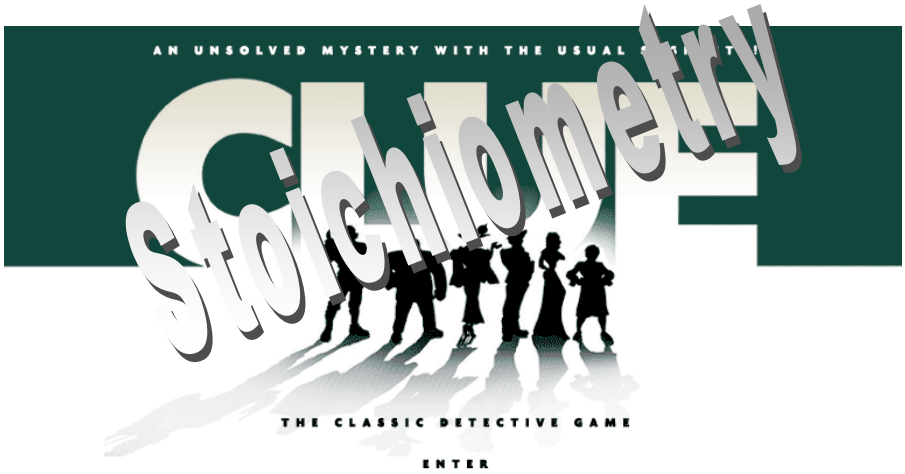
Name _____ Date _____ Pd. _____

**Chemistry 1 Version**




Use the clues to determine the identity of the murderer, the weapon and the location.

- Show all work.
- Calculate all answers to 3 significant digits.
- Write UNITS and FORMULAS next to each number as you solve the problems.

Good Luck!

| Suspects | |
|---|---|
| Colonel Mustard | |
| Professor Plum | |
| Mr. Green | |
| Mrs. Peacock | |
| Miss Scarlet | |
| Mrs. White | |
| Weapons | |
| Knife | |
| Candlestick | |
| Revolver | |
| Rope | |
| Lead Pipe | |
| Wrench | |
| Poison | |
| Rooms | |
| Hall | |
| Lounge | |
| Dining Room | |
| Kitchen | |
| Ball Room | |
| Conservatory | |
| Billiard Room | |
| Library | |
| Study | |

**Final Investigative Report**

***Murderer:*** _____

***Weapon:*** _____

***Location:*** _____

Name _____ Date _____ Pd. _____
**Chemistry 1 Version**

1. Sodium bicarbonate, NaHCO3, is used in baking (baking soda), fire extinguishers, and in the manufacture of plastics and ceramics. It decomposes according to the equation shown below. If you decompose 2.33 moles of sodium bicarbonate, how many moles of water will be produced?

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

*a. If the moles of water is less than 1.00 mole, eliminate the ballroom.*
*b. If the moles of water is between 1.00 mole and 1.25 moles, eliminate the hall.*
*c. If the moles of water is greater than 1.25 moles, eliminate the kitchen.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

2. Suppose you want to produce 3.54 L of $CO_2$ at STP using the reaction in #1. What mass of sodium bicarbonate should you use?

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

*a. If your answer is greater than 10.0g, eliminate the knife.*
*b. If your answer is less than 10.0g, eliminate the lead pipe.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

3. Upon decomposing, a sample of sodium bicarbonate produces 0.0160 g of sodium carbonate, $Na_2CO_3$. How many grams of water does it produce? (Use the balanced equation from question #1).

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

*a. If your answer is less than .0025g, eliminate Ms. Peacock.*
*b. If your answer is between 0.0025 and 0.00300g, eliminate Mrs. Scarlet.*
*c. If your answer is greater than 0.00300g, eliminate Mrs. White.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

4. Propane, $C_3H_8$, can be used as a fuel in your home, car, or barbecue grill because it is easily liquefied and transported. If 397 g of propane is burned, what mass (in grams) of oxygen, $O_2$, is required for complete combustion?

$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O_{(g)}$$

*a. If your answer is less than 17ŌOg, eliminate the study.*
*b. If your answer is between 17ŌOg and 1850g, eliminate the conservatory.*
*c. If your answer is greater than 1850g, eliminate the billiard room.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

5. Ammonia ($NH_3$) reacts with oxygen gas to make water and nitrogen monoxide (NO). Balance the equation and determine the coefficient for water.

$$\_\_\_NH_3 + \_\_\_O_2 \rightarrow \_?\_H_2O + \_\_\_NO$$

*a. If the coefficient is 2, eliminate the revolver.*
*b. If the coefficient is 4, eliminate the candlestick.*
*c. If the coefficient is 6, eliminate the rope.*
*d. If the coefficient is 8, eliminate the wrench.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

6. Using the same balanced equation as question #5, how many molecules of $O_2$ are required to completely react with 2.78 grams of $NH_3$?

$$NH_3 + O_2 \rightarrow H_2O + NO$$

*a. If your answer is less than 8.00 x $10^{22}$ molecules, eliminate the candlestick.*
*b. If your answer is greater than 8.00 x $10^{22}$ molecules, eliminate the revolver.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

7. Using the same balanced equation as question #5, how many liters of NO would be produced if you react 14.6 L of $NH_3$ with excess oxygen?

$$NH_3 + O_2 \rightarrow H_2O + NO$$

*a. If you answered less than 15 L, eliminate Professor Plum.*
*b. If you answered greater than 15 L, eliminate Colonel Mustard.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

8. Iron(III) chloride is used to treat drinking and waste water. It can be made by reacting iron with chlorine gas. Calculate the volume of chlorine gas ($Cl_2$) at STP that will react with 5.60 grams of iron.

Balanced Equation: $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

*a. If you answered less than 0.500 liters, eliminate the conservatory.*
*b. If you answered between 0.500 and 2.50 liters, eliminate the hall.*
*c. If you answered greater than 2.50 liters, eliminate the lounge.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

9. Aluminum chloride, $AlCl_3$, is an inexpensive reagent used in many industrial processes. It is made by treating scrap aluminum metal with chlorine according to the balanced equation shown below. Which reactant is limiting if 3.11 g of Al and 4.79 g of $Cl_2$ are reacted?

$$2\ Al + 3\ Cl_2 \rightarrow 2\ AlCl_3$$

*a. If the limiting reactant is Al, eliminate Professor Plum.*
*b. If the limiting reactant is $Cl_2$, eliminate Mrs. White.*
*c. If the limiting reactant is $AlCl_3$, eliminate Mr. Green.*
*d. If there is no limiting reactant because the reactants are in perfect stoichiometric rations, eliminate Miss Scarlet.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

10. Careful decomposition of ammonium nitrate gives laughing gas, ($N_2O$) and water. Balance the equation for this reaction and determine the coefficient for water.

$$\_\_\_NH_4NO_3 \rightarrow \_\_\_N_2O + \_?\_H_2O$$

*a. If the coefficient is 1, eliminate the hall.*
*b. If the coefficient is 2, eliminate the conservatory.*
*c. If the coefficient is 3, eliminate the lounge.*

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**Chemistry 1 Version**

11. Using the same equation as question #10, if 12.2 g of ammonium nitrate is decomposed, what mass of laughing gas will be produced?

$$\_\_\_NH_4NO_3 \rightarrow \_\_\_N_2O + \_\_\_H_2O$$

*a. If you answered less than 6.00.g, eliminate Miss Scarlet.*
*b. If you answered between 6.00g and 10.00g, eliminate Mr. Green.*
*c. If you answered greater than 10.00g, eliminate Professor Plum.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

12. Using the same equation as question #10, how many grams of water would be produced if 4.16 g of ammonium nitrate were decomposed?

$$\_\_\_NH_4NO_3 \rightarrow \_\_\_N_2O + \_\_\_H_2O$$

*a. If you answered less than 1.50 grams, eliminate the lead pipe and the ball room*
*b. If you answered between 1.50 and 1.95 grams, eliminate the wrench and the ballroom.*
*c. If you answered greater than 1.95 grams, eliminate the poison and the lounge.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

13. What is the mass, in grams, of $6.33 \times 10^{23}$ atoms of lead? (This is a mole conversion problem...not really a stoichiometry problem. You are just converting atoms to moles to grams).

*a. If you answered less than 100.g, eliminate the Colonel Mustard and the conservatory.*
*b. If you answered between 100.g and 110.g, eliminate Mr. Green and the wrench.*
*c. If you answered greater than 110.g, eliminate Mrs. Peacock and the billiards room.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

14. In an explosive chemical reaction, potassium metal reacts with water to form potassium hydroxide and hydrogen gas as shown below. Suppose that 0.73 grams of potassium reacts with 2.64 grams of water. Which compound is the limiting reactant?

$$2K + 2H_2O \rightarrow 2KOH + H_{2(g)}$$

*a. If potassium is the limiting reactant, eliminate the poison and the library.*
*b. If water is the limiting reactant, eliminate the poison and the dining room.*
*c. If potassium hydroxide is the limiting reactant, eliminate the billiard room and the wrench.*

Name _____ Date _____ Pd. _____

**Chemistry 1 Version**

15. Using the initial mass of the limiting reactant in problem #14, what volume of hydrogen gas will be produced in the reaction at STP?

$$2K + 2H_2O \rightarrow 2KOH + H_{2(g)}$$

*a. If you answered less than 0.1L, eliminate the poison and the dining room.*
*b. If you answered between 0.1L and 1.5L, eliminate the kitchen and the lead pipe.*
*c. If you answered greater than 1.5L, eliminate Mrs. White and the library.*