Unit-1

Forces & Motion

Forces & Motion

a) Units

b) Movement & Position

c) Forces, Movement, Shape & Momentum.

Units

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Intended Learning Outcomes

Students will be assessed on their ability to:

Paper-1 & Paper-2

- 1.1 use the following units: kilogram(kg), metre (m), metre/second (m/s),metre/secondd^2 (m/s^2), newton (N), second(s) and newton/kilogram (N/kg)

- **1.2P use the following units: newton metre (Nm), kilogram metre/second (kg m/s)**

Only in Paper-2

1.1 & 1.2P -Units

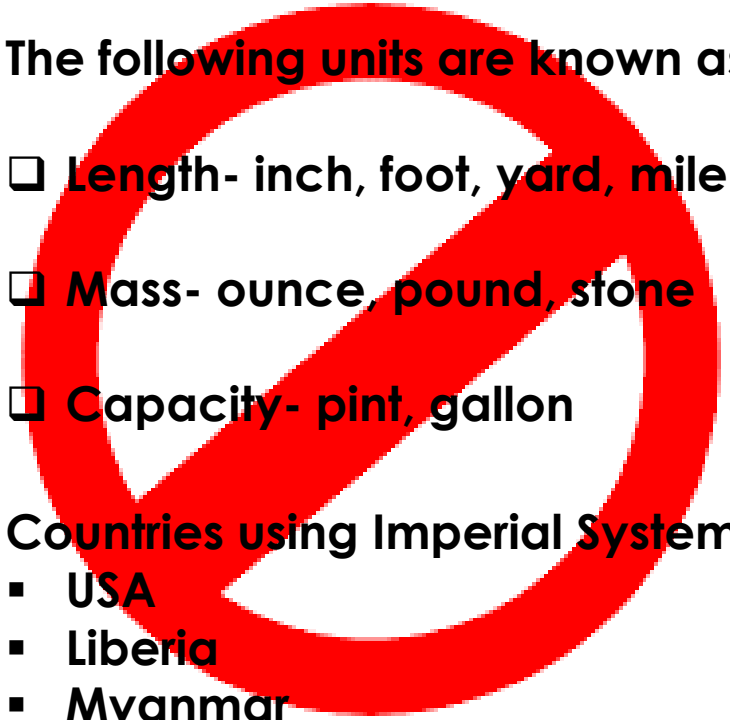
- Physicists, like other scientists, make observations and ask basic questions. For example, how big is an object? How much mass does it have? How far did it travel? To answer these questions, they make measurements with various instruments (e.g., meter stick, balance, stopwatch, etc.).

1.1 & 1.2P -Units

- The measurements of physical quantities are expressed in terms of units, which are standardized values.
- For example, the length of a race, which is a physical quantity, can be expressed in meters (for sprinters) or kilometers (for long distance runners). Without standardized units, it would be extremely difficult for scientists to express and compare measured values in a meaningful way.

Imperial units

The following units are known as imperial units and they are not used in the syllabus.



- Length- inch, foot, yard, mile
- Mass- ounce, pound, stone
- Capacity- pint, gallon

Countries using Imperial System:

- USA
- Liberia
- Myanmar

Base units(SI units)

- There are seven fundamental units in Physics.
- They are known as International System of units.(SI units).
- In this lesson we are learning about three of them.

metre(m) kilogram(kg) second(s)

SI units(metric system)

Mass-
kilogram (kg)

Force-
newton(N)

Time-
second(s)

SI derived units

- A derived unit is a unit that results from a mathematical combination of SI base units.

Example:

Unit of Volume → cubic metre(m^3)

Unit of force→ newton(N or $kg\ m/s^2$)

Unit of speed→ metre per second (m/s)

Other accepted units

Non-SI units accepted for use with the SI by the CIPM and this *Guide*

Name		Symbol	Value in SI units
minute	time	min	1 min = 60 s
hour	time	h	1 h = 60 min = 3600 s
day	time	d	1 d = 24 h = 86 400 s
degree	plane angle [a]	°	1° = (π/180) rad
minute	plane angle [a]	'	1' = (1/60)° = (π/10 800) rad
second	plane angle [a]	"	1" = (1/60)' = (π/648 000) rad
hectare [h]		ha	1ha = 1 hm^2 = 10^4 m^2
liter		L [b], l	1 L = 1 dm^3 = 10^{-3} m^3
metric ton [c]		T	1 t = 10^3 kg

Rules and conventions for writing base units and their symbols

Rules and conventions for writing base units and their symbols

1. The units named after scientists are not written with a capital initial letter.

For example : newton, watt 

Newton, Watt 

Rules and conventions for writing base units and their symbols

2. The symbols of the units named after scientist should be written by a capital letter.

For example : N for newton, W for watt 

n for newton, w for watt 

Rules and conventions for writing base units and their symbols

3. Lower case letters are used as symbols for units not derived from a proper name.

For example : m for metre, kg for kilogram 

M for metre, Kg or KG for kilogram 

Rules and conventions for writing base units and their symbols

4. No full stop or other punctuation marks should be used within or at the end of symbols.(unless at the end of a sentence)

For example : 50 m and not as 50 m.

Rules and conventions for writing base units and their symbols

5. The symbols of the units do not take plural form. For example : 10 kg not as 10 kgs

Rules and conventions for writing base units and their symbols

6. Use of solidus is recommended only for indicating a division of one letter unit symbol by another unit symbol. Not more than one solidus is used.
(Unless parentheses are used)

For example : $m\ s^{-1}$ or m / s, J / K mol or J $K^{-1}\ mol^{-1}$ but not J / K / mol.

Rules and conventions for writing base units and their symbols

7. Some space is always to be left between the number and the symbol of the unit and also between the symbols for compound units such as force, momentum, etc.

example, it is not correct to write 2.3m. The correct representation is 2.3 m ; kg m s^{-1} and not as kgms^{-1}



Multiples & Subdivisions

Multiples & Subdivisions

- For very large measurements, the multiples of base units are used and for very small measurements, the subdivisions of base units are used.

Example:

- Measurements of mass made in subdivisions of the kilogram like grams (g) and milligrams (mg).
- Measurements of length in multiples of metre like the kilometre and subdivisions like centimetre(cm) and millimetre(mm).

Multiples & Submultiples (Prefixes)

- The symbols that are added before the SI units are called prefixes, they are usually used to describe very large or small quantities.

Name of the multiple	Symbol	Value
Mega	M	10^6
Giga	G	10^9
Tera	T	10^{12}

Name of the submultiple	Symbol	Value
centi	c	10^{-2}
milli	m	10^{-3}
nano	n	10^{-9}

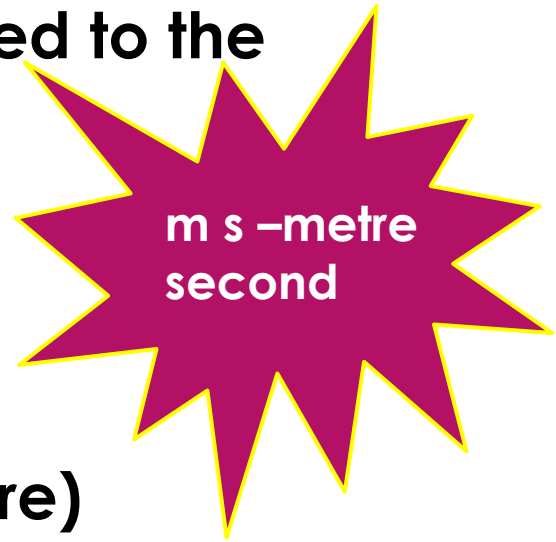
Examples:

- 200 nm= 200 x 10^{-9} m
- 72 ms = 72 x 10^{-3} s
- 25 km = 25 x 10^{3} m

Rules and conventions for writing base units and prefixes

- A prefix is part of the unit, and its symbol is prepended to the unit symbol without a separator.

Ex: ms (millisecond) ✓ m s (millisecond) ✗



- Compound prefixes are not permitted.

Ex: nm(nanometre) ✓ but not : cnm(centinanometre) ✗

- All prefixes larger than 10^3(kilo) are uppercase.

Quantities & their units

The following SI units and SI derived units are used in UNIT-1

- Distance-metre(m)
- Mass-kilogram(kg)
- Time-second(s)
- Speed-metre per second(m/s or $m\,s^{-1}$)
- Acceleration-metre per second square(m/s^2 or $m\,s^{-2}$)
- Gravitational field strength- newton per kilogram(N/kg)
- Force-newton(N)
- Moment(torque) – newton metre(N m)
- Momentum- kilogram metre per second(kg m/s)

Resources

- Edexel IGCSE(9-1) Specification.
- IGCSE(9-1) Physics student book
- https://www.nist.gov/pml