Chemistry 11

Gram A → Gram B

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Date:
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1. Given the following equation for the combustion of hexane (C_6H_{14}):

$$C_6H_{14} + O_2 \rightarrow CO_2 + H_2O$$

a) What is the balanced equation?

$$2\,C_6H_{14} + 19\,O_2 \longrightarrow 12\,CO_2 + 14\,H_2O$$

b) What mass of CO_2 is produced by burning 268 g of C_6H_{14}?

$$268\text{g } C_6H_{14} \times \frac{1\text{ mol } C_6H_{14}}{86.21\text{g}} \times \frac{12\text{ mol } CO_2}{2\text{ mol } C_6H_{14}} \times \frac{44.01\text{g}}{1\text{ mol } CO_2} = 821\text{ g } CO_2$$

c) What mass of oxygen is consumed when 3.00 kg of hexane reacts?

$$3.00\text{kg } C_6H_{14} \times \frac{1000\text{g } C_6H_{14}}{1\text{kg } C_6H_{14}} \times \frac{1\text{ mol } C_6H_{14}}{86.21\text{g } C_6H_{14}} \times \frac{19\text{ mol } O_2}{2\text{ mol } C_6H_{14}} \times \frac{32.00\text{g } O_2}{1\text{ mol } O_2} = 10600\text{g } O_2 = 1.06\times10^4\text{ g } O_2$$

d) If burning a quantity of hexane produces 78.0 grams of H_2O, what mass of CO_2 would be produced at the same time?

$$78.0\text{g } H_2O \times \frac{1\text{ mol } H_2O}{18.02\text{g}} \times \frac{12\text{ mol } CO_2}{14\text{ mol } H_2O} \times \frac{44.01\text{g}}{1\text{ mol } CO_2} = 163\text{g } CO_2$$

e) Carbon dioxide is a greenhouse gas. What mass of carbon dioxide is produced by burning 20.0 moles of hexane?

$$20.0\text{mol } C_6H_{14} \times \frac{12\text{ mol } CO_2}{2\text{ mol } C_6H_{14}} \times \frac{44.01\text{g}}{1\text{ mol } CO_2} = 5280\text{g } CO_2 \text{ or } 5.28\times10^3\text{g } CO_2$$

2. The balanced equation for hexamine combustion is:

$$4\,C_6H_{15}N + 43\,O_2 \rightarrow 24\,CO_2 + 30\,H_2O + 4\,NO_2$$

a) Calculate the molar mass for each compound.

$C_6H_{15}N = 101.22\text{g/mol}$
$O_2 = 32.00\text{g/mol}$
$CO_2 = 44.01\text{g/mol}$
$H_2O = 18.02\text{g/mol}$
$NO_2 = 46.01\text{g/mol}$

b) What mass of oxygen is required to react with 763.2 g of $C_6H_{15}N$?

$$763.2\text{g } C_6H_{15}N \times \frac{1\text{ mol } C_6H_{15}N}{101.22\text{g}} \times \frac{43\text{ mol } O_2}{4\text{ mol } C_6H_{15}N} \times \frac{32.00\text{g}}{1\text{ mol } O_2} = 2594\text{g } O_2$$

c) Calculate the mass of water produced when 253 g of O_2 are consumed.

$$253\text{g } O_2 \times \frac{1\text{ mol } O_2}{16.00\text{g } O_2} \times \frac{30\text{ mol } H_2O}{43\text{ mol } O_2} \times \frac{18.02\text{g } H_2O}{1\text{ mol } H_2O} = 99.4\text{g } H_2O$$

3. A reaction between potassium and chlorine produced 250.0 grams of the product. How many grams of potassium and chlorine were needed for the reaction?

$$2K + Cl_2 \rightarrow 2KCl$$

$$250.0\text{g KCl} \times \frac{1\text{mol KCl}}{74.55\text{g KCl}} \times \frac{2\text{mol K}}{2\text{mol KCl}} \times \frac{39.10\text{g}}{1\text{mol K}} = \boxed{131.1\text{g K}}$$

$$250.0\text{g KCl} \times \frac{1\text{mol KCl}}{74.55\text{g KCl}} \times \frac{1\text{mol Cl}_2}{2\text{mol KCl}} \times \frac{70.90\text{g}}{1\text{mol Cl}_2} = \boxed{118.9\text{g Cl}_2}$$

4. Aluminum reacts with Fe_2O_3 to give aluminum oxide and iron. If 40.2 g of iron are produced, find the masses of the other chemicals involved.

$$2Al + Fe_2O_3 \rightarrow 2Fe + Al_2O_3$$

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{2\text{mol Al}}{2\text{mol Fe}} \times \frac{26.98\text{g}}{1\text{mol Al}} = \boxed{19.4\text{g Al}}$$

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{1\text{mol Fe}_2O_3}{2\text{mol Fe}} \times \frac{159.70\text{g}}{1\text{mol Fe}_2O_3} = \boxed{57.5\text{g Fe}_2O_3}$$

$$40.2\text{g Fe} \times \frac{1\text{mol Fe}}{55.85\text{g Fe}} \times \frac{1\text{mol Al}_2O_3}{2\text{mol Fe}} \times \frac{101.96\text{g}}{1\text{mol Al}_2O_3} = \boxed{36.7\text{g Al}_2O_3}$$

5. Sulphur and oxygen react together to produce SO_2. If 356 g of SO_2 is produced, find the masses of the two reactants.

$$S_8 + 8O_2 \rightarrow 8SO_2$$

$$35\text{6g SO}_2 \times \frac{1\text{mol SO}_2}{64.07\text{g SO}_2} \times \frac{1\text{mol S}_8}{8\text{mol SO}_2} \times \frac{256.56\text{g}}{1\text{mol S}_8} = \boxed{178\text{g S}_8}$$

$$356\text{g SO}_2 \times \frac{1\text{mol SO}_2}{64.07\text{g SO}_2} \times \frac{8\text{mol S}_8}{8\text{mol SO}_2} \times \frac{32.00\text{g S}_8}{1\text{mol S}_8} = \boxed{178\text{g S}_8}$$

6. When isopropanol (C_3H_8O) burns in oxygen, carbon dioxide and water are produced. Determine how many grams of carbon dioxide and water are produced when 5682 kg of isopropanol is burned.

$$2C_3H_8O + 9O_2 \rightarrow 6CO_2 + 8H_2O$$

$$5682\text{kg C}_3\text{H}_8\text{O} \times \frac{1000\text{g}}{1\text{kg}} \times \frac{1\text{mol C}_3\text{H}_8\text{O}}{60.11\text{g C}_3\text{H}_8\text{O}} \times \frac{6\text{mol CO}_2}{2\text{mol C}_3\text{H}_8\text{O}} \times \frac{44.01\text{g}}{1\text{mol CO}_2} = 12480\text{kg CO}_2$$

$$5682\text{kg C}_3\text{H}_8\text{O} \times \frac{1000\text{g}}{1\text{kg}} \times \frac{1\text{mol C}_3\text{H}_8\text{O}}{60.11\text{g C}_3\text{H}_8\text{O}} \times \frac{8\text{mol H}_2\text{O}}{2\text{mol C}_3\text{H}_8\text{O}} \times \frac{18.02\text{g}}{1\text{mol H}_2\text{O}} = 6813\text{kg H}_2\text{O}$$

1b. 821g 1c. 1.06×10^4g 1d. 163g 1e. 5.28×10^3g 2a. 101.22g/mol, 32.00g/mol, 44.01g/mol, 18.02g/mol, 46.01g/mol 2b. 2594g 2c. 99.4g 3. 131.1g K, 118.9g Cl_2 4. 19.4g Al, 57.5g Fe_2O_3, 36.7g Al_2O_3 5. 178g S_8, 178g O_2 6. 1.248×10^4kg CO_2, 6813kg H_2O