

**Chapter 3 Practice Worksheet:
Formulas, Equations, and Moles: Part II**

1) Stoichiometry: Chemical Arithmetic

For each equation and starting amount and substance shown, calculate the amount of the product produced.

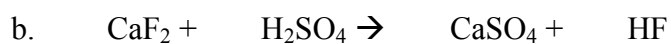
<u>Equation</u>	<u>Starting amount/substance</u>	<u>Product amount/substance</u>
$S(s) + O_2(g) \rightarrow SO_2(g)$	2.35 moles S	moles SO_2
$Si(s) + 2Cl_2(g) \rightarrow SiCl_4(l)$	4.1 moles Cl_2	grams $SiCl_4$
$3H_2(g) + N_2(g) \rightarrow 2NH_3(g)$	0.03445 grams H_2	grams NH_3
$KCN(aq) + HCl(aq) \rightarrow KCl(aq) + HCN(g)$	1.09 grams HCl	moles HCN
$2NH_3(g) + H_2SO_4(aq) \rightarrow (NH_4)_2SO_4(aq)$	0.00568 grams NH_3	grams $(NH_4)_2SO_4$
$2NO(g) + O_2(g) \rightarrow 2NO_2(g)$	6.50 moles O_2	moles NO_2

2) Yields of Chemical Reactions/Limiting Reactants

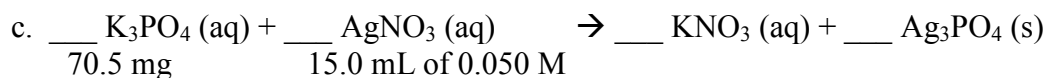
a. MnO_2 reacts with HCl to produce $MnCl_2$, Cl_2 , and H_2O . Write a balanced equation for this reaction. If 0.86 moles of MnO_2 and 48.2 grams of HCl react, which reagent will be used up first? How many grams of Cl_2 will be produced? How many moles of the excess reagent will be left over? If 19.8 grams of Cl_2 were obtained in lab, what is the percent yield?

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In the reaction above, you begin with 6.00 g of CaF_2 and 12.592 g H_2SO_4 . You obtain 2.86 g of HF as a product. What is the percent yield of HF?



Find the mass of precipitate formed in this reaction.

3) Concentrations of Reactants in Solution: Molarity

a. How many moles of solute are in the following solutions?

10.76 mL of 1.54 M HF

250.0 mL of 0.99 M glucose ($\text{C}_6\text{H}_{12}\text{O}_6$)

50.1 mL of a 0.145 M solution of H_2SO_4

b. What is the concentration of a solution made by adding 15.5666 g of KOH in a 250.0 mL flask?

c. What mass of AgNO_3 is needed to make 500.0 mL of a 1.500 M solution?

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- d. Calculate the molarity of a solution that contains 0.0345 mol NH_4Cl in 400 mL of solution.
- e. How many grams of HNO_2 are present in 35.0 mL of a 2.20 M solution of nitric acid?
- f. What is the concentration of 156 mL of solution made from 2.5 grams of KCl ?
- g. How many milliliters of 1.50 M KOH solution are needed to give 0.125 mol of KOH ?
- h. How many grams of KMnO_4 are needed to make 500 mL of solution whose concentration is 1.75 M?

4) Diluting Concentrated Solutions

- a. You have a 1.00 L bottle of 12.0 M HCl on your lab bench. How would you make a 250.0 mL solution of 1.00 M HCl ?
- b. What is the concentration of a solution made by adding 15.0 mL of 18.0 M H_2SO_4 to 100.0 mL of water?
- c. A bottle of 15.0 M HCl has 27.5 mL left. What will the concentration of HCl be if water is added to the bottle to fill it to the 500.0 mL mark?

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d. 260.0 mL of water are added to 37.8 mL of 1.66 M HCl. What is the concentration of the diluted solution?

e. How many milliliters of 3.0 M H₂SO₄ are required to make 450 mL of 0.10 M H₂SO₄?

f. How would you prepare 1.45×10^3 mL of a 1.45 M HNO₃ solution using 12.0 M stock solution of HNO₃? (How much water must be added to the stock solution?)

5) Solution Stoichiometry

a. ___ CaCO₃ (s) + ___ HCl (aq) → ___ CaCl₂ (aq) + ___ H₂O (l) + ___ CO₂ (g)

What mass of CaCO₃ is required to react with 25.0 mL of 0.750 M HCl?

b. ___ HNO₃ (aq) + ___ NaOH (aq) → ___ NaNO₃ (aq) + ___ H₂O (l)

250.0 mL of 0.100 M HNO₃ is combined with an excess of NaOH. How much H₂O (in g) will be produced by this reaction?

c. You add 500 mL of 0.100 M AgNO₃ solution to a solution containing an excess of NaCl. How many grams of AgCl precipitate will you form? (Hint: Write a net ionic equation for the precipitation of AgCl.)

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d. If you mix 0.200 L of 0.100 M $\text{Pb}(\text{NO}_3)_2$ and 0.300 L of 0.200 M NaCl , how much PbCl_2 precipitate will you form? (Hint: Limiting reactant problem!)

f. A 156.7 mL solution of 1.50 M AgNO_3 is mixed with a 4.22 g of solid K_3PO_4 . When mixed together, a new solid forms. Identify the precipitate. Determine what mass of precipitate will form. Calculate the percent yield if only 6.045 g of precipitate was formed in lab.

g. Calculate the mass of the precipitate formed when 2.27 L of 0.0820 M AgNO_3 are mixed with 3.06 L of 0.0664 M K_2SO_4 .

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6) **Titration**

a. How many milliliters of 0.155 M HCl are needed to neutralize completely 35.0 mL of 0.101 M Ba(OH)₂ solution? (Hint: Write a balanced equation first.)

b. How many milliliters of 2.50 M H₂SO₄ are needed to neutralize 75.0 g of NaOH? (Hint: Write a balanced equation first.)

c. What is the molarity of a hydrochloric acid solution if it took 30.0 mL to neutralize 48.0 mL of 0.100 M NaOH? (Hint: Write a balanced equation first.)

d. 25.0 mL of 0.050 M Ba(OH)₂ neutralized 40.0 mL of nitric acid (HNO₃). Determine the concentration of the acid.

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e. What is the concentration of NaOH if it takes 25 mL of 0.75 M HCl to neutralize 16.7 mL of NaOH? (Write a balanced equation first.)

f. How many grams of solid NaOH are required to neutralize 48.2 mL of 1.25 M H₂SO₄? (Write a balanced equation first.)

Percent Composition and Empirical Formulas

7) What is the mass percent of each element in the following compounds?

a. CaCl₂

b. Fe₂O₃

c. C₆H₁₀S₂O

8) Calculate the empirical formulas of compounds containing the following percentages of elements. Use the molar mass to calculate the molecular formula for that compound as well.

a. 44.4% C, 6.21% H, 39.5% S, and 9.86% O; molar mass = 486.39 g/mol

b. 20.2% Al, 79.8% Cl; molar mass = 266.6 g/mol

c. 2.1% H, 65.2% O, 32.6% S; molar mass = 195.95 g/mol

d. 19.8% C, 2.50% H, 11.6% N, 66.1% O; molar mass = 360 g/mol