

# Review Assignment KEY

## Chemistry 11 Stoichiometry Review Assignment



Name: \_\_\_\_\_ Date: \_\_\_\_\_ Block: \_\_\_\_\_

*Answer the following practice questions on a separate page*

### Define the following terms:

1. Stoichiometry: **quantitative relationships among substances as they participate in chemical reactions**
2. Stoichiometric ratio: **the molar ratio of substances in a chemical reaction (coefficients in a balanced chemical equation)**
3. Limiting reactant **the reactant in a chemical reaction is the substance that is totally consumed when the chemical reaction is complete. The amount of product formed is limited by this reagent, since the reaction cannot continue without it.**
4. Excess reactant **In a chemical reaction, reactants that are not use up when the reaction is finished are called excess reagents.**
5. Percent yield **is calculated to be the experimental yield divided by theoretical yield multiplied by 100%.**

### (Mole-Mole Conversions)

6. The combustion of the organic fuel, decane, is outlined in the chemical equation below. You must balance the equation in order to answer the subsequent questions a-c.



- a. How many moles of  $\text{CO}_2$  are produced if 5.0 moles of  $\text{C}_{10}\text{H}_{22}$  react with an excess of  $\text{O}_2$ ?
- b. How many moles of  $\text{O}_2$  react with 0.75 moles of  $\text{C}_{10}\text{H}_{22}$ ?
- c. How many moles of  $\text{O}_2$  would be required to produce 4.0 moles of  $\text{H}_2\text{O}$ ?

$$\text{a) } \frac{5.0 \text{ mol C}_{10}\text{H}_{22} \left| \frac{20 \text{ mol CO}_2}{2 \text{ mol C}_{10}\text{H}_{22}} \right.}{=} = \boxed{5.0 \times 10^1 \text{ mol CO}_2}$$

$$\text{b) } \frac{0.75 \text{ mol C}_{10}\text{H}_{22} \left| \frac{31 \text{ mol O}_2}{2 \text{ mol C}_{10}\text{H}_{22}} \right.}{=} = \boxed{12 \text{ mol O}_2}$$

$$\text{c) } \frac{4.0 \text{ mol H}_2\text{O} \left| \frac{31 \text{ mol O}_2}{22 \text{ mol H}_2\text{O}} \right.}{=} = \boxed{5.6 \text{ mol O}_2}$$

...

7. Use the following equation to solve the problems below:



a. If 6.0 moles of  $\text{SiO}_2$  react, how many moles of:

- Al react?
- Si are produced?
- $\text{Al}_2\text{O}_3$  are produced?

b. If 2.5 moles of  $\text{Al}_2\text{O}_3$  are produced, how many moles of:

- Al react?
- $\text{SiO}_2$  react?

$$\therefore \text{a) i) } \frac{6.0 \text{ mol SiO}_2}{3 \text{ mol SiO}_2} \left| \frac{4 \text{ mol Al}}{3 \text{ mol SiO}_2} \right. = \boxed{8.0 \text{ mol Al}}$$

$$\text{ii) } \frac{6.0 \text{ mol SiO}_2}{3 \text{ mol SiO}_2} \left| \frac{3 \text{ mol Si}}{3 \text{ mol SiO}_2} \right. = \boxed{6.0 \text{ mol Si}}$$

$$\text{iii) } \frac{6.0 \text{ mol SiO}_2}{3 \text{ mol SiO}_2} \left| \frac{2 \text{ mol Al}_2\text{O}_3}{3 \text{ mol SiO}_2} \right. = \boxed{4.0 \text{ mol Al}_2\text{O}_3}$$

$$\text{b) i) } \frac{2.5 \text{ mol Al}_2\text{O}_3}{2 \text{ mol Al}_2\text{O}_3} \left| \frac{4 \text{ mol Al}}{2 \text{ mol Al}_2\text{O}_3} \right. = \boxed{5.0 \text{ mol Al}}$$

$$\text{ii) } \frac{2.5 \text{ mol Al}_2\text{O}_3}{2 \text{ mol Al}_2\text{O}_3} \left| \frac{3 \text{ mol SiO}_2}{2 \text{ mol Al}_2\text{O}_3} \right. = \boxed{3.8 \text{ mol SiO}_2}$$

### (Mole-Mass / Mass-Mole Conversions)



a) If 15.0g of  $\text{N}_2\text{O}_4$  was produced, how many moles of  $\text{O}_2$  were required?

$$\frac{15.0\text{g N}_2\text{O}_4}{92.0\text{g N}_2\text{O}_4} \left| \frac{1 \text{ mol N}_2\text{O}_4}{1 \text{ mol N}_2\text{O}_4} \right| \left| \frac{2 \text{ mol O}_2}{1 \text{ mol N}_2\text{O}_4} \right. = 0.326 \text{ mol O}_2$$

b) If  $4.0 \times 10^{-3}$  moles of oxygen reacted, how many grams of  $\text{N}_2$  were needed?

$$\frac{4.0 \times 10^{-3} \text{ mol O}_2}{2 \text{ mol O}_2} \left| \frac{1 \text{ mol N}_2}{2 \text{ mol O}_2} \right| \left| \frac{28.0\text{g N}_2}{1 \text{ mol N}_2} \right. = 5.6 \times 10^{-2} \text{ g N}_2$$

9.  $\text{Cu} + 2\text{AgNO}_3 \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{Ag}$  How many moles of Cu are needed to react with 3.50g of  $\text{AgNO}_3$ ?

$$\frac{3.50\text{g AgNO}_3}{169.9\text{g AgNO}_3} \left| \frac{1 \text{ mol AgNO}_3}{169.9\text{g AgNO}_3} \right| \left| \frac{1 \text{ mol Cu}}{2 \text{ mol AgNO}_3} \right. = 1.03 \times 10^{-2} \text{ mol Cu}$$

10. Mercury (II) oxide decomposes into mercury and oxygen gas.

a) Write and balance the equation.



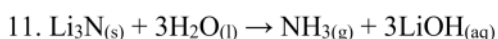
b) How many moles of mercury (II) oxide are needed to produce 125g of oxygen?

$$\frac{125\text{g O}_2}{32.0\text{g O}_2} \times \frac{1\text{ mol O}_2}{1\text{ mol O}_2} \times \frac{2\text{ mol HgO}}{1\text{ mol O}_2} = 7.81\text{ mol HgO}$$

c) How many grams of mercury are produced if 24.5 moles of mercury (II) oxide decomposes?

$$\frac{24.5\text{ mol HgO}}{2\text{ mol HgO}} \times \frac{2\text{ mol Hg}}{2\text{ mol HgO}} \times \frac{200.6\text{g Hg}}{1\text{ mol Hg}} = 4.91 \times 10^3\text{ g Hg}$$

### (Mass-Mass Conversions)



a. What mass of lithium hydroxide are produced when 0.38g of lithium nitride react?

$$\frac{0.38\text{g Li}_3\text{N}}{34.7\text{g Li}_3\text{N}} \times \frac{1\text{ mol Li}_3\text{N}}{1\text{ mol Li}_3\text{N}} \times \frac{3\text{ mol LiOH}}{1\text{ mol Li}_3\text{N}} \times \frac{23.9\text{g LiOH}}{1\text{ mol LiOH}} = 0.79\text{g LiOH}$$

b. How many grams of lithium nitride would react with 4.05g of H<sub>2</sub>O?

$$\frac{4.05\text{g H}_2\text{O}}{18.0\text{g H}_2\text{O}} \times \frac{1\text{ mol H}_2\text{O}}{3\text{ mol H}_2\text{O}} \times \frac{1\text{ mol Li}_3\text{N}}{1\text{ mol Li}_3\text{N}} \times \frac{34.7\text{g Li}_3\text{N}}{1\text{ mol Li}_3\text{N}} = 2.60\text{g Li}_3\text{N}$$

12. In the combustion of 54.50g of butane (C<sub>4</sub>H<sub>6</sub>), how many grams of CO<sub>2</sub> are produced? Write and balance the equation before solving.



$$\frac{54.50\text{g C}_4\text{H}_6}{54.0\text{g C}_4\text{H}_6} \times \frac{1\text{ mol C}_4\text{H}_6}{2\text{ mol C}_4\text{H}_6} \times \frac{8\text{ mol CO}_2}{1\text{ mol C}_4\text{H}_6} \times \frac{44.0\text{g CO}_2}{1\text{ mol CO}_2} = 178\text{g CO}_2$$

13. In the following **unbalanced** equation,

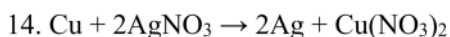


a) How many grams of iron (IV) sulphide are used when 9.0g of O<sub>2</sub> react?

$$\frac{9.0\text{g O}_2}{32.0\text{g O}_2} \times \frac{1\text{ mol O}_2}{11\text{ mol O}_2} \times \frac{4\text{ mol FeS}_2}{1\text{ mol O}_2} \times \frac{120.0\text{g FeS}_2}{1\text{ mol FeS}_2} = 12\text{g FeS}_2$$

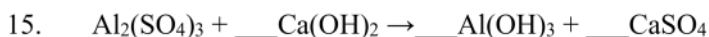
b) What is the mass of iron (III) oxide produced when 25.0g of iron (IV) sulphide are used?

$$\frac{25.0\text{g FeS}_2}{120.0\text{g FeS}_2} \times \frac{1\text{ mol FeS}_2}{4\text{ mol FeS}_2} \times \frac{2\text{ mol Fe}_2\text{O}_3}{1\text{ mol FeS}_2} \times \frac{159.6\text{g Fe}_2\text{O}_3}{1\text{ mol Fe}_2\text{O}_3} = 16.6\text{g Fe}_2\text{O}_3$$

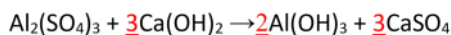


How many grams of silver are produced when 36.92g of copper react?

36.92g Cu	1 mol Cu	2 mol Ag	107.9g Ag	= 125g Ag
	63.5g Cu	1 mol Cu	1 mol Ag	



Balance and answer the following questions.



- a. What mass of aluminum (III) hydroxide are produced if 165.7g of aluminum (III) sulfate react?

165.7g Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	1 mol Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	2 mol Al(OH) <sub>3</sub>	78.0g Al(OH) <sub>3</sub>	= 75.5g Al(OH) <sub>3</sub>
	342.3g Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	1 mol Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>		

- b. How many grams of calcium hydroxide are needed to form 6.35g of calcium sulphate?

6.35g CaSO <sub>4</sub>	1 mol CaSO <sub>4</sub>	3 mol Ca(OH) <sub>2</sub>	74.1g Ca(OH) <sub>2</sub>	= 3.45g Ca(OH) <sub>2</sub>
	136.2g CaSO <sub>4</sub>	3 mol CaSO <sub>4</sub>	1 mol Ca(OH) <sub>2</sub>	

**(Mass- Volume/ Volume-Volume Conversions)**

16. Given the following equation:



- a. What mass of water is required to react with 15.5 L of Nitrogen dioxide?  
 b. What volume of Nitrogen monoxide would be produced from 100.0 g of water?  
 c. If 42.0 L of NO<sub>(g)</sub> is produced, what volume of NO<sub>2 (g)</sub> reacted?

a. 
$$\frac{15.5 \text{ L NO}_2}{22.4 \text{ L NO}_2} \times \frac{1 \text{ mol NO}_2}{3 \text{ mol NO}_2} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \times \frac{18.0 \text{ g H}_2\text{O}}{1 \text{ mol H}_2\text{O}} = \boxed{4.15 \text{ g H}_2\text{O}}$$

b. 
$$\frac{100.0 \text{ g H}_2\text{O}}{18.0 \text{ g H}_2\text{O}} \times \frac{1 \text{ mol H}_2\text{O}}{1 \text{ mol H}_2\text{O}} \times \frac{1 \text{ mol NO}}{1 \text{ mol H}_2\text{O}} \times \frac{22.4 \text{ L NO}}{1 \text{ mol NO}} = \boxed{124 \text{ L NO}}$$

c. 
$$\frac{42.0 \text{ L NO}}{22.4 \text{ L NO}} \times \frac{1 \text{ mol NO}}{1 \text{ mol NO}} \times \frac{3 \text{ mol NO}_2}{1 \text{ mol NO}} \times \frac{22.4 \text{ L NO}_2}{1 \text{ mol NO}_2} = \boxed{126 \text{ L NO}_2}$$

17. When Magnesium reacts with Nitric Acid, Hydrogen gas and aqueous Magnesium nitrate are formed. What volume of Hydrogen gas will be produced if 40.0 g of Magnesium is reacted with an excess of Nitric Acid?



$$\frac{40.0 \text{ g Mg}}{24.3 \text{ g Mg}} \times \frac{1 \text{ mol Mg}}{1 \text{ mol Mg}} \times \frac{1 \text{ mol H}_2}{1 \text{ mol Mg}} \times \frac{22.4 \text{ L H}_2}{1 \text{ mol H}_2} = \boxed{36.9 \text{ L H}_2}$$

18. The corrosion (rusting) of iron is represented as follows: (at STP)



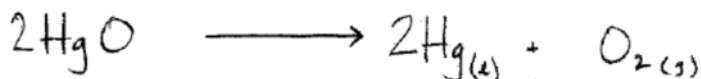
a. What volume of Oxygen gas would be required to produce 16.0 g of  $\text{Fe}_2\text{O}_3$ ?

b. What mass of Iron would be required to react with 10.0 L of  $\text{O}_2$  gas?

$$\frac{16.0 \text{ g Fe}_2\text{O}_3}{159.6 \text{ g Fe}_2\text{O}_3} \times \frac{1 \text{ mol Fe}_2\text{O}_3}{2 \text{ mol Fe}_2\text{O}_3} \times \frac{3 \text{ mol O}_2}{1 \text{ mol Fe}_2\text{O}_3} \times \frac{22.4 \text{ L O}_2}{1 \text{ mol O}_2} = \boxed{3.37 \text{ L O}_2}$$

$$\frac{10.0 \text{ L O}_2}{22.4 \text{ L O}_2} \times \frac{1 \text{ mol O}_2}{3 \text{ mol O}_2} \times \frac{4 \text{ mol Fe}}{1 \text{ mol O}_2} \times \frac{55.8 \text{ g Fe}}{1 \text{ mol Fe}} = \boxed{33.2 \text{ g Fe}}$$

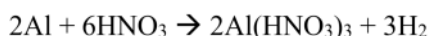
19. Mercury (II) oxide decomposes when heated to produce liquid Mercury and Oxygen gas. What mass of Mercury (II) oxide would be required to produce 30.5 L of Oxygen gas? (Assume STP)



$$\text{i) } \frac{30.5 \text{ L O}_2}{22.4 \text{ L O}_2} \times \frac{1 \text{ mol O}_2}{1 \text{ mol O}_2} \times \frac{2 \text{ mol HgO}}{1 \text{ mol O}_2} \times \frac{216.6 \text{ g HgO}}{1 \text{ mol HgO}} = \boxed{5.9 \times 10^2 \text{ g HgO}}$$

$$\text{ii) } \frac{295 \text{ g HgO}}{216.6 \text{ g HgO}} \times \frac{1 \text{ mol HgO}}{2 \text{ mol HgO}} \times \frac{2 \text{ mol Hg}}{1 \text{ mol HgO}} \times \frac{200.6 \text{ g Hg}}{1 \text{ mol Hg}} \times \frac{1 \text{ cm}^3 \text{ Hg}}{13.6 \text{ g Hg}} = \boxed{20.1 \text{ cm}^3 \text{ Hg}}$$

20. How many mL of 2.00M  $\text{HNO}_3$  is needed to consume 5.4g of aluminum?

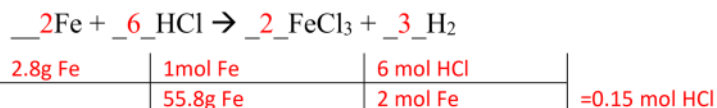


$$\frac{5.4 \text{ g Al}}{27.0 \text{ g Al}} \times \frac{1 \text{ mol Al}}{2 \text{ mol Al}} \times \frac{6 \text{ mol HNO}_3}{2 \text{ mol Al}} = 0.60 \text{ mol HNO}_3$$

$$[\text{HNO}_3] = \# \text{ mols} \div \text{volume}$$

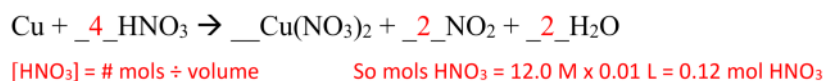
$$\text{So, Volume} = \text{mols} \div [\text{HNO}_3] = 0.60 \text{ mol} \div 2\text{M} = 0.3 \text{ L} (\times 1000) = 3.0 \times 10^2 \text{ mL HNO}_3$$

21. 20mL of HCl is needed to consume 2.8g Fe. What is the concentration of HCl?



$$[\text{HCl}] = n \div V = 0.15 \text{ mol HCl} \div 0.02 \text{ L} = 7.5 \text{ M HCl}$$

22. What mass of copper will react with 10.0mL of 12.0M nitric acid?



Name: \_\_\_\_\_ Block: \_\_\_\_\_ Date: \_\_\_\_\_

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Chemistry 11      **Limiting Reagents and Percent Yield Key**      Assignment

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|---|---|
| <p>1. O<sub>2</sub> is limiting.</p> <p>2. Mg(OH)<sub>2</sub> is limiting.</p> <p>3. H<sub>2</sub>SO<sub>4</sub> is limiting.</p> <p>4. NaCl is in excess.</p> <p>5. 12g of CrCl<sub>3</sub></p> <p>6. 15.5g SO<sub>3</sub></p> <p>7. 44.2g Fe</p> <p>8. 27.3g N<sub>2</sub></p> <p>9. 22.9g NaCl</p> <p>10. a) Pb(NO<sub>3</sub>)<sub>2</sub> + 2NaI → 2NaNO<sub>3</sub> + PbI<sub>2</sub><br/>         b) 8.51g NaNO<sub>3</sub><br/>         c) NaI<br/>         d) 8.4g Pb(NO<sub>3</sub>)<sub>2</sub> would be left over.</p> <p>11. 42% yield</p> | <p>12. 49.1% yield</p> <p>13. 81.6% yield</p> <p>14. a) 20.00g FeCl<sub>2</sub><br/>         b) 20.0% yield</p> <p>15. a) 22.2g CS<sub>2</sub><br/>         b) 2.1g SO<sub>2</sub> left over.</p> <p>16. 0.279g BaBr<sub>2</sub></p> <p>17. a) 21.1g SiF<sub>4</sub><br/>         b) 8.03g left unused.<br/>         c) 34.2% yield</p> |
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