

普通化學甲

蔡蘊明

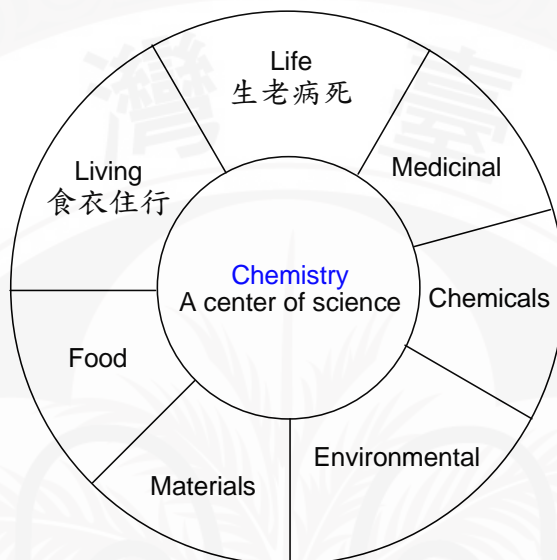
1 Chemists and Chemistry



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

International Symposium
Nano-Science of Advanced Metal Complexes

塵

March 22-24, 2003
Okazaki Conference Center
Institute for Molecular Science

10 ⁶⁸	無量大數	無量數	10 ⁻¹	分厘	deci(d)
10 ⁶⁴	不可思議		10 ⁻²	厘毫	centi(c)
10 ⁶⁰	那由他		10 ⁻³	毫	milli(m)
10 ⁵⁶	阿僧祇	阿僧祇	10 ⁻⁴		
10 ⁵²	恒河沙		10 ⁻⁵	忽	
10 ⁴⁸	極		10 ⁻⁶	微	micro(u)
10 ⁴⁴	載		10 ⁻⁷	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	杼	10 ⁻¹²	漠	pico(P)
10 ²⁰	垓		10 ⁻¹³	模糊	
10 ¹⁸			10 ⁻¹⁴	逡	
10 ¹⁶	京	exa(E)	10 ⁻¹⁵	須臾	femto(f)
10 ¹⁵			10 ⁻¹⁶	瞬息	
10 ¹²	兆	peta(P)	10 ⁻¹⁷	彈指	
10 ⁹	億	giga(G)	10 ⁻¹⁸	刹那	atto(a)
10 ⁸			10 ⁻¹⁹	六德	
10 ⁶	萬	mega(M)	10 ⁻²⁰	虛空	
10 ⁴	千		10 ⁻²¹	清淨	
10 ³	百	kilo(k)			
10 ²	十	hecto(h)			
10 ¹	一	deka(da)			
0	零				

清朝「數理精蘊」

檢索 版式設定 字體轉換 背景音色 版本追查 常用字典
臺灣大學 中央大學 東吳大學 政治大學 清華大學 元智大學

目錄 版本對照 標點批注 分類收卷 下載編輯 原文打印 糾錯勸導

刻十五分以下與前同

又有日十二時又為二十四小時時八刻又以小時為四刻

織纖六十忽忽六十芒芒六十塵塵

田法則曰頃百畝積二百四十步分積二十四步

里法則三百六十步計一百八十丈為一里古稱在天一度在地二百五十里今尺驗之在天一度在地二百里蓋古尺

撮為勺十勺為合漢應劭又以四圭為撮孟康以六十四黍為圭小爾雅一手之盛謂之溢兩手謂之掬掬四謂之盈四謂之區區四謂之釜釜二有半謂之數數二有半謂之石石二謂之鍾鍾二謂之乘乘十六斛衡之異名者如漢志注岳二謂之黍黍為粟十粟為銖小爾雅二十四銖曰兩兩有半曰捷捷曰兩兩有半謂之鈔鈔謂之鈞鈞四謂之斤斤十謂之衡衡有半謂之秤秤二謂之鈞鈞四謂之石石四謂之鼓通考唐劉承珪以忽萬為分絲則千豪則百釐則十轉以十倍倍之則為一錢黍以二千四百枚為一兩粟以二百四十銖以二十四是則度量衡之名不一故其為制不同而紛雜難用然時易世殊古今沿革有必不可比而同者故入算之際不過取其大同者以審不齊之物耳要之度定於丈量定於石衡定於兩大之而遞進於無窮小之而遞析於不可測爰悉其名目於左以為數學之所資焉

度法丈以下曰尺十寸十分十釐釐十毫毫十絲絲十忽忽十微微十纖纖十沙沙十塵塵十埃埃十渺渺十漠漠十淨

以下皆以十析模糊遠巡須臾瞬息彈指刹那六德虛空清

量法石以下曰斗十升升十合合十勺勺十撮撮十抄抄十圭圭六粟粟

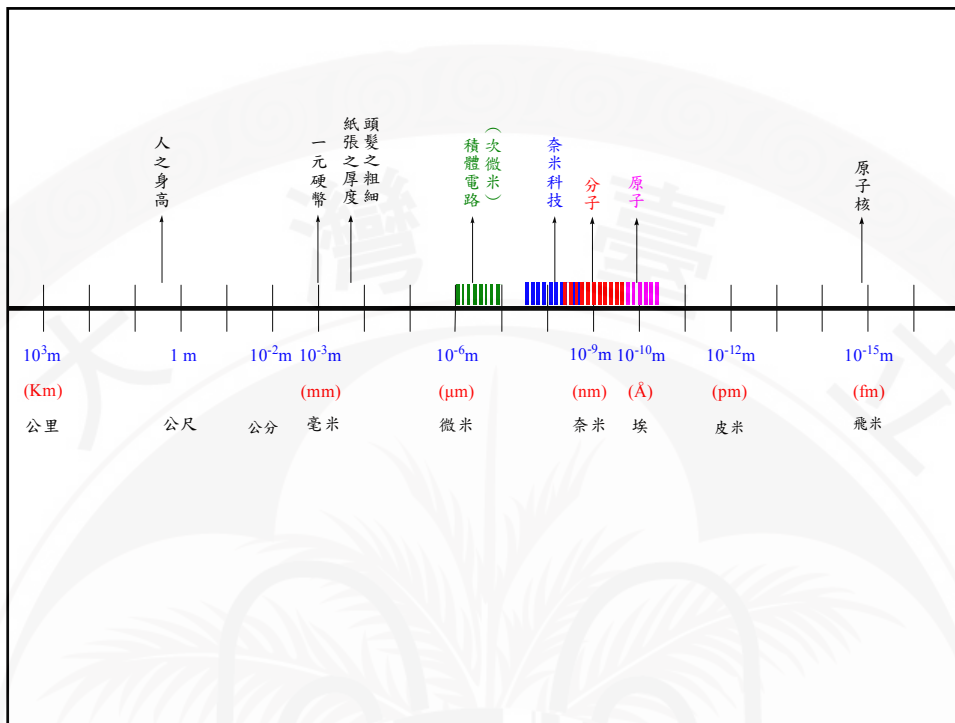
衡法兩以下曰錢十分十分釐釐十豪豪十絲絲十忽忽以下並與度法同


凡度量衡自單位以上則曰百千萬億兆京垓穰溝澗正載極恒河沙阿僧祇那由他不可思議無量數

自億以上有以十進者如十萬曰億十億曰兆兆之類有以萬進者如萬萬曰億億曰兆兆之類有以自乘之數進者如萬萬曰億億曰兆兆之類今立法從中數

歷法則曰宮三十度度六十分分六十秒秒六十微微六十織纖六十忽忽六十芒芒六十塵塵

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128 共937頁
數理精蘊
下編卷一第部一
清文閣閣四庫全書本

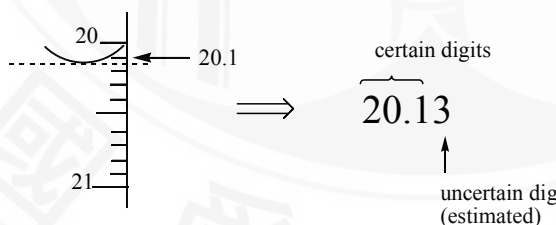




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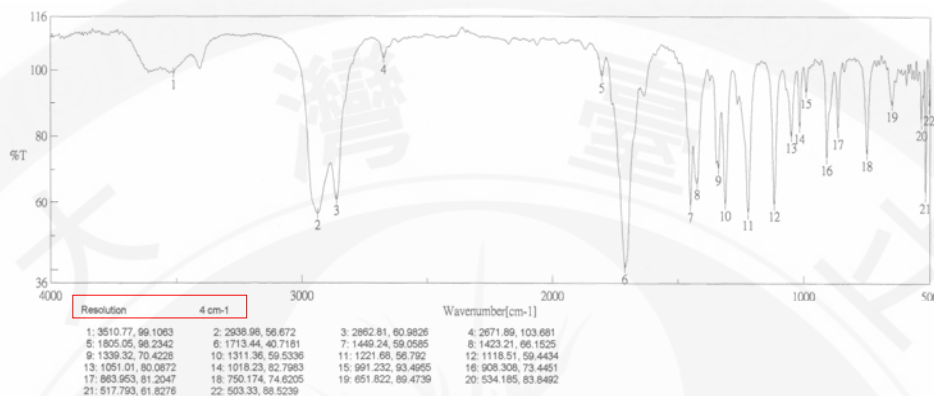
※ Uncertainty in measurement

A measurement always has some degrees of uncertainty



Take only one uncertain digit

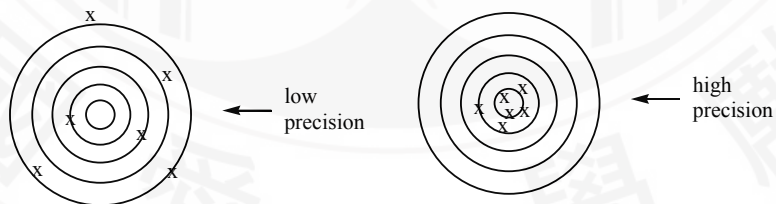
An IR spectrum of cyclohexanone



※ Precision and accuracy

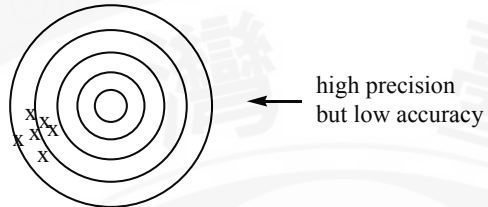
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Precision (精確度): The degree of agreement among several measurements.



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. \times, \div

Same as the least precise measurement

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

四捨五入

2. +, -

$$\begin{array}{r} 12.11 \\ 18.0 \\ 1.013 \\ \hline 31.123 \end{array} \xrightarrow{\text{corrected}} 31.1$$

↑