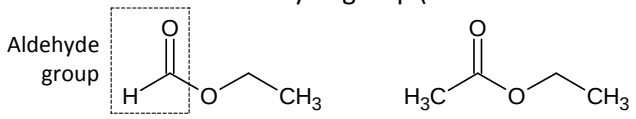
Question

I am having two samples. Out of these i want to know which one is ehtyl acetate and which one is ethyl formate. Is there any simple methods to identify this?

Answer

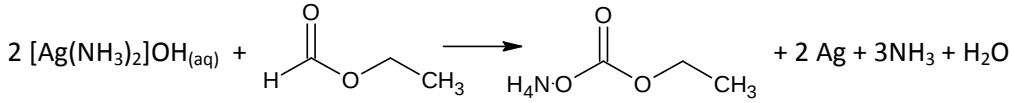
Firstly, these two esters may be identified by their odors. Ethyl formate has the characteristic smell of rum and is also partially responsible for the flavor of raspberries. Ethyl acetate has a characteristic sweet smell (similar to pear drops). It is often used in nail polish removers, so you may know this smell as a smell of a nail polish remover.

But the substances may be definitely identified chemically. Both substances involve ester groups, but ethyl formate involves also aldehyde group (see structures below).



ethyl formate ethyl acetate

Like any other aldehyde, ethyl formate may be identified by silver-mirror test using Tollens' reagent ($[Ag(NH_3)_2]OH$). Tollens' reagent oxidizes an aldehyde into the corresponding carboxylic acid (actually the ammonium salt of the acid):



The reaction is accompanied by the reduction of silver ions in Tollens' reagent into metallic silver, which, if the test is carried out in a clean glass test tube, forms a **mirror on the test tube**.

The test is generally carried out in a test tube in a warm water bath.

Ethyl acetate has no aldehyde group and does not react with Tollens' reagent.

Tollens' reagent is not commercially available due to its short shelf life; it must be freshly prepared in the laboratory. One common preparation involves two steps. First a few drops of dilute sodium hydroxide are added to some aqueous silver nitrate. In this solution, the Ag^+ ions from the aqueous silver nitrate exist in a hydrated form as $[Ag(H_2O)_4]^+$ complexes, i.e. tetraaquasilver(I) ion. The OH^- ions from the sodium hydroxide react with the Ag^+ ions to give silver oxide, Ag_2O. This is insoluble, and precipitates out of the solution as a brown solid. Aqueous sodium nitrate is also produced in the mixture as a by-product. This then creates:

$$2\ AgNO_{3(aq)} + 2\ NaOH_{(aq)} \rightarrow Ag_2O_{(s)} + 2\ NaNO_{3(aq)} + H_2O_{(l)}$$

In the next step, aqueous ammonia is added until all of the brown silver(I) oxide is dissolved. At this point the mixture will be clear, and there are now aqueous silver ions existing as $[Ag(NH_3)_2]^+$ complexes in the mixture, which is the main component of Tollens' reagent.

$$Ag_2O_{(s)} + 4\ NH_{3(aq)} + H_2O_{(l)} \rightarrow 2\ [Ag(NH_3)_2]OH_{(aq)}$$