Stoichiometry Worksheet

1. Silver sulfide (Ag_2S) is the common tarnish on silver objects. What weight of silver sulfide can be made from 1.23 mg of hydrogen sulfide (H_2S) obtained from a rotten egg? The reaction of formation of silver sulfide is given below:

   $Ag(s) + H_2S(g) + O_2(g) \rightarrow Ag_2S(s) + H_2O(l)$ ***(Equation must first be balanced.)***

2. A somewhat antiquated method for preparing chlorine gas involves heating hydrochloric acid with pyrolusite (manganese dioxide), a common manganese ore. (Reaction given below.) How many kg of HCl react with 5.69 kg of manganese dioxide?

   $HCl(aq) + MnO_2(s) \rightarrow H_2O(l) + MnCl_2(aq) + Cl_2(g)$ ***(Equation must first be balanced.)***

3. Given the following equation: $2\ C_4H_{10} + 13\ O_2$ ---> $8\ CO_2 + 10\ H_2O$, show what the following molar ratios should be.

   a. C_4H_{10} / O_2 b. O_2 / CO_2 c. O_2 / H_2O
   d. C_4H_{10} / CO_2 e. C_4H_{10} / H_2O

4. Given the following equation: $2\ KClO_3$ ---> $2\ KCl + 3\ O_2$

   How many moles of O_2 can be produced by letting 12.00 moles of $KClO_3$ react?

5. Given the following equation: $2\ K + Cl_2$ ---> $2\ KCl$

   How many grams of KCl is produced from 2.50 g of K and excess Cl_2. From 1.00 g of Cl_2 and excess K?

6. Given the following equation: $Na_2O + H_2O$ ---> $2\ NaOH$

   How many grams of NaOH is produced from 1.20×10^2 grams of Na_2O? How many grams of Na_2O are required to produce 1.60×10^2 grams of NaOH?

7. Given the following equation: $8\ Fe + S_8$ ---> $8\ FeS$

   What mass of iron is needed to react with 16.0 grams of sulfur? How many grams of FeS are produced?

8. Given the following equation: $2\ NaClO_3$ ---> $2\ NaCl + 3\ O_2$

   12.00 moles of $NaClO_3$ will produce how many grams of O_2? How many grams of NaCl are produced when 80.0 grams of O_2 are produced?

9. Given the following equation: $Cu + 2\ AgNO_3$ ---> $Cu(NO_3)_2 + 2\ Ag$

   How many moles of Cu are needed to react with 3.50 moles of $AgNO_3$? If 89.5 grams of Ag were produced, how many grams of Cu reacted?

10. Molten iron and carbon monoxide are produced in a blast furnace by the reaction of iron(III) oxide and coke (pure carbon). If 25.0 kilograms of pure Fe_2O_3 is used, how many kilograms of iron can be produced? The reaction is: $Fe_2O_3 + 3\ C$ ---> $2\ Fe + 3\ CO$
11. The average human requires 120.0 grams of glucose ($C_6H_{12}O_6$) per day. How many grams of CO_2 (in the photosynthesis reaction) are required for this amount of glucose? The photosynthetic reaction is:

    $6\ CO_2 + 6\ H_2O$ ---> $C_6H_{12}O_6 + 6\ O_2$

12. Given the reaction: $4\ NH_3\ (g) + 5\ O_2\ (g)$ ---> $4\ NO\ (g) + 6\ H_2O\ (l)$

    When 1.20 mole of ammonia reacts, the total number of moles of products formed is:

    a. 1.20 b. 1.50 c. 1.80 d. 3.00 e. 12.0

Answers to Stoichiometry Worksheet

1. Silver sulfide (Ag_2S) is the common tarnish on silver objects. What mass of silver sulfide can be made from 1.23 mg of hydrogen sulfide (H_2S) obtained from a rotten egg? The reaction of formation of silver sulfide is given below:

$4Ag(s) + 2H_2S(g) + O_2(g) \rightarrow 2Ag_2S(s) + 2H_2O(l)$

m = 1.23 mg m=???

$$n_{H_2S} = \frac{m}{M} = \frac{0.00123g}{34.08g/mol} = 3.61\times10^{-5}mol$$

M_{H_2S}
2H = 2.02g/mol
1S = 32.06g/mol
34.06g/mol

$$n_{Ag_2S} = n_{H_2S} \text{ (Since 2 : 2 mole ratio)} = 3.61 \times 10^{-5}mol$$

$$m_{Ag_2S} = nM = (3.61\times10^{-5}\,mol)(247.80g/ml) = 0.00895g$$

M_{Ag_2S}
2Ag = 215.74g/mol
1S = 32.06g/mol
247.80g/mol

2. A somewhat antiquated method for preparing chlorine gas involves heating hydrochloric acid with pyrolusite (manganese dioxide), a common manganese ore. (Reaction given below.) How many kg of HCl react with 5.69 kg of manganese dioxide?

$4\,HCl(aq) + MnO_2(s) \rightarrow 2\,H_2O(l) + MnCl_2(aq) + Cl_2(g)$

m(kg) = ? m = 5.69 kg

Note that since you are asked for the mass in kg and given the mass in kg, then you don't need to convert to grams. Just keep the "k" and cancel out everything you can, and the answer will turn out in kg.

$$n_{MnO_2} = \frac{m}{M} = \frac{5.69kg}{86.94g/mol} = 0.0654kmol$$
(Note only the "g"'s cancel; left with kmol)

M_{MnO_2}
1Mn = 54.94g/mol
2O = 32.00g/mol
86.94g/mol

$$n_{HCl} = n_{MnO_2} \times 4 = 0.0654kmol \times 4 = 0.2616kmol$$

$$m_{HCl} = nM = 0.2616kmol \times 36.46g/mol = 9.538kg$$
(Note only the "mol" cancels; left with "kg")

M_{HCl}
1H = 1.01g/mol
1Cl = 35.45g/mol
36.46g/mol

3. Given the following equation: 2 C_4H_{10} + 13 O_2 ---> 8 CO_2 + 10 H_2O, show what the following molar ratios should be.

a. C_4H_{10} / O_2 b. O_2 / CO_2 c. O_2 / H_2O d. C_4H_{10} / CO_2 e. C_4H_{10} / H_2O

a. 2/13 b.13/8 c.13.10 d.2/8 e.2/10

4. Given the following equation: 2 $KClO_3$ ---> 2 KCl + 3 O_2

How many moles of O_2 can be produced by letting 12.00 moles of $KClO_3$ react?

2 $KClO_3$(s) → 2 KCl(s) + 3 O_2(g)

n=12.00 mol **n = ???**

$$n_{O_2} = n_{KClO_3} \times \frac{2}{3} = 12.00\text{mol} \times \frac{2}{3} = 18.00\text{mol}$$

5.Given the following equation: 2 K + Cl_2 ---> 2 KCl

How many grams of KCl is produced from 2.50 g of K and excess Cl_2.?

2 K + Cl_2 → 2 KCl

m = 2.50 g **m = ???**

$$n_K = \frac{m}{M} = \frac{2.50\text{g}}{39.10\text{g/mol}} = 0.0639\text{mol}$$

$$n_{KCl} = n_K = 0.0639\text{mol}$$

$$m_{KCl} = nM = 0.0639\text{mol} \times 74.55\text{g/mol} = 4.77\text{g}$$

M_{KCl}
1K = 39.10g/mol
1Cl = 35.45g/mol
74.55g/mol

From 1.00 g of Cl_2 and excess K?

$$n_{Cl_2} = \frac{m}{M} = \frac{1.00\text{g}}{70.90\text{g/mol}} = 0.0141\text{mol}$$

$$n_{KCl} = n_{Cl_2} \times 2 = 0.0282\text{mol}$$

$$m_{KCl} = nM = 0.0282\text{mol} \times 74.55\text{g/mol} = 21.0\text{g}$$

6. Given the following equation: Na_2O + H_2O ---> 2 NaOH

How many grams of NaOH is produced from 1.20 x 10^2 grams of Na_2O?

Na_2O + H_2O → 2 NaOH

m = 1.20×10^2 m = ???

$n_{Na_2O} = \frac{m}{M} = \frac{1.20\times10^2 g}{61.98 g/mol} = 1.94 mol$ $n_{NaOH} = n_{Na_2O} \times 2 = 3.87 mol$ $m_{NaOH} = nM = 3.87 mol \times 40.00 g/mol = 155 g$	M_{Na_2O} 2Na = 45.98g/mol 1O = 16.00g/mol 61.9806g/mol	M_{NaOH} 1Na = 22.99g/mol 1O = 16.00g/mol 1H = 1.01g/mol 40.00g/mol

How many grams of Na_2O are required to produce 1.60 x 10^2 grams of NaOH?

$n_{NaOH} = \frac{m}{M} = \frac{1.60\times10^2 g}{40.00 g/mol} = 4.00 mol$ $n_{Na_2O} = n_{NaOH} \times \frac{1}{2} = 2.00 mol$ $m_{Na_2O} = nM = 2.00 mol \times 61.98 g/mol = 124 g$	**See molar masses above**

7. Given the following equation: 8 Fe + S_8 ---> 8 FeS

What mass of iron is needed to react with 16.0 grams of sulfur?

8 Fe + S_8 → 8 FeS

m = ??? m = 16.00g

$$n_{S_8} = \frac{m}{M} = \frac{16.00 g}{256.48 g/mol} = 0.0624 mol$$
$$n_{Fe} = n_{S_8} \times 8 = 0.0624 mol \times 8 = 0.500 mol$$
$$m_{Fe} = nM = 0.500 mol \times 55.85 g/mol = 27.9 g$$

How many grams of FeS are produced?

8 Fe + S_8 → 8 FeS

n = 0.500mol m = ???

$n_{Fe} = 0.500 mol$ (from previous calculation) $n_{FeS} = n_{Fe} = 0.500 mol$ $m_{FeS} = nM = 0.500 mol \times 87.91 g/mol = 43.9 g$	M_{FeS} 1Fe = 55.85g/mol 1S = 32.06g/mol 87.91g/mol

8. Given the following equation: 2 $NaClO_3$ ---> 2 NaCl + 3 O_2

12.00 moles of $NaClO_3$ will produce how many grams of O_2?

2 $NaClO_3$ → 2 NaCl + 3 O_2

n = m = ???

12.00mol

$$n_{O_2} = n_{NaClO3} \times \frac{3}{2} = 18.00\text{mol}$$
$$m_{O_2} = nM = 18.00\text{mol} \times 32.00\text{g/mol} = 576.0\text{g}$$

How many grams of NaCl are produced when 80.0 grams of O_2 are produced?

$2\ NaClO_3$	$\rightarrow$	**$2\ NaCl$**	+	**$3\ O_2$**
		m = ???		**m = 80.0g**

$$n_{O_2} = \frac{m}{M} = \frac{80.0\text{g}}{32.00\text{g/mol}} = 2.50\text{mol}$$
$$n_{NaCl} = n_{O_2} \times \frac{2}{3} = 1.67\text{mol}$$
$$m_{NaCl} = nM = 1.67\text{mol} \times 58.44\text{g/mol} = 97.4\text{g}$$

M_{NaCl}
1Na = 22.99g/mol
1Cl = 35.45g/mol
58.44g/mol

9. Given the following equation: Cu + 2 $AgNO_3$ ---> $Cu(NO_3)_2$ + 2 Ag

How many moles of Cu are needed to react with 3.50 moles of $AgNO_3$?

Cu	+	**$2\ AgNO_3$**	$\rightarrow$	**$Cu(NO_3)_2$**	+	$MnCl_2$ (aq)	+	**2 Ag**
n = ???		n = 3.50mol						

$$n_{Cu} = n_{AgNO_3} \times \frac{1}{2} = 3.50\text{mol} \times \frac{1}{2} = 1.75\text{mol}$$

If 89.5 grams of Ag were produced, how many grams of Cu reacted?

Cu	+	**$2\ AgNO_3$**	$\rightarrow$	**$Cu(NO_3)_2$**	+	$MnCl_2$ (aq)	+	**2 Ag**
m = ???								m = 89.5g

$$n_{Ag} = \frac{m}{M} = \frac{89.5\text{g}}{107.87\text{g/mol}} = 0.829\text{mol}$$
$$n_{Cu} = n_{Ag} \times \frac{1}{2} = 0.829\text{mol} \times \frac{1}{2} = 0.415\text{mol}$$
$$m_{Ci} = nM = 0.415\text{mol} \times 63.55\text{g/mol} = 26.4\text{g}$$

10. Molten iron and carbon monoxide are produced in a blast furnace by the reaction of iron(III) oxide and coke (pure carbon). If 25.0 kilograms of pure Fe_2O_3 is used, how many kilograms of iron can be produced? The reaction is: $Fe_2O_3 + 3\ C \rightarrow 2\ Fe + 3\ CO$

Fe_2O_3	+	**3 C**	$\rightarrow$	**2 Fe**	+	$MnCl_2$ (aq)	+	**3 CO**
m = 25.0 kg				m (kg)= ???				

Note that since you are asked for the mass in kg and given the mass in kg, then you don't need to convert to grams. Just keep the "k" and cancel out everything you can, and the answer will turn out in kg.

$$n_{Fe_2O_3} = \frac{m}{M} = \frac{25.0\,kg}{159.69\,g/mol} = 0.156\,kmol$$

(Note only the "g" 's cancel; left with kmol)

$$n_{Fe} = n_{Fe_2O_3} \times 2 \quad = 0.156 kmol \times 2 \quad = 0.312 kmol$$

$$m_{Fe} = nM = 0.312 kmol \times 55.85 g/mol \quad = 17.5 kg$$

(Note only the "mol" cancels; left with "kg")

11. The average human requires 120.0 grams of glucose ($C_6H_{12}O_6$) per day. How many grams of CO_2 (in the photosynthesis reaction) are required for this amount of glucose? The photosynthetic reaction is: $6\ CO_2 + 6\ H_2O$ ---> $C_6H_{12}O_6 + 6\ O_2$

$6\ CO_2$	+	6 H_2O	$\rightarrow$	$C_6H_{12}O_6$	+	$6\ O_2$
m = ???				m = 120.0		

$$n_{C_6H_{12}O_6} = \frac{m}{M} = \frac{120.0g}{180.18g/mol} = 0.6660mol$$

$$n_{CO_2} = n_{C_6H_{12}O_6} \times \frac{6}{1} = 0.6660mol \times \frac{6}{1} = 3.996mol$$

$$m_{CO_2} = nM = 3.996mol \times 44.01g/mol \quad = 175.9g$$

$M_{C_6H_{12}O_6}$

6C = 72.06g/mol

12H = 12.12g/mol

6O = 96.00g/mol

180.18 g/mol

M_{CO_2}

C = 12.01g/mol

2O = 32.00g/mol

44.01g/mol

12. Given the reaction: $4\ NH_3\ (g) + 5\ O_2\ (g)$ ---> $4\ NO\ (g) + 6\ H_2O\ (l)$

When 1.20 mole of ammonia reacts, the total number of moles of products formed is:

a. 1.20 b. 1.50 c. 1.80 d. 3.00 e. 12.0

The correct answer is d.

$NH_3 / (NO + H_2O) = 4 / 10$

4 / 10 = 1.20 / x x = 3.00 mol