

## Semester Mixed Stoichiometry Practice

Name \_\_\_\_\_

Chemistry

Date \_\_\_\_\_ Hour \_\_\_\_\_

The following set of questions is a mix of the different types of stoichiometry problems that we have encountered throughout the second semester. This includes the following types of stoichiometry problems:

*Standard Stoichiometry**Solutions**Limiting Reactants**Gases**Thermochemical Equations*

You may use any of the following formulas or conversion factors to solve these problems on a **separate sheet of paper**:

$$1 \text{ mol X} = \text{MMg X}$$

$$M = \frac{\text{moles of solute}}{\text{Lites of solution}}$$

$$\text{Celsius} + 273 =$$

*Kelvin**MM = molar mass on the periodic table*

$$1 \text{ mol X} = 6.02 \times 10^{23} \text{ particles X}$$

$$PV = nRT$$

$$R = 0.082 \frac{L \cdot atm}{K \cdot mol}$$

*Particles = atoms, ions, formula units, or molecules*

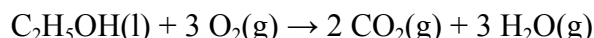
$$\# \text{ mol X} : \# \text{ mol Y}$$

*# is the coefficient from the original chemical equation*

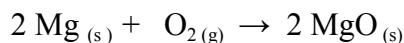
$$\# \text{ mol X} : \#\# \text{ kilojoules of heat}$$

*# is the coefficient from the original chemical equation**## is the amount of heat energy from the original chem equation.*

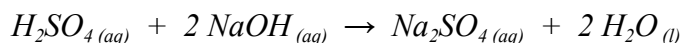
1. When ethanol ( $\text{C}_2\text{H}_5\text{OH}$ ) is burned, it reacts with oxygen ( $\text{O}_2$ ). It also releases 1,369 kJ of heat energy to the surroundings and produces  $\text{CO}_2$  gas and  $\text{H}_2\text{O}$  gas.



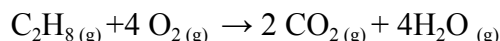
- a. Calculate how much heat energy (in kJ) is released when 12.5 moles of ethanol burns. *-17,100 kJ*
- b. Calculate how many moles of carbon dioxide are produced if 787 kJ of heat energy are produced. *1.15 mol  $\text{CO}_2$*
- c. Calculate how much heat energy (in kJ) is released when 124.7 grams of oxygen are reacted. *-1778 kJ*
2. A combination reaction occurs between solid magnesium metal (Mg) and diatomic oxygen gas ( $\text{O}_2$ ). Solid magnesium oxide (MgO) is produced.



- a. 17.54 moles of solid magnesium reacts completely with excess oxygen gas. Complete a BCA table.
- b. Using your BCA table and dimensional analysis, calculate the **grams** of MgO produced. *707.0 grams MgO*
3. Aqueous solutions of sulfuric acid and sodium hydroxide undergo a double-replacement reaction to form aqueous sodium sulfate and liquid water.

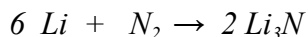


- a. Complete the BCA table when 55.89 g of  $\text{Na}_2\text{SO}_4$  is **produced** by this reaction. Remember BCA tables can only contain moles! *0.3935 mol  $\text{Na}_2\text{SO}_4$*
- b. Calculate the number of molecules of NaOH that reacted.  *$4.738 \times 10^{23}$  molecules NaOH*
4. Dicarbox octohydride ( $\text{C}_2\text{H}_8$ ) combusts completely with excess oxygen ( $\text{O}_2$ ) to form carbon dioxide ( $\text{CO}_2$ ) & water ( $\text{H}_2\text{O}$ ).



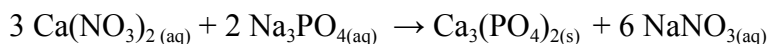
- a. How many particles of  $\text{CO}_2$  are produced if 3 moles of  $\text{C}_2\text{H}_8$  undergo complete combustion. Complete a BCA table.

5. 10.6g of Li and 3.83g of  $\text{N}_2$  react to form  $\text{Li}_3\text{N}$ .



- What is the maximum amount of moles of lithium nitride that can be made? *0.274 moles of  $\text{Li}_3\text{N}$*
- What is the maximum amount of molecules of lithium nitride that can be made?  *$1.65 \times 10^{23}$  molecules  $\text{Li}_3\text{N}$*
- What is the limiting reactant?
- How many moles of limiting reactant are used? *0.137 moles  $\text{N}_2$*
- How many particles of limiting reactant are used?  *$8.25 \times 10^{22}$  molecules  $\text{N}_2$*
- What is the excess reactant?
- How much excess reactant remains in moles? *0.708 moles of Li*
- How much excess reactant remains in grams? *4.91 grams of Li*

6. Calcium nitrate ( $\text{Ca}(\text{NO}_3)_2$ ) and sodium phosphate ( $\text{Na}_3\text{PO}_4$ ) undergo a double-replacement reaction according to the following balanced equation:



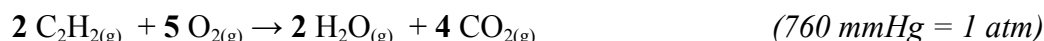
- Suppose 2.75 L of 0.325M  $\text{Ca}(\text{NO}_3)_2$  reacts completely with all of the  $\text{Na}_3\text{PO}_4$ . Complete a BCA table.
- How many grams of the precipitate will be produced in this reaction? *92.4 g  $\text{Ca}_3(\text{PO}_4)_2$*
- If the final product contains 3.50L of aqueous  $\text{NaNO}_3$ , what is the molarity of the  $\text{NaNO}_3$  solution? *0.511M  $\text{NaNO}_3$*
- If the scientist was using 0.575M  $\text{Ca}(\text{NO}_3)_2$  instead, what volume, in liters, would be necessary to produce the same amount of  $\text{Ca}_3(\text{PO}_4)_2$  that you calculated in your BCA table. *1.55 L  $\text{Ca}(\text{NO}_3)_2$*

6. Potassium chlorate decomposes into potassium chloride and oxygen gas, according to the following chemical equation:



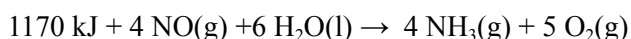
- What mass of potassium chlorate reacted in order to produce 3.90 L of  $\text{O}_2$  gas at  $23.8^\circ\text{C}$  and 0.997 atm? *13.1 g  $\text{KClO}_3$*

7. A hydrocarbon,  $\text{C}_2\text{H}_2$ , combusts according to the following chemical equation:



- How many grams of  $\text{C}_2\text{H}_2$  are needed to produce 26.5 liters of carbon dioxide gas at  $40.0^\circ\text{C}$  and 788 mmHg? *13.9 g  $\text{C}_2\text{H}_2$*

8. Nitrogen monoxide gas and liquid water can be reacted to form oxygen gas and ammonia. In the process, 1170 kJ of heat energy are gained.



- Calculate how much heat energy (in kJ) is needed to produce 7.6 moles of ammonia. *2200 kJ*
- Calculate the amount of heat energy required (in kJ) to react 78.98 g of nitrogen monoxide gas. *770. kJ*
- CHALLENGE Use dimensional analysis to calculate how many kilograms of water vapor are needed to absorb 15,980 J of heat energy. Remember: 1000 g = 1 kg and 1000 J = 1 kJ *0.001476 kg*