UNITS & MEASUREMENTS

Physical Quantities, Units & Prefixes

A **physical quantity** consist of a numerical magnitude and a unit.

SI units (Base quantities)
Base quantites are the fundamental physical quantities that cannot be broken down further.

Base quantity	SI unit	Symbol
Length	metre	m
Mass	kilo	kg
Time	second	s
Electric current	ampere	A
Thermodynamic Temperature	kelvin	K
Luminous intensity	candela	cd
Amount of substance	mole	mol

Derived quantities
Derived quantities are obtained by product or quotient combinations of base units.

Derived quantity	Formula	Units	Special name
Speed	$S = \dfrac{D}{t}$	$\mathrm{m\ s^{-1}}$	Nil
Force	$F = ma$	$\mathrm{kg\ m\ s^{-2}}$	Newton (N)
Pressure	$P = \dfrac{F}{A}$	$\mathrm{kg\ m^{-1}\ s^{-2}}$	Pascal (Pa)
Kinetic energy	$KE = \dfrac{1}{2}mv^2$	$\mathrm{kg\ m^2\ s^{-2}}$	Joule (J)
Power	$P = \dfrac{W}{t}$	$\mathrm{kg\ m^2\ s^{-2}}$	Watt (W)

Prefixes
Note that prefixes 10^6 and above are written in **CAPs.**

Giga	Mega	kilo	deci	centi	milli	micro	nano
G	M	k	d	c	m	μ	n
10^9	10^6	10^3	10^{-1}	10^{-2}	10^{-3}	10^{-6}	10^{-9}

Length measurements

| Instrument	Precision	Range	Special property
Tape measure	1 mm	5 m	Curved length (eg. circumference)
Metre rule	1 mm	1 m	-
Vernier caliper	0.1 mm	15 cm	Inner diameter, depth
Micrometer screw gauge	0.01 mm	2.5 cm	-

To choose the right instrument, consider in this order:
1. Range   2. Precision
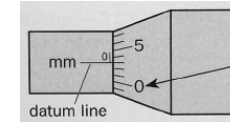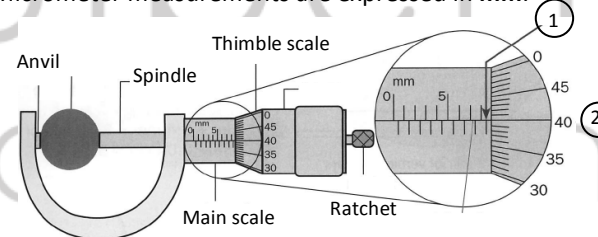The precision of the reading usually indicates the type of instruments used.

Vernier Calipers
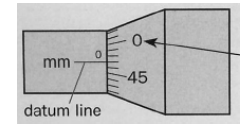Vernier caliper measurements are expressed in **cm**.

Read from the **LEFT**

Zero error = $+0.03$ cm

Read from the **RIGHT**
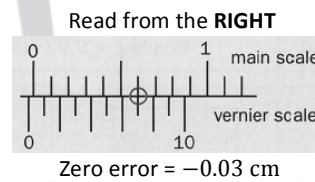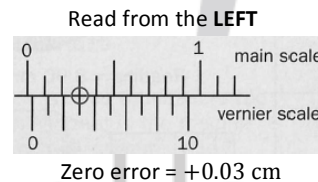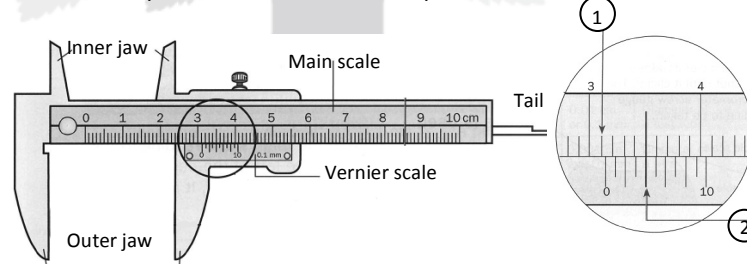
Zero error = -0.03 cm

Micrometer Screw Gauge
Micrometer measurements are expressed in **mm**.

Zero error = $+0.03$ mm   Zero error = -0.03 mm

Time measurements

Instrument	Precision (s)
Stopclock	1
Stopwatch (analogue)	0.1
Stopwatch (digital)	0.01

Pendulum Oscillation

One complete oscillation is the movement from maximum displacement to maximum displacement in opposite direction and back.
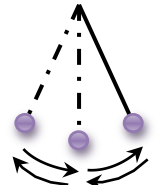
Period, T, of a pendulum is the time for one complete oscillation. Unit (s)

Frequency, f, is the number of complete oscillations per unit time. Unit (Hz)

Period of pendulum oscillation depends on
1. Length, l $(l \uparrow, T \uparrow)$
2. Gravitational field strength, g $(g \uparrow, T \downarrow)$
independent of
1. Angle of displacement
2. Mass of bob

Types of Errors

Systematic error is one that occurs consistently more or consistently less than the actual reading. Eg. calibration error, zero error

Random error is one that gives a scatter of readings about a mean value. Eg. parallax error, human reaction error