

# Stoichiometry Worksheet #1

1. Aluminum chloride,  $\text{AlCl}_3$ , is used as a catalyst in various industrial reactions. It is prepared from hydrogen chloride gas and aluminum metal shavings.



1A. How many moles of  $\text{AlCl}_3$  can be prepared from 3.5 moles of hydrogen chloride gas with an excess of aluminum?

$$3.5 \text{ mol HCl} \times \frac{2 \text{ mol AlCl}_3}{6 \text{ mol HCl}} = 1.2 \text{ mol AlCl}_3$$

Ans: 1.2 mol  $\text{AlCl}_3$

1B. How many moles of hydrogen gas would be produced from the use of 8.5 moles of aluminum with an excess of hydrogen chloride?

Ans: 13 mol  $\text{H}_2$

$$8.5 \text{ mol Al} \times \frac{3 \text{ mol H}_2}{2 \text{ mol Al}} = 13 \text{ mol H}_2$$

2. When dinitrogen pentoxide,  $\text{N}_2\text{O}_5$ , a white solid, is heated, it decomposes to nitrogen dioxide and oxygen.



2A. How many moles of nitrogen dioxide can be formed from the decomposition of 1.25 g of  $\text{N}_2\text{O}_5$ ?

$$1.25 \text{ g N}_2\text{O}_5 \times \frac{1 \text{ mol N}_2\text{O}_5}{108.02 \text{ g N}_2\text{O}_5} \times \frac{4 \text{ mol NO}_2}{2 \text{ mol N}_2\text{O}_5} = 0.0231 \text{ mol NO}_2$$

Ans: 0.0231 mol  $\text{NO}_2$

2B. How many grams of oxygen can be formed from the decomposition of 2.3 g of  $\text{N}_2\text{O}_5$ ?

$$2.3 \text{ g N}_2\text{O}_5 \times \frac{1 \text{ mol N}_2\text{O}_5}{108.02 \text{ g N}_2\text{O}_5} \times \frac{1 \text{ mol O}_2}{2 \text{ mol N}_2\text{O}_5} \times \frac{32.00 \text{ g O}_2}{1 \text{ mol O}_2} = 0.34 \text{ g O}_2$$

Ans: 0.34 g  $\text{O}_2$

3. Chlorine is prepared from sodium chloride by electrochemical decomposition. Formerly chlorine was produced by heating hydrochloric acid with pyrolusite [manganese dioxide or manganese(IV) oxide,  $\text{MnO}_2$ ], a common manganese ore. Small amounts of chlorine may be prepared in the laboratory by the same reaction.



3A. How many grams of HCl react with 5.00 g of  $\text{MnO}_2$ , according to the equation?

$$5.00 \text{ g MnO}_2 \times \frac{1 \text{ mol MnO}_2}{86.94 \text{ g MnO}_2} \times \frac{4 \text{ mol HCl}}{1 \text{ mol MnO}_2} \times \frac{36.46 \text{ g HCl}}{1 \text{ mol HCl}} = 8.39 \text{ g HCl}$$

Ans: 8.39 g HCl

3B. If a chemist wanted to prepare 100. g of chlorine, how many grams of  $\text{MnO}_2$  are needed, assuming there is more than enough hydrochloric acid?

Ans: 123 g  $\text{MnO}_2$

$$100. \text{ g Cl}_2 \times \frac{1 \text{ mol Cl}_2}{70.90 \text{ g Cl}_2} \times \frac{1 \text{ mol MnO}_2}{1 \text{ mol Cl}_2} \times \frac{86.94 \text{ g MnO}_2}{1 \text{ mol MnO}_2} = 123 \text{ g MnO}_2$$

3C. How many molecules of water are produced from the reaction of 5.0 g of HCl?

Ans:  $4.1 \times 10^{23}$  molec.  $\text{H}_2\text{O}$

$$5.0 \text{ g HCl} \times \frac{1 \text{ mol HCl}}{36.46 \text{ g HCl}} \times \frac{2 \text{ mol H}_2\text{O}}{4 \text{ mol HCl}} \times \frac{6.02 \times 10^{23} \text{ molecules H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = 4.1 \times 10^{23} \text{ molecules H}_2\text{O}$$

4. Sodium is a soft, reactive metal that instantly reacts with water to give hydrogen gas and a solution of sodium hydroxide,



4A. How many grams of sodium metal are needed to give 7.81 g of hydrogen by this reaction?

Ans: 178 g Na

$$7.81 \text{ g H}_2 \times \frac{1 \text{ mol H}_2}{2.02 \text{ g H}_2} \times \frac{2 \text{ mol Na}}{1 \text{ mol H}_2} \times \frac{22.99 \text{ g Na}}{1 \text{ mol Na}} = 178 \text{ g Na}$$

4B. How many sodium atoms are needed to react with  $1.25 \times 10^{24}$  molecules of water?

Ans:  $1.25 \times 10^{24}$  atoms Na

$$1.25 \times 10^{24} \text{ molecules H}_2\text{O} \times \frac{1 \text{ mol H}_2\text{O}}{6.02 \times 10^{23} \text{ molecules H}_2\text{O}} \times \frac{2 \text{ mol Na}}{2 \text{ mol H}_2\text{O}} \times \frac{6.02 \times 10^{23} \text{ atoms Na}}{1 \text{ mol Na}} =$$

# Chemistry Unit 9 Review Answers Stoichiometry

**Arturo Cuomo**



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