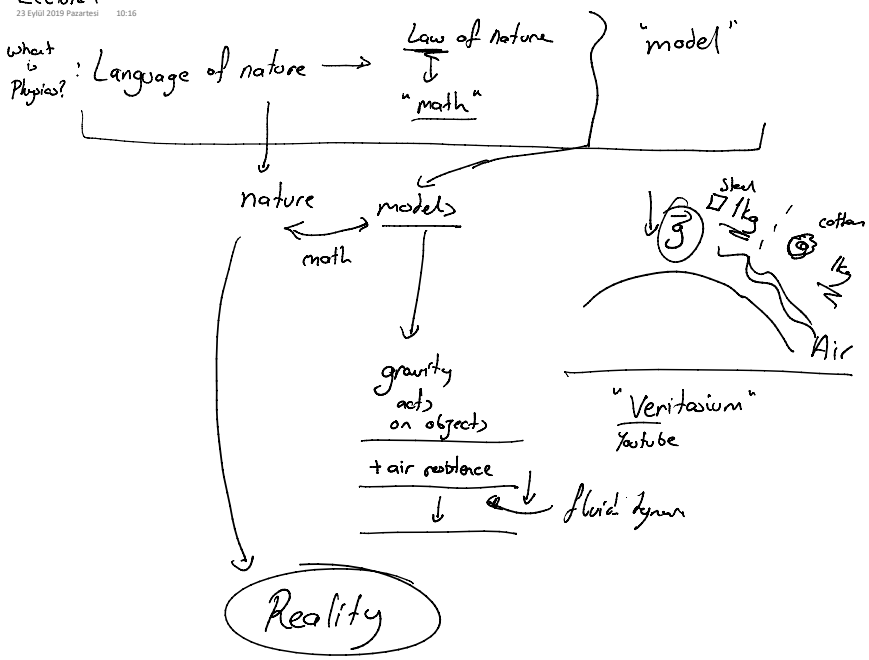
Lecture 1

23 Eylül 2019 Pazartesi 10:16



⇒ "Experiment", "Physics is an experimental science!"

→ "Measure what is measurable, make what is not so!" ← Galileo Galilei

Units, Physical Quantities & Vectors

→ Time, → Temperature, → Length, → Mass ....

↓

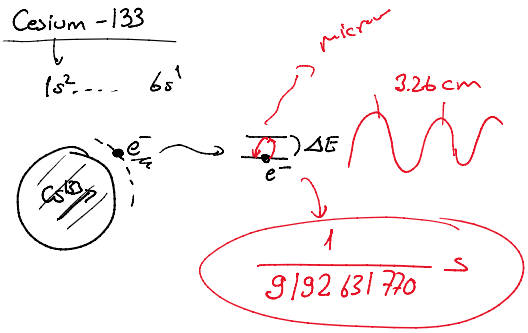
"Seconds" (minutes, hours)

?1 sec.?

→ (1967)

Cesium-133

$1s^2 \ldots 6s^1$



$\frac{1}{9192631770}$ s

→ Length (1983)

c → speed of light

↓

"Einstein"

1 meter = $\frac{1}{299792458}$ of the distance travelled by light in 1 second

3 countries

UK → Kenya?

→ Imperial system

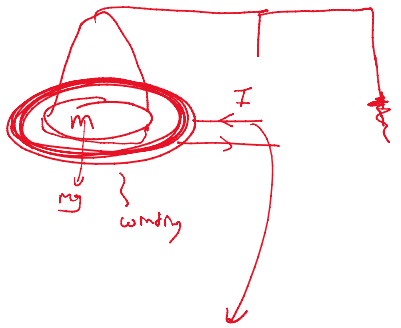
↓

metric system

→ Mass (2019)

→ Mass (2019)

> Watt Balance (Kibble Balance)



kilogram

Planck's Constant: $6.626\,07015 \times 10^{-34}\ kg\ \frac{m^2}{s}$

metric system

1" = 2.54 cm

12" = 1 foot

yard

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meter /10 ⇒ decimeter

1000× kilometer /100 ⇒ centimeter

kilo

10^3 /1000 = millimeter

⋮

10^6 /1 000 000 = micrometers — micron

10^9 /1 000 000 000 = nanometers

10^{12} = picometers

ham

50 μm ⌀

Angstrom ⇒ 10^{-10}

⇒ second /1000 millisecond

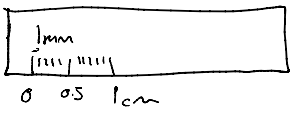
/ ⋮ micro

nano s.

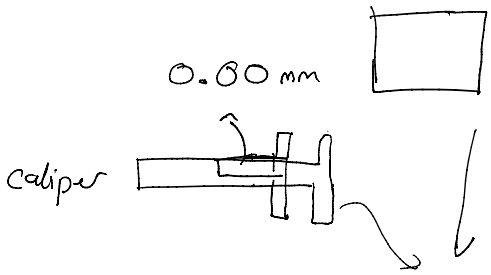
p

→ Uncertainty & Significant Figures

> Uncertainty → error in a measurement →



ruler



5mm

~~5.00 mm~~

~~5.0 mm~~

5.00 mm

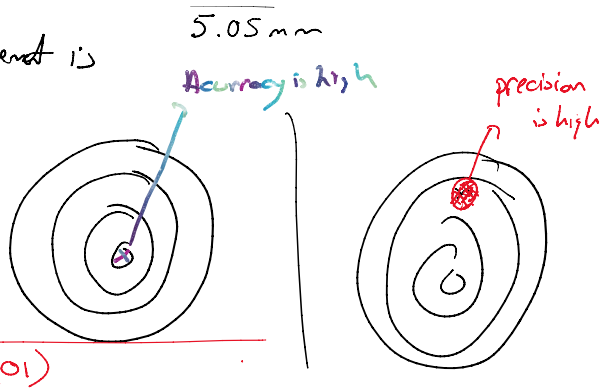
5.05 mm

Accuracy is high

precision

> Accuracy ~ How close your measurement is

> Accuracy ~ How close your measurement is to the true value.



> 5.00 ± 0.01 mm → 5.00 (01)

3 significant figures

> 1.7865 ± 0.0005

5 significant figures

Multiplication / division

$0.534 \times 5.7 = 3.0438 \Rightarrow 3.04 = 3.0$

$5.34\,10^{-1}$ — 3 sig fig. — 2 sig. fig.

Addition / subtraction

$18.257 - 3.5 = 14.8$

0.1 precision — 0.1 precision.

Ex) Energy of a light particle (photon) $E = h \cdot f$

kilogram

$6.62607015\,10^{-34}\ kg\,m^2/s$ = $J.s$

$4.135\,667\,698\,10^{-15}\ eV.s$

$\Rightarrow 1.5\,eV$

$J = e.V$

$f = ? = \dfrac{1.5\ eV}{4.135667698\,10^{-15}\ eV.s} = 0.362\,698\,386\,4\,10^{15}\ s^{-1} = 3.6269\ldots 10^{14}$

$= 0.36\,10^{15}\ s^{-1}$

Ex)

$E = mc^2$

rest energy

$m_e = 9.11\,10^{-31}\ kg$ ⇒ mass of an electron

3 sig. fig.

$2.99792458\,10^{8}\ m/s$

$E = (9.11 \times 10^{-31}\ kg)(c\ m/s)^2$

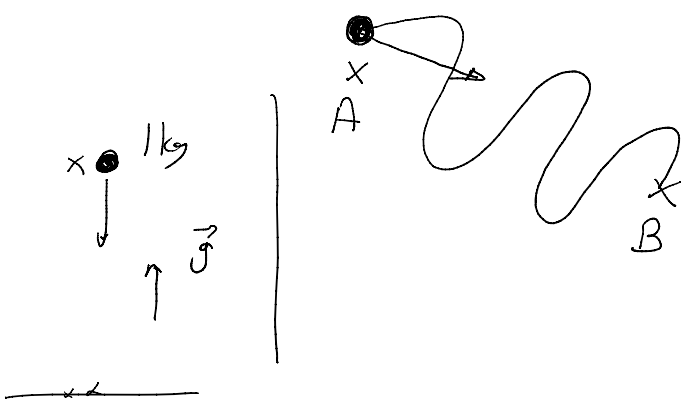
$$E = (9.11 \times 10^{-31}\ kg)(c\ m/s)^2$$

$$= 8.187659678 \times 10^{-14}\ kg\,m^2/s^2$$

(Joules)

$$= 8.19 \times 10^{-14}\ J$$

⇒ Distance, velocity, acceleration

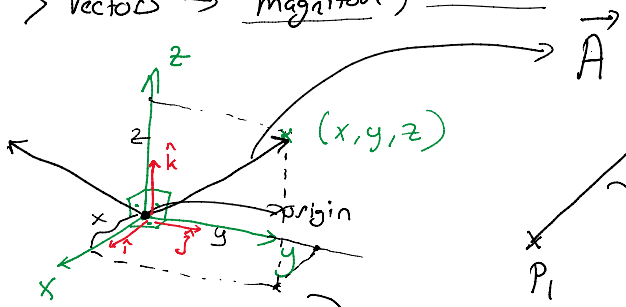


- How fast it will reach from A → B?
-

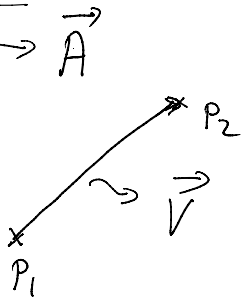
Vector & Vector Algebra

> Scalars → magnitude

> Vectors → magnitude, direction



Coordinate system "Cartesian"



Magnitude

$|\vec{A}|$ = scalar

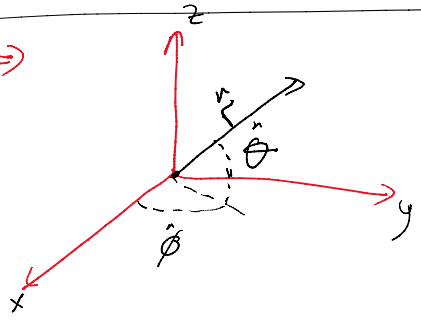
→ unit vectors

↳ unit length

$\hat{i}, \hat{j}, \hat{k}$ — along cartesian coordinates

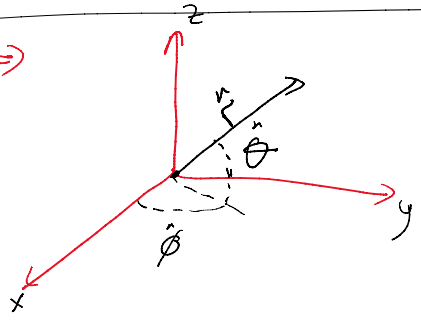
$(\hat{x}, \hat{y}, \hat{z})$

⇒



$(\hat{r}, \hat{\theta}, \hat{\phi})$

"Spherical" Cordinate system.



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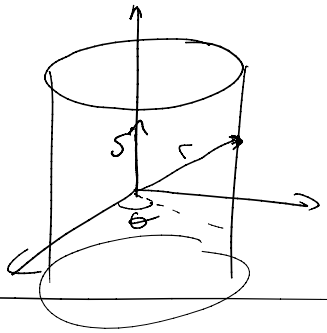
"Spherical" Coordinate system.



"Cylindrical"

$\Rightarrow \vec{A} \times \vec{B}$?

$\vec{A} + \vec{B}$?

$\vec{A} - \vec{B}$?