Table 23.10 Values of $pK_a$ for selected pharmaceutical bases

| Base | Cation | $pK_a$ | Example |
|---|---|---|---|
| Potassium Hydroxide | Potassium | ~14 | Benzylpenicillin |
| Sodium hydroxide | Sodium | ~14 | Diclofenac |
| Zinc hydroxide | Zinc | ~14 | Bacitracine |
| Calcium hydroxide | Calcium | 12.6, 11.57 | Fenoprofen |
| Magnesium hydroxide | Magnesium | 11.4 | Menbutone |
| Choline | Choline | >11 | Theophylline |
| Lysine | Lysine | 10.79, 9.18, 2.16 | Ibuprofen |
| Benzathine | Benzathine | 9.99, 9.39 | Ampicillin |
| Piperazine | Piperazine | 9.82, 5.58 | Naproxen |
| Meglumine | Meglumine | 9.5 | Flunixin |
| Ammonia | Ammonium | 9.27 | Glycyrrhizinic acid |
| Tromethamine | Trometamol | 8.02 | Lodoxamide |
| Aluminium hydroxide | Aluminium | >7 | |

(Stahl and Wermuth, 2011).

Table 23.11 Frequency of pharmaceutical anions and cations of drugs in USP 29-NF24

| Anion | Frequency (%) | Cation | Frequency (%) |
|---|---|---|---|
| Hydrochloride | 39.96 | Sodium | 62.79 |
| Sulphate | 10.58 | Potassium | 11.05 |
| Acetate | 6.70 | Calcium | 8.72 |
| Phosphate | 4.97 | Aluminium | 4.65 |
| Chloride | 4.54 | Benzathine | 2.33 |
| Maleate | 3.67 | Meglumine | 2.33 |
| Citrate | 3.02 | Zinc | 2.33 |
| Mesilate | 2.59 | Magnesium | 1.74 |
| Succinate | 2.38 | Tromethamine | 1.74 |
| Nitrate | 2.38 | Lysine | 1.16 |

metabolites in biochemical pathways. These include hydrochloride and sodium salts and, as such, they are considered to be unrestricted in their use.

*Second class* salt formers are those that are not naturally occurring but which have found common application and have not shown significant toxicological or tolerability issues (such as the sulphonic acids, e.g. mesilates).

*Third class* salt formers are those that are used in special circumstances to solve a particular problem. They are not naturally occurring, nor are they in common use.