

Chem 1311- Gas Laws

Notes and formulas:

1. Which gas law involves an inverse relationship with pressure and one other variable?

- a. Combined Gas Law
- b. Boyle's Law $P_1 V_1 = P_2 V_2$
- c. Charles' Law
- d. Gay-Lussac's Law

2. Which gas law involves a direct relationship with volume and one other variable?

- a. Combined Gas Law
- b. Boyle's Law
- c. Charles' Law $\frac{V_1}{T_1} = \frac{V_2}{T_2}$
- d. Gay-Lussac's Law

3. A student is given the following problem.

What is the molar mass of a gas if 0.0494 g of the gas occupies a volume of 0.100 L at a temperature of 26.0 °C and a pressure of 0.404 atm?

$$26 + 273 = 299$$

She gets an answer of 2.61 g/mol. Is her answer correct or incorrect, and why?

$$PV = nRT$$

$$n = \frac{PV}{RT}$$

$$n = \frac{0.404 \text{ atm} (0.1 \text{ L})}{0.08216 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} (299 \text{ K})}$$

$$n = 0.00164 \text{ mol}$$

4. What is the density (g/L) of dinitrogen monoxide, N_2O , at a temperature of 325 K and a pressure of 113.0 kPa? = 1.11 atm

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

$$d = \frac{1.11 \text{ atm} (44.0 \text{ g/mol})}{0.08216 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} (325 \text{ K})}$$

$$M = \frac{0.0494 \text{ g}}{0.00164 \text{ mol}} = 30.0 \text{ g/mol}$$

INCORRECT, bc she did not convert the temp.

$$M = 44.0 \text{ g/mol}$$

$$d = 1.83 \text{ g/L}$$

$$\frac{2.34 \text{ g CO}_2}{1} \times \frac{1 \text{ mol CO}_2}{44.0 \text{ g}} = 0.0532 \text{ mol}$$

5. Determine the volume of occupied by 2.34 grams of carbon dioxide gas at STP.

$$PV = NRT$$

$$V = \frac{NRT}{P}$$

$$V = 1.19 \text{ L}$$

$$V = \frac{0.0532 \text{ mol} (0.08206 \frac{\text{L} \cdot \text{atm}}{\text{mol} \cdot \text{K}}) (273 \text{ K})}{1.00 \text{ atm}}$$

$$\frac{1.00 \text{ atm}}{273 \text{ K}}$$

6. Nitrogen is collected over water at 40.0 °C. What is the partial pressure of nitrogen if the total pressure is 99.42 kPa? (The partial pressure of water at 40.0 °C is 7.38 kPa)

$$99.42 \text{ kPa} - 7.38 \text{ kPa} = 92.04 \text{ kPa}$$

7. Which statement is false?

- a. The density of a gas is constant if pressure increases, but temperature remains the same.
- b. Gases can be expanded without limit in an open container. ✓
- c. Gases diffuse into each other and mix almost immediately when put into the same container. ✓
- d. Pressure must be exerted on a sample of a gas to confine it. ✓

8. Which statement is true?

- a. Effusion is the spread of a gaseous substance in a confined space. X
- b. Diffusion is the escape of gas particles through a small hole and into an evacuated space. X
- c. Gas particles of lesser molecular weight move faster than heavier ones. ✓
- d. Higher temperatures cause gas particles to move at slower molecular speeds. X

9. Which one of the following statements is not consistent with the kinetic-molecular theory of gases?

- a. Individual gas molecules are relatively far apart. ✓
- b. The actual volume of the gas molecules themselves is very small compared to the volume occupied by the gas at ordinary temperatures and pressures. ✓
- c. The average kinetic energies of different gases are different at the same temperature. X
- d. The theory explains most of the observed behavior of gases at ordinary temperatures and pressures. ✓