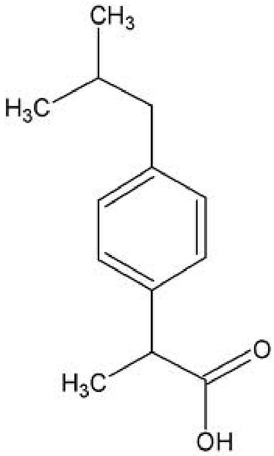
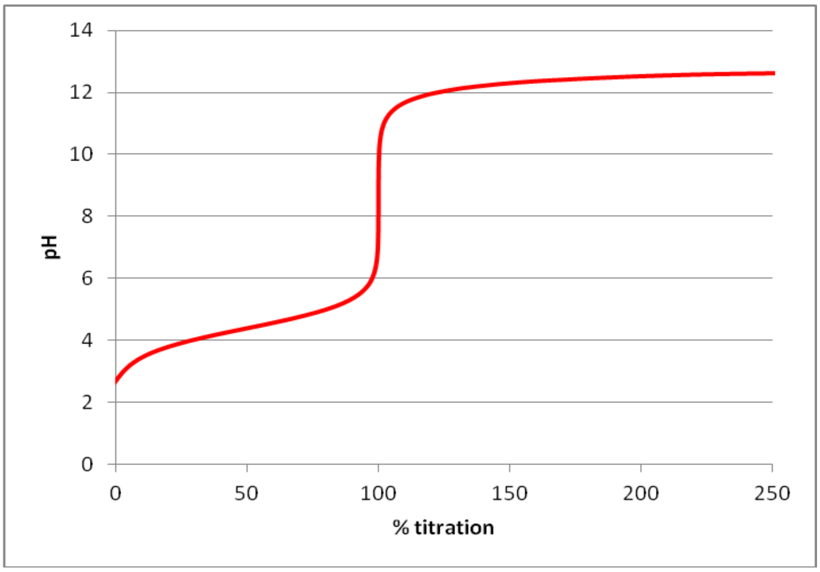
8B. Acid-base titration of Ibuprofen in tablets

Ibuprofen is an organic compound (its chemical name is (*RS*)-2-[4-(2-methylpropyl)phenyl]propionic acid) widely used as nonsteroidal anti-inflammatory drug applied in fever, arthritis, and as pain reliever. Ibuprofen is known to have an antiplatelet effect, though it is relatively mild and somewhat short-lived when compared with aspirin. Its analgesic (pain relieving) action starts after 30 min and lasts few hours. Ibuprofen is removed with urine and does not cumulate in human body. Numerous drugs contain this compound, the most popular are Ibum, Ibufen, Ibumax, Ibuprofen, Ibuprom, MIG, Nurofen, Modafen etc.



Ibuprofen

In our exercise students will analyze tablets of commercial drugs containing Ibuprofen and calculate the content of the active component $C_{12}H_{17}COOH$.
Tablets usually contain different neutral components, like starch, which however do not obscure the endpoint. Ibuprofen has one ionizable hydrogen (one-carboxylic acid) and the dissociation constant is pK_{a1}=4.40 [1]. This makes its acid-base titration relatively simple, not very different from that of, say, acetic acid (pKa=4.8).



Titration curve of 0.1 M Ibuprofen using 0.1 M NaOH titrant.

As seen from the theoretical titration curve, the proper indicator in this experiment will be Phenylphthalein, which becomes red starting at ca. pH=8.3. The only problem can be very low solubility of Ibuprofen in water (21 mg/L at 25°C). On the other hand, this compound is well soluble in alcohols, including the polyhydroxyl ones (for example glycerol, HO-CH_2-CH(OH)-CH_2-OH), and we will exploit this fact in our procedure. However, commercial glycerol usually contains traces of acids and this could influence the result, so it should be neutralized prior to titration.

Procedure

1. Pour ca. 50 mL of glycerol and ca. 50 mL of hot water to Erlenmayer flask and heat it to ca. 60^{o}C (the liquid is hot but does not burn).
2. Add 2-3 drops of Phenylphthalein and add slowly, drop by drop, your titrant NaOH solution, stirring the content vigorously until rose color appears. Add titrant solution to the burette up to initial mark or note the actual level of it.
3. Place the tablet in the flask, crush it with your glass stirring rod. Add additional 1-2 drops of indicator and titrate the content until red color appears.

Make two independent titrations at least.

Calculations

As seen from the theoretical titration curve, Ibuprofen behaves in this experiment like typical monoprotic acid. Thus, the number of moles of NaOH added at the end point of titration should be directly equal to that of Ibuprofen in the tablet.

Calculate the mass of the acid, independent for these two titrations and their arithmetic mean. Compare the obtained result with that claimed by drug producer (usually 200-400 mg, this number will be obtained from your teacher after completing the experiments).

Remember that this is quantitative analysis and all the numbers during measurements and calculations should be noted in proper number of significant digits.

The molecular mass of Ibuprofen is equal to 206.28 g/mol.

Report:

Note all the intermediate numbers and calculations. Compare your result with that given by the producer of the drug.

The same can be done pehametrically in identical way, but using pH-meter and plotting the pH=f($V_{titrant}$) dependence – see 09a or 09c instructions for some details.

[1] M. Meloun, S. Bordovska, L. Galla, Journal of Pharmaceutical and Biomedical Analysis 45 (2007) 552–564
Other sources: internet, in particular Wikipedia and textbooks.