8.7: In-Text References

1. The rate of reaction is discussed in the next section. ↵
2. Recall that the pH $=-\log\left[\mathrm{H}^{+}\right]$, so $\left[\mathrm{H}^{+}\right]=10-\mathrm{pH}$, if the pH is $=1$ then the concentration of $\mathrm{H}^{+}=10^{-1}$, or 0.1 M. ↵
3. We write acetic acid in this condensed formula for clarity, remembering that the actual structure of acetic acid is $\mathrm{CH_3C=O(O-H)}$, and it is the H on the terminal O that is donated to a base (water). ↵
4. This is true provided that we are talking about reasonably large numbers of molecules - the smaller the number of molecules, the “noisier” the process. You can think about the molecular movements of a single molecule compared to the movement of many molecules, as an example. ↵
5. One very unfortunate consequence of this is that flour stored in grain silos can explode without warning, if exposed to a spark or other energy source. http://en.Wikipedia.org/wiki/Grain_e...tor_explosions ↵
6. The slope of the tangent is the change in concentration/change in time or the rate of the reaction. The slope of the tangent is the derivative of the curve at that point (calculus!). ↵
7. You might ask yourself: How do we know the molecules are still reacting if we can only observe the macroscopic level? There are a number of ways of tracking what happens at the molecular level. For example, there are spectroscopic techniques such as NMR that can be used, but they are beyond the scope of this book. ↵
8. In fact, this reaction has a number of different products. For now we will concentrate on this one. ↵
9. We call these kinds of reactions substitution reactions because one group has been substituted for another. In fact, they are also nucleophilic substitution reactions, because the hydroxide is acting as a nucleophile here. ↵
10. It is not necessary to be able to follow this mathematical reasoning; it is included to show where the equation comes from. ↵
11. http://en.Wikipedia.org/wiki/Spontan...man_combustion ↵
12. R is known as the gas constant; it turns up in many different equations. For example, the ideal gas law $\mathrm{PV}=n\mathrm{RT}$ (the units depend on the equation where it is used). R is also related to the Boltzmann constant k_{B}, (or k, yet another confusing use of symbols, since the Boltzmann constant is in no way related to the rate constant (k), or the equilibrium constant (K)). ↵
13. http://www.ncbi.nlm.nih.gov/pubmed/21332126 ↵
14. Here is an example: http://www.febsletters.org/article/S...971-4/abstract ↵
15. http://www.webmd.com/diet/features/t...ence-and-risks ↵
16. Strictly speaking, it is not concentrations that appear in the expression for K. Rather, it is another property called the activity (a)—often called the effective concentration. The activity takes into account the interactions between molecules and ions and solvents, but for our purposes it is acceptable to use concentrations in the expressions for K_{eq}. One outcome of this is that activity is a dimensionless quantity, so equilibrium constants are one of the few places where we don’t have to worry about getting the right units! ↵
17. Once more it is important to note that in thermodynamic terms, reactions referred to as spontaneous (inappropriately, in our view) do not indicate the rate at which a reaction will happen, but rather whether it will ever happen. In fact some “Spontaneous” reactions either do not occur at all (wood in an atmosphere containing oxygen does not burn spontaneously) or occur quite slowly (iron rusting). ↵
18. Of course, there is no such thing as acetate ($\mathrm{CH_3COO^-}$) alone. There must also be a counter-ion present. Typically, we use ions such as $\mathrm{Na^+}$ or \mathrm{K}^{+}\), stable monovalent cations that will not participate in any further reaction. So when we say we add acetate to the solution, we really mean we add sodium acetate—the sodium salt of acetic acid (just like sodium chloride is the sodium salt of hydrochloric acid). ↵
19. If you think about it for a moment you will see that if the concentration of any species changes in a closed system, then the concentrations of all the other species must also change. ↵
20. You might be wondering if there is some trick here. There is—we are ignoring several side reactions that in fact tend to cancel each other out. If you are interested, there are a number of helpful sites that can assist you with the more complex calculations required. ↵
21. The production of ammonia is a commercially-important process because nitrogen is an important element necessary for plant growth (it is commonly added to fertilizers). However, the major source of nitrogen is “locked up” in the air as molecular nitrogen, - a substance that is quite unreactive and inaccessible to most plants. ↵
22. By analogy, consider the NCAA basketball tournament: if the field is widened to allow more participants, it helps the weaker teams because the stronger teams would have made it into the tournament anyway. ↵
23. http://www.youtube.com/watch?v=IBa4kgXI4Cg ↵

24. This type of adaptation is physiological and occurs within individual organisms; it is distinct from, but based on, evolutionary processes that act on populations of organisms. ↵