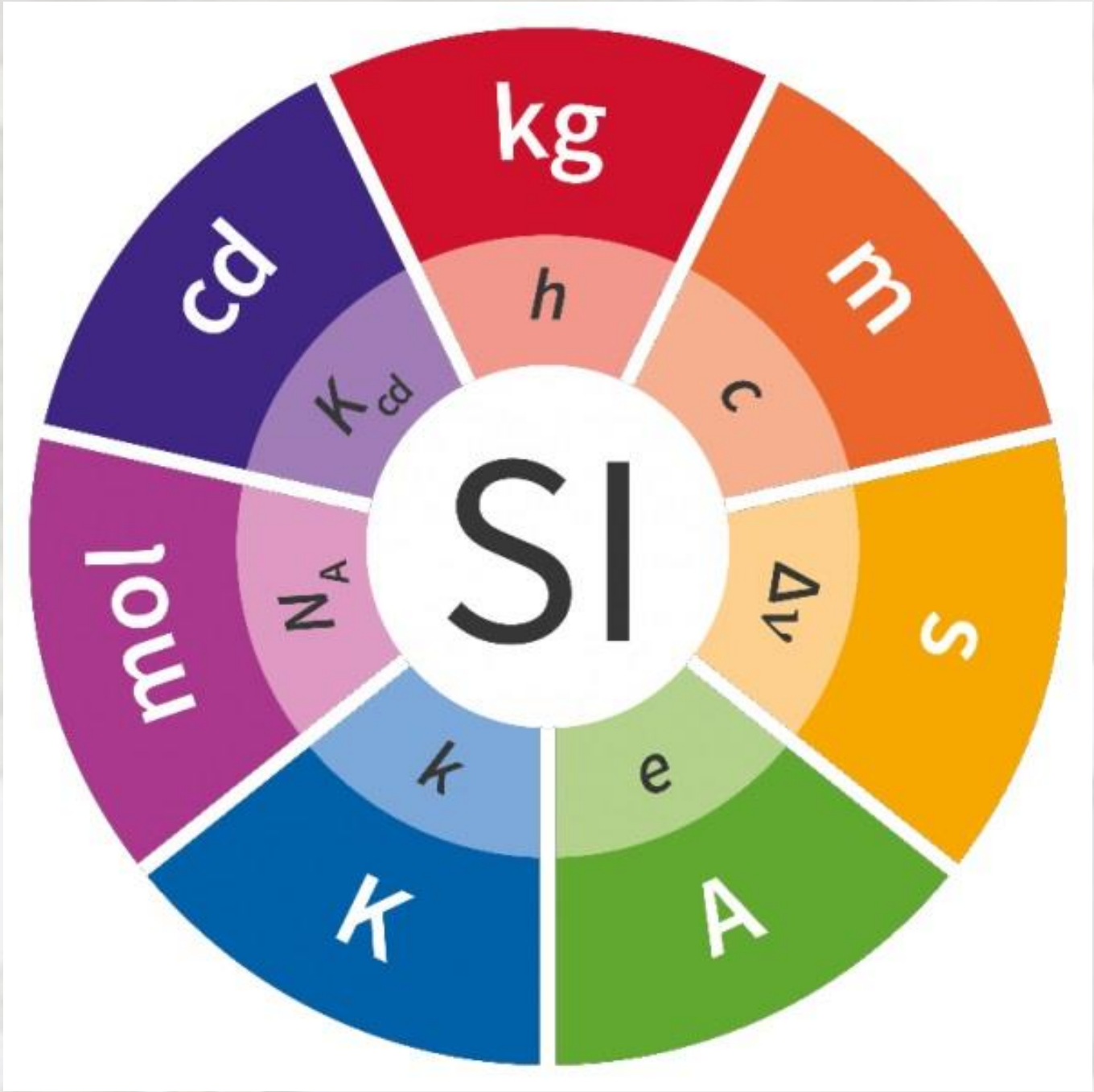
Introduction to Students

Practical work in physics is intended to teach the student how to select and set up apparatus skillfully and well, to make careful observations and precise measurements while at the same time realising the limitations of the measuring instruments employed, and to use the experimental results obtained to the best advantage.

The SI System of Units


kg
m
s
A
K
mol
cd
h
c
$\Delta\nu$
e
k
N_A
K_{cd}
SI

The **System International Unites**, abbreviated to the **SI** system of units, was approved in 1960 by the **General Conference of Weights and Measures**, an international organization, and is coming into increasing use throughout the world because of its many advantages over the many national systems it is now superseding's.

Table (1): - The International System (SI)

Physical Quantity	Unit	Symbol
Length	Meter	m
Mass	Kilogram	kg
Time	Second	sec
Electric Current	Ampere	A
Temperature	Degree Kelvin	K
Luminous Intensity	Candela	cd
Amount of Substance	Mole	mol

All other units are derived from these units. The more important derivative units, which all have special names, are as follows: -

Unit Name	Unit Symbol	Quantity Measure	Definition
meter (metre)	m	Length	*Original* (1793): 1/10,000,000 of the meridian through Paris between the North Pole and the Equator. *Current* (1983): The distance travelled by light in a vacuum in 1/299,792,458 second.
kilogram	kg	Mass	*Original* (1793): The **grave** (original name of the kilogram) was defined as being the weight [mass] of one cubic decimeter of pure water at its freezing point. *Current* (1889): The **mass** of the International Prototype Kilogram (Le Grand K).
second	s	Time	*Original* (Medieval): 1/86,400 of a day. *Current* (1967): 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.
kelvin	K	Thermodynamic Temperature	*Original* (1743): The centigrade scale is obtained by assigning 0 °C to the freezing point of water and 100 °C to the boiling point of water. *Current* (1967): 1/273.16 of the thermodynamic temperature of the triple point of water.

mole	mol	Amount of a Substance	*Original* (1900): The molecular weight of a substance in mass grams. *Current* (1967): The amount of substance of a system which contains as many elementary entities as there are atoms in 0.012 kilogram of carbon-12.
ampere	A	Electric Current	*Original* (1881): A tenth of the electromagnetic Centimeter–gram–second system unit of current. The Centimeter–gram–second electromagnetic unit of current is that current, flowing in an arc 1 cm long of a circle 1 cm in radius, that creates a field of one oersted at the centre. *Current* (1946): The constant current which, if maintained in two straight parallel conductors of infinite length, of negligible circular cross-section, and placed 1 meter apart in vacuum, would produce between these conductors a force equal to 2×10^{-7} newtons per meter of length.
candels	cd	Luminous Intensity	*Original* (1946): The value of the new candle is such that the brightness of the full radiator at the temperature of solidification of platinum is 60 new candles per square centimeter. *Current* (1979): The luminous intensity, in a given direction, of a source that emits monochromatic radiation of frequency 5.4×10^{14} hertz and that has a radiant intensity in that direction of 1/683 watt per steradian.

Symbol	Defining constant	Exact value
$\Delta\nu_{\mathrm{Cs}}$	hyperfine transition frequency of Cs	9 192 631 770 Hz
c	speed of light	299 792 458 m/s
h	Planck constant	$6.626\,070\,15 \times 10^{-34}$ J·s
e	elementary charge	$1.602\,176\,634 \times 10^{-19}$ C
k	Boltzmann constant	$1.380\,649 \times 10^{-23}$ J/K
N_{A}	Avogadro constant	$6.022\,140\,76 \times 10^{23}$ mol^{-1}
K_{cd}	luminous efficacy of 540 THz radiation	683 lm/W

Table (2): - Derived Units.

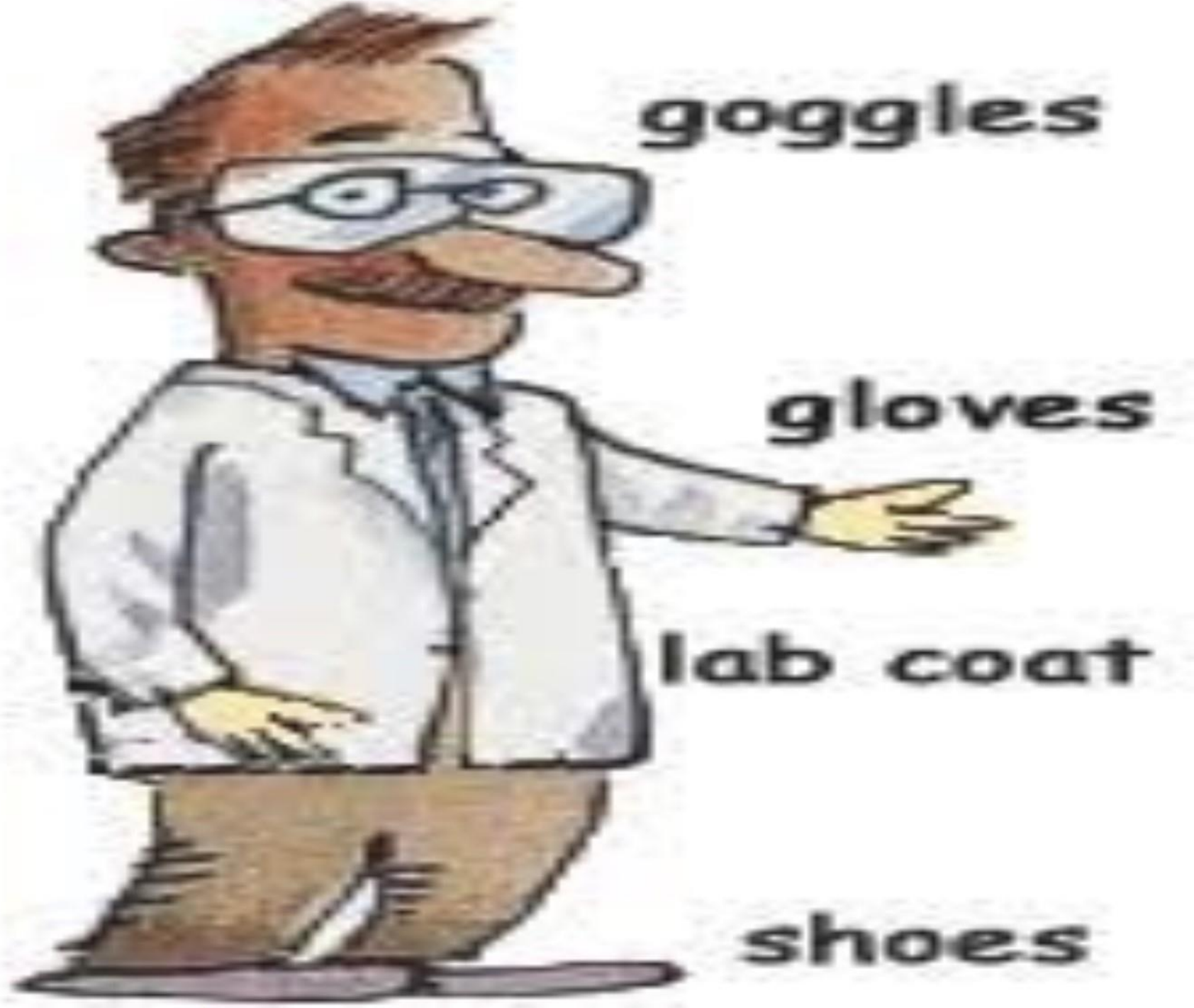
Physical Quantity	Unit	Abbreviation	Dimensions
Force	Newton	N	kg m / sec^2
Pressure	Pascal	Pa , N/m^2	kg / m sec^2
Energy	Joule	J , Nm	kg m^2 / sec^2
Power	Watt	W , J/sec	kg m^2 / sec^3
Torque	Meter-Newton	τ , mN	kg m^2 / sec^2
Electric charge	Coulomb	C	A sec
Electric potential	Volt	V , J/C	kg m^2 / sec^3 A
Electrical resistance	Ohm	Ω , V/A	kg m^2 / sec^3 A^2
Capacitance	Farad	F , C/V , C^2/J	sec^4 A^2/ kg m^2
Inductance	Henry	H , J/A^2 , Ωsec	kg m^2 / sec^2 A^2
Magnetic flux	Weber	Wb , J/A , Vsec	kg m^2 / sec^2 A
Magnetic intensity	Tesla	T, Wb/m^2, $Vsec/m^2$	kg / sec^2 A
Frequency	Hertz	Hz	1 / sec
Luminous flux	Lumen	lm	cd sr
Illumination	Lux	lx	lm / m^2
Disintegration rate	Becquerel	Bq	1 / sec
Absorbed dose	Gray	Gy , J/kg	m^2 / sec^2

Note: -

The abbreviation for steradian, the SI unit of solid angle, is sr.

Table (3): - Non-SI Units.

Physical Quantity	Unit	Symbol
Mass	gram	g
Length	foot centimeter	ft cm
Volume	liter	---
Time	minute	min
Force	dyne $pound_{force}$	--- lb_f
Energy	calorie, kilocalorie	cal, kcal
Power	kilocalories/minute	kcal/min
Pressure	$pounds/inch^2$ millimeter of mercury centimeter of water atmosphere	psi mmHg cmH_2O atm
Temperature	Fahrenheit Celsius	F C


goggles
gloves
lab coat
shoes