Units

Metric system or SI Système International d'Unités

1) Length [m]

1983 : The meter is the length of the path traveled by light in vacuum during a time interval of $\frac{1}{299\,792\,458}$ s

Aug 25-10:22 AM

If $L = 1\,m$

$T = \frac{1}{299\,792\,458}\,s$

$c = \frac{L}{T} = \frac{1\,m}{\frac{1}{299\,792\,458}\,s} =$

$= 299\,792\,458\,m/s$

Aug 25-10:38 AM

2) Time

1967: The second is the duration of 9 192 631 770 periods of the radiation corresponding to the transition between 2 levels of ground state of cesium atom (atomic clock)

Aug 25-10:40 AM

3) Mass

- defined based on prototype kilogram made of special platinum-iridium
- kept in International Bureau of Weights in France

Aug 25-10:43 AM

7 independent base units

length	[m]	Ampere	[A] electric current
time	[s]	Kelvin	[T] temperature
mass	[kg]	mole	[mol] amount of a substance
		candela	[cd] luminosity

Aug 25-10:44 AM

tera	10^{5}
mega	10^{6}
→ kilo	10^{3}
hecto	10^{2}
deca	10
deci	10^{-1}
centi	10^{-2}
mili	10^{-3}
micro	10^{-6}
nano	10^{-9}
pico	10^{-12}

Aug 25-10:47 AM

- Scientific notation prefers you to write 420 000 as $4.2 \cdot 10^5$
- Significant figures

What is Earth's circumference?

$2\pi R_E$ $\quad R_E = 6.37 \cdot 10^6 \text{ m}$

$\rightarrow \pi = 3.14159...$

Aug 25-10:49 AM

- if * or / 2 numbers the answer should have the number of significant figures as the least accurate number

$(2.3) \cdot 1.45$

- if + or -

1.248
$+ \ 0.00654$
1.25454

Aug 25-10:52 AM

Problem solving (IDEA)

1) Interpret: what am I being asked?
2) Develop: what's my plan? draw figure out the eqns to use
3) Evaluate: do the math
4) Assess: does my answer make any sense?

Aug 25-10:55 AM

Example

Earthquake generated tsunamis are so devastating because the entire ocean, from surface to bottom participates in the wave motion. For such waves the wave speed is given by $v = \sqrt{gh}$ where $g = 9.8 \text{ m/s}^2$ is the acceleration due to gravity, h is the depth of the ocean. Determine a tsunami's speed in ocean with a depth of 3 km.

Aug 25-11:02 AM

1) Interpret $\quad h = 3\text{km} = 3 \cdot 10^3 \text{ m}$

$g = 9.8 \text{ m/s}^2$

2) Develop $\quad v = ?$

$v = \sqrt{gh}$

Aug 25-11:04 AM

3) Evaluate

$v = \sqrt{3 \cdot 10^3 \text{ m} \cdot 9.8 \frac{\text{m}}{\text{s}^2}} = \sqrt{\frac{\text{m}^2}{\text{s}^2}} =$

$= 171 \frac{\text{m}}{\text{s}}$

4) Assess

$v = \frac{171 \text{ m}}{1 \text{ s}} = \left(171 \cdot 10^{-3} \text{ km} \cdot \frac{1}{\frac{1}{3600} \text{ h}}\right) \approx 615 \frac{\text{km}}{\text{h}}$

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$v = \frac{615\ km}{h} = \frac{615 \cdot \frac{1}{1.6}\ miles}{h} =$

384 miles/h

Aug 25-11:11 AM

Motion in a straight line

The study of motion without regard do its cause → kinematics

- the simplest case - object moving in a straight line

Aug 25-11:12 AM

Average motion

- you drive 15 minutes to a pizza place 10 km away, grab your pizza & return home in another 15 min
- you traveled 20 km, trip took 30 min

Average speed = $\frac{\text{distance}}{\text{time}} = \frac{20\ km}{1/2\ h} = 40\ km/h$

Aug 25-11:29 AM

- to describe your motion more precisely we introduce:

x - gives your position at any time t

Δx - displacement or net change in position

$\Delta x = x_2 - x_1$ x_2 is the ending point

x_1 is the starting point

Aug 25-11:33 AM

Average velocity

$\bar{v} = \frac{\text{displacement}}{\text{time interval}} = 0\ km/h$

$t_1 = 0$ $x_1 = 0$

$t_2 = 30$ $x_2 = 0$

???

Why

Aug 25-11:35 AM