

## Stoichiometry Test Form A

**Multiple Choice: Place the best answer to each question or problem on your answer sheet.**

- The calculation of quantities in chemical equations is called \_\_\_\_\_.  
a. Stoichiometry    b. Dimensional analysis    c. percent composition    d. percent yield
- When an equation is used to calculate the amount of product that will form during a reaction, then the value obtained is called the \_\_\_\_\_.  
a. actual yield    b. percent yield    c. theoretical yield    d. minimum yield
- Which of the following is an **INCORRECT** interpretation of the balanced equation shown below?  
 $2 \text{S(s)} + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{SO}_3(\text{g})$   
a. 2 atoms S + 3 molecules  $\text{O}_2 \rightarrow 2$  molecules  $\text{SO}_3$     c. 2 mol S + 3 mol  $\text{O}_2 \rightarrow 2$  mol  $\text{SO}_3$   
b. 2 g S + 3 g  $\text{O}_2 \rightarrow 2$  g  $\text{SO}_3$     d. all of the above are correct
- Excess aluminum reacts with oxygen to give aluminum oxide according to the following reaction:  
 $4 \text{Al(s)} + 3 \text{O}_2(\text{g}) \rightarrow 2 \text{Al}_2\text{O}_3(\text{s})$ . Which of the following is true?  
a. You need 3.0 moles of  $\text{O}_2$  to produce 1.0 moles of  $\text{Al}_2\text{O}_3$ .  
b. You need 16.0 moles of  $\text{O}_2$  to produce 16.0 moles of  $\text{Al}_2\text{O}_3$ .  
c. You need 8.0 moles of  $\text{O}_2$  to produce 4.0 moles of  $\text{Al}_2\text{O}_3$ .  
d. You need 1.5 moles of  $\text{O}_2$  to produce 1.0 moles of  $\text{Al}_2\text{O}_3$ .
- How many moles of aluminum are needed to react completely with 1.2 mol of FeO?  
 $2 \text{Al(s)} + 3 \text{FeO(s)} \rightarrow 3 \text{Fe(s)} + \text{Al}_2\text{O}_3(\text{s})$   
a. 1.2 mol    b. 0.80 mol    c. 1.6 mol    d. 2.4 mol
- Which of the following is **NOT** true about limiting and excess reactants?  
a. The amount of product obtained is determined by the limiting reactant.  
b. A balanced equation is necessary to determine which reactant is the limiting reactant.  
c. Some of the excess reactant is left over after the reaction is complete.  
d. The reactant that has the smallest given mass is always the limiting reactant.
- When two substances react to form products, the reactant which is used up is called the \_\_\_\_\_.  
a. determining reactant    b. limiting reactant    c. excess reactant    d. catalytic reactant
- If 15 moles of nitrogen react with 25 moles of hydrogen according to the balanced equation below, what is the limiting reactant?  
 $\text{N}_2(\text{g}) + 3 \text{H}_2(\text{g}) \rightarrow 2 \text{NH}_3(\text{g})$   
a.  $\text{N}_2$     b.  $\text{H}_2$     c.  $\text{NH}_3$     d. Cannot be determined.
- Which of the following is **NOT** a reason why the actual yield in a chemical reaction is less than the theoretical yield?  
a. impure reactants present    c. loss of product during purification  
b. competing side reactions    d. conservation of mass
- A reaction was run according to the following equation:  
 $\text{H}_3\text{PO}_4(\text{aq}) + \text{Ca}(\text{OH})_2(\text{aq}) \rightarrow \text{Ca}_3(\text{PO}_4)_2(\text{aq}) + \text{H}_2\text{O}(\text{l})$   
The theoretical yield of water was 24.3 g. If the actual yield of water was 21.7 g, what was the percent yield?  
a. 112%    b. 89.3%    c. 12.0%    d. 10.7%

Name: \_\_\_\_\_

Form A

## Stoichiometry Exam

- |          |          |          |           |
|----------|----------|----------|-----------|
| 1. _____ | 4. _____ | 7. _____ | 10. _____ |
| 2. _____ | 5. _____ | 8. _____ | 11. _____ |
| 3. _____ | 6. _____ | 9. _____ | 12. _____ |

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**For the following problems, be sure to show all of your work in an organized manner including units and rounding for significant figures.**

13. Given the UNBALANCED equation:  $\text{Fe} + \text{Cl}_2 \rightarrow \text{FeCl}_3$

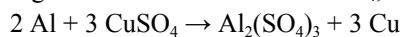
If 8.12 moles of  $\text{Cl}_2$  react completely, how many moles of  $\text{FeCl}_3$  can be produced?

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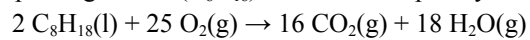
14. How many moles of  $\text{H}_3\text{PO}_4$  are produced when 71.0 g of  $\text{P}_4\text{O}_{10}$  reacts completely to form  $\text{H}_3\text{PO}_4$  according to the following reaction?  $\text{P}_4\text{O}_{10}(\text{s}) + 6 \text{H}_2\text{O}(\text{l}) \rightarrow 4 \text{H}_3\text{PO}_4(\text{aq})$

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15. If 54.0 g of Al react with excess  $\text{CuSO}_4$ , how many grams of Cu would be produced?



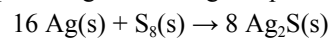
16. A 567.2 g sample of gasoline ( $C_8H_{18}$ ) is burned completely according to the following reaction:



- What is the theoretical yield of  $CO_2$  in this reaction?
- If the actual yield of  $CO_2$  is 1658 g, what is the percent yield of the reaction?

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17. A 3.0 g sample of Ag and a 3.0 g sample of  $S_8$  are placed in a flask and allowed to react according to the following equation:



- What substance is the limiting reactant? (Support your answer with calculations.)
- What mass of silver sulfide will be produced?
- How many grams of the excess reactant will react in the reaction?

Answer Key (from ChatGPT)

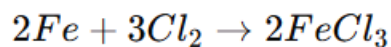
## Multiple Choice

1. a — Stoichiometry
2. c — theoretical yield
3. b — grams are not in the mole ratio of the equation
4. d — 1.5 mol O<sub>2</sub> produce 1.0 mol Al<sub>2</sub>O<sub>3</sub>
5. b — 0.80 mol Al
6. d — smallest mass is not always limiting
7. b — limiting reactant
8. b — H<sub>2</sub> is limiting
9. d — conservation of mass
10. b — 89.3%



13.

Balance first:



Given:

$$8.12 \text{ mol } Cl_2$$

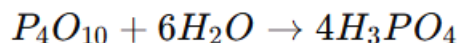
Use mole ratio:

$$8.12 \text{ mol } Cl_2 \times \frac{2 \text{ mol } FeCl_3}{3 \text{ mol } Cl_2} \\ = 5.41 \text{ mol } FeCl_3$$

Answer:

$$5.41 \text{ mol } FeCl_3$$

14.



Step 1: Convert grams to moles

Molar mass of  $P_4O_{10}$ :

$$(4)(30.97) + (10)(16.00) = 283.88 \text{ g/mol}$$

$$71.0 \text{ g} \times \frac{1 \text{ mol}}{283.88 \text{ g}} = 0.250 \text{ mol } P_4O_{10}$$

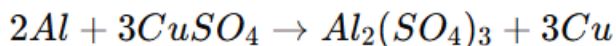
Step 2: Mole ratio

$$\begin{aligned} 0.250 \text{ mol } P_4O_{10} \times \frac{4 \text{ mol } H_3PO_4}{1 \text{ mol } P_4O_{10}} \\ = 1.00 \text{ mol } H_3PO_4 \end{aligned}$$

Answer:

$$\boxed{1.00 \text{ mol } H_3PO_4}$$

15.



Step 1: Convert Al to moles

Molar mass Al:

$$26.98 \text{ g/mol}$$

$$54.0 \text{ g} \times \frac{1 \text{ mol}}{26.98 \text{ g}} = 2.00 \text{ mol } Al$$

Step 2: Mole ratio

$$2.00 \text{ mol } Al \times \frac{3 \text{ mol } Cu}{2 \text{ mol } Al} = 3.00 \text{ mol } Cu$$

### Step 3: Convert to grams

Molar mass Cu:

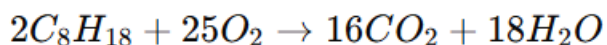
$$63.55 \text{ g/mol}$$

$$3.00 \text{ mol} \times 63.55 \text{ g/mol} = 190.7 \text{ g}$$

Answer:

$$\boxed{191 \text{ g Cu}}$$

16.



#### a) Theoretical Yield of $CO_2$

##### Step 1: Convert gasoline to moles

Molar mass of  $C_8H_{18}$ :

$$114.23 \text{ g/mol}$$

$$567.2 \text{ g} \times \frac{1 \text{ mol}}{114.23 \text{ g}} = 4.966 \text{ mol}$$

##### Step 2: Mole ratio

$$\begin{aligned} 4.966 \text{ mol } C_8H_{18} \times \frac{16 \text{ mol } CO_2}{2 \text{ mol } C_8H_{18}} \\ = 39.73 \text{ mol } CO_2 \end{aligned}$$

### Step 3: Convert to grams

Molar mass  $\text{CO}_2$ :

$$44.01 \text{ g/mol}$$

$$39.73 \times 44.01 = 1748 \text{ g}$$

Answer:

$$\boxed{1748 \text{ g CO}_2}$$

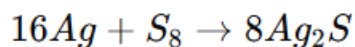
### b) Percent Yield

$$\begin{aligned} \% \text{yield} &= \frac{\text{actual}}{\text{theoretical}} \times 100 \\ &= \frac{1658}{1748} \times 100 \\ &= 94.9\% \end{aligned}$$

Answer:

$$\boxed{94.9\%}$$

17.



a) Limiting Reactant

Step 1: Convert to moles

Silver

$$3.0 \text{ g} \times \frac{1 \text{ mol}}{107.87 \text{ g}} = 0.0278 \text{ mol Ag}$$

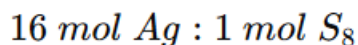
Sulfur

Molar mass  $S_8$ :

$$256.48 \text{ g/mol}$$
$$3.0 \text{ g} \times \frac{1 \text{ mol}}{256.48 \text{ g}} = 0.0117 \text{ mol } S_8$$

Step 2: Determine limiting reactant

Need ratio:



To use all  $0.0117 \text{ mol } S_8$ :

$$0.0117 \times 16 = 0.187 \text{ mol Ag}$$

Only  $0.0278 \text{ mol Ag}$  available.

Therefore:

<i>Ag is the limiting reactant</i>
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## b) Mass of $Ag_2S$ Produced

Step 1: Mole ratio

$$0.0278 \text{ mol } Ag \times \frac{8 \text{ mol } Ag_2S}{16 \text{ mol } Ag} = 0.0139 \text{ mol } Ag_2S$$

Step 2: Convert to grams

Molar mass  $Ag_2S$ :

$$(2)(107.87) + 32.06 = 247.80 \text{ g/mol}$$

$$0.0139 \times 247.80 = 3.44 \text{ g}$$

Answer:

$$\boxed{3.44 \text{ g } Ag_2S}$$

## C) Excess Reactant Used

Step 1: Sulfur used

$$0.0278 \text{ mol } Ag \times \frac{1 \text{ mol } S_8}{16 \text{ mol } Ag} = 0.00174 \text{ mol } S_8$$

Step 2: Convert to grams used

$$0.00174 \times 256.48 = 0.446 \text{ g}$$