Chapter 6. Cracolice, 2/e. Chemistry X11.

⇒ There are two **worksheets** on Ch 6 material, one on naming and one on formulas of ionic compounds. Both are at the web site, as the usual DOC files. The "naming" worksheet is also available online as an interactive web page, so you can work on it online and check yourself as you go. The level of these two worksheets is "basic".

⇒ A **practice quiz** that focuses on Ch 6 material is at the web site.

Chapter 6

This chapter is part of your learning to speak chemistry. Much of it is more about vocabulary than about ideas -- and it may not seem very interesting. We will cover this chapter a little at a time, rather than straight through. The best way to learn most of this material is by example, by practice. It doesn't work very well to try to memorize the material. Use it; use it some more. Do lots of practice. Try to see the logic, but realize that not everything is completely logical. Ask questions. Let this material grow on you over time; memorizing and cramming won't work.

The bulk of the chapter explains how to name chemicals. Individually, the rules are not particularly difficult. However, there are many of them, and sometimes they seem to conflict. Most rules have exceptions or special cases. There is also a scattering of good chemistry in the chapter.

Things not to do…

- Memorize rules, without knowing when they apply.
- Worry about the exceptions until you fully understand the rules to which they are exceptions.
- Worry much about the exceptions at all.
- Memorize long lists of anything.
- Study nomenclature without a periodic table.
- Let Table 6.9 intimidate you.
- Let Table 6.10 intimidate you.
- Think that learning the names of chemicals is learning chemistry.

Ch 6 is good reference material; refer to it often as you proceed through the course. Nomenclature is not an end in itself, but a communication tool. Your ability to deal with chemical names should develop along with your understanding of chemical behavior.

You may have noticed that I often write both the formula and name of chemicals on the board. Maybe you have noticed some patterns in the names. And maybe you have noticed some names that don't fit the patterns. I encourage you to continue this way on your own. Look for patterns (rules); be alert for exceptions. Try to relate the rules to the periodic table (it helps with some, not with others). Be aware that some of the rules have a fair amount of logic, but some are really quite arbitrary. Ask when you don't understand the reason for a name.

You do want to spend some time on this chapter, and make some progress. Do problems, and ask questions. The best problems are the last set (#26-end, p 164), because they cover everything. The first issue with these problems is: what type of compound is it? That is, which rule applies? If you focus primarily on the earlier, section-specific problems, you may find that those become easy but you can't deal with "real" questions. That is because the early problems are largely grouped by type. Figuring out which type you have often will be more difficult than applying individual rules. (This point is also relevant to tests, where questions are ungrouped.)

A brief overview of the Ch by section follows:

⇒ You are not responsible for the Bonding-before-nomenclature Option boxes in this Ch (referred to near end of Sect 6.1) at this time -- for the reason Cracolice states.

Section 6.2. Important. **You should know** the seven elements that commonly occur as diatomic molecules. Look where they are on the PT.

> Caution. Do not over-interpret this "rule". It refers to the common form of the free element. Consider oxygen as an example. Common oxygen gas, in the air, is diatomic, O_2. O_3 (ozone) is also a real and important chemical; it is rather unstable, compared to ordinary oxygen, but that is part of why it can be interesting. Ozone is a key part of "smog", and is a key part of the upper atmosphere, where it absorbs ultraviolet radiation from the sun; in both cases, the amount of ozone is small. Under special conditions, oxygen atoms, O, may even be important. But when someone refers to ordinary oxygen, to oxygen gas, it means O_2. And when oxygen occurs in molecules with other atoms -- not as a free substance -- there may be any number of O atoms or ions, as appropriate to the particular substance. Examples include H_2O, Fe_2O_3, and $C_{12}H_{22}O_{11}$ (sucrose). There is an entry in my web site Glossary on this issue, under "diatomic".
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> Fig 6.2e shows a C_{60} molecule, often called a "buckyball". To make your own buckyballs, see the Download page at the web site. (Suitable for youngsters?) Also see p 416 for a feature discussion of buckyballs.

Sect 6.3. The important part is to remember when this naming rule applies: two nonmetals. **You should know** the numeric prefixes in Table 6.1.

Sect 6.4. The terms cation and anion are important. (Cation is pronounced cat-ion.) The ions discussed in this section are monatomic ions. You should learn to distinguish the ions that can be easily predicted from the PT from those that are special. In fairness, the distinction is not entirely clear, but there is a main pattern. Emphasize the main pattern, not the exceptions.

Sect 6.5 & 6. An introduction to acids. And a real minefield. Be careful not to get bogged down here. **You should know** the common acids and their anions, Table 6.2; their formulas are not easily predicted. (You may want to put these on your note page for the tests.) Table 6.3

shows a number of important terms; at our level, the most important point is to recognize that "similar" names refer to different chemicals. Sodium chlorate and sodium chlorite are different chemicals. I don't expect you to remember all the details of this. Treat these mainly as reference sections; Cracolice's stated goals for these sections are "minor" for now. (But you do need to know the things in Table 6.2, as noted.)

Sect 6.7. Special cases; learn the common ones from practice. You are responsible for this at the level of the stated Goal 7. Note Cracolice's comment (p 152) that the accompanying tables are good for reference.

> The most important polyatomic ions not listed in Table 6.2 are hydroxide and ammonium. **You should know** these two common ions. Goal 7.

Sect 6.8 & 9. Important. There are two issues in writing ionic formulas. First, you must recognize what the ions are. Second, you must combine the ions to achieve a neutral compound. The second step is not really chemistry; it is simple math, much like finding the least common denominator for two fractions. It is important that you are able to combine ions into compounds. Recognizing the ions is more complicated. I will only expect you to know the more common ions (as discussed above).

Sect 6.10. An important practical point. Many lab chemicals come as hydrates. The raised dot in the formula means "complexed with". **You should know** about hydrates and the raised dot**.**

Sect 6.11. Use Table 6.9 as a guide or summary of what you have learned, but don't worry too much about it. Certainly, don't try to learn nomenclature from this table.

Sect 6.12. Practical, but don't worry about it.

Further reading

F Cacace et al, Experimental detection of tetranitrogen. Science 295:480, 1/18/02. Tetranitrogen? That is N_4. Ordinary nitrogen is N_2, of course. Remember that ordinary oxygen is O_2, but O_3 (ozone) is known; it is relatively unstable. Here they show they can make N_4, which they say is "long-lived" -- it has a lifetime exceeding one microsecond, which is long enough to study it. They are intrigued by the possibility that N_4 might be a useful energy source. Interestingly, the next article (p 482) is on another unstable molecule that is related to more familiar molecules: H_2O_3, with the structure H-O-O-O-H.

A B Kirk et al, Perchlorate and iodide in dairy and breast milk. Environ Sci Technol 39:2011-2017, 4/1/05. Perchlorate ion has been much in the news lately. The story is that perchlorate is being found in drinking water in some places, probably as the result of runoff from the manufacture of rocket fuels (e.g., NH_4ClO_4); perchlorates are strong oxidizing agents. For the most part, perchlorate is probably not very toxic. However, it does seem to have a specific effect on the thyroid, as a result of inhibiting the uptake of iodide ion, which is necessary for thyroid function. This effect may well be most important during fetal development and with infants. This paper explores the issue of perchlorate in milk; they make a case that this may be more important than water contamination. They discuss the current regulatory questions.

N A Piro et al, Triple-bond reactivity of diphosphorus molecules. Science 313:1276, 9/1/06. The common form of elemental nitrogen is the triply bonded N_2, whereas the common form of phosphorus is the tetrahedral P_4. This fits with the general difficulty of making multiple bonds between large atoms. Here, they explore the chemistry of the more exotic species, the triply bonded P_2. (Although the common forms of the elements are introduced in Ch 6, the issues of bonding and geometry wait until Ch 11-12.)

S P Green et al, Stable magnesium(I) compounds with Mg-Mg bonds. Science 318:1754, 12/14/07. They make two ionic compounds containing the Mg_2^{2+} ion, which can be thought of as two Mg^+ ions bound together covalently (as in the more common Hg_2^{2+} ion). They use complex organic anions, which are designed to help stabilize the unusual Mg species. These are the first reported stable compounds containing the 1+ form of any member of the alkaline earth group (group IIA). This is interesting, in showing how new things get made. However, it still remains true that an ion of any group IIA metal you encounter is almost certainly 2+.

P G Falkowski & Y Isozaki, Geology: The story of O_2. Science 322:540, 10/24/08. News. The oxygen in the atmosphere is from oxygenic photosynthesis, as found in the cyanobacteria and plants. Thus the story of the earth's atmosphere is intricately tied to the story of the evolution of the cyanobacteria. This item is a brief overview of what we know -- and don't know -- about various factors affecting the accumulation of O_2 in the atmosphere.

G Yang et al, H_2S as a physiologic vasorelaxant: Hypertension in mice with deletion of cystathionine-lyase. Science 322:587, 10/24/08. Hydrogen sulfide is best known as the odor of rotten eggs. Now, evidence mounts that it is a normal part of our physiology, with a role in regulating blood pressure and blood vessel function -- at least in mice.

Computer resources (See web page for details and links.)

Movie: Formation of ionic bonds. The animated cartoon shows how a barium atom and two fluorine atoms form the ionic compound barium fluoride. (You may also want to look at this movie along with Ch 11.)