

AP Chemistry Quiz Topic #4

Gas Laws

25 points

Name Key

Date 4/20/12 Period _____

Directions: Answer each of the following. For questions involving math, please show all of your work and circle your final answer. Please pay attention to significant digits.

1. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure (in atm) of the nitrogen?

$$P_{N_2} = \left(\frac{\text{mole } N_2}{\text{Total mole}} \right) P_{\text{Total}} = \left(\frac{7.0 \text{ mole } N_2}{10.00 \text{ total}} \right) (0.90)$$

$$= \boxed{0.63 \text{ atm}}$$

2. Hydrogen gas is collected over water at 24 °C. The total pressure of the sample is 755 millimeters of mercury. At 24°C, the vapor pressure of water is 22 millimeters of mercury. What is the partial pressure (in mmHg) of the hydrogen gas?

$$P_T = P_{H_2} + P_{H_2O}$$

$$755 \text{ mm} = P_{H_2} + 22 \text{ mm} ; P_{H_2} = \boxed{733 \text{ mm Hg}}$$

3. A 2.00-liter sample of nitrogen gas at 27°C and 600. millimeters of mercury is heated until it occupies a volume of 5.00 liters. If the pressure remains unchanged, calculate the final temperature (in °C) of the gas.

Charles Law

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$\frac{2.00 \text{ L}}{300 \text{ K}} = \frac{5.00 \text{ L}}{x}$$

$$(2.00) x = 1500 \text{ L}$$

$$x = \boxed{750. \text{ K}}$$

☺

$= \boxed{477 \text{ °C}}$

4. $2 \text{ K(s)} + 2 \text{ H}_2\text{O(l)} \rightarrow 2 \text{ K}^+(\text{aq}) + 2 \text{ OH}^-(\text{aq}) + \text{H}_2(\text{g})$
 When 0.400 mole of potassium reacts with excess water at standard temperature and pressure as shown in the equation above, the volume of hydrogen gas (in liters) produced is _____

At STP 2 mole gas = 22.4 L

2 0.400 mol K	mol H ₂	22.4 L
2 mol K	1 mol	

$\boxed{4.48 \text{ L H}_2}$

$$PV = nRT$$



Same Volume
same temp
same P
Same # of moles

5. Represented above are five identical balloons, each filled to the same volume at 25°C and 1.0 atmosphere pressure with the pure gas indicated.

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

CO₂ has the greatest MM

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

Same Same temp

(c) Which balloon contains the gas that would be expected to deviate most from the behavior of an ideal gas? Explain.

CO₂ because it has the greatest

(d) Twelve hours after being filled, all the balloons have decreased in size. Predict which balloon will be the smallest. Explain your reasoning.

He

6. If a sample of CH₄ gas effuses at a rate of 9.0 mole/hour at 35°C, which gas will effuse at approximately twice the rate under the same conditions?

a) CO b) He c) O₂ d) F₂ e) SiH₄

$$\frac{r_1}{r_2} = \sqrt{\frac{MM_2}{MM_1}}$$

$$\frac{4.5}{9} = \sqrt{\frac{16}{x}}$$

$$(.5)^2 = \frac{16}{x}$$

$$.25x = 16$$

7. An ideal gas sample weighs 1.28 grams at 127°C and 1.00 atm has a volume of 0.250 L. Determine the molar mass of the gas.

$MM = \frac{dRT}{P}$
$d = \frac{PMM}{RT}$

$$MM = \frac{\left(\frac{1.28g}{.250L}\right) \left(.0821 \frac{L \cdot atm}{mole \cdot K}\right) (400.K)}{1.00 atm}$$

8. Aluminum metal reacts with HCl to produce aluminum chloride and hydrogen gas. How many grams of aluminum metal must be added to an excess of HCl to produce 33.6 L of hydrogen gas, if the gas is at STP?

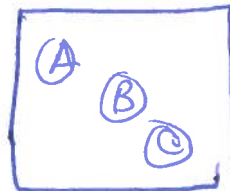


33.6 L H ₂	mol H ₂	mol Al	27g
	0.2 mol H ₂	3 mol H ₂	mol Al

13.5 g Al

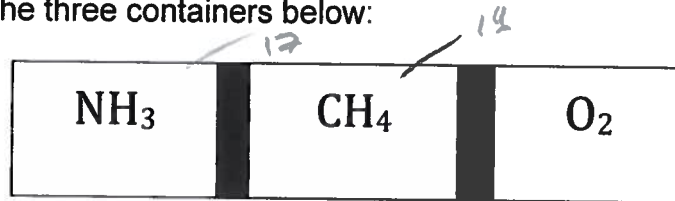
9. A sealed, rigid container is filled with three ideal gases: A, B, and C. The partial pressure of each gas is known. The temperature and volume of the system are known. What additional information is needed to determine the masses of the gases in the container?

- ✓ P
- ✓ T
- ✓ V



I can find # mole,

10. Consider the three containers below:



- ✓ P
- ✓ V
- ✓ T

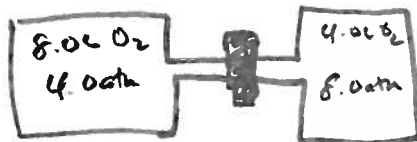
∴ same # of mole

If each container is 1.0 liter at STP, which container ...

- a) do the molecules have the highest average velocity? CH₄, it has lowest mass
- b) contains the greatest number of molecules? same # of molecules cause same # mole
- c) has the largest mean free path?

11. Calculate the density of nitrogen gas at 37°C and 1.10 atm.

$$d = \frac{PM}{RT} = \frac{(1.10 \text{ atm})(28 \text{ g/mol})}{(0.0821 \frac{\text{L atm}}{\text{mol K}})(310. \text{ K})} = 1.21 \frac{\text{g}}{\text{L}}$$



12. A valve separates two tanks, one containing 8.0 liters of oxygen at 4.0 atm and the other containing 4.0 liters of carbon dioxide at 8.0 atm. When the valve is opened and the two gases are allowed to come together, what is final pressure?

$$P_{O_2} = P_1 V_1 = P_2 V_2$$

$$(4.0 \text{ atm})(8.0 \text{ L}) = P_2 (12.0 \text{ L})$$

$$P_2 = \frac{32}{12} \text{ atm}$$

$$P_{CO_2} = P_1 V_1 = P_2 V_2$$

$$(8.0 \text{ atm})(4.0 \text{ L}) = P_2 (12.0 \text{ L})$$

$$P_2 = \frac{32}{12}$$

$$P_{\text{Total}} = \frac{32}{12} + \frac{32}{12} = \frac{64}{12} = \underline{5.3 \text{ atm}}$$

100g O₂
100°C
V_i = 1L

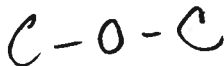
13. 100 grams of O₂(g) and 100 grams of He(g) are in separate containers of equal volume. Both gases are at 100°C. Which of the following statements is/are true?

- a. Both gases would have the same pressure.
 b. The average KE of the O₂ molecules is greater than the KE of He molecules.
 c. There are equal numbers of He molecules and O₂ molecules.
 d. The pressure of the He(g) would be greater than that of the O₂(g).

100g He
100°C
V_i = 1L

For #14-20, indicate whether each statement is "T" true or "F" false.

- F 14. STP corresponds to 25°C and 1 atm. C = PV
- T 15. The following relationship is a statement of Boyle's law: $P = c/V$.
- F 16. The mean free path of O₂ in the atmosphere is expected to decrease with increasing altitude. $N_2 + 3H_2 \rightarrow 2NH_3$
- F 17. According to Avogadro's hypothesis, when one volume of nitrogen reacts with three volumes of hydrogen to form ammonia, four volumes of ammonia should form.
- T 18. According to Graham's law, you should expect NH₃(g) to effuse faster through a tiny hole than CO₂(g).
- F 19. You would expect a gas at high pressures to behave like an ideal gas.
- T 20. The vapor pressure of ether is greater than the vapor pressure of ethanol. Therefore you should expect more vapor above ether than ethanol in a closed system.



dimethyl ether



21. The diffusion time for carbon dioxide gas was 105 sec. For gas X, 126 sec was required for the same number of moles of gas to diffuse under the same conditions. What is the approximate molecular weight of the unknown gas?

$$\frac{t_1}{t_2} = \sqrt{\frac{MM_1}{MM_2}}$$

$$\frac{105}{126} = \sqrt{\frac{MM}{44g}}$$

$$MM = 64.8 \text{ g/mole}$$

22. List 2 ways that an ideal gas differs from a real gas.

- Ideal gases are gases at every temp & pressure
- Ideal gases have no attractive forces!

23. List the most plentiful gas in the Earth's atmosphere.

N_2 is 78%

24. List 2 greenhouse gases.

CO_2 & H_2O

O_2 is 21%

25. Name the gas which smells like rotten eggs.

SO_2

Many reactions produce gases. Identify the gas produced in each of the following reactions. Place your answers on the provided blanks.

