

Physical Measurement

Order of Magnitude

- The order of magnitude is the power of 10 closest to that number
 - 2000 has an order of magnitude of 3 (or 10^3)
 - 3×10^8 has an order of magnitude of 8 (or 10^8)
 - 1×10^{-15} has an order of magnitude of -15 (or 10^{-15})

Estimating Order of Magnitude

- What is the order of magnitude of...

• Mass of sun 10^{30} kg	• Height of a person 10^0 m
• Mass of earth 10^{25} kg	• Diameter of earth 10^7 m
• Mass of an apple 10^{-1} kg	• Distance from earth to moon 10^8 m
• Mass of a proton 10^{-27} kg	• Distance from earth to nearest star 10^{11} m (our Sun)
• Mass of a person 10^2 kg (70 kg)	

Fundamental Units

- A set of fundamental (or base) units is a set of units for physical quantities from which every other unit can be generated.

SI Fundamental Units

- meter (m)
 - The metre is the length of the path travelled by light in vacuum during a time interval of $1/299\,792\,458$ of a second.
- kilogram (kg)
 - The kilogram is equal to the mass of the international prototype of the kilogram.

- second (s)
 - The second is the duration of $9\,192\,631\,770$ periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom.
- ampere (A)
 - The ampere is that constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 metre apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newton per metre of length.

- kelvin (K)
 - The kelvin is the fraction $1/273.16$ of the thermodynamic temperature of the triple point of water.
- mole (mol)
 - The mole is the amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon 12. When the mole is used, the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles.
- candela (cd)
 - The candela is the luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 540×10^{12} hertz and that has a radiant intensity in that direction of $1/683$ watt per steradian.

Significant Figures

- Non-zero digits are always significant.
- Zeroes placed before other digits are not significant.
- Zeroes placed between other digits are always significant.
- Zeroes placed after other digits but behind a decimal point are significant.
- Zeroes at the end of a number with no decimal point are usually not significant.
 - To avoid confusion, use scientific notation to place significant zeroes behind a decimal point.

Uncertainties

- Addition and Subtraction
 - Add the uncertainties
- Multiplication and Division
 - Add the percentage uncertainties
- Powers and roots
 - Multiply the percentage uncertainty by the power (or root expressed as a power)
- Average
 - $\frac{\text{max} - \text{min}}{\text{number}}$

Linearization

- Relationships are most easily described in linear relationships of the form $y=mx+b$
- Graphs that demonstrate non-linear relationships should be adjusted or linearized
 - For example a relationship $y=x^2$ should be graphed as y vs x^2 so that the relationship appears linear
