STOICHIOMETRIC PROBLEMS

SHEET #1: MOLE RATIO PROBLEMS

1. The combustion of a sample of butane, C_4H_{10} (lighter fluid), produced 2.46 g of water according to the following equation:

$$2C_4H_{10} + 13O_2 \Longrightarrow 8CO_2 + 10H_2O$$

Calculate:
a) the amount of water formed.
b) the amount of butane burned.
c) the mass of butane burned.
d) the mass of oxygen used.

2. The ethanol in ethanol gasoline burns according to the following equation:

$$C_2H_6O + 3O_2 \Longrightarrow 2CO_2 + 3H_2O$$

a) If 25 mol of ethanol burns this way, what amount of oxygen is needed?
b) If 30 mol of oxygen is consumed by this reaction, what amount of ethanol is used up? How many moles of carbon dioxide are formed?
c) In one test, 23 mol of carbon dioxide was produced by this reaction. How many moles of oxygen were consumed?
d) In another test, 41 mol of water is collected from this reaction. What amount of oxygen was used up? What amount of carbon dioxide was formed?

3. One way to change iron ore, Fe_2O_3, into metallic iron is to heat it with hydrogen gas.

$$Fe_2O_3(s) + 3H_2(g) \Longrightarrow 2Fe(s) + 3H_2O(l)$$

a) How many moles of iron are made from 25 mol of Fe_2O_3?
b) What amount of hydrogen is needed to make 30 mol of Fe?
c) If 120 mol of H_2O forms, what mass of Fe_2O_3 was used up?

4. The reaction between hydrazine, N_2H_4, and hydrogen peroxide is used to power some rocket engines. The balanced equation for the reaction is:

$$N_2H_4 + 7H_2O_2 \Longrightarrow 2HNO_3 + 8H_2O$$

2.68 mol of hydrazine is completely consumed in a rocket engine. Calculate:
a) the amount of H_2O_2 required.
b) the amount of HNO_3 formed.
c) the amount of water formed.

5. The metal tungsten, which is used to make filaments for incandescent light bulbs, can be obtained from its oxide by heating it with hydrogen.

$$WO_3(s) + 3H_2(g) \Longrightarrow W(s) + 3H_2O(l)$$

a) What mass of tungsten can be obtained from 250 g of tungsten (VI) oxide?
b) What mass of hydrogen is required in part a)?

Answers:
1. a) 0.137 mol H_2O, b) 0.0273 mol C_4H_{10}, c) 1.59 g C_4H_{10}, d) 5.68 g O_2
2. a) 75 mol O_2, b) 10 mol C_2H_6O, 20 mol CO_2 c) 34.5 mol O_2, d) 41 mol O_2, 27.3 mol CO_2
3. a) 50 mol Fe, b) 45 mol H_2, c) 6388 g Fe_2O_3
4. a) 18.76 mol H_2O_2, b) 5.36 mol HNO_3, c) 21.44 mol H_2O
5. a) 198 g W, b) 6.54 g H_2