Stoichiometry Exercises:

name: SOLUTIONS

1) The reaction caused by the burning of butane in air is represented by the following equation:

$$2C_4H_{10}(g) + 13O_2(g) \rightarrow 8CO_2(g) + 10H_2O(g) + \text{Energy}$$

During a laboratory experiment you reacted 29 g of butane (C_4H_{10}) in the presence of oxygen. What mass of oxygen was needed for this reaction?

$n = \frac{m}{M}$

2 moles
$m = n \cdot M$
$m = 2(58)$
$m = 116g$

13 moles
$m = n \cdot M$
$m = 13(32)$
$m = 416g$

29g — x

$\frac{116x}{116} = \frac{416(29)}{116}$

$x = 104g$ of O_2

2) What mass of carbon dioxide is needed in the neutralization of 100 g of nitric acid given the equation:

$$2HNO_3 + CaCO_3 \rightarrow Ca(NO_3)_2 + H_2O + CO_2$$

2 moles
$m = n \cdot M$
$m = 2(63)$
$m = 126g$

1 mole
$m = n \cdot M$
$m = 1(44)$
$m = 44g$

100g — x

$x = 34.9g\ CO_2$

3) Calculate the mass of sodium hydroxide that neutralizes 14.7 g of sulfuric acid. The equation of this reaction is: *Hint: Begin by completing and balancing the chemical equation!*

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

1 mole
$m = n \cdot M$
$m = 1(98)$
$m = 98g$

2 moles
$m = n \cdot M$
$m = 2(40)$
$m = 80g$

14.7g — x

$x = 12g$

$Na^+ \quad SO_4^{-2}$

Na_2SO_4

4) Iron, Fe, and carbon monoxide, CO, are produced when iron oxide Fe_2O_3, reacts with carbon, C. You would like to produce 50 moles of iron. What mass of iron oxide is required?

$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$

1 mole — 2 moles

x — 50 moles

$x = 25 \text{ moles } Fe_2O_3$

$n = \frac{m}{M}$

$m = n \cdot M$

$m = 25(160)$

$m = 4000\text{g}$

5) Octane, C_8H_{18}, is one of the main components of gasoline. When a car engine is running, octane burns by reacting with oxygen gas, O_2, in the air. Carbon dioxide, CO_2, and water vapour, H_2O, are produced during this combustion reaction. The balanced equation for this reaction is;

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

$n = \frac{m}{M}$

The car engine ran for a certain period of time and 57 g of octane were burned. What mass of carbon dioxide was released into the atmosphere?

2 mole

$m = n \cdot M$

$m = 2(114)$

$m = 228\text{g}$

16 moles

$m = n \cdot M$

$m = 16(44)$

$m = 704\text{g}$

57g — x

$x = 176\text{g of } CO_2$

6) One of the substances responsible for acid rain is nitrogen dioxide (NO_2). In the atmosphere, nitrogen dioxide reacts with water vapour in the air to produce nitric acid, HNO_3, according to the following balanced equation:

$3NO_2 + H_2O \rightarrow 2HNO_3 + NO$

If 1000 g of NO_2 reacts in the atmosphere during a certain period of time, what mass of nitric acid is produced?

3 moles

$m = n \cdot M$

$m = 3(46)$

$m = 138\text{g}$

2 moles

$m = n \cdot M$

$m = 2(63)$

$m = 126\text{g}$

1000g — x

$x = 913\text{g } HNO_3$

7) In industry, water vapour is decomposed by passing the water vapour over hot iron.

$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

The iron reacts with the water to form an oxide of iron, Fe_3O_4, and hydrogen gas, H_2. What mass of iron is required if you produced 2 moles of hydrogen?

3moles — 4moles
x — 2moles

$x = 1.5$ moles of Fe

$n = \frac{m}{M}$

$m = n \cdot M$
$m = 1.5(55.8)$
$m = 84g$ of Fe

8) By burning methane, CH_4, in air containing oxygen gas, O_2, you produce carbon dioxide, CO_2, and water vapour, H_2O. You are to burn 192 g of methane. What mass of carbon dioxide gas will be produced?

$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

1mole — 1mole
$m = n \cdot M$ — $m = n \cdot M$
$m = 1(16)$ — $m = (1)(44)$
16g — 44g
192g — x

$x = 528g\ CO_2$

9) How many grams of carbon would be needed to produce 6 moles of Iron ?

$2Fe_2O_3 + 3C \rightarrow 3CO_2 + 4Fe$

3moles — 4moles
x — 6 moles

$x = 4.5$ moles of C

$n = \frac{m}{M}$

$m = n \cdot M$
$m = 4.5(12)$
$m = 54g$ of C