Prefixes

Name	Symbol	Factor
Tera	T	$\times 10^{12}$
Giga	G	$\times 10^{9}$
Mega	M	$\times 10^{6}$
Kilo	K	$\times 10^{3}$
Deci	d	$\times 10^{-1}$
Centi	c	$\times 10^{-2}$
Milli	m	$\times 10^{-3}$
Micro	μ	$\times 10^{-6}$
Nano	n	$\times 10^{-9}$
Pico	p	$\times 10^{-12}$

Systematic Error and Random Error

Systematic errors: cause readings to deviate in a fixed direction and magnitude from the true value. They are fixed in direction and magnitude.

Causes: Instrument error (e.g. zero errors). Environmental conditions. Poor experimental techniques (e.g. parallax error).

Since systematic errors are reproducible, they can be eliminated if the source of the error is known.

Random errors: cause readings to be scattered or spread about the average or mean value of the measurement. They are varying in both magnitude and direction.

Causes: Variations in environmental conditions. Irregularity of the quantity being measured. Limitation of equipment.

Random error cannot be completely eliminated but can be minimized by finding the average of repeated or combined measurements.

Precision: refers to the reproducibility of a measurement. Repeated measurements which are very close to one another are precise measurements. Thus an experiment which has *small random errors* (small spread of readings) is said to have high precision.

Accuracy: refers to the agreement between the measured value and the true or accepted value of a quantity. An experiment which has *small systematic errors* is said to have *high accuracy*. The *average value* is close to the true value.

Base Quantities and Derived Quantities

Base Quantities:	Derived Quantities:
Physical quantities that cannot be defined in other quantities.	Physical quantities that can be expressed in terms of two or more base quantities
Length, Mass, Time, Temperature, Current, Amount of Substance, Luminous Intensity	Pressure, Force, Moments, Energy, Etc…

Scalars and Vectors: A vector quantity is one that has a magnitude and direction (e.g. displacement, velocity, acceleration, momentum, etc.). A scalar quantity is one that has a magnitude only (e.g. energy, mass, speed, distance, etc.).

- **Vector Addition**: Parallelogram/triangle method

- **Change of a Vector**: $\Delta v = final\ vector - initial\ vector$

- **Resolving Vectors**: vector can be split into adjacent (cosine function) and opposite (sine function) components

Errors and Uncertainties

Experimental uncertainty or error = Measured value − True value

Rule	Operations		Formulae for Combining
1	Addition/ Subtraction	$c = a + b$	$\Delta c = \Delta a + \Delta b$
		$d = a - b$	$\Delta d = \Delta a + \Delta b$
2	Multiplication/ Division	$p = ab$	$\dfrac{\Delta p}{p} = \dfrac{\Delta a}{a} + \dfrac{\Delta b}{b}$
		$q = \dfrac{a}{b}$	$\dfrac{\Delta q}{q} = \dfrac{\Delta a}{a} + \dfrac{\Delta b}{b}$
3	Factors	$r = ka$	$\Delta r = |k|(\Delta a)$
4	Powers	$s = a^n$	$\dfrac{\Delta s}{s} = |n|(\dfrac{\Delta a}{a})$