

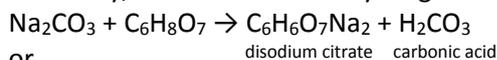
Question

What are the products of reaction $\text{Na}_2\text{CO}_3 + \text{C}_6\text{H}_8\text{O}_7 + \text{H}_2\text{O}$?

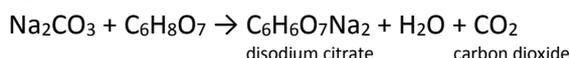
Answer and explanation

When citric acid ($\text{C}_6\text{H}_8\text{O}_7$) interacts with sodium bicarbonate (Na_2CO_3) in water solution, sodium citrates and carbonic acid are formed. Carbonic acid spontaneously decomposes to water and carbon dioxide (CO_2). That is why gassing is observed.

Generally, brutto-reaction may be given as

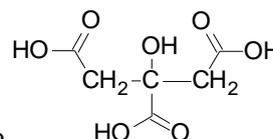


or



(H_2O is a solvent and it is not necessary to write it in the reaction scheme)

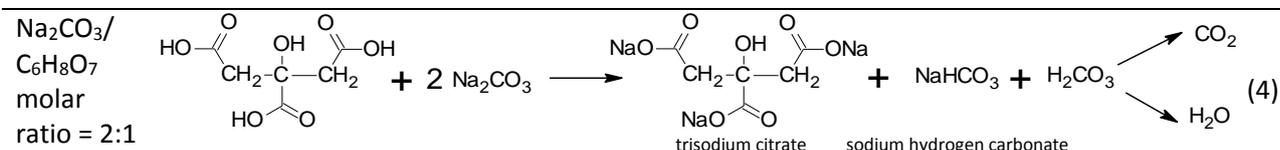
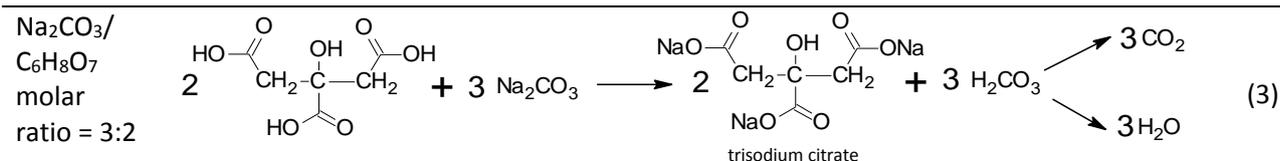
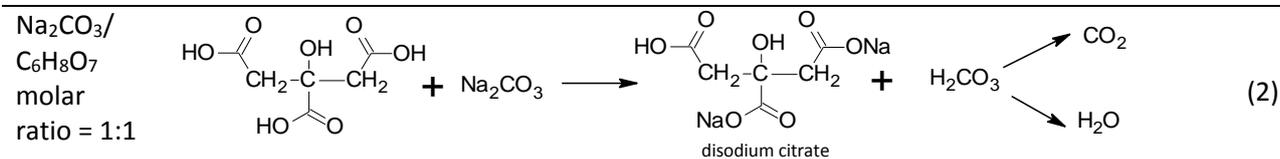
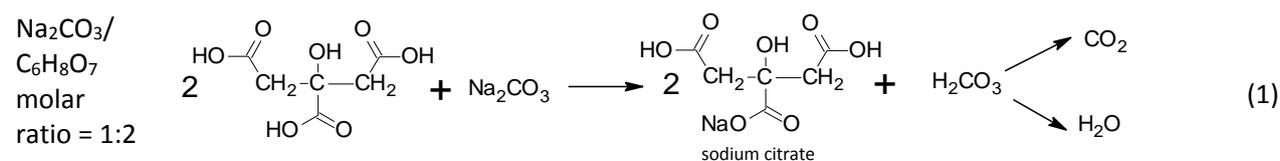
Given scheme, however, is only an example, one of possible alternatives.



Citric acid ($\text{C}_6\text{H}_8\text{O}_7$) is tribasic acid having the following structure

Since citric acid is tribasic, i.e. contains three carboxyl groups, three types of salts (sodium citrates) may be formed: sodium citrate, disodium citrate and trisodium citrate. So, the exact composition of the reaction products depends on the $\text{Na}_2\text{CO}_3 / \text{C}_6\text{H}_8\text{O}_7$ ratio.

All possible alternatives are given in schemes below



In the first case (1) there is molar excess of citric acid.

In the second case (2) the reactants are taken in equimolar ratio.

In the third (3) and fourth (4) cases there is molar excess of sodium bicarbonate.

In the fourth case (4) sodium hydrogen carbonate is formed.

Actually, not only one but several of given reactions may occur at the same time, and reaction products mixture may include all three types of citrates. However, some of the possible reactions and some of the citrates considerably prevail over other alternatives, depending on the reactants ratio.

Answer: sodium citrate ($\text{C}_6\text{H}_7\text{O}_7\text{Na}$), disodium citrate ($\text{C}_6\text{H}_6\text{O}_7\text{Na}_2$), trisodium citrate ($\text{C}_6\text{H}_5\text{O}_7\text{Na}_3$), water (H_2O), carbon dioxide (CO_2), carbonic acid (H_2CO_3), sodium hydrogen carbonate (NaHCO_3).