Dealing With Units and Numbers

Scientific Notation~ changing very small or very large numbers to a value between 1 and 10.

$650\ 000\ 000$ m $= 6.5 \times 10^8$ m
$0.000\ 005\ 90$ g $= 5.90 \times 10^{-6}$ g
1000 t $= 1 \times 10^3$ t

$1 \leq x < 10$

Example: a) $7500000 = 7.5 \times 10^6$

b) $-89.0 = -8.9 \times 10^1$

c) $6 = 6 \times 10^0$

d $0.000173 = 1.73 \times 10^{-4}$

Metric System (SI) Système Internationale

'mks' m ~ metre, k ~ kilogram, s ~ second

metre~ distance between two lines on a platinum-iridium bar kept at 0°C at Sèvres, France. (1/10 000 000 of the distance between the North Pole and the Equator)

~1960 - length of 1650 763.73 wavelengths of the orange-red spectral line emitted by Krypton-86

~ 1983 - the distance light travels in 1/299 792 458 s. = 1/c s

kilogram ~ cylindrical piece of platinum-iridium kept at Sèvres, France.

2019 → ~ the fixed numerical value of the Planck constant h to be $6.62607015 \times 10^{-34}$ when expressed in the unit J·s, which is equal to $kg \cdot m^2 \cdot s^{-1}$, where the metre and the second are defined in terms of c and ΔνCs.

second ~ 1/86 400 of a solar day

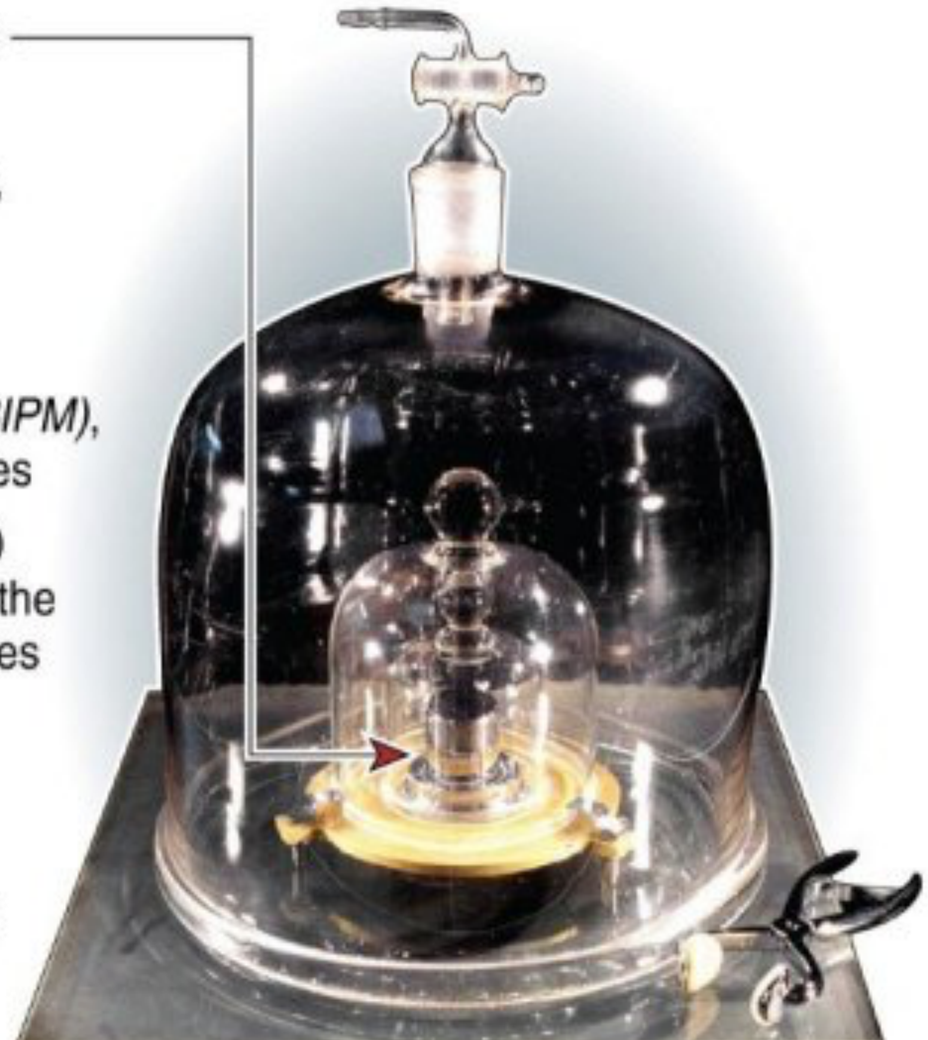
~ 1967 - the interval of time representing 9 192 631 770 periods of radiation produced by a specific energy change in the Cesium - 133 atom.

The kilogramme prototype

The kilogramme is officially defined by a lump of metal stored in a vault in France for more than 120 years under the International System of Units (SI)

The International prototype

- Manufactured in 1889
- Made up of 90% platinum, and 10% iridium
- Kept in a vault at the International Bureau of Weights and Measures *(BIPM)*, along with six official copies
- The basis of more than 80 copies distributed around the world as national prototypes
- Steam-cleaned under strict guidelines on a regular basis
- The last remaining base unit measured against a specific material artefact



The chunk of metal is under triple lock-and-key in Sevres, France

AFP *Source: BIPM*

<u>Fundamental Units</u> ~ the basic units of physics

metre	**length**	**m**
kilogram	**mass**	**kg**
second	**time**	**s**
Kelvin	**temperature**	**K**
ampere	**electric current**	**A**
mole	**number of particles**	**mol**
candela	**light intensity**	**cd**

Derived Units ~ all other units are derived from the seven basic units.

Examples: speed = km/h, m/s

Force = Newtons (kg *m/s^2)

Pressure = kilopascals (N/m^2)

Significant Digits are digits that are the result of careful measurement.

Rules

1. All non-zero digits are significant i.e. 4.2359 (5)
2. Zeros contained between non-zero digits are significant.
   i.e. 2.09 (3)
3. Zeros after a decimal following a non-zero are significant.
   i.e. 2.3000 (5)
4. Zeros used to locate a decimal are not significant
   i.e. 3000 (1), 0.0009 (1)

HINT Use scientific notation to avoid confusion.
i.e. $0.009073 = 9.073 \times 10^{-3}$ (4)

Operations with Significant Figures

* Always try to round off at the end of a calculation.

1. Addition/Subtraction

(round to the least accurate place value)

e.g. 2.2 m + 6.35 m = 8.55 =8.6 m

The sum cannot be more accurate than the least accurate measurement involve (smallest amount of decimals).

2. Multiplication/Division

The answer carries the least number of significant digits used in the calculatio

e.g. 41.25 m x 6.43 m = 265.2375 m^2 =265 m^2

(4) (3)

The only "exact" quantities are numbers that are obtained by counting or by definition.

i.e. # days in week 1 dozen = 12 units

100 cm = 1 m 1 mole = 6.022 x 10^{23}

Rounding

N.B. the key digit is the number you are **<u>rounding with</u>** not the number you are rounding.

1. If the key digit is less than five the value is rounded down (or to put it another way the number stays the same and all else becomes zero)

   i.e 26632 rounded to the nearest hundred would be 26600

2. If the key digit is greater than five the value is rounded up.

   i.e.   31493 rounded to the nearest hundred would be 31500

3. If the key digit is five and followed by any non-zero digits the value is rounded up.

   i.e.   7523 rounded to the nearest thousand would be 8000

4. If the key digit is five followed by only zeros or nothing, the value is rounded to the nearest even digit if odd (but stays the same if it is even)

   i.e.   4500 rounded to the nearest thousand would be 4000
   3500 rounded to the nearest thousand would be 4000

Conversions with SI Prefixes

Steps

1. Put the value in scientific notation.
2. Determine the conversion (↓x, ↑÷)
3. Adjust the exponent (x +, ÷ -)