臺灣大學化學系 NTU CHEMISTRY

普通化學甲

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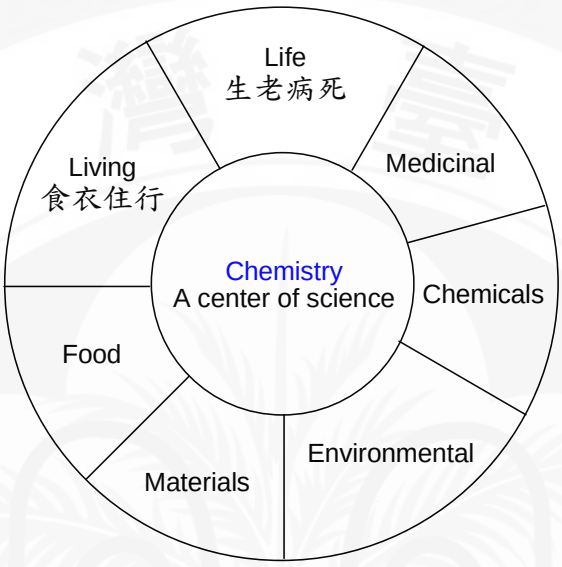
臺灣大學化學系 NTU CHEMISTRY

1 Chemists and Chemistry

化學是研究物質的組成、製備、性質及其應用的科學。

Chemistry is the study of the compositions, preparations, properties of substances and its applications.

※ Introduction



A science of problem solving

Literature search: understand the structure
the reaction

↓

Identify the mechanism: source of the problem

↓

Propose some solutions

↓

Experiments

Scientific method

1. Observation { Qualitative / Quantitative
2. Hypothesis
3. Prediction
4. Tested by experiments → new observation

{ Theory – explain what happens (theory may change)
  Law – summarizes what happens

◎ Industrial chemistry

Isolation of natural product as raw material
Process raw material → commercial product
The use of chemicals

Economy and safety are critical

Research in industrial chemistry

1. Identify a need
2. Develop a process
3. Evaluation: efficiency, cost, ease of production, safety, environmental impact
4. Pilot plant

↓

Real production

※ Units of measurement

Prefix	Symbol	Exponential Notation
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
hecto	h	10^{2}
deka	da	10^{1}
deci	d	10^{-1}
centi	c	10^{-2}
mili	m	10^{-3}
micro	μ	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}
femto	f	10^{-15}
atto	a	10^{-18}

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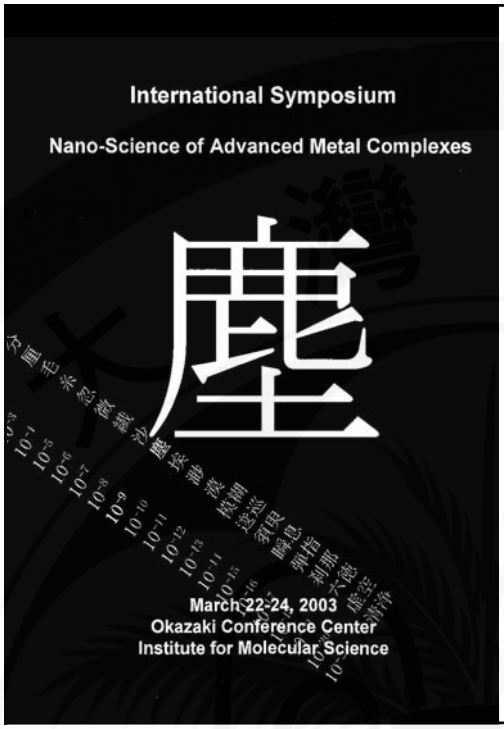
DAILY DOSE

Toxicologically proposed limits on elemental impurities differ among standards groups

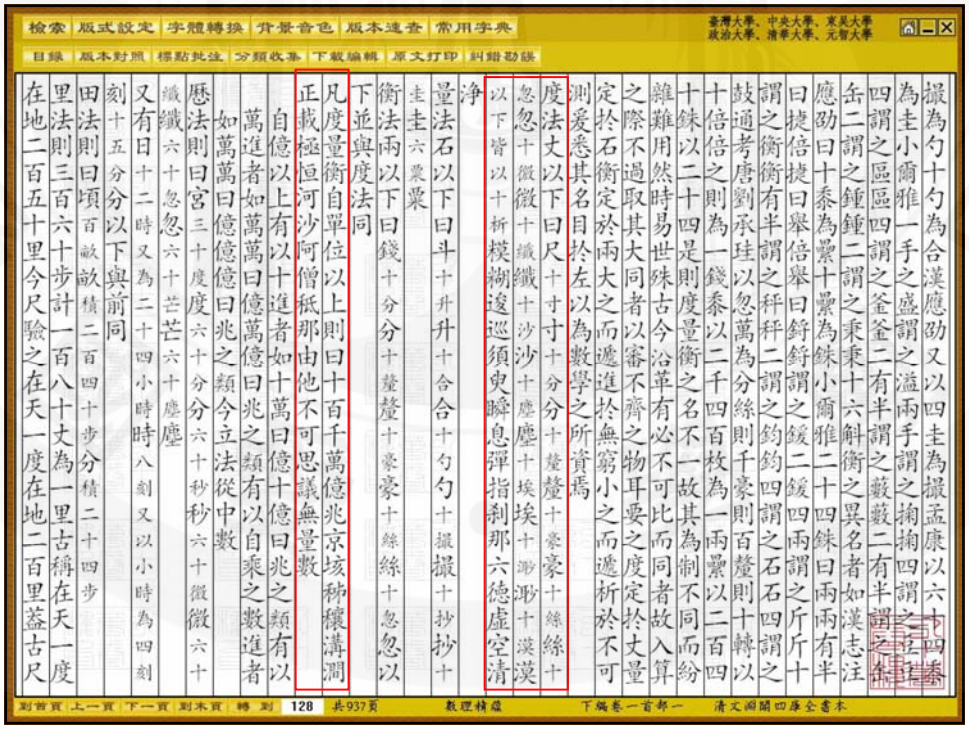
ORAL PERMITTED DAILY EXPOSURE (μg/DAY)[a]	USP[b]	ICH[c]	EMA[d]
Arsenic (inorganic)	1.5	15	na
Lead	5	5	na
Mercury (inorganic)	15	40	na
Cadmium	25	5	na
Palladium	100	100	100
Platinum	100	1,000	100
Iridium	100	1,000	100[e]
Osmium	100	1,000	100[e]
Ruthenium	100	1,000	100[e]
Rhodium	100	1,000	100[e]
Molybdenum	100	180	250
Vanadium	100	120	250
Nickel	500	600	250
Copper	1,000	1,300	2,500
Chromium	nc	11,000	250

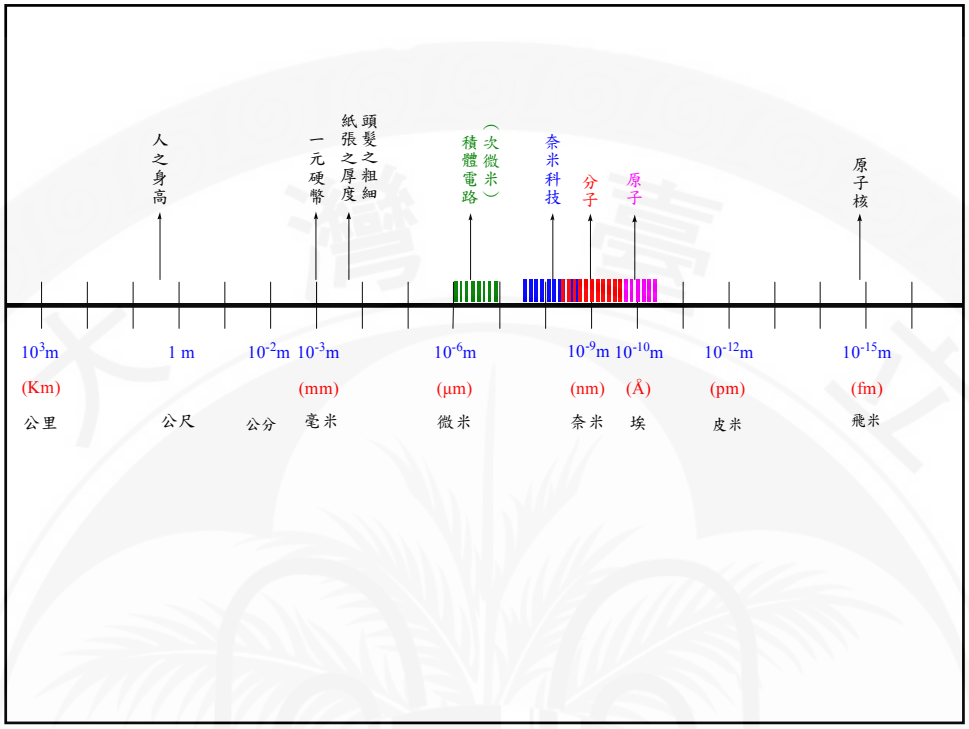
a Based on a 50-kg (110 lb) person. **b** As of Feb. 1, 2013. **c** As of July 26, 2013. List also includes antimony, barium, cobalt, gold, lithium, selenium, silver, thallium, and tin. **d** EMA 2008 guideline covers metal residues from catalysts and reagents and also includes iron, manganese, and zinc. **e** Total limit for subclass of iridium, ruthenium, rhodium, and osmium. **USP** = U.S. Pharmacopeial Convention. **ICH** = International Conference on Harmonisation of Technical Requirements for Registration of Pharmaceuticals for Human Use. **EMA** = European Medicines Agency. **na** = not applicable in this guideline. **nc** = not a safety concern. **SOURCES:** USP, ICH, EMA



			SI system				SI system
10^{68}	無量大數	無量數		10^{-1}	分		deci(d)
10^{64}	不可思議			10^{-2}	厘		centi(c)
10^{60}	那由他			10^{-3}	毛	豪	milli(m)
10^{56}	阿僧祇	阿僧祇		10^{-4}	糸		
10^{52}	恒河沙			10^{-5}	忽		
10^{48}	極			10^{-6}	微		micro(u)
10^{44}	載			10^{-7}	纖	纖	
10^{40}	正			10^{-8}	沙		
10^{36}	澗			10^{-9}	塵		nano(n)
10^{32}	溝			10^{-10}	埃		
10^{28}	穰			10^{-11}	渺		
10^{24}	杼	秭		10^{-12}	漠		pico(P)
10^{20}	垓			10^{-13}	模糊		
10^{18}			exa(E)	10^{-14}	逡巡		
10^{16}	京			10^{-15}	須臾		femto(f)
10^{15}			peta(P)	10^{-16}	瞬息		
10^{12}	兆		tera(T)	10^{-17}	彈指		
10^{9}			giga(G)	10^{-18}	剎那		atto(a)
10^{8}	億			10^{-19}	六德		
10^{6}			mega(M)	10^{-20}	虛空		
10^{4}	万			10^{-21}	清淨		
10^{3}	千		kilo(k)				
10^{2}	百		hecto (h)				
10^{1}	十		deka(da)				
0	零						

清朝「數理精蘊」





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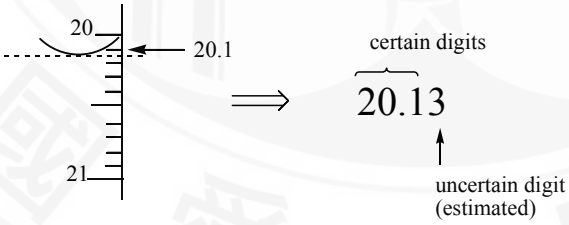
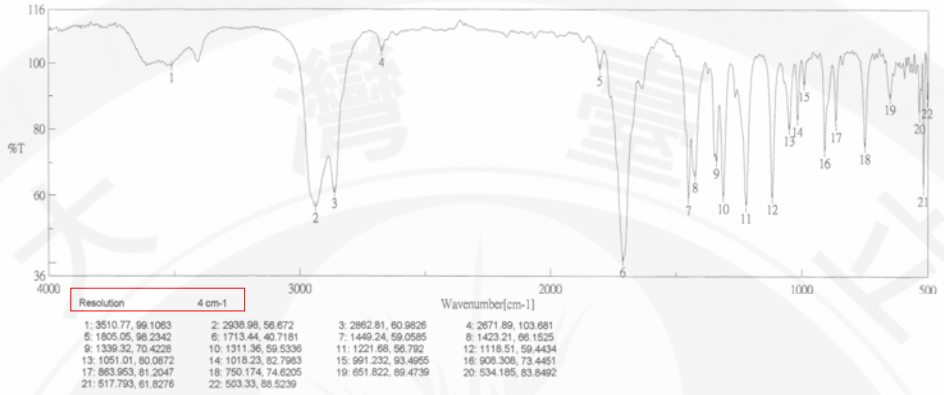
※ Uncertainty in measurement

A measurement always has some degrees of uncertainty



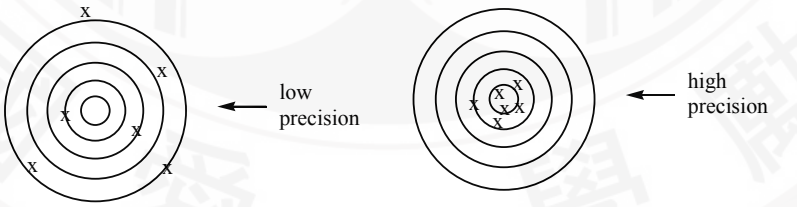
Take only one uncertain digit

An IR spectrum of cyclohexanone



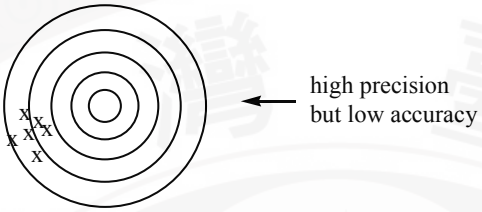
※ Precision and accuracy

Precision (精確度): The degree of agreement among several measurements.



The error is called random error or indeterminate errors (非定向的)

Accuracy (準確度): Agreement with the true value



The error is called systematic error or determinate error

Ex.

Weighting	Result
1	2.486
2	2.487
3	2.485
4	2.484
5	2.488

Avg: 2.486 ⇨ Without systematic error, this value is the closest to the true value.

May be recorded as 2.486 ± 0.002

※ Significant figures and calculations

Significant figures (digits)

Rules

1. Nonzero integers: always count

2. Zeros

a. Leading zeros: preceding all the nonzero digits — does not count.

0.0025
↑ ↑ ↑

b. Captive zeros - count

1.008
↑ ↑

c. Trailing zeros

2500
↑ ↑
do not count

25.00
↑ ↑
count

$2.500 \times 10^3 = 2500.$
↑ ↑
count

3. Exact numbers

Not obtained using measuring devices

Arise from definition

Infinite number of digits

Ex. $2\pi r$

↑ Exact number

8 apples

1 in = 2.54 cm

↑ Definition

Mathematical operations

1. ×, ÷

Same as the least precise measurement

$$4.56 \times 1.4 = 6.384 \xrightarrow{\text{corrected}} 6.4$$

(4.56: == two; 6.4: == two)

四捨五入

2. ＋, –