Problems in translating Japanese chemical texts into English

(Session by Jon Johanning at ATA Conference in Phoenix, November 2003)

Three main sources of problems:

1) Number (not needed in Japanese, needed in English)
2) Reverse word orders
3) Lack of spaces between Japanese words and fewer punctuation marks

Some knowledge of chemistry is needed for solving these problems.

Best source of this knowledge is chemistry textbooks and textbook outlines; some Web sites are also helpful (see references at end).

Topics which are especially important:

1) Periodic Table
2) Formation of compounds by bonding [ionic (mostly inorganic compounds) and covalent (mostly organic compounds)]
3) Main families of organic compounds: alkanes, alkenes, alkynes, arenes, alcohols, ethers, amines aldehydes, ketones, carboxylic acids, esters, etc.
4) Nomenclature of organic compounds (IUPAC and common names), and relationship to structural formulas

1) Periodic Table

Gives much information about how elements relate to each other
Two forms: old and new (different ways of numbering groups). Most Japanese texts, especially patents, still use the old system of numbering groups).

2) Bonds between elements in compounds

Elements with incomplete outer shells (all except the farthest-right group in the Periodic Table — the "noble gases") form either ionic or covalent bonds.

a) Ionic: elements with almost complete outer shells "steal" electrons from ones with few outer shell electrons: e.g., salt (sodium chloride):

$$Na^+ + Cl^- \rightarrow NaCl.$$

These compounds are mostly "inorganic" ones.

b) Covalent: elements with about half-completed outer shells "share" electrons: e.g.,

Carbon, four valence electrons

Four hydrogens, each with one valence electron

Lewis dot structure for methane, CH_4

Note that, since carbon has four valence electrons, it is especially suitable for forming covalent bonds with hydrogen (one valence electron) and other atoms and groups of atoms (or "radicals") which can complete the outer carbon shell. Carbon also bonds with itself, especially to form benzene rings. This is the basis of organic chemistry, which is sometimes called "the chemistry of carbon," and deals with the structures and reactions of millions of compounds.

3) Main families of organic compounds

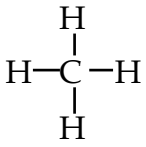
The table on the next page lists some of the main families of organic compounds, with their IUPAC (International Union of Pure and Applied Chemistry) and common (older) names, general formulas, and groups or radicals which are formed from them. (Source: Solomons, T. W. Graham: New York, *Organic Chemistry* (John Wiley & Sons, 1976), p. 74)

4) Nomenclature and relationship to formulas

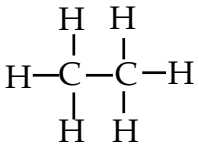
The common names are the ones which began to be used in the 19th century, when there were many fewer organic compounds known than are known today. Beginning in 1892, the IUPAC began to develop a systematic nomenclature, which gives each compound a particular name, allowing chemists to name any compound once its structure is known, and conversely derive the structure of a compound from its IUPAC name.

For example, alkanes are essentially strings of carbon atoms with hydrogen atoms attached to fill their outer shells. Examples of unbranched alkanes are:

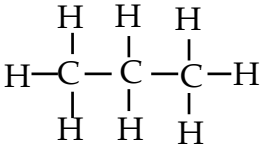
Methane:



Ethane:



Propane:



Hexane:

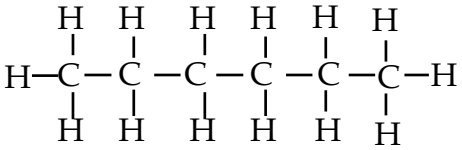
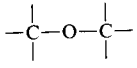
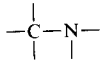
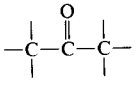
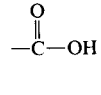
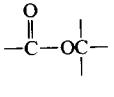
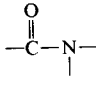


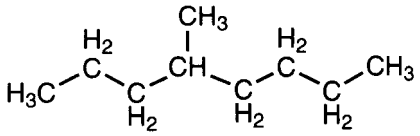
TABLE 2.2 Important families of organic compounds

	Family												
	ALKANE	ALKENE	ALKYNE	ARENE	HALOALKANE	ALCOHOL	ETHER	AMINE	ALDEHYDE	KETONE	CARBOXYLIC ACID	ESTER	AMIDE
Specific example	CH_3CH_3	$CH_2{=}CH_2$	$HC{\equiv}CH$		CH_3CH_2Cl	CH_3CH_2OH	CH_3OCH_3	CH_3NH_2	$CH_3\overset{O}{\overset{\|}{C}}H$	$CH_3\overset{O}{\overset{\|}{C}}CH_3$	$CH_3\overset{O}{\overset{\|}{C}}OH$	$CH_3\overset{O}{\overset{\|}{C}}OCH_3$	$CH_3\overset{O}{\overset{\|}{C}}NH_2$
IUPAC name	Ethane	Ethene	Ethyne	Benzene	Chloro-ethane	Ethanol	Methoxy-methane	Methan-amine	Ethanal	Propanone	Ethanoic acid	Methyl ethanoate	Ethananide
Common name*	Ethane	Ethylene	Acetylene	Benzene	Ethyl chloride	Ethyl alcohol	Dimethyl ether	Methyl-amine	Acetal-dehyde	Acetone	Acetic acid	Methyl acetate	Acetamide
General formula	RH	$RCH{=}CH_2$ $RCH{=}CHR$ $R_2C{=}CHR$ $R_2C{=}CR_2$	$RC{\equiv}CH$ $RC{\equiv}CR$	ArH	RX	ROH	ROR	RNH_2 R_2NH R_3N	$R\overset{O}{\overset{\|}{C}}H$	$R\overset{O}{\overset{\|}{C}}R$	$R\overset{O}{\overset{\|}{C}}OH$	$R\overset{O}{\overset{\|}{C}}OR$	$R\overset{O}{\overset{\|}{C}}NHR$ $R\overset{O}{\overset{\|}{C}}NR_2$
Functional group	C—H and C—C bonds		$-C{\equiv}C-$	Aromatic ring									

*These names are also accepted by the IUPAC.

(Source: Solomons: *Organic Chemistry*, p. 74)

If the right-end hydrogens are removed, “alkyl” groups are formed: “methyl,” “ethyl,” “propyl,” and “hexyl.” {Note that the names of the groups end in “-yl,” in place of “-ane.”) Since these groups have one valence electron, like a hydrogen atom, they can be attached to carbon atoms in place of hydrogen atoms.



4-Methyloctane

This compound has eight carbons in its main chain; therefore, it is an octane. The CH3- (methyl) group is attached to the fourth carbon in the chain; therefore, the compound is named “4-methyloctane.”

By linking chains like this, sometimes branching off of carbons in the main chain, and attaching groups, as well as individual atoms, to various carbons, a great many compounds, all in the alkane family, can be formed.

Similarly, compounds in the other families are formed by attaching *substituents* in the locations “R” in the formulas shown in the table on the previous page.

By studying the references listed below, you will become more familiar with the principles of the IUPAC nomenclature.

Miscellaneous translation problems

a: Acid names: J “-ン” / E “-ic,” “-ous,” endings

E.g.: **リン酸** phosphoric acid H_3PO_4

亜リン酸 phosphorous acid H_3PO_3

次亜リン酸 hypophosphoric acid $H_4P_2O_6$

Corresponding salts:

リン酸塩 phosphates (e.g.: **リン酸ナトリウム** sodium phosphate Na_2HPO_4)

亜リン酸塩 phosphites (e.g.: **亜リン酸ナトリウム** sodium phosphite Na_2HPO_3)

次亜リン酸塩 hypophosphites (phosphinates) (e.g.: **次亜リン酸ナトリウム** sodium hypophosphite (sodium phosphinate) NaH_2PO_2)

b: **アルカリ** (“alkali” n.) vs. **アルカリ性** (“alkaline” adj.) vs. **アルカリ土類金属** (“alkaline-earth metals” – Group 2 elements) (but: “alkali metals”– Group 1 elements)

c: **酸素** vs. **リン酸** etc.: **酸** can mean “oxygen” or “acid.”

d: **オキシー** used to be used for the -OH group (from German); now, this group is internationally called **ヒドロッキシー** (hydroxy), but the older term is still found in patents, etc. Properly, **オキシー** is now used for -O- in ethers.

e: "**置換**" - replacing atmosphere in reactor, not the reactor!

f: **アセトアミド、アセトアミノ、アセトアセチル、アセト酢酸** - Acetamide (not "acetoamide") and "acetamino-," but "acetoacetyl," "acetoacetic acid," etc.

g: "**脱**-X" = "de-X-(various suffixes)"

"Deamination," "deacetylation,""dehydrogenation," "denitrification (**脱窒**),"

"denitration (**脱ニトロ化**),"etc.

h: Meanings of **価**

Valence (valency): **原子価** (combining power of atom or radical)

Alcohols and phenols: **二価アルコール** = "dihydric alcohol," **二価フェノール** = "dihydric phenol" [number of hydroxyl (-OH) groups in molecule]

酸価 = "acid value" or "acid number": amount of free acids in fats

Selected References (just a few of many available ones)

Periodic Table:

Atkins, P. W.: *The Periodic Kingdom* (New York: BasicBooks, 1995)
(excellent introduction to chemistry in general, as well as the PT)

http://periodic.lanl.gov
(Los Alamos National Laboratories site – aimed at beginning chemistry students)

General textbooks, etc.

General chemistry:

Numerous chemistry textbooks and college outlines (Barron's, Barnes & Noble, etc.)

http://www.du.edu/~jcalvert/phys/organic.htm
(good outline to supplement textbook treatments)

Organic compounds nomenclature:

Claff, Chester, E.: *A Translator's Guide to Organic Chemical Nomenclature*
http://accurapid.com/journal/sci-tech.htm
(download zip file of first 7 installments from there, and then download remaining ones)
(excellent translators' reference for understanding English nomenclature)

http://www.chem.qmul.ac.uk/iupac/
(main IUPAC web site)

http://acdlabs.com/iupac/nomenclature
(another informative site)

http://www.aocs.org/member/division/analytic/fanames.htm
(common names for fatty acids)

www.spsj.or.jp/c19/iupac/IUPACRecommendationslist.html
(list of Japanese publications on polymer nomenclature)

Dictionaries and Web sites:

化学大辞典（東京化学同人, 1989)

Daintith, John, ed.: *A Dictionary of Chemistry* (3rd edition, Oxford and New York:

Oxford University Press, 1996)
Parker, Sybil P., ed.: *McGraw-Hill Dictionary of Chemical Terms* (New York: McGraw-Hill Book Company)
http://www.monjunet.ne.jp/PT/chemical/ (database of chemical substance names)

Other references:

Encyclopedias, such as the Encyclopedia Britannica (available as CD-ROM and on the Web)
The Merck Index (Rahway, Merck & Co., numerous editions)