Review for Unit Test: Stoichiometry

1. What is meant by the "limiting factor"? Explain why the limiting factor is important.

2. For the reaction: $AlCl_3$ (aq) + 3 NaOH (aq) → $Al(OH)_3$ (s) + 3 NaCl (aq)

a) How many **moles** of sodium hydroxide are needed in order to form 8.43 moles of aluminum hydroxide?

b) What mass of sodium hydroxide is required to react with 50.7 g of aluminum chloride?

3. For the reaction: 4 Fe (s) + 3 O_2 (g) → 2 Fe_2O_3 (s)

a) What volume of pure oxygen gas at STP is required to react with 1.5 g of pure iron?

b) Air is 20.9 % oxygen. What volume of air is required to react with 1.5 g of pure iron?

4. For the reaction: SiO_2 (s) + 4 HF (g) → SiF_4 (s) + 2 H_2O (v)

What volume of H_2O (v) is produced when 35.0 g of SiO_2 react with 63.0 L of HF gas? Assume that all gases and vapours are at STP.

5. An unknown element "X" reacts according to the following chemical equation:

2 X (s) + 2 H_2O (l) → 2 XOH (aq) + H_2 (g)

When 22.76 g of "X" reacts, 1.000 g of hydrogen gas is produced (at STP). What is the molar mass and probable identity of the element "X" ?

6. Plants produce sugar by photosynthesis using the reaction:

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

a) How many litres of pure carbon dioxide are required by a green plant in order to produce 450.0 g of glucose, $C_6H_{12}O_6$ (s) ?

b) How many litres of air are needed to supply the required CO_2 in part (a), assuming that air is 0.0400% carbon dioxide by volume?

7. For the reaction: 2 Fe_2O_3 (s) + 3 C (s) → 4 Fe (s) + 3 CO_2 (g)

What volume of carbon dioxide will be formed when 50.0 g of iron (III) oxide react with 2.50 g of pure carbon?

8. An unknown element "Q" reacts according to the following chemical equation:

XeQ_6 (s) + 3 H_2O (l) → XeO_3 (aq) + 6 HQ (g)

When XeQ_6 reacts with exactly 13.80 g of water, 30.65 g of HQ (g) are formed. What is the molar mass and likely identity of "Q"?

9. For the reaction: P_4 (s) + 5 O_2 (g) → 2 P_2O_5 (s)

a) If 7.50 grams of P_4 are reacted with excess O_2, how many grams of P_2O_5 may be produced? That is, what is the theoretical yield of P_2O_5?
b) If 13.6 g of P_2O_5 are actually produced, what is the percentage yield of P_2O_5?

10. One way to remove carbon dioxide from the air is to react it with lithium hydroxide, according to the reaction: CO_2 (g) + 2 LiOH (s) → Li_2CO_3 (s) + H_2O (l)

a) When 20.00 g of lithium hydroxide are reacted with carbon dioxide gas, what mass of lithium carbonate may be produced?
b) If the actual mass of lithium carbonate that is produced is 29.40 g, calculate the percentage yield for this reaction.

Answers:

2a)	25.3 mol NaOH	b) 45.6 g
3a)	0.45 L of O_2	b) 2.2 L of air
4)	SiO_2 is the limiting factor. 26.1 L of H_2O is produced.	
5)	MM_X is 22.99 g/mol. "X" is probably sodium.	
6a)	336 L of CO_2	b) 8.40×10^5 L of air
7)	C is limiting factor. 4.66 L of CO_2 will form.	
8)	MM_Q is 19.00 g/mol. "X" is probably fluorine.	
9a)	17.2 g of P_2O_5	b) 79.1% yield
10a)	30.85 g of Li_2CO_3	b) 95.30 % yield