

Station 1

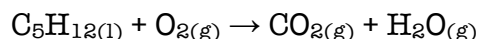
Answer questions 1a - 1d. Color leaf one the color that corresponds to the answer that is used twice.

Outline the leaf in one of the other colors.

Polka-dot the leaf in the third color.

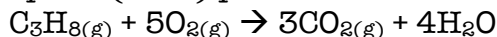
- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

1a. Which of the following statements is true about the total number of reactants and the total number of products in this reaction?



- A) 9 moles of reactants regroup to form 11 moles of product**
- B) 9 grams of reactants regroup to form 11 grams of product
- C) 9 liters of reactants regroup to form 11 liters of product
- D) 9 atoms of reactants regroup to form 11 atoms of product
- E) 22.4 liters of reactants regroup to form 22.4 liters of product

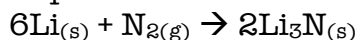
1b) The combustion of propane (C_3H_8) produces CO_2 and H_2O :



The reaction of 10 mol of O_2 will produce _____ mol of H_2O .

- A) 4.0
- B) 10.0
- C) 2.5
- D) 8.0**
- E) 1.0

1c) Lithium and nitrogen react to produce lithium nitride:



How many moles of N_2 are needed to react with 0.500 mol of lithium?

- A) 3.00
- B) 0.500
- C) 0.167
- D) 1.50
- E) 0.0833**

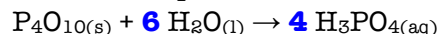
1d) What is conserved in all chemical reactions?

- A) only mass
- B) only mass and moles
- C) only mass, moles, and molecules
- D) only mass, moles, molecules and volume
- E) atoms and mass**

Station 2 - Color leaf 2 the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

2) How many moles of H_3PO_4 are produced when 71.0 g P_4O_{10} reacts completely to form H_3PO_4 ?



A) 0.0635 mol

B) 1.00 mol

C) 4.00 mol

D) 16.0 mol

E) 98.0 mol

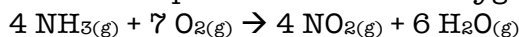
$$\frac{71.0 \text{ g P}_4\text{O}_{10}}{1} \times \frac{1 \text{ mole P}_4\text{O}_{10}}{283.886 \text{ g P}_4\text{O}_{10}} \times \frac{4 \text{ moles H}_3\text{PO}_4}{1 \text{ mole P}_4\text{O}_{10}} = 1.00 \text{ moles H}_3\text{PO}_4$$

Station 3

Color leaf 3 the answer for question 3a. Polka-dot leaf 3 the answer to question 3b.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

3a) The combustion of ammonia in the presence of excess oxygen yields NO_2 and H_2O :



The combustion of 28.8 g of ammonia consumes _____ g of oxygen.

A) 94.7

B) 54.1

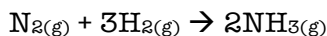
C) 108

D) 15.3

E) 28.8

$$\frac{28.8 \text{ g NH}_3}{1} \times \frac{1 \text{ mole NH}_3}{17.031 \text{ g NH}_3} \times \frac{7 \text{ moles O}_2}{4 \text{ mole NH}_3} \times \frac{31.998 \text{ g O}_2}{1 \text{ mole O}_2} = 94.7 \text{ g O}_2$$

3b) Under appropriate conditions, nitrogen and hydrogen undergo a combination reaction to yield ammonia:



A 7.1-g sample of N_2 requires _____ g of H_2 for complete reaction.

A) 0.51

B) 0.76

C) 1.2

D) 1.5

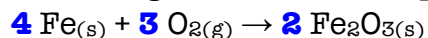
E) 17.2

$$\frac{7.1 \text{ g N}_2}{1} \times \frac{1 \text{ mole N}_2}{28.014 \text{ g N}_2} \times \frac{3 \text{ moles H}_2}{1 \text{ mole N}_2} \times \frac{2.016 \text{ g H}_2}{1 \text{ mole H}_2} = 1.5 \text{ g H}_2$$

Station 4 – Color leaf 4 the color that corresponds to the answer.

- A – Red
- B – Blue
- C – Yellow
- D – Purple
- E – Orange

4) Iron(III) oxide is formed when iron combines with oxygen in the air. How many grams of Fe_2O_3 are formed when 16.7 g of Fe reacts completely with oxygen?



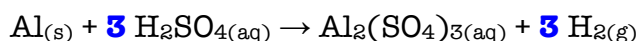
- A) 12.0 g
- B) 23.9 g**
- C) 47.8 g
- D) 95.6 g
- E) 267 g

$$\frac{16.7 \text{ g Fe}}{1} \times \frac{1 \text{ mole Fe}}{55.933 \text{ g Fe}} \times \frac{2 \text{ moles Fe}_2\text{O}_3}{4 \text{ moles Fe}} \times \frac{159.863 \text{ g Fe}_2\text{O}_3}{1 \text{ mole Fe}_2\text{O}_3} = 23.9 \text{ g Fe}_2\text{O}_3$$

Station 5 – Color leaf 5 the color that corresponds to the answer.

- A – Red
- B – Blue
- C – Yellow
- D – Purple
- E – Orange

5) Aluminum reacts with sulfuric acid to produce aluminum sulfate and hydrogen gas. How many grams of aluminum sulfate would be formed if 250 g H_2SO_4 completely reacted with aluminum?



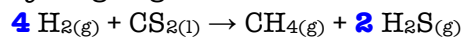
- A) 0.85 g
- B) 290 g
- C) 450 g
- D) 870 g
- E) 2600 g

$$\frac{250 \text{ g H}_2\text{SO}_4}{1} \times \frac{1 \text{ mole g H}_2\text{SO}_4}{98.078 \text{ g H}_2\text{SO}_4} \times \frac{1 \text{ mole Al}_2(\text{SO}_4)_3}{3 \text{ moles H}_2\text{SO}_4} \times \frac{342.15 \text{ g Al}_2(\text{SO}_4)_3}{1 \text{ mole Al}_2(\text{SO}_4)_3} = 290 \text{ g Al}_2(\text{SO}_4)_3$$

Station 6 - Color leaf 6 the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

6) How many liters of hydrogen gas are needed to react with CS₂ to produce 2.50 L of CH₄, at STP?



- A) 2.50 L
- B) 0.625 L
- C) 5.00 L
- D) 7.50 L
- E) 10.0 L**

$$\frac{2.50 \text{ L CH}_4}{1} \times \frac{4 \text{ L H}_2}{1 \text{ L CH}_4} = 10.0 \text{ L H}_2$$

Station 7

Color leaf 7 the answer for question 7a. Polka-dot leaf 7 the answer to question 7b.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

7a) Automotive air bags inflate when sodium azide decomposes explosively to its constituent elements:

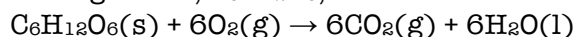


How many moles of N₂ are produced by the decomposition of 5.25 mol of sodium azide?

- A) 5.25
- B) 8.64
- C) 7.88**
- D) 0.960
- E) 1.44

$$\frac{5.25 \text{ mole NaN}_3}{1} \times \frac{3 \text{ moles N}_2}{2 \text{ moles NaN}_3} = 7.88 \text{ moles N}_2$$

7b) How many moles of glucose, C₆H₁₂O₆, can be burned when 60.0 mol of oxygen is available?



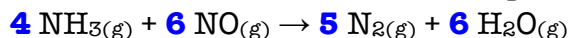
- A) 0.938 mol
- B) 10 mol**
- C) 60 mol
- D) 120 mol
- E) 301 mol

$$\frac{60.0 \text{ mole O}_2}{1} \times \frac{1 \text{ mole C}_6\text{H}_{12}\text{O}_6}{6 \text{ moles O}_2} = 10.0 \text{ mole C}_6\text{H}_{12}\text{O}_6$$

Station 8 - Color leaf 8 the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

8) How many liters of NH_3 are needed to react completely with 30.0 L of NO (at STP)?



- A) 5.0 L
- B) 20.0 L**
- C) 7.5 L
- D) 120.0 L
- E) 180.0 L

$$\frac{30.0 \text{ L NO}}{1} \times \frac{4 \text{ L NH}_3}{6 \text{ L NO}} = 20.0 \text{ L NH}_3$$

Station 9 - Color leaf 9 the color that corresponds to the answer that occurs the most among the following three questions.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

9a) Which of the following is NOT a true statement concerning limiting and excess reagents?

- A) The amount of product obtained is determined by the limiting reagent.
- B) A balanced equation is necessary to determine which reactant is the limiting reagent.
- C) Some of the excess reagent is left over after the reaction is complete.
- D) The reactant that has the smallest given mass is the limiting reagent.**
- E) Adding more of the limiting reagent to the reaction chamber will cause more product to be produced.

9b) Which of the following is **NOT** a true statement about "yield"?

- A) The value of the actual yield must be given in order for the percent yield to be calculated.
- B) The actual yield is often less than the theoretical yield.
- C) The percent yield is the ratio of the actual yield to the theoretical yield.
- D) The actual yield may be different from the theoretical yield because reactions do not always go to completion.
- E) The actual yield may be different from the theoretical yield because insufficient limiting reagent was used.**

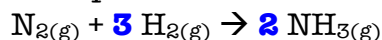
9c) Which of the following is not a reason why actual yield is less than theoretical yield?

- A) Impure reactants present
- B) Competing side reactions
- C) Loss of product during purification
- D) Conservation of mass**
- E) None of these

Station 10 – Color leaf 10 the color that corresponds to the answer.

- A – Red
- B – Blue
- C – Yellow
- D – Purple
- E – Orange

10) What is the maximum mass in grams of NH_3 that can be produced by the reaction of 1.0 g of N_2 with 3.0 g of H_2 via the equation below?



- A) 2.0
- B) 1.2**
- C) 0.61
- D) 17
- E) 4.0

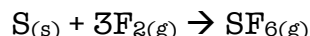
$$\frac{1.0 \text{ g N}_2}{1} \times \frac{1 \text{ mole N}_2}{28.014 \text{ g N}_2} \times \frac{2 \text{ mole NH}_3}{1 \text{ moles N}_2} \times \frac{17.031 \text{ g NH}_3}{1 \text{ mole NH}_3} = 1.2 \text{ g NH}_3$$

$$\frac{3.0 \text{ g H}_2}{1} \times \frac{1 \text{ mole H}_2}{2.016 \text{ g H}_2} \times \frac{2 \text{ mole NH}_3}{3 \text{ moles H}_2} \times \frac{17.031 \text{ g NH}_3}{1 \text{ mole NH}_3} = 17 \text{ g NH}_3$$

Station 11 – Color leaf 11 the color that corresponds to the answer.

- A – Red
- B – Blue
- C – Yellow
- D – Purple
- E – Orange

11) Sulfur and fluorine react in a combination reaction to produce sulfur hexafluoride:



The maximum amount of SF_6 that can be produced from the reaction of 3.5 g of sulfur with 4.5 g of fluorine is _____ g.

- A) 12
- B) 3.2
- C) 5.8**
- D) 16
- E) 8.0

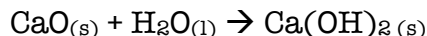
$$\frac{3.5 \text{ g S}}{1} \times \frac{1 \text{ mole S}}{32.066 \text{ g S}} \times \frac{1 \text{ mole SF}_6}{1 \text{ moles S}} \times \frac{146.054 \text{ g SF}_6}{1 \text{ mole SF}_6} = 16 \text{ g SF}_6$$

$$\frac{4.5 \text{ g F}_2}{1} \times \frac{1 \text{ mole F}_2}{37.996 \text{ g F}_2} \times \frac{1 \text{ mole SF}_6}{3 \text{ moles F}_2} \times \frac{146.054 \text{ g SF}_6}{1 \text{ mole SF}_6} = 5.8 \text{ g SF}_6$$

Station 12 - Color leaf 12 the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

12) Calcium oxide reacts with water in a combination reaction to produce calcium hydroxide:



A 4.50-g sample of CaO is reacted with 4.34 g of H₂O. How many grams of water remain after completion of reaction?

- A) 0.00
- B) 0.00892
- C) 2.90**
- D) 1.04
- E) 0.161

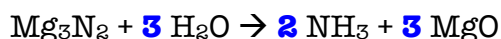
$$\frac{4.50 \text{ g CaO}}{1} \times \frac{1 \text{ mole CaO}}{56.077 \text{ g CaO}} \times \frac{1 \text{ mole H}_2\text{O}}{1 \text{ mole CaO}} \times \frac{18.015 \text{ g H}_2\text{O}}{1 \text{ mole H}_2\text{O}} = 1.4456 \text{ g H}_2\text{O was used}$$

$$\text{Amount of water left} = 4.34 \text{ g} - 1.4456 \text{ g} = 2.89 \text{ g H}_2\text{O}$$

Station 13 - Color leaf 13 the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

13) A 3.82-g sample of magnesium nitride is reacted with 7.73 g of water.



The actual yield of MgO is 3.60 g. What is the percent yield in the reaction?

- A) 94.5
- B) 78.7**
- C) 46.6
- D) 49.4
- E) 99.9

$$\frac{3.82 \text{ g Mg}_3\text{N}_2}{1} \times \frac{1 \text{ mole Mg}_3\text{N}_2}{100.929 \text{ g Mg}_3\text{N}_2} \times \frac{3 \text{ mole MgO}}{1 \text{ moles Mg}_3\text{N}_2} \times \frac{40.304 \text{ g MgO}}{1 \text{ mole MgO}} = 4.54 \text{ g NH}_3$$

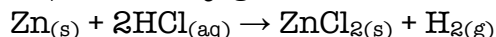
$$\frac{7.73 \text{ g H}_2\text{O}}{1} \times \frac{1 \text{ mole H}_2\text{O}}{18.015 \text{ g H}_2\text{O}} \times \frac{3 \text{ moles MgO}}{3 \text{ moles H}_2\text{O}} \times \frac{40.304 \text{ g MgO}}{1 \text{ mole MgO}} = 17.3 \text{ g MgO}$$

$$\text{Percent Yield} = \frac{3.60 \text{ g MgO}}{4.54 \text{ g MgO}} \times 100 = 79.29\%$$

Station 14 - Color the outside circles the color that corresponds to the answer.

- A - Red
- B - Blue
- C - Yellow
- D - Purple
- E - Orange

14) Hydrogen gas is produced when zinc reacts with hydrochloric acid. If the actual yield of this reaction is 85%, how many grams of zinc are needed to produce 112 L of H_2 at STP?



- A) 2.2 g
- B) 95 g
- C) 180 g
- D) 280 g
- E) 380 g**

$$\text{Percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

The problem states the actual yield = 112 L H_2 . However, the theoretical yield is the number needed to determine the amount of zinc that was reacted. Using the percent yield equation, solve for the theoretical yield.

$$\text{Theoretical yield} = \frac{\text{actual yield}}{\text{percent yield}} \times 100 = \frac{112 \text{ L } H_2}{85\%} \times 100 = 132 \text{ L } H_2$$

132 L H_2 represents the amount of hydrogen that was ACTUALLY reacted but only 85% of it resulted in making the product.

$$\frac{132 \text{ L } H_2}{1} \times \frac{1 \text{ mole } H_2}{22.4 \text{ L } H_2} \times \frac{1 \text{ mole Zn}}{1 \text{ mole } H_2} \times \frac{65.39 \text{ g Zn}}{1 \text{ mole Zn}} = 385 \text{ g Zn}$$