Empirical Formula and Combustion Analysis

1. A hydrocarbon fuel is fully combusted with 18.214 g of oxygen to yield 23.118 g of carbon dioxide and 4.729 g of water. Find the empirical formula for the hydrocarbon.

2. After combustion with excess oxygen, 12.501 g of a petroleum compound produced 38.196 g of carbon dioxide and 18.752 g of water. A previous analysis determined that the compound does not contain oxygen. Establish the empirical formula of the compound.

3. During the combustion analysis of an unknown compound containing only carbon, hydrogen, and nitrogen, 12.923 g of carbon dioxide and 6.608 g of water were measured. Treatment of the nitrogen with H_2 gas resulted in 2.501 g NH_3. The complete combustion of 11.014 g of the compound needed 10.573 g of oxygen. What is the compound's empirical formula?

4. 33.658 g of oxygen was used to react with a hydrocarbon sample in a combustion reaction completely. The reaction products were 33.057 g of carbon dioxide and 10.816 g of water. Ascertain the empirical formula of the compound.

Empirical Formula and Combustion Analysis

Answers

1. A hydrocarbon fuel is fully combusted with 18.214 g of oxygen to yield 23.118 g of carbon dioxide and 4.729 g of water. Find the empirical formula for the hydrocarbon.

   Moles of C = (23.118 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.525 mol C/0.525 mol = 1

   Moles of H = (4.729 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 0.525 mol H/0.525 mol = 1

   Empirical formula = CH

2. After combustion with excess oxygen, 12.501 g of a petroleum compound produced 38.196 g of carbon dioxide and 18.752 g of water. A previous analysis determined that the compound does not contain oxygen. Establish the empirical formula of the compound.

   Moles of C = (38.196 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.867 mol/0.867 = 1 x 5 = 5

   Moles of H = (18.752 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 2.081 mol/0.867 = 2.4 x 5 = 12

   Empirical formula = C_5H_{12}

3. During the combustion analysis of an unknown compound containing only carbon, hydrogen, and nitrogen, 12.923 g of carbon dioxide and 6.608 g of water were measured. Treatment of the nitrogen with H_2 gas resulted in 2.501 g NH_3. The complete combustion of 11.014 g of the compound needed 10.573 g of oxygen. What is the compound's empirical formula?

   Moles of C = (12.923 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.29363 mol/0.1468 = 2

   Moles of H = (6.608 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 0.7334 mol/0.1468 = 5

   Moles of N = (2.501 g/17.04 g/mol NH_3) x (1 mol N/1 mol NH_3) = 0.1468 mol/0.1468 = 1

   Empirical formula = C_2H_5N

4. 33.658 g of oxygen was used to react with a hydrocarbon sample in a combustion reaction completely. The reaction products were 33.057 g of carbon dioxide and 10.816 g of water. Ascertain the empirical formula of the compound.

   Moles of C = (33.057 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.751 mol/0.751 = 1 x 5 = 5

   Moles of H = (10.816 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 1.201 mol/0.751 = 1.6 x 5 = 8

   Empirical formula = C_5H_8