

SHOW ALL WORK TO RECEIVE CREDIT

$$PV = nRT \quad \frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \quad P_1 V_1 T_2 = P_2 V_2 T_1 \quad R = \frac{0.0821 \text{ L} \cdot \text{atm}}{\text{mol} \cdot \text{K}} = \frac{62.4 \text{ L} \cdot \text{torr}}{\text{mol} \cdot \text{K}}$$

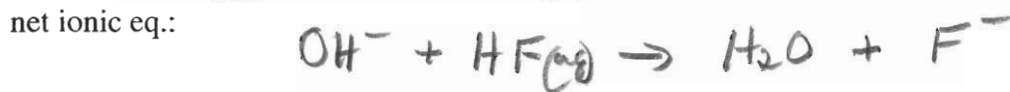
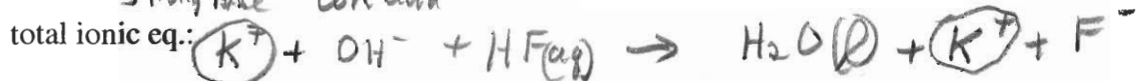
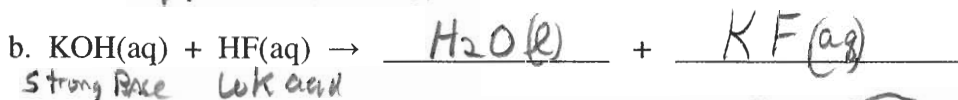
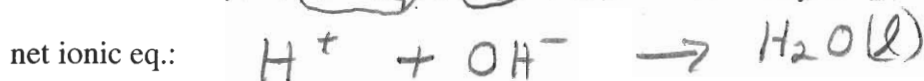
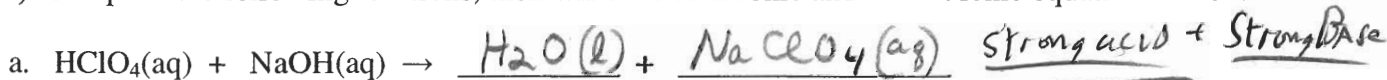
1. (4 Pts) A balloon containing 3.0 L of CO_2 at 22°C and a pressure of 725 torr is placed in a freezer at -7°C . Assume the pressure does not change and calculate the new volume of the balloon.

$$\begin{aligned} P_1 &= 725 \text{ torr} & P_2 &= \text{same} \\ V_1 &= 3.0 \text{ L} & V_2 &= ? \\ T_1 &= 295 \text{ K} & T_2 &= 267 \text{ K} \end{aligned} \quad V_2 = \frac{P_1 V_1 T_2}{P_2 T_1} = \frac{(3.0 \text{ L})(267 \text{ K})}{295 \text{ K}} = \boxed{2.7 \text{ L}}$$

2. (5 Pts) Determine the temperature in K of 95.0 g of N_2 gas if the volume of the container is 8.00 L and the pressure is 850 mmHg.

$$\begin{aligned} P &= 850 \text{ mmHg} \\ V &= 8.00 \text{ L} \\ n &= \frac{95.0 \text{ g}}{28.02 \text{ g/mol}} = 3.39 \text{ mol} \\ R &= 62.4 \text{ L} \cdot \text{torr} / \text{mol} \cdot \text{K} \end{aligned} \quad PV = nRT \quad T = \frac{PV}{nR} = \frac{(850 \text{ torr})(8.00 \text{ L})}{(3.39 \text{ mol})(62.4 \text{ L} \cdot \text{torr} / \text{mol} \cdot \text{K})} = \boxed{32.1 \text{ K}}$$

3. (6 Pts) Complete the following reactions, then write the total ionic and the net ionic equations for each.



4. (5 Pts) Determine the density of O_2 gas at 25°C and 725 mmHg. (Atomic mass of O is 16.00).

$$\begin{aligned} \text{Density} &= \text{g/mL or g/L (for gases)} \\ P &= 725 \text{ mmHg} \\ V &= ? \\ n &= \text{assume 1 mol } \text{O}_2 (32.0 \text{ g}) \\ R &= 62.4 \text{ L} \cdot \text{torr} / \text{mol} \cdot \text{K} \\ T &= 298 \text{ K} \end{aligned} \quad PV = nRT \quad V = \frac{nRT}{P} = \frac{(1 \text{ mol})(62.4 \text{ L} \cdot \text{torr})(298 \text{ K})}{(725 \text{ torr})} = 25.65 \text{ L} \quad D = \frac{32.00 \text{ g}}{25.65 \text{ L}} = \boxed{1.25 \text{ g/L}}$$

5. (5 Pts) A 0.540 g sample of air at 25°C and a pressure of 710 mmHg, occupies a volume of 500 mL. Determine the average molar mass of the air.

$$\begin{aligned} \text{molar mass} &= \text{g/mol} \\ P &= 710 \text{ mmHg} \\ V &= 500 \text{ mL} = 0.500 \text{ L} \\ n &= ? \\ R &= 62.4 \text{ L} \cdot \text{torr} / \text{mol} \cdot \text{K} \\ T &= 298 \text{ K} \end{aligned} \quad PV = nRT \quad n = \frac{PV}{RT} = \frac{(710 \text{ torr})(0.500 \text{ L})}{(62.4 \text{ L} \cdot \text{torr} / \text{mol} \cdot \text{K})(298 \text{ K})} = 0.0191 \text{ mol} \quad \text{molar mass} = \frac{0.540 \text{ g}}{0.0191 \text{ mol}} = \boxed{28.3 \text{ g/mol}}$$

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Atomic masses: H 1.008; C 12.01; N 14.007; O 16.00; Na 22.99; K 39.10; S 32.07; Cl 35.45; Ba 137.33

1. (5 Pts) Calculate the mass of sodium sulfate needed to prepare 500 mL of 0.150 M Na_2SO_4 solution.

$$\frac{500 \text{ mL}}{1000 \text{ mL}} \times \frac{0.150 \text{ mol Na}_2\text{SO}_4}{1 \text{ L}} \times \frac{142.05 \text{ g}}{1 \text{ mol}} = 10.65 \text{ g Na}_2\text{SO}_4$$

10.7 g

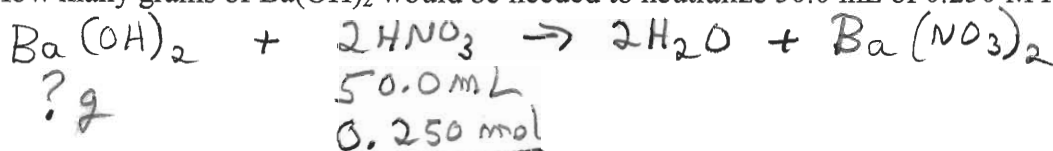
2. (5 Pts) A 0.110 M solution of Na_2SO_4 has been prepared. How many mL of this solution and how many mL of water are need to prepare 500 mL of 0.050 M Na_2SO_4 solution?

$$M_1 V_1 = M_2 V_2$$

$$(0.110 \text{ M})(V_1) = (0.050 \text{ M})(500 \text{ mL})$$

$$V_1 = 227 \text{ mL Na}_2\text{SO}_4 \text{ and } 273 \text{ mL H}_2\text{O}$$

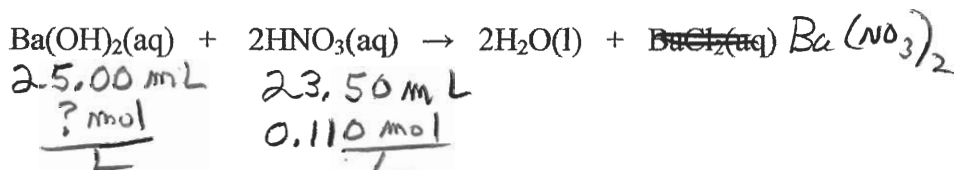
3. (6 Pts) Given the reaction: $\text{Ba}(\text{OH})_2(\text{aq}) + 2\text{HNO}_3(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l}) + \text{Ba}(\text{NO}_3)_2(\text{aq})$ B
How many grams of $\text{Ba}(\text{OH})_2$ would be needed to neutralize 50.0 mL of 0.250 M HNO_3 ?



$$\frac{50.0 \text{ mL HNO}_3}{1000 \text{ mL}} \times \frac{0.250 \text{ mol HNO}_3}{1 \text{ L}} \times \frac{1 \text{ mol Ba}(\text{OH})_2}{2 \text{ mol HNO}_3} \times \frac{171.346 \text{ g}}{1 \text{ mol}} = 1.07 \text{ g Ba}(\text{OH})_2$$

25.00 mL of

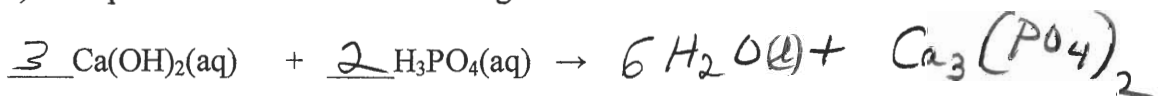
4. (6 Pts) A titration was performed to standardize a solution of barium hydroxide. It took 23.50 mL of 0.110 M nitric acid solution to completely neutralize the barium hydroxide solution. Determine the molarity of the barium hydroxide solution.



$$\frac{23.50 \text{ mL HNO}_3}{1000 \text{ mL}} \times \frac{0.110 \text{ mol HNO}_3}{1 \text{ L}} \times \frac{1 \text{ mol Ba}(\text{OH})_2}{2 \text{ mol HNO}_3} = 0.0517 \text{ mol Ba}(\text{OH})_2$$

25.00 x 10⁻³ L Ba(OH)₂

5. (3 Pts) Complete and balance the following reaction:



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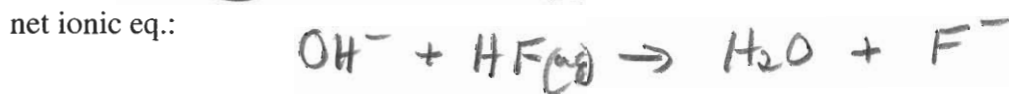
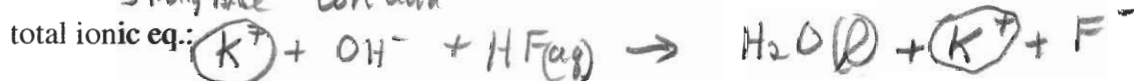
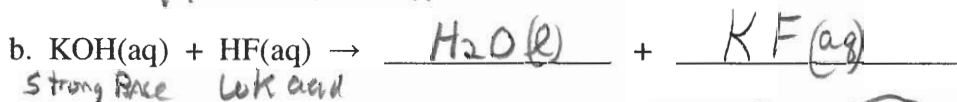
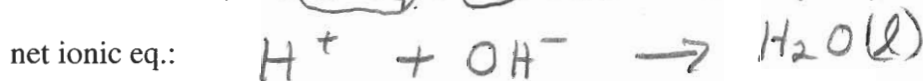
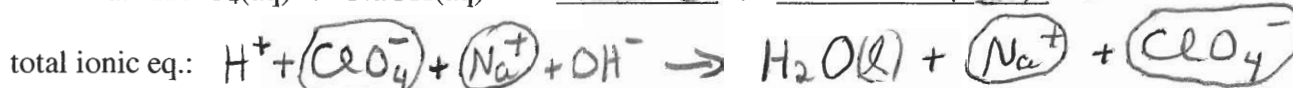
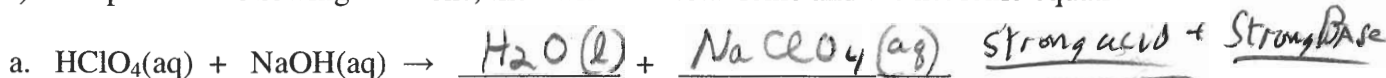
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