Combustion Analysis Worksheet

1. A 15-g sample of an unknown hydrocarbon is analyzed by combustion analysis. The sample produced 50.70 grams of carbon dioxide and 10.42 grams of water. Find the empirical formula.

2. A 4.24 g sample of carboxylic acid (composed of only C, H, and O) is burned. The reaction produces 6.21 g of carbon dioxide and 2.54 g of water. The compound was found to have a molar mass of ~ 180 g/mol in a separate experiment. What is the molecular formula of the compound?

3. A 3.87 g sample of ascorbic acid (containing C, H, and O only) produces 5.80 g CO_2 and 1.58 g H_2O on combustion. What is the empirical formula of ascorbic acid?

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Answers

1. A 15-g sample of an unknown hydrocarbon is analyzed by combustion analysis. The sample produced 50.70 grams of carbon dioxide and 10.42 grams of water. Find the empirical formula.

   Moles of C = (50.70 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 1.525 mol /1.152 mol = 1

   Moles of H = (10.42 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 1.157 mol H/1.152 mol = 1

   Empirical formula = CH

2. A 4.24 g sample of carboxylic acid (composed of only C, H, and O) is burned. The reaction produces 6.21 g of carbon dioxide and 2.54 g of water. The compound was found to have a molar mass of ~ 180 g/mol in a separate experiment. What is the molecular formula of the compound?

   Moles of C = (6.21 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.141 mol/0.141 mol = 1

   Moles of H = (2.54 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 0.282 mol/0.141 mol = 2

   Amount of C = 0.141 mol x 12.01 g/mol = 1.693 g

   Amount of H = 0.282 mol x 1.01 g/mol = 0.285 g

   Amount of O = 4.24 g - (1.693 g + 0.285 g) = 2.316 g

   Moles of O = (2.316 g/16.015 g/mol O) = 0.145 mol/0.141 mol = 1

   Empirical formula = CH_2O

3. A 3.87 g sample of ascorbic acid (containing C, H, and O only) produces 5.80 g CO_2 and 1.58 g H_2O on combustion. What is the empirical formula of ascorbic acid?

   Moles of C = (5.80 g/44.01 g/mol CO_2) x (1 mol C/1 mol CO_2) = 0.131 mol/0.131 mol = 1 x 3 = 3

   Moles of H = (1.58 g/18.02 g/mol H_2O) x (2 mol H/1 mol H_2O) = 0.175 mol/0.131 mol = 1.338 x 3 = 4

   Amount of C = 0.131 mol x 12.01 g/mol = 1.58 g

   Amount of H = 0.175 mol x 1.01 g/mol = 0.177 g

   Amount of O = 3.87 g - (1.58 g + 0.177 g) = 2.113 g

   Moles of O = (2.013 g/16.015 g/mol O) = 0.132 mol/0.131 mol = 1

   Empirical formula = C_3H_4O