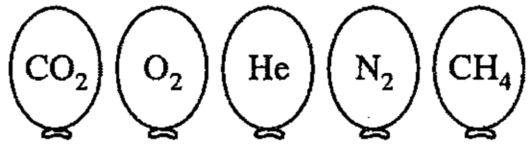
6. Write the formula for **kinetic energy** below, and define the terms involved:

$\overline{KE} = \frac{3}{2} RT$

T - kelvin temp

R - ideal gas constant = $8.314 \frac{J}{mol \cdot K}$

KE - kinetic energy



7. Represented above are five identical balloons, each filled to the same volume at 25°C and 1.0 atm with the pure gas indicated. ⇒ implies same amount of gas ∴ moles equal

   a. Which balloon contains the greatest mass of gas? Explain.

   CO_2 - highest molar mass 44.01 g/mol

   b. Compare the average kinetic energies of the gas molecules in the balloons. Explain.

   All have same KE because at same temp & KE is a function of Temperature.

   KE = 3/2 RT

   c. Which gas contains the gas that would expect to deviate most from the behavior of an ideal gas? Explain.

   CO_2 because it is the heaviest. & largest molecule therefore its size will have a greater affect at low temps & high pressures.

8. Consider a 2.47 L sample of gaseous SO_2 at a pressure of 4.21 kPa. If the pressure is changed to 19 kPa at a constant temperature, what will be the new volume of the gas (in L)?

   2.47 (4.21) = X (19) $P_1V_1 = P_2V_2$

   X = 0.55 L

9. 3.00 L of a gas is known to contain 0.840 mol of molecules. If the amount of gas is increased to 1.60 mol, what new volume will result (in L), assuming an unchanged temperature and pressure?

   $\frac{V_1}{n_1} = \frac{V_2}{n_2}$ $\frac{3.00}{0.840} = \frac{X\ L}{1.60}$

   X = 5.71 L

10. What volume (in L) will 1.50 mol of oxygen (O_2) occupy at -15°C and 1.8 atm?

    n = 1.50 mol PV = nRT
    T = -15 = 258 K
    P = 1.8 atm $V = \frac{nRT}{P}$
    R = 0.0821 L·atm/mol·K
    V = ?

    $V = \frac{1.5(0.0821)(258)}{1.8}$

    V = 17.6 L

    18 L

11. The following reaction occurs at STP: $C_2H_4 (g) + 3O_2 (g) \rightarrow 2CO_2 (g) + 2H_2O (g)$

Xg used; 18.0g; 18.0g; 305.2g; X L @ STP; X L H_2O

28.054; 96g O_2; 44.8L; 102.3L

a. How many liters of CO_2 gas are produced when 305.2 grams of C_2H_4 are consumed?

$$\frac{305.2}{28.054} : \frac{X \text{ L } CO_2}{44.8 \text{ L } CO_2}$$

X = 487 L CO_2

b. If 18.0 g of C_2H_4 burns with 18.0 g of O_2 how many liters of water vapor will be produced at 350.°C and 1.00 atm?

2 mol H_2O @ 350°C & 1.00 atm → 623K

V = 2 (0.0821)(623) / 1 ; V = 102.3 L

C_2H_4: 18.0 / 28.054 = 0.6416 ; O_2 limiting: 18.0 / 96.0 = 0.1875

$$\frac{18.0}{96.0} : \frac{X \text{ L } H_2O}{102.3 \text{ L}}$$

X = 19.2 L

c. How much oxygen will remain after the reaction comes to completion?

Ø grams because it is the limiting reactant & it will all be consumed.

d. How much C_2H_4 will remain after the reaction comes to completion?

$$\frac{18.0 \text{ g } O_2}{96.0 \text{ g } O_2} : \frac{X \text{ g } C_2H_4}{28.054 \text{ g } C_2H_4}$$

X = 5.26 g used

Excess : 18.0 − 5.26g

12.7g C_2H_4 in excess

12. A sample of gas at 12.0°C occupies 400 mL under a pressure of 820 torr. To decrease the volume of this gas to 300 mL and decrease its temperature to 8.00°C, what pressure (in atm) must be achieved?

$$\frac{400(820)}{(12+273)} = \frac{300(X)}{(8+273)}$$

X = 1077 torr

$$\frac{760 \text{ torr}}{1077 \text{ torr}} = \frac{1 \text{ atm}}{X \text{ atm}}$$

X = 1.42 atm

13. 8.00 L of a gas is found to exert 3.00 kPa of pressure at 20.0°C. Assuming constant volume, what would be the required temperature (in Celsius) to change the pressure to standard pressure?

$$\frac{3.00 \text{ kPa}}{293} = \frac{101.325 \text{ kPa}}{X}$$

X = 9896 K − 273 = 9620°C

14. A balloon contains 0.100 atm of oxygen and 0.420 atm of carbon dioxide and, X atm of nitrogen, If the balloon is at STP what is the partial pressure of nitrogen?

$P_{tot} : P_1 + P_2 + P_3$ P_{tot} = 1.00 because @ STP

P_{N_2} = 1.00 − (0.100 + 0.420) = 0.48 atm

15. A gas with a volume of 400. mL has a temperature of 20.0°C. The gas is heated at constant pressure, and it expands to a volume of 1000 mL. What is the temperature (K) of the gas after being heated?

$$\frac{400 \text{ mL}}{293 \text{ K}} = \frac{1000 \text{ mL}}{X \text{ K}}$$

$X = 732$ K

16. A 4.00 L sample of a gas is collected at 25.0°C and 800.0 mmHg. What is the volume of the gas at STP?

$$\frac{4.00\,(800.0)}{298} = \frac{X\,(760)}{273}$$

$X = 3.86$ L

17. A 3.00 mole sample of bromine gas has a temperature of -20.0°C at 105 kPa. What is the density (g/L) of the gas? $D = \frac{g}{L}$ MM: 159.808 (Br_2)

$D = \frac{PM}{RT}$

$$\frac{105\,(159.808)}{8.314\,(253)} = 7.98 \frac{g}{L}$$

or

$3.00 \text{ mol} \times \frac{159.808 \text{ g}}{\text{mol}} = 479.424$ g

$V = \frac{3.00\,(8.314)(253)}{105}$

$V = 60.098$

$D = \frac{479.424}{60.098}$

$D = 7.98 \frac{g}{mol}$

18. Potassium perchlorate decomposes by the following reactions:

$$2\ KClO_3\ (s) \rightarrow 2\ KCl\ (s) + 3\ O_2\ (g)$$

The oxygen produced was collected over water at 22.0°C at a total pressure of 760. mmHg. The volume of gas collected was 1.20 liters. Calculate the partial pressure (atm) of O_2 collected. The vapor pressure of water is 21.0 mmHg.

$P_{TOT} = 760.$ mmHg

$P_{H_2O} = 21.0$ mmHg

$P_{O_2} = ?$

$P_{O_2} = 760 - 21.0$

$= 739$ mmHg