Stoichiometry Worksheet

Note: rough answers are provided in ( ) but may not match yours in terms of sig figs

Name: ________________ Section: ____________ Due Date: ___ ____

1. Ammonia gas reacts with oxygen gas according to the following equation:

$$4\ NH_3 + 5\ O_2 \rightarrow 4\ NO + 6\ H_2O$$

a. How many moles of oxygen gas are needed to react with 23 moles of ammonia? (29 mole)

$23\ mol\ NH_3 \times \frac{5O_2}{4NH_3} = 29\ mol\ O_2$
(2SF)

b. How many grams of NO are produced when 25 moles of oxygen gas react with an excess of ammonia? (600 g)

$25\ mol\ O_2 \times \frac{4NO}{5O_2} \times \frac{(14.01+16.00)g}{1NO} = 6.0\times10^2\ g\ NO$
(2SF) (4SF)

c. If 24 grams of water (H₂O) are produced, how many moles of nitrogen monoxide (NO) are formed? (0. 89 mole)

$24g \times \frac{1\ mol\ H_2O}{(2\times1.01+16.00)g} \times \frac{4\ mol\ NO}{6\ mol\ H_2O} = 0.89\ mol\ NO$
(2SF) (4SF)

d. How many grams of oxygen are needed to react with 6.78 grams of ammonia? (16.0 g)

$6.78g\ NH_3 \times \frac{1\ mol\ NH_3}{(14.01+3\times1.01)g} \times \frac{5\ mol\ O_2}{4\ mol\ NH_3} \times \frac{2\times16.00g}{1\ mol\ O_2} = 15.9g$
(3SF) (4SF) (4SF)

2. The compound calcium carbide, CaC_2, is made by reacting calcium carbonate with carbon at high temperatures. The UNBALANCED EQUATION for the reaction is:

$$2\,CaCO_3 + 5\,C \rightarrow 2\,CaC_2 + 3\,CO_2$$

a. Balance the equation.

b. How many moles of carbon (C) are required to produce 5.0 moles CO_2? (8.3 mole)

$5.0\,mol\,CO_2 \times \frac{5\,mol\,C}{3\,mol\,CO_2} = 8.3\,mol\,C$
(2SF)

c. How many grams of calcium carbide (CaC_2) are produced when 4.0 moles of carbon (C) reacts with an excess of calcium carbonate? (102 g) (4SF)

$4.0\,mol\,C \times \frac{2\,mol\,CaC_2}{5\,mol\,C} \times \frac{(40.08+2\times12.01)g}{1\,mol\,CaC_2} = 1.0\times10^2\,g\,CaC_2$
(2SF)

d. How many moles of carbon dioxide (CO_2) are produced when 55 grams of calcium carbonate ($CaCO_3$) react with an excess of carbon? (0.83 mole)

$55g \times \frac{1\,mol\,CaCO_3}{(40.08+12.01+3\times16.00)g} \times \frac{3\,mol\,CO_2}{2\,mol\,CaCO_3} = 0.82\,mol\,CO_2$
(2SF) (4SF)

e. How many grams of carbon (C) are needed to react with 453 grams of calcium carbonate ($CaCO_3$)? (136 g)

$453g \times \frac{1\,mol\,CaCO_3}{(40.08+12.01+3\times16.00)g} \times \frac{5C}{2\,CaCO_3} \times \frac{12.01g}{1\,C} = 136.g$
(3SF) (5SF) (4SF)

f. How many grams of calcium carbonate ($CaCO_3$) are needed to form 598 grams of calcium carbide (CaC_2)? (934 g)

$598g \times \frac{1\,mol\,CaC_2}{(40.08+2\times12.01)g} \times \frac{2\,mol\,CaCO_3}{2\,mol\,CaC_2} \times \frac{(40.08+12.01+3\times16.00)g}{1\,mol\,CaCO_3}$
(3SF) (4SF) (5SF)

$= 934g$

For the given combustion of **octane, C_8H_{18},** answer the following questions:

$$2\,C_8H_{18} \;+\; 25O_2 \;\rightarrow\; 16CO_2 \;+\; 18H_2O$$

a. How many moles of CO_2 would be produced by reacting 0.67 moles of octane (C_8H_{18}) with excess of oxygen? (Amount of oxygen is not involved in the calculation) (5.4 mol CO_2)

$0.67\text{ mol } C_8H_{18} \times \frac{16\text{ mol } CO_2}{2\text{ mol } C_8H_{18}} = 5.4\text{ mol } CO_2$
(2SF)

b. How many moles of H_2O would be produced by reacting 0.67 moles of octane with excess of oxygen? (6.0 mol H_2O)

$0.67\text{ mol } C_8H_{18} \times \frac{18\text{ mol } H_2O}{2\text{ mol } C_8H_{18}} = 6.0\text{ mol } H_2O$
(2SF)

c. If we react 225g of octane C_8H_{18} with oxygen, how many moles of O_2 are required? (24.7 mol O_2)

$225g \times \frac{1\text{ mol } C_8H_{18}}{(8\times12.01+18\times1.01)g} \times \frac{25\text{ mol } O_2}{2\text{ mol } C_8H_{18}} = 24.6\text{ mol } O_2$
(3SF) (5SF)

d. If we react 225g of C_8H_{18} with excess oxygen, how many moles of CO_2 are produced? (15.8 mol CO_2)

$225g \times \frac{1\text{ mol } C_8H_{18}}{(8\times12.01+18\times1.01)g} \times \frac{16\text{ mol } CO_2}{2\text{ mol } C_8H_{18}} = 15.8\text{ mol } CO_2$

e. If we react 225g of octane C_8H_{18} with excess oxygen, how many moles of H_2O are produced? (17.8 mol H_2O)

$225g \times \frac{1\text{ mol } C_8H_{18}}{(8\times12.01+18\times1.01)g} \times \frac{18\text{ mol } H_2O}{2\text{ mol } C_8H_{18}} = 17.7\text{ mol } H_2O$
(3SF)

f. If we wish to make 7.5 mol CO_2, how many grams of C_8H_{18} will be used? (110g C_8H_{18})

$7.5\text{ mol } CO_2 \times \frac{2\text{ mol } C_8H_{18}}{16\text{ mol } CO_2} \times \frac{(8\times12.01+18\times1.01)g}{1\text{ mol } C_8H_{18}} = 110g\ C_8H_{18}$
(2SF)

g. If we wish to make 7.5 mol CO_2, how many grams of O_2 do we need? (380g O_2)

$$7.5\,mol\,CO_2 \times \frac{25\,mol\,O_2}{16\,mol\,CO_2} \times \frac{(16.00 \times 2)g}{1\,mol\,O_2} = 380\,g\,O_2$$

(2SF)

h. If we wish to make 7.5 mol CO_2, how many grams of H_2O will be produced? (150g H_2O)

$$7.5\,mol\,CO_2 \times \frac{18\,mol\,H_2O}{16\,mol\,CO_2} \times \frac{(2 \times 1.01 + 16.00)g}{1\,mol\,H_2O} = 150\,g\,H_2O$$

(2SF)

i. If we have 3.56g C_8H_{18}, how many grams of O_2 do we need to react with it? (12.5g O_2)

$$3.56\,g\,C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{(8 \times 12.01 + 18 \times 1.01)g} \times \frac{25\,mol\,O_2}{2\,mol\,C_8H_{18}} \times \frac{(2 \times 16.00)g}{1\,mol\,O_2}$$

(3SF)

$= 12.5\,g\,O_2$

j. If we have 3.56g C_8H_{18}, how many grams of CO_2 will be produced? (11.0g CO_2)

$$3.56\,g\,C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{(8 \times 12.01 + 18 \times 1.01)g} \times \frac{16\,mol\,CO_2}{2\,mol\,C_8H_{18}} \times \frac{(12.01 + 2 \times 16.00)g}{1\,mol\,CO_2}$$

(3SF)

$= 11.0\,g\,CO_2$

k. If we have 3.56g C_8H_{18}, how many grams of H_2O will be produced? (5.06g H_2O)

$$3.56\,g\,C_8H_{18} \times \frac{1\,mol\,C_8H_{18}}{(8 \times 12.01 + 18 \times 1.01)g} \times \frac{18\,mol\,H_2O}{2\,mol\,C_8H_{18}} \times \frac{(2 \times 1.01 + 16.00)g}{1\,mol\,H_2O}$$

(3SF)

$= 5.05\,g\,H_2O$

l. Using the answers from I, j,and k for burning of 3.56g of octane, check if the law of conversion of mass is obeyed or not.

$$3.56\,g\,C_8H_{18} + 12.5\,g\,O_2 \stackrel{?}{=} 11.0\,g\,CO_2 + 5.05\,g\,H_2O$$

$$16.1\,g = 16.1\,g$$

V V

Yes, it is obeyed.