

Answer on Question #54718 - Chemistry – General Chemistry

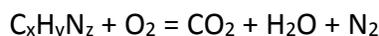
Question

Combustion analysis was performed on 1.00 g of a compound containing C, H, and N, and 2.79 g of CO₂ and 0.57 g of H₂O were produced.

What is the empirical formula? Express your answer as a chemical formula.

Answer:

The reaction of combustion of compound containing C, H, and N:



Numbers of moles of CO₂ and H₂O produced:

$$n(CO_2) = \frac{m(CO_2)}{M(CO_2)} = \frac{2.79}{44.0} = 0.0634 \text{ mol}$$

$$n(H_2O) = \frac{m(H_2O)}{M(H_2O)} = \frac{0.57}{18.0} = 0.0317 \text{ mol}$$

So, the number of moles of CO₂ is twice as big as that of H₂O, and stoichiometric coefficient for CO₂ is two times bigger than that for H₂O:



The number of moles of oxygen atoms is:

$$n(O) = 2n(CO_2) + n(H_2O) = 2 \cdot 0.0634 + 0.0317 = 0.1585 \text{ mol} = 5n(H_2O)$$

or:

$$n(O_2) = 2.5n(H_2O)$$



Then the mass of oxygen is:

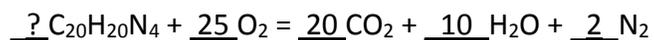
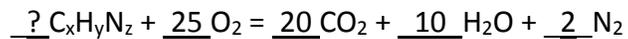
$$m(O) = n(O) \cdot M(O) = 0.1585 \cdot 15.99 = 2.54 \text{ g} = m(O_2)$$

The mass of nitrogen is (the total mass of substances before reaction is equal to the total mass of reaction products after reaction):

$$m(N_2) = m(C_xH_yN_z) + m(O_2) - m(CO_2) - m(H_2O) = 1 + 2.54 - 2.79 - 0.57 = 0.18 \text{ g}$$

$$n(N_2) = \frac{m(N_2)}{M(N_2)} = \frac{0.18}{28.0} = 0.0064 \text{ mol} = 0.1n(CO_2)$$

Multiple all stoichiometric coefficients by 10, using $n(N_2) = 0.1n(CO_2)$:



Divide indexes in formula by 4, then the reaction is:



Answer: the empirical formula of the compound is C₅H₅N.