NPHY-171E

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Week 1

Outline

1. Units and measurements
   - Units
     - The basic SI Units
     - The derived SI Units
     - Unit Convertions
   - Sub-division and multiples of S.I. units
   - Unit conversions
   - Numbers
     - Engineering Notation
     - Significant figures

Basic SI Units

All quantities in the physical world can be expressed in terms of mainly six basic or S.I. units

Quantity	Unit	Symbol
Length	meter	m
Time	second	s
Mass	kilogram	kg
Temperature	kelvin	K
Electric current	ampere	A
Luminous Intensity	candela	cd

Rules

When writing units, the following rules must always be adhered to, namely:-

1. Whenever a unit is written out in full, it must always start with a small letter, even if the unit is named after a scientist

Example

Use ampere not Ampere

2. When symbols are used, and the unit is named after a scientist, the first letter of the symbol is a capital letter.

Example

thus A for ampere, but kg for kilogram

Rules(continued)

3. Either write the units in full or use the correct symbols. No abbreviations allowed

Example

2 Amps, 5 sec or any other abbreviations are not acceptable.

4. When using symbols, don't add "s" to indicate plural form

Example

2 kilograms and 25 metres remain 2 kg and 25 m.

Derived SI units

All other S.I. units are derived from the **base** units.
Specialnames are oftern used for derived units.

Example

$$
\begin{aligned}
Force &= mass \times acceleration \\
&= mass \times \frac{velocity}{time} \\
&= mass \times \frac{\frac{displacement}{time}}{time} \\
&= kg \times \frac{\frac{m}{s}}{s} \\
&= kg.m.s^{-2} \qquad \text{known as newton}
\end{aligned}
$$

Derived SI Units

Excercise

Derive the S.I. units of the pressure from its defining equation.

Multiples and Submultiples of SI Units

Because a basic unit in a system may NOT be convenient in size for a given measurement, other units have come in to use within each system.

Example

Long distances are usually expressed in kilometers rather than in meters.

SI units vs Customary Units

S.I. units makes calculations easy whereas the customary units are quite irregular.

Example

$1km = 1000m$

But

$1mi = 5280ft$

Unit Conversions

Example

Convert 15 mi to km *(NB 1mi=1.61km)*

$$\frac{1mi}{15mi} = \frac{1.61km}{x}$$

$$x\,\cancel{mi} = (15\cancel{mi})(1.61km)$$ *Set cross products equal*

$$x = 24.15km$$

Excercise

(a) *a 365-day year in seconds?*
(b) $20^{o}c$ *in kelvins*
(c) $20^{o}c$ *in fahrenheits*
(d) *31.45 g in kilograms*
(e) $15\ m.s^{-1}$ *in* $km.h^{-1}$
(f) $120\ km.h^{-s}$ *in* $m.s^{-1}$
(g) *22.3 tonnes in grams*
(h) *8 mi to ft*
(i) $52m^2$ *to* ft^2

Scientific Notation

SWBAT:-

1. write numbers in scientific notation

Scientific notation

Rules

1. move the **decimal point** to the first **non-zero digit**.
   $+ \leftarrow\leftarrow$ "." $\rightarrow\rightarrow -$
2. write the number in the form (" . " $\times 10^{\pm moves}$).

Example 1 : Change a general number to scientific notation

1. $0.00\mathbf{3}5 = \mathbf{3}.5 \times 10^{-3}$ "." $\rightarrow\rightarrow$
2. $\mathbf{5}6765.32 = \mathbf{5}.676532 \times 10^{4}$ $\leftarrow\leftarrow$ "."

Example 2 : Change scientific notation to a general number

3. $\mathbf{5}.4646 \times 10^{4} = \mathbf{5}4646$ "." $\rightarrow\rightarrow$
4. $\mathbf{5}.304 \times 10^{-3} = 0.00\mathbf{5}304$ $\leftarrow\leftarrow$ "."

Scientific notation

Check more excercises on page 34 of the workbook

Example

a) $5.02 \times 10^3 = 5.02 \times 1000 = 5020$ BIG number

b) $5.02 \times 10^{-3} = 5.02 \div 1000 = 0.00502$ small number

Powers of 10

$x10^5 = 100\ 000$
$x10^4 = 10000$
$x10^3 = 1000$
$x10^2 = 100$
$x10^1 = 10$
$x10^0 = 1$
$x10^{-1} = 0.1$
$x10^{-2} = 0.01$
$x10^{-3} = 0.001$
$x10^{-4} = 0.0001$
$x10^{-5} = 0.00001$

Execrise : Write the missing numbers

General $\Longleftrightarrow$ Scientific

1) $54646.459 = 5.4646459 \times 10^4$
2) $2{,}523 =$
3) $4\ 254.45 =$
4) $45.45 =$
5) $0.00800 = 8 \times 10^{-3}$
6) $0.00\ 000\ 067 =$
7) $0.034 =$
8) $= 4.454 \times 10^{-3}$
9) $= 0.034347 \times 10^{-2}$
10) $= 0.000120 \times 10^{-5}$
11) $= 4\ 454\ 003\ 34 \times 10^{-6}$

TWBAT:-

1. write numbers in engineering notation

Multiples and Sub-multiples of SI units

Example

a) $5.02 \times 10^{3} V = 5.02 \times 1000 = 5.020 kV$ kilovolts

b) $5.02 \times 10^{-3} V = 5.02 \div 1000 = 5.02 mV$ millivolts

Unit prefixes

$x10^{12}$	tera	T
$x10^{9}$	giga	G
$x10^{6}$	mega	M
$x10^{3}$	kilo	k
$x10^{-2}$	centi	c
$x10^{-3}$	milli	m
$x10^{-6}$	micro	μ
$x10^{-9}$	nano	n

Fill the missing information

1)	54×10^{3}V	$= 54$ kV
2)	1.64×10^{9} V	$= 1.64$ GV
3)		$= 8 m\Omega$
4)		$= 10\ \mu$A
5)		$= 9$ GW
6)	0.00 067 A	$=$
7)	0.034 V	$=$
8)		$= 10$ kV
9)	2000 V	$=$
10)		$= 0.5\ \mu$V
11)		$= 10$ MV

Identifying the number of significant figures

1. All non-zero numerals are significant.

Example

112,6 has four significant figures.

2. Only zeros between non-zero numerals, or following a non-zero numeral **AND CONTINUING TO THE RIGHT OF THE DECIMAL POINT** are significant.

Example

Other zeros are not significant

(a) *1 004 has four significant figures*

(b) *0.000 060 has two significant figures*

(c) *50.00 has four significant figures*

(d) *50 000 really has only one significant*

Adding, Subtracting, Dividing and Multiplying values with different significant figures

- If the result is calculated by multiplying or dividing measured values, it may contain only as many significant figures as contained in the least precise of the readings.

Example

$0.02 \times 3.2 = 0.06$

- If the result is calculated by adding or subtracting measured values, it may contain only as many decimal places as there are in the value with the least number of decimal places

Example

$0.02 + 3.2 = 3.2$

Test your Knowledge

Excercise

Write answers in correct significant figures.

(a) $8.91 - 6.435 =$

(b) $5.6792\ m + 0.6\ m + 4.33\ m =$

(c) $4.51\ cm \times 3.666\ 6\ cm =$

(d) $3.7\ g + 2.35\ kg =$

(e) $(1.00 \times 10^4) \times (9.9 \times 10^6) + 10^9 =$

(f) $(5.61 \times 7.891) \times 9.1 =$

Excercise

Assignment 1: *Visit https://b.socrative.com/login/student/*
Room Name = *type [RHYME]*
Enter your name = *type [ONLY your student number]*
Submit before Week 2 Starts.