PDF notes

Tuesday, September 11, 2012
12:09 PM

Introduction to Chemistry

Chemistry is the branch of science that deals with the properties, composition and behavior of **matter.**

Chemistry is found all around us in our daily lives:

Ex. Plastics, computer chips, climate change, lenses, GE foods, ceramics, pesticides…

Elements have incredible flexibility, and can be changed into a multitude of different components:

Ex. Silicon (Si) – found in computer chips, glasses, ceramics, optical fibres, rocks and minerals…

Chemists seek to understand matter through **experimentation**, which involves making careful unbiased observations

Observations: done by using your senses to experience and can be –

Qualitative: (descriptive) – colors, odors, textures, flavors…
Quantitative: (numbers) – measurements; mass, temperature, length, amount…

Interpretations: (aka inferences) are conclusions based on your observations and experiences

Observations must be repeated several times by different people in order to be accepted as true; reproducibility

When a regularity is observed in the behavior of mater, a **hypothesis** (or temporary explanation) is formed about the observation

When the hypothesis has been tested by; accounting for observed events AND predicting future events, we call it a **theory**

To explain a theory we use **models**: these can be physical objects, symbols, equations and/or images. The models must change as the theory is disproved by future experimentation.

Introduction to Matter

Matter is anything that has mass (also defined as inertia, or resistance to change in motion) and occupies space (examples?)

Not matter: Energy (light, sound…), feelings, emotions

Properties of matter include melting point (mp) boiling point (bp) density, colour, odour, chemical reactivity, electrical conductivity (***intensive property***). But does **NOT** include things like; mass, volume which are dependant on the size of the sample and/or the temperature (***extensive property***)

Measurement and units

Scientific Measurement

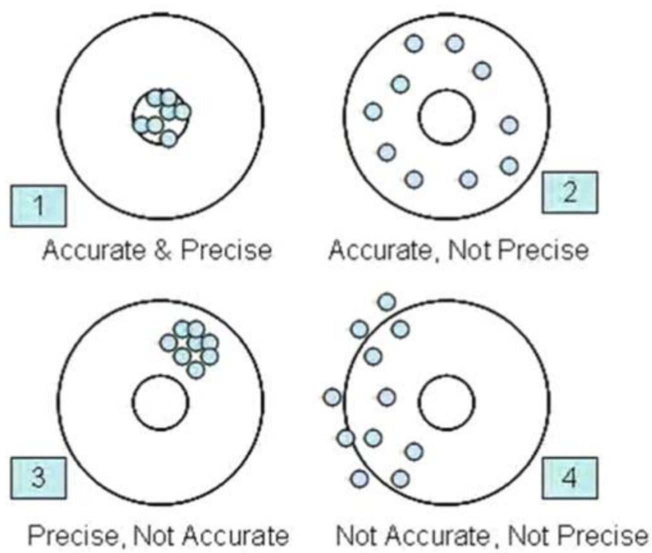
Measurement in scientific studies is meant to be as accurate and precise as possible so we can get good reliable results.

Scientific Notation

Numbers used in science are often very big or very small, such as the speed of light (30,000,0000 m/s) of the size of an atom (~0.00000000010 m). In science we write these numbers in a condensed format like: 3.0×10^{8} or 1.0×10^{-10}. It is always written as a number from 1 – 10 multiplied by some power of ten.

Accuracy vs Precision

Accuracy can be defined as the closeness to the accepted value (average)
Precision can be defined as the **repeatability** of a test, or the amount of uncertainty given to a measurement



SI Units – *Système international d'unités*

- meters, seconds, kilograms, amps, kelvin, candela, and moles

ALWAYS INCLUDE UNITS WHEN MAKING MEASUREMENTS!

Prefixes: - pico, nano, micro, milli, centi, deci (12, 9, 6, 3, 2, 1)
+ tera, giga, mega, kilo, hecta, deca

pg. 17-18 Hebden.

Metric conversions

Q: How many cm (uQ) is 1 Km (KQ)?

Proper Unit conversions

KQ × ―― × ―― = uQ ☆

$1\,Km \times \frac{1000\,m}{1\,Km} \times \frac{100\,cm}{1\,m} = 1\times10^{5}\,cm$

Hebden: Read 2.1 pg 9-16
do Questions 11-29
pg 16-23

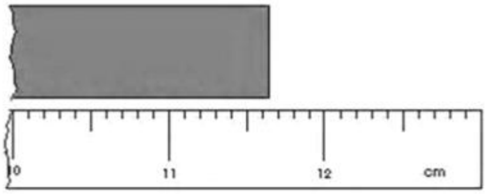
mL → c.c.

$1\,mL = 1\,cm^3$

$1000\,mL = 1\,L = ?\,m^3$

$1\,L \times \frac{1000\,mL}{1\,L} \times \frac{1\,cm^3}{1\,mL} \times \left(\frac{1\,m}{100\,cm}\right)^3 = 10^{-3}\,m^3$

Significant Figures and Uncertainty



When we make a measurement, whether it's with a ruler, a graduated cylinder, or a mass spectrometer, there is always an amount of uncertainty associated with that measurement.

For example, with this ruler (above) you could say that the object (in grey) is larger than 11cm, but smaller than 12 cm. More precisely you could say it's between 11.6 and 11.7cm. But a scientist would record it as 11.66cm or 11.64 cm but that last digit is an approximation.

So we always record one more figure (or digit) beyond the smallest division mark on our measuring device. And that last digit is the uncertain (or approximate) digit.

A reading of 11cm has 2 significant figures (or Sig Fig's) 11.6cm has 3, and 11.64cm has 4 sig figs (notice all these measurements have units)

We want to have measurements with the most sig figs possible; this gives us better precision in our data.

Uncertainty

When you make measurements uncertainty is given as the range that a value could fall under, so for the previous question a range for the ruler would be between 11.64cm and 11.66cm, we could record this as 11.65 ± 0.01 cm. The "plus/minus" 0.01cm is the uncertainty.

If you are measuring on a digital scale or a device that you can not see the increments then the uncertainty should be labeled on the device you're using.

If you can see the increments (as with a ruler or graduated cylinder) then take generally we take it to be the first uncertain digit

When adding or subtracting uncertainties the resultant uncertainty is the sum of the individual uncertainties

When multiplying or dividing the resultant uncertainty is the sum of the percentage of uncertainty in the measurements.

1-3 →

0.000000052

Sig figs:

100,000 ← about 100,000 ← 95,000 / 105,000

2000 ← 1 sig fig // 2100 ← 2 sig figs

2067 ← 4 sig figs   1,000,000.00
1.000 000 x10^6

2-1 → 2-4   Hebden - #43-52

Rules with Sig Figs

50.00   50

When you read a measurement, or more importantly when you do a calculation with a measurement, you need to know how many sig figs.

Generally we omit zeros unless they are between two non zeros. Zeros that are before (leading) a small number or after (trailing) a large number are NOT SIGNIFICANT place holders

★ Numbers in scientific notation are all significant (not the x 10^x part)

Ex.

1,125,600	5 sig figs
0.00021	2 sig figs
3.95×10^3	3 sig figs
50,505,000	5 sig figs
0.00000000000009	1 sig fig

Calculations with Sig Figs

When multiplying or dividing your answer should have the same number of sig figs as the measurement with the LOWEST sig figs

Ex.

1210 ÷ 43	28.1395...	28
45 x 751	33795	34000
$5 \times 10^{-4} \times 2.534 \times 10^3$	1.267	1

When adding or subtracting your answer should have the same number of digits (place values) as the measurement with the lowest number of digits (place values)

Ex.

1+10		10
0.0005 + 15.02		15.02
65.0 - 15	50	5.0×10^1
$5 \times 10^{-4} + 2.534 \times 10^{-3}$		3.0×10^{-3}

Standard not. → 0.0005 + 0.002534 = 0.003034
ten thousandths   millionths   0.0030

improper sci not.

$0.5 \times 10^{-3} + 2.534 \times 10^{-3} = 3.0 \times 10^{-3}$

420 + 37 = 457 ⇒ 460

7500 000 x 3 = 22 500 000 ⇒ 20 000 000

$7500{,}000 \times 3 = 22{,}500{,}000 \Rightarrow 20{,}000{,}000$

$4.5 \times 10^4 + 7.5 \times 10^2 = 45750 \Rightarrow 46{,}000$

$85 \div 100 = 0.85 \Rightarrow 0.9$

$4{,}500{,}000 \div 1.7 \times 10^{-3} = 2647058824 \Rightarrow 2.6 \times 10^9$

HW: Hebden #54 → 59 - do all
pg. 36–40

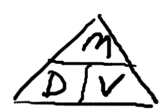
Bring Heath lab book – Lab 3A

- Density (review)

- Density is mass per volume (usually g/mL)

$D = \frac{m}{V}$ or $D \cdot V = m$

(sometimes ρ (rho)) $\frac{m}{D} = V$? →



- AKA: Specific weight
- generally: solids > liquids >>> gases
- density changes inversely with temperature
  ie. T↑ : D↓

LAB 3A:

Al: $\rho = 2.70$ g/mL

thickness = 0.016 mm

Hebden # 31 – 40 (41)
pg 26