Vanillin, a compound used as flavoring agent in food products, has the following percentage composition: 64.2% C, 5.26% H and 31.6% O. What is the empirical formula of vanillin?

\[
\text{mass ratio} = \frac{64.2 \text{ gC}}{5.26 \text{ gH}} : \frac{5.26 \text{ gH}}{31.6 \text{ gO}}
\]

\[
\text{molar ratio} = \left( \frac{64.2 \text{ gC}}{12.01 \text{ gC}} \right) : \left( \frac{5.26 \text{ gH}}{1.008 \text{ gH}} \right) : \left( \frac{31.6 \text{ gO}}{16.00 \text{ gO}} \right)
\]

\[
= \frac{5.345 \text{ mol C}}{1.975} : \frac{5.218 \text{ mol H}}{1.975} : \frac{1.975 \text{ mol O}}{1.975}
\]

\[
\text{reduced ratio} = \frac{5.345 \text{ mol C}}{1.975} : \frac{5.218 \text{ mol H}}{1.975} : \frac{1.975 \text{ mol O}}{1.975}
\]

\[
= 2.71 \text{ mol C} : 2.64 \text{ mol H} : 1.00 \text{ mol O}
\]

\[
x3 = 8.13 \text{ mol C} : 7.92 \text{ mol H} : 3.00 \text{ mol O}
\]

\[
\text{Ans. C}_8\text{H}_8\text{O}_3 \quad \text{Note: Normally, 8.13 mole is still too far from 8 to be rounded to 8.}
\]

The textbook made a mistake in the %C. It should have been 63.1% C instead, in which case the solution to the problem would look like this.

\[
\text{mass ratio} = \frac{63.1 \text{ gC}}{5.26 \text{ gH}} : \frac{5.26 \text{ gH}}{31.6 \text{ gO}}
\]

\[
\text{molar ratio} = \left( \frac{63.1 \text{ gC}}{12.01 \text{ gC}} \right) : \left( \frac{5.26 \text{ gH}}{1.008 \text{ gH}} \right) : \left( \frac{31.6 \text{ gO}}{16.00 \text{ gO}} \right)
\]

\[
= \frac{5.253 \text{ mol C}}{1.975} : \frac{5.218 \text{ mol H}}{1.975} : \frac{1.975 \text{ mol O}}{1.975}
\]

\[
\text{reduced ratio} = \frac{5.253 \text{ mol C}}{1.975} : \frac{5.218 \text{ mol H}}{1.975} : \frac{1.975 \text{ mol O}}{1.975}
\]

\[
= 2.66 \text{ mol C} : 2.64 \text{ mol H} : 1.00 \text{ mol O}
\]

\[
x3 = 7.98 \text{ mol C} : 7.92 \text{ mol H} : 3.00 \text{ mol O}
\]

This is much more reasonable to be rounded to C$_8$H$_8$O$_3$.

\[
\text{Vanillin has the structure shown below:}
\]

\[
\text{Does it have the formula C}_8\text{H}_8\text{O}_3?\]