

Chapter 4 Review

1. How many grams of carbon dioxide should form if a student heats 50.00 grams of Aluminum carbonate and it decomposes?



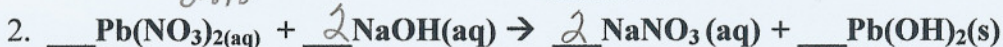
a. Balance the equation.

b. Find the grams of CO_2 .

$$\# \text{ g CO}_2 = 50.00 \text{ g Al}_2(\text{CO}_3)_3 \times \frac{1 \text{ mol Al}_2(\text{CO}_3)_3}{234 \text{ g}} \times \frac{3 \text{ mol CO}_2}{1 \text{ mol Al}_2(\text{CO}_3)_3} \times \frac{44 \text{ g CO}_2}{1 \text{ mol CO}_2} = 28.2 \text{ g CO}_2$$

c. If the actual lab value of CO_2 is 25.0 grams, what is the %yield?

$$\frac{25.0}{28.2} \times 100\% = 88.7\%$$



9. A reaction combines 133.484 g of lead (II) nitrate with 45.010 g of sodium hydroxide.

a. Which reactant is limiting?

$$\begin{aligned} \text{Pb}(\text{NO}_3)_2 &: 133.484 \text{ g Pb}(\text{NO}_3)_2 \times \frac{1 \text{ mol Pb}(\text{NO}_3)_2}{331.2 \text{ g}} = 0.403 \text{ mol Pb}(\text{NO}_3)_2 \\ \text{NaOH} &: 45.010 \text{ g NaOH} \times \frac{1 \text{ mol NaOH}}{40.0 \text{ g}} = 1.125 \text{ mol NaOH} \end{aligned}$$

From the balanced equation, 1 mol $\text{Pb}(\text{NO}_3)_2$ reacts with 2 mol NaOH .
 For 0.403 mol $\text{Pb}(\text{NO}_3)_2$, we need $0.403 \times 2 = 0.806$ mol NaOH .
 Since we have 1.125 mol NaOH , $\text{Pb}(\text{NO}_3)_2$ is the limiting reactant.

3. What is the molarity of a solution that contains 8.00 grams of Na_2SO_4 in 500 mL of solution?

$$\# \text{ mole Na}_2\text{SO}_4 = 8.00 \text{ g Na}_2\text{SO}_4 \times \frac{1 \text{ mole Na}_2\text{SO}_4}{142 \text{ g}} = 0.0563 \text{ mole Na}_2\text{SO}_4$$

$$\text{Molarity Na}^+ \text{ ion} = 0.0563 \text{ M Na}_2\text{SO}_4 \times \frac{2 \text{ Na}^+}{1 \text{ Na}_2\text{SO}_4} = 0.113 \text{ M Na}^+ \text{ ions}$$

4. How would you prepare 150 mL of a 2.00 M of HCl if you have a 12.0 M solution?

$$M_1 V_1 = M_2 V_2$$

$$(12.0)(x) = (2.00)(150)$$

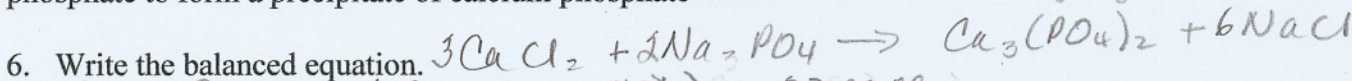
$$x = 2.5 \text{ L}$$

Add 2.5 L of 12 M HCl to 125 L of H_2O

5. How would you prepare 250 mL of a 3.00 M solutions of NaOH ?

$$g = (3.00)(0.250)(40) = 30 \text{ g NaOH}$$

40 mL of a .500 M solution of calcium chloride reacts completely with 30.0 mL of a solution of sodium phosphate to form a precipitate of calcium phosphate. *Stoichiometrically equal*



6. Write the balanced equation.

7. What is the molarity of the sodium phosphate solution?

$$\# \text{ mole Na}_3\text{PO}_4 = 0.02 \text{ mole CaCl}_2 \times \frac{2 \text{ mole Na}_3\text{PO}_4}{3 \text{ mole CaCl}_2} = 0.0133 \text{ mole Na}_3\text{PO}_4$$

8. What is the number of grams of precipitate formed? Choose either reactant. They both limit.

$$\# \text{ g Ca}_3(\text{PO}_4)_2 = 0.02 \text{ mole CaCl}_2 \times \frac{1 \text{ mole Ca}_3(\text{PO}_4)_2}{3 \text{ mole CaCl}_2} \times \frac{310 \text{ g}}{1 \text{ mole Ca}_3(\text{PO}_4)_2} = 2.06 \text{ g Ca}_3(\text{PO}_4)_2$$

1996 B

Concentrated sulfuric acid (18.4-molar H_2SO_4) has a density of 1.84 grams per milliliter. After dilution with water to 5.20-molar, the solution has a density of 1.38 grams per milliliter and can be used as an electrolyte in lead storage batteries for automobiles.

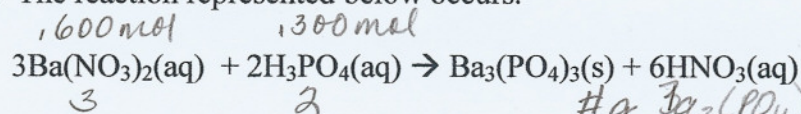
9. (a) Calculate the volume of concentrated acid required to prepare 1.00 liter of 5.20-molar H_2SO_4 .

$$M_1 V_1 = M_2 V_2$$

$$(18.4)(x) = (5.20)(1.00)$$

$$x = 0.283 \text{ L } 18.4 \text{ M } \text{H}_2\text{SO}_4$$

In a reaction vessel, 0.600 mol of $\text{Ba}(\text{NO}_3)_2$ and 0.300 mol of H_3PO_4 (aq) are combined with deionized water to a final volume of 2.00 L. The reaction represented below occurs.



10. Calculate the mass of $\text{Ba}_3(\text{PO}_4)_2$ formed.

$$\begin{array}{l} \text{Ba}(\text{NO}_3)_2 \\ \frac{0.600 \text{ mol Ba}(\text{NO}_3)_2}{3 \text{ mol}} = \frac{x \text{ mol Ba}_3(\text{PO}_4)_2}{1 \text{ mol}} \\ x = 0.2 \text{ mol} \end{array} \quad \begin{array}{l} \text{H}_3\text{PO}_4 \\ \frac{0.300 \text{ mol H}_3\text{PO}_4}{2 \text{ mol}} = \frac{x \text{ mol Ba}_3(\text{PO}_4)_2}{1 \text{ mol}} \\ x = 0.15 \text{ mol Ba}_3(\text{PO}_4)_2 \text{ limits} \end{array}$$

11. What is the concentration, in mol L^{-1} , of the nitrate ion, $\text{NO}_3^-(\text{aq})$ after the reaction reaches completion?

conservation of mass

$$\# \text{ ions NO}_3^- = 0.600 \text{ mol Ba}(\text{NO}_3)_2 \times \frac{2 \text{ mol NO}_3^-}{1 \text{ mol Ba}(\text{NO}_3)_2} = 1.2 \text{ mol NO}_3^-$$

Total volume solution = 2.00 L

$$\frac{1.2 \text{ mol NO}_3^-}{2.00 \text{ L}} = \boxed{0.600 \text{ M}}$$

b. How much precipitate formed?

$$\# \text{ g Ba}_3(\text{PO}_4)_2 = 0.15 \text{ mol Ba}_3\text{PO}_4 \times \frac{696 \text{ g}}{1 \text{ mol}} = 104.4 \text{ g Ba}_3(\text{PO}_4)_2$$