Methyl salicylate, a compound of hydrogen, carbon and oxygen, is commonly known as oil of wintergreen. It is often used in medical rubs. If a 20.00g sample of methyl salicylate was burned in air and it produced 9.46g of water and 46.30g of carbon dioxide, show that the empirical formula of this compound must be C8H8O3.

Recall that the equation of the combustion for a carbohydrate (any compound made of carbon, hydrogen and oxygen) is:  
  
CxHyOz+O2→CO2+H2O  
  
Balancing by elements (atoms), yields:  
  
n(C)=n(CO2)=46.3044.0=1.05 mol  
  
n(H)=2⋅n(H2O)=2×9.4618.0=1.05 mol  
  
Note that it is not possible to deduce the number of moles of oxygen formed in the same way as carbon and hydrogen, because there is an unknown input of oxygen in the reaction ( combustion).  
  
However, if n(C)=n(H)=1.05 mol, then there are 1.05×12.0+1.05×1.0=13.68 g of carbon and hydrogen originating from the carbohydrate. This means that 20.00−13.68=6.32 g must be the oxygen in the carbohydrate!  
  
So, n(O)=6.32/16.0=0.395 mol  
  
Therefore, n(C):n(H):n(O)=1.05:1.05:0.395  
  
=2.66:2.66:1.00  
  
=8:8:3  
  
Hence, the empirical formula is C8H8O3