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?

$$C_5H_{12(l)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O_{(g)}$$

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:

$$C_3H_{8(g)} + 5O_{2(g)} \rightarrow 3CO_{2(g)} + 4H_2O$$

The reaction of10 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:

$$6Li_{(s)} + N_{2(g)} \rightarrow 2Li_3N_{(s)}$$

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?

$$P_4O_{10(s)} + \mathbf{6}\ H_2O_{(l)} \rightarrow \mathbf{4}\ H_3PO_{4(aq)}$$

A)0.0635 mol
B) 1.00 mol
C)4.00 mol
D)16.0 mol
E)98.0 mol

$$\frac{71.0\ g\ P_4O_{10}}{1}\ x\ \frac{1\ mole\ P_4O_{10}}{283.886\ g\ P_4O_{10}}\ x\ \frac{4\ moles\ H_3PO_4}{1\ mole\ P_4O_{10}} = 1.00\ moles\ H_3PO_4$$

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:

$$4\ NH_{3(g)} + 7\ O_{2(g)} \rightarrow 4\ NO_{2(g)} + 6\ H_2O_{(g)}$$

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

$$\frac{28.8\ g\ NH_3}{1}\ x\ \frac{1\ mole\ NH_3}{17.031\ g\ NH_3}\ x\ \frac{7\ moles\ O_2}{4\ mole\ NH_3}\ x\ \frac{31.998\ g\ O_2}{1\ mole\ O_2} = 94.7\ g\ O_2$$

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

$$N_{2(g)} + 3H_{2(g)} \rightarrow 2NH_{3(g)}$$

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

$$\frac{7.1\ g\ N_2}{1}\ x\ \frac{1\ mole\ N_2}{28.014\ g\ N_2}\ x\ \frac{3\ moles\ H_2}{1\ mole\ N_2}\ x\ \frac{2.016\ g\ H_2}{1\ mole\ H_2} = 1.5\ g\ H_2$$

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?

$$\mathbf{4}\ Fe_{(s)} + \mathbf{3}\ O_{2(g)} \rightarrow \mathbf{2}\ Fe_2O_{3(s)}$$

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

$$\frac{16.7\ g\ Fe}{1}\ x\ \frac{1\ mole\ Fe}{55.933\ g\ Fe}\ x\ \frac{2\ moles\ Fe_2O_3}{4\ moles\ Fe}\ x\ \frac{159.863\ g\ Fe_2O_3}{1\ mole\ Fe_2O_3} = 23.9\ g\ Fe_2O_3$$

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?

$$Al_{(s)} + \mathbf{3}\ H_2SO_{4(aq)} \rightarrow Al_2(SO_4)_{3(aq)} + \mathbf{3}\ H_{2(g)}$$

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

$$\frac{250\ g\ H_2SO_4}{1}\ x\ \frac{1\ mole\ g\ H_2SO_4}{98.078\ g\ H_2SO_4}\ x\ \frac{1\ mole\ Al_2(SO_4)_3}{3\ moles\ H_2SO_4}\ x\ \frac{342.15\ g\ Al_2(SO_4)_3}{1\ mole\ Al_2(SO_4)_3} = 290\ g\ Al_2(SO_4)_3$$

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 CS_2 to produce 2.50 L of CH_4, at STP?

$$\mathbf{4}\ H_{2(g)} + CS_{2(l)} \rightarrow CH_{4(g)} + \mathbf{2}\ H_2S_{(g)}$$

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

$$\frac{2.50\ L\ CH_4}{1}\ x\ \frac{4\ L\ H_2}{1\ L\ CH_4} = 10.0\ L\ H_2$$

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:

$$2NaN_3\ (s) \rightarrow 2Na\ (s) + 3N_2\ (g)$$

How many moles of N_2 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

$$\frac{5.25\ mole\ NaN_3}{1}\ x\ \frac{3\ moles\ N_2}{2\ moles\ NaN_3} = 7.88\ moles\ N_2$$

7b)How many moles of glucose, $C_6H_{12}O_6$, can be burned when 60.0 mol of oxygen is available?

$$C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$$

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

$$\frac{60.0\ mole\ O_2}{1}\ x\ \frac{1\ mole\ C_6H_{12}O_6}{6\ moles\ O_2} = 10.0\ mole\ C_6H_{12}O_6$$

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)?

$$\mathbf{4}\ NH_{3(g)} + \mathbf{6}\ NO_{(g)} \rightarrow \mathbf{5}\ N_{2(g)} + \mathbf{6}\ H_2O_{(g)}$$

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

$$\frac{30.0\ L\ NO}{1}\ x\ \frac{4\ L\ NH_3}{6\ L\ NO} = 20.0\ L\ NH_3$$

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?

$$N_{2(g)} + \mathbf{3}\ H_{2(g)} \rightarrow \mathbf{2}\ NH_{3(g)}$$

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

$$\frac{1.0\ g\ N_2}{1} \ x\ \frac{1\ mole\ N_2}{28.014\ g\ N_2}\ x\ \frac{2\ mole\ NH_3}{1\ moles\ N_2} x\ \frac{17.031\ g\ NH_3}{1\ mole\ NH_3} = 1.2\ g\ NH_3$$

$$\frac{3.0\ g\ H_2}{1} \ x\ \frac{1\ mole\ H_2}{2.016\ g\ H_2}\ x\ \frac{2\ mole\ NH_3}{3\ moles\ H_2} x\ \frac{17.031\ g\ NH_3}{1\ mole\ NH_3} = 17\ g\ NH_3$$

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:

$$S_{(s)} + 3F_{2(g)} \rightarrow SF_{6(g)}$$

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

$$\frac{3.5\ g\ S}{1} \ x\ \frac{1\ mole\ S}{32.066\ g\ S}\ x\ \frac{1\ mole\ SF_6}{1\ moles\ S} x\ \frac{146.054\ g\ SF_6}{1\ mole\ SF_6} = 16\ g\ SF_6$$

$$\frac{4.5\ g\ F_2}{1} \ x\ \frac{1\ mole\ F_2}{37.996\ g\ F_2}\ x\ \frac{1\ mole\ SF_6}{3\ moles\ F_2} x\ \frac{146.054\ g\ SF_6}{1\ mole\ SF_6} = 5.8\ g\ SF_6$$

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:

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2\,(s)}$$

A 4.50-g sample of CaO is reacted with 4.34 g of H_2O. 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

$$\frac{4.50\ g\ CaO}{1}\ x\ \frac{1\ mole\ CaO}{56.077\ g\ CaO}\ x\ \frac{1\ mole\ H_2O}{1\ mole\ CaO}\ x\ \frac{18.015\ g\ H_2O}{1\ mole\ H_2O} = 1.4456\ g\ H_2O\ was\ used$$

$$Amount\ of\ water\ left = 4.34\ g - 1.4456\ g = 2.89\ g\ H_2O$$

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.

$$Mg_3N_2 + \mathbf{3}\ H_2O \rightarrow \mathbf{2}\ NH_3 + \mathbf{3}\ MgO$$

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

$$\frac{3.82\ g\ Mg_3N_2}{1}\ x\ \frac{1\ mole\ Mg_3N_2}{100.929\ g\ Mg_3N_2}\ x\ \frac{3\ mole\ MgO}{1\ moles\ Mg_3N_2}\ x\ \frac{40.304\ g\ MgO}{1\ mole\ MgO} = 4.54\ g\ NH_3$$

$$\frac{7.73\ g\ H_2O}{1}\ x\ \frac{1\ mole\ H_2O}{18.015\ g\ H_2O}\ x\ \frac{3\ moles\ MgO}{3\ moles\ H_2O}\ x\ \frac{40.304\ g\ MgO}{1\ mole\ MgO} = 17.3\ g\ MgO$$

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

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?

$$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(s)} + H_{2(g)}$$

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

$$Percent\ yield = \frac{actual\ yield}{theoretical\ yield}\ x\ 100$$

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.

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

132 L H2 represents the amount of hydrogen that was ACTUALLY reacted but only 85% of it resulted in making the product.

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