Properties of Ionic Solids

- hard and brittle — crystalline structure that does not deform (falls apart instead)
- electrostatic interactions result in high melting points

$Al(s)$ aluminum metal melting point 660 °C
Al_2O_3 aluminum oxide melting point 2050 °C

- not conductive (no mobile charge carriers)

But conductive when melted or dissolved in water (charge carriers can move)

Chapter 3: Measurement

UNITS

measurements in science (ex temperature) usually involve units (but not always: pH)

Science uses the SI system of units. A partial list: (Table 3.1)

Measurement	Base unit	Symbol
length		
mass		
time		
temperature		

Chem1311 The SI system is a metric system, which means that it uses powers of ten / decimal places.

use length to demonstrate this (m = meter)

1000 m	$= 10^3$ m	= 1 km	kilometer
0.01 m	$= 10^{-2}$ m	= 1 cm	centimeter
0.001 m	$= 10^{-3}$ m	= 1 mm	millimeter
	10^{-6} m	= 1 μm	micrometer
	10^{-9} m	= 1 nm	nanometer
	10^{-10} m	= 1 Å	angstrom (not an SI unit but used for bond lengths: ex C-H bond length ≈ 1 Å)

see Table 3.3

big SI prefixes are commonly used with computers

megabyte	10^6
gigabyte	10^9
terabyte	10^{12}

Need to be able to use powers of ten when writing numbers

$917.3 = 91.73 \times 10^1 = 9.173 \times 10^2$

$= 0.9173 \times 10^3 = 9173 \times 10^{-1}$

To convert units, always write the units in and cancel properly

ex convert 100 g to kg

ex convert 917 $kg\,m^{-3}$ to g/mL (density of ice)

first we need to know that 1 mL = 1 cm^3 (cubic centimeter)

Temperature scales

	water boils	water freezes
Fahrenheit	212°F	32°F
Celcius	100°C	0°C
Kelvin	373.15 K	273.15 K

$T_C = \frac{5}{9}(T_F - 32)$ $T_F = \frac{9}{5}T_C + 32$ $T_K = T_C + 273.15$

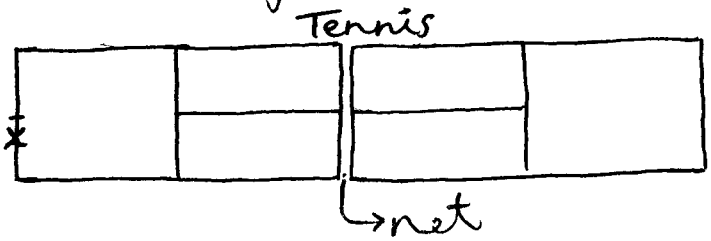
On the Kelvin scale, $T \geq 0$ recall $T = \frac{2}{3k_B}\frac{1}{N}\sum_{i=1}^{N}\frac{1}{2}mv_i^2$

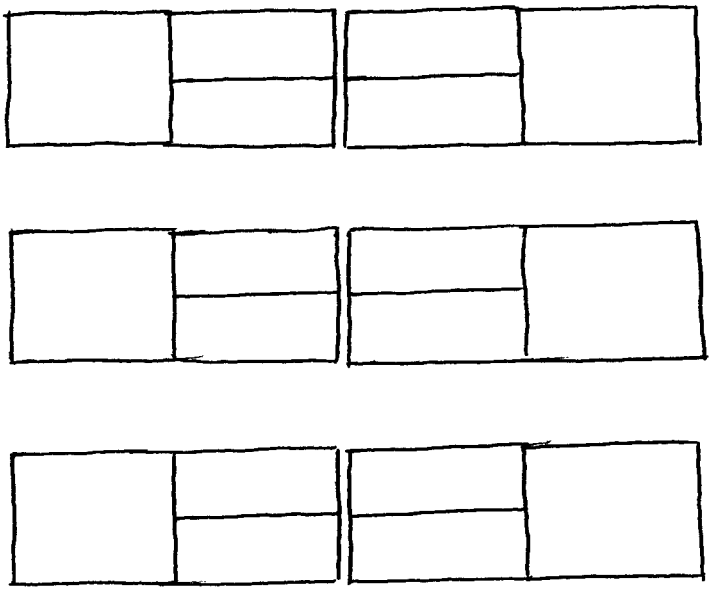
$\neq$

Uncertainty in measurement

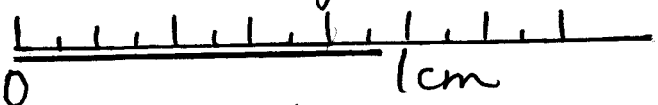
precision : reproducible?

accuracy : correct?





Only the last digit in a measurement has uncertainty in it
(assuming the measuring device is accurate)



measure 0.93 cm

estimate

known

how do we write this in nm?

we do not write 9300000 nm because # of sig. figs. is not clear.

Here there are only two significant figures

The leading 0 (0.93 cm) is a placeholder just like the trailing zeros in 9300000 nm

ex 0.93 cm = 9.3 mm (2 sig. figs)

If there is a zero as a significant figure at the end, it must be put in scientific (power of ten) notation and/or after the decimal point.

Rules for significant figures when adding/subtracting or multiplying/dividing numbers that are measured.

multiply/divide: answer gets # of least precise measurement

$1.074 \times 9.87 =$ (10.60038 on calculator)

$1.074 \times 9.92 =$ (10.65408 on calculator)

$1.074 \times 9.9 =$ (10.6326 on calculator)

add/subtract: answer gets # of decimal places as measurement with the fewest (must write all quantities using the same power of ten.)

$$\begin{array}{r} 1.03 \\ +\ 1.7 \\ \hline \end{array}$$

$$\begin{array}{r} 1.09 \\ +\ 1.7 \\ \hline \end{array}$$

What about 1.031 cm + 1.1 mm?

Only tricky rounding issue — if we need to drop a 5 and there are no digits following the 5

round down if preceding digit is even 8.165 → 8.16

round up if preceding digit is odd 8.175 → 8.18

logarithms (ex. pH)

- only count digits after decimal point as sig. figs.

$\ln(\underbrace{11.5}_{3}) = 2.\underbrace{442}_{3}$

→ only indicates the powers of 10/e, so not a sig. fig.