

1A Exam 3
(end of Ch 4 redox, dilutions;
Chapter 10 gas laws)

NAME:

key

10Q x 5pts = 50 pts total

Read Carefully. All work & calculations must be shown. All UNITS must be shown! Relax & Good luck!

1. 1.5L of an 8.5M solution is diluted by adding 350mL of water. Calculate the new concentration of the solution.

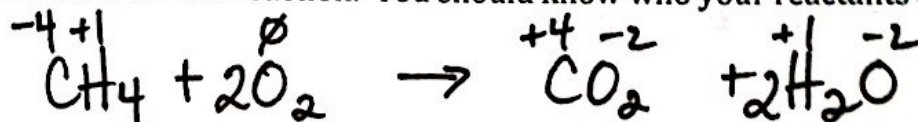
$$\begin{array}{l} V_1 = 1.5L \\ M_1 = 8.5M \\ V_2 = 0.350L \\ \quad + 1.5L \end{array} \quad \frac{M_1 V_1}{V_2} = \frac{M_2 V_2}{V_2}$$

$$M_2 = \frac{(8.5M)(1.5L)}{(1.5L + 0.350L)} = \boxed{6.9M}$$

2pts

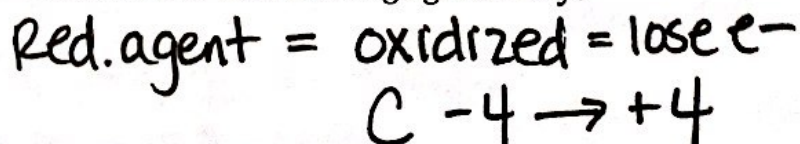
2. Methane gas, CH₄, combusts into water and carbon dioxide gases.

a. Write a balanced reaction. You should know who your reactants are!

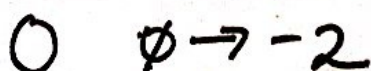
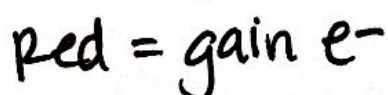


b. Assign oxidation numbers to EACH ATOM.

c. Which atom is the reducing agent? Why?



d. Which atom is reduced? Why?



3. 3.0 grams of dry ice (solid CO₂) sublimates into a balloon at 25.0°C and 750mmHg. Calculate the volume in mL of CO₂ that occupies the balloon.

$$m = 3.0g \times \frac{\text{mol}}{44.0g} = 0.0682 \text{ mol}$$

$$T = 25.0^\circ\text{C} + 273 = 298\text{K}$$

$$P = 750 \text{ mmHg} / 760 = 0.987 \text{ atm}$$

$$V = ?$$

$$PV = nRT$$

$$V = \frac{nRT}{P} = \frac{(0.0682 \text{ mol})(0.08206 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}})(298\text{K})}{0.987 \text{ atm}}$$

$$= \boxed{1.69 \text{ L}} \rightarrow \boxed{1690 \text{ mL}}$$

4. A gas at 60.0°C and 12L is cooled to 40.0°C. What is the new volume?

$$T_1 = 60.0^\circ\text{C} + 273 = 333\text{K}$$

$$V_1 = 12\text{L}$$

$$T_2 = 40.0^\circ\text{C} + 273 = 313\text{K}$$

$$V_2 = ?$$

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

$$\frac{V_1 T_2}{T_1} = V_2 \quad \frac{(12\text{L})(313\text{K})}{(333\text{K})} = \boxed{11.3 \text{ L}}$$

5. Calculate the molar mass of a gas if 2.50 g occupies 0.865 L at 690 torr and 36°C.

$$\frac{g}{\text{mol}} = \frac{2.50g}{0.031 \text{ mol}} = \boxed{80.6 \text{ g/mol}}$$

2 pts

$$V = 0.865 \text{ L}$$

$$P = 690 \text{ torr} / 760 = 0.908 \text{ atm}$$

$$T = 36^\circ\text{C} + 273 = 309 \text{ K}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(0.908 \text{ atm})(0.865 \text{ L})}{(0.08206 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}})(309 \text{ K})} = 0.031 \frac{\text{mol}}{3 \text{ pts}}$$

6. 4.0L of a gas is collected over water 18°C and a pressure of 755mmHg. How many moles of gas is this? (P water @ 18°C = 15.5 torr)

$$V = 4.0 \text{ L}$$

$$T = 18.0^\circ\text{C} + 273 = 291 \text{ K}$$

$$P_{\text{total}} = 755 \text{ mmHg}$$

$$P_{\text{H}_2\text{O}} = 15.5 \text{ torr}$$

$$PV = nRT$$

$$n = \frac{PV}{RT} = \frac{(0.973 \text{ atm})(4.0 \text{ L})}{(0.08206 \frac{\text{atm}\cdot\text{L}}{\text{mol}\cdot\text{K}})(291 \text{ K})} = \boxed{0.163 \text{ mol}}$$

$$P_{\text{gas}} = ? \quad 755 - 15.5 = 739.5 \text{ mmHg} / 760 = 0.973 \text{ atm}$$

2 pts

7. A cylinder with a movable piston contains 1.75 moles of helium. How many moles of helium were added to the cylinder if the volume was changed from 2.00 L to 2.70 L?

$$\begin{aligned}
 n_1 &= 1.75 \text{ mol} \\
 V_1 &= 2.00 \text{ L} \quad 1 \text{ pt} \\
 V_2 &= 2.70 \text{ L} \\
 n_2 &= ? \\
 \text{mol added} &= ?
 \end{aligned}$$

$$\frac{n_1}{V_1} = \frac{n_2}{V_2}$$

$$\frac{n_1 V_2}{V_1} = n_2 = \frac{(1.75 \text{ mol})(2.70 \text{ L})}{2.00 \text{ L}} = 2.3625 \text{ mol} \quad 2 \text{ pt}$$

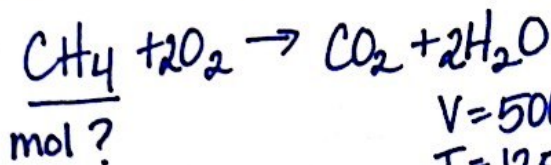
$$\begin{array}{r}
 \text{mol added} = 2.3625 \\
 - 1.75 \\
 \hline
 0.6125 \text{ mol} \quad 2 \text{ pt}
 \end{array}$$

8. Calculate the density in g/L of nitrogen monoxide using the molar volume of a gas at STP (22.4 liters/mole).

$$\begin{aligned}
 \text{NO} &= 30 \text{ g/mol} \\
 &22.4 \text{ L/mol}
 \end{aligned}$$

$$\frac{\text{g}}{\text{L}} = \frac{30 \text{ g}}{\text{mol}} \times \frac{\text{mol}}{22.4 \text{ L}} = \boxed{1.34 \text{ g/L}}$$

9. Calculate the amount in moles of methane gas (CH₄) that must be combusted in order to produce 500L of water vapor at 125°C and 760mmHg.



mol ?

$$V = 500 \text{ L}$$

$$T = 125^\circ\text{C} + 273 = 398 \text{ K}$$

$$P = 760 \text{ mmHg} = 1 \text{ atm}$$

$$n = \frac{PV}{RT} = \frac{(1 \text{ atm})(500 \text{ L})}{(0.08206)(398 \text{ K})} = 15.3 \text{ mol} \quad 3 \text{ pts}$$

$$15.3 \text{ mol H}_2\text{O} \times \frac{1 \text{ mol CH}_4}{2 \text{ mol H}_2\text{O}} = \boxed{7.65 \text{ mol}} \quad 2 \text{ pts}$$

10. Calculate the velocity of nitrogen gas that is present in the atmosphere on a warm day (35°C).

$$N_2 = 28 \text{ g/mol}$$

1 pt

$$V = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3(8.314 \text{ J/mol}\cdot\text{K})(308 \text{ K})}{0.028 \text{ kg/mol}}}$$

$$0.028 \text{ kg/mol} \quad 3 \text{ pts}$$

$$= \boxed{524 \frac{\text{m}}{\text{s}}} \quad 1 \text{ pt}$$