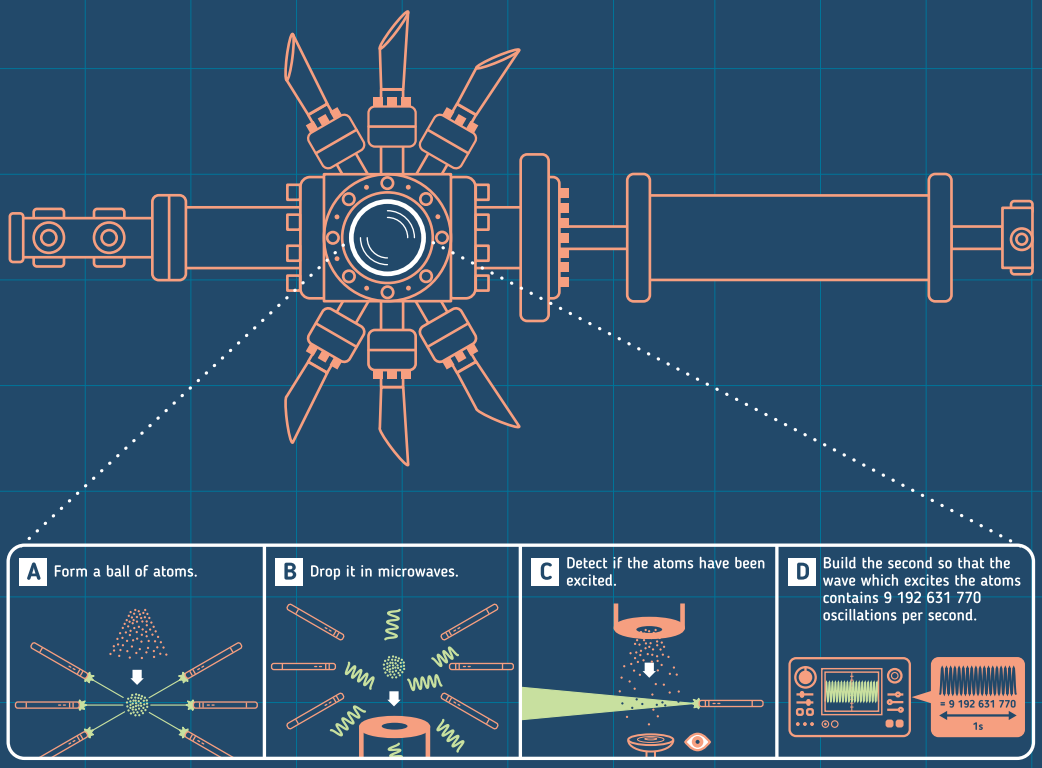
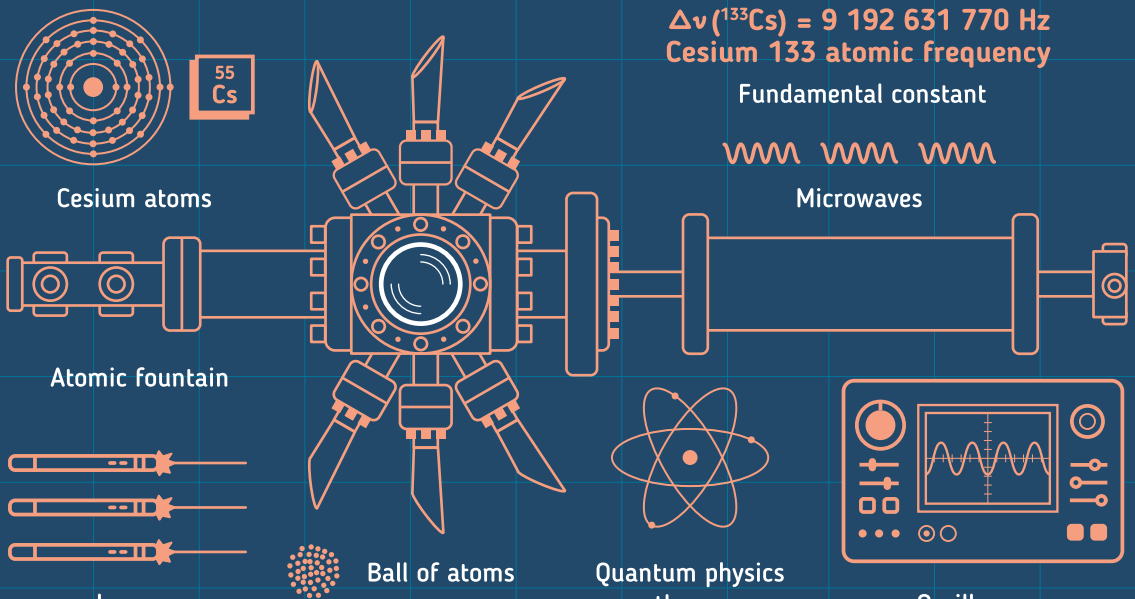
INSTRUCTION MANUAL TO BUILD A SECOND





MATERIAL TO BUILD A SECOND

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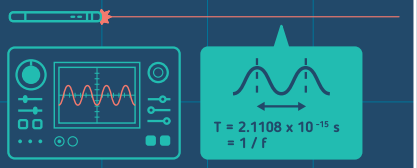
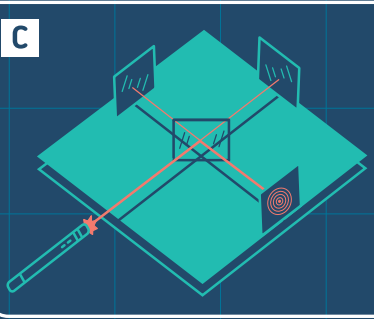
INSTRUCTION MANUAL TO BUILD A METER

A Measure the période (T) of a laser.



B Compute the wavelenght by forcing the value for the speed of light (c) 299 792 458 m.s^{-1}.

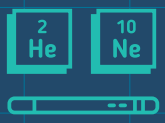
C



Send the light of a laser in an interferometer and measure the movement of one of the mirrors, you'll see the fringes shifting and going back to their position. Do it twice and you'll have moved the mirror by 632.8 nm.

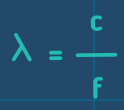
Michelson interferometer

Unit

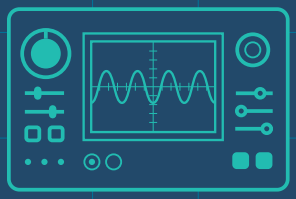


Laser

Invention of lasers



Physics formula



Oscilloscope

Calculator

Ruler

Pencil

$E = mc^2$

Special relativity theory

$c = 299\ 792\ 458\ m.s^{-1}$

speed of light

Fundamental constant

MATERIAL TO BUILD A METER

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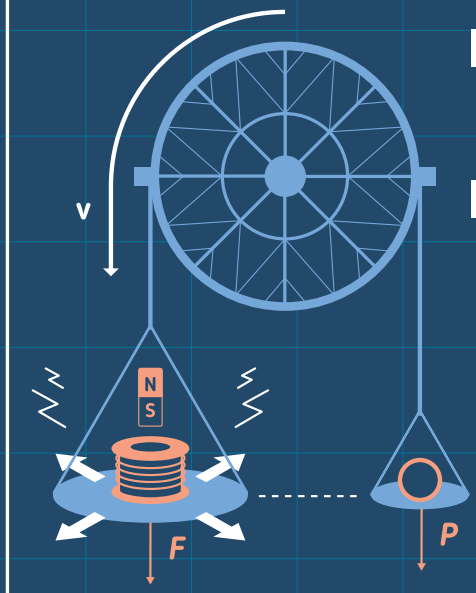
INSTRUCTION MANUAL TO BUILD A KILOGRAM



A Build a Watt balance.
On one side of the scale put the weight you want to measure.
On the other side put an electrical coil and a magnetic field.

B Measure the current flowing through the coil on an even scale, then on an uneven scale.

Josephson Hall

C Force Planck's constant value (h) and deduce the mass of the weight.

$h = 6.626\ 070\ 15 \times 10^{-34}$ J.s

second meter

Units

Classical mecanics theory

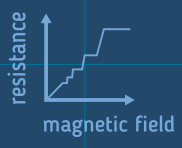
Quantum physics theory

$h = 6.626\ 070\ 15 \times 10^{-34}$ J.s
Planck's constant

Fundamental constant

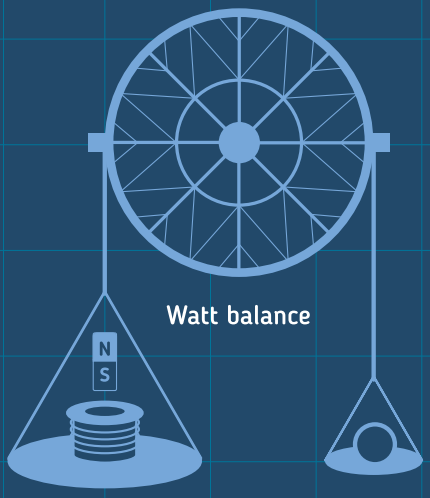
Invention of electricity and induction

Josephson effect



Quantum Hall effetc

Quantum effects with steps



Watt balance

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INSTRUCTION MANUAL TO BUILD A MOLE

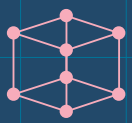
A Crystallize the purest possible silicon sphere.

B Mesure its volume with an optical interferometer and the distance between its atoms with X-rays. Deduce the number of atoms in the sphere.

C Divide by the Avogadro constant N_A = 6,022 140 76 x 10^{23} and deduce the number of moles in the sphere.

$$\text{Number of moles} = \frac{\text{Number of atoms}}{N_A}$$

$$M_{mol} = \frac{m_{sphere}}{\text{Number of moles}}$$



Crystallography

N_A = 6.022 14 076 x 10^{23}
Avogadro number

Fundamental constant

Scale

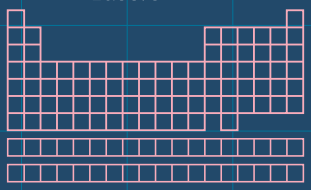
Oven

Lasers

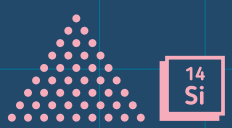
$$M_{mol} = \frac{m_{TOT}}{\text{Number of moles}}$$

Chemistry formula

Optical interferometer



Periodic table of elements



Silicon atoms (sand)

MATERIAL TO BUILD A MOLE

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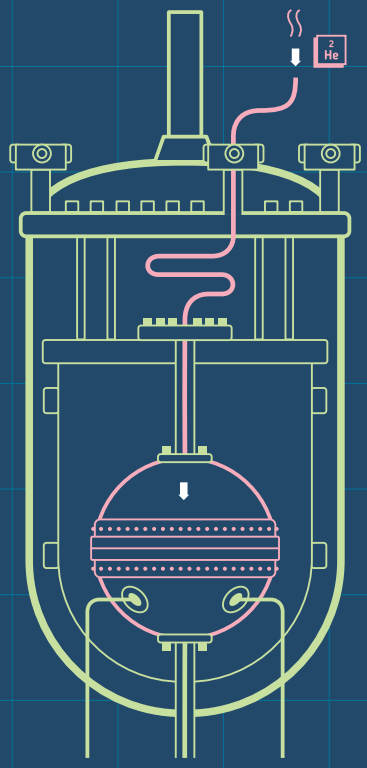
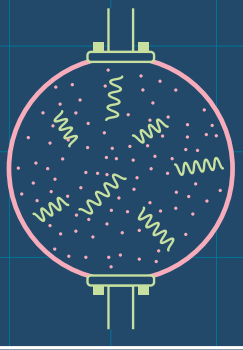
INSTRUCTION MANUAL TO BUILD A KELVIN



A Build an acoustic thermometer.
Fill a sphere with helium and mesure its vibrations. Deduce the speed of sound (v) in the gas.



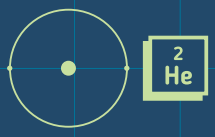
B Force the Boltzmann's constant (k_B) to be 1.380 649 x 10^{-23} $J.K^{-1}$.
Deduce the temperature (T) of the gas :

$$v^2 = \frac{\gamma k_B \times T}{m}$$

(m : mass of the gas atoms)

$$v^2 = \frac{\gamma k_B \times T}{m}$$

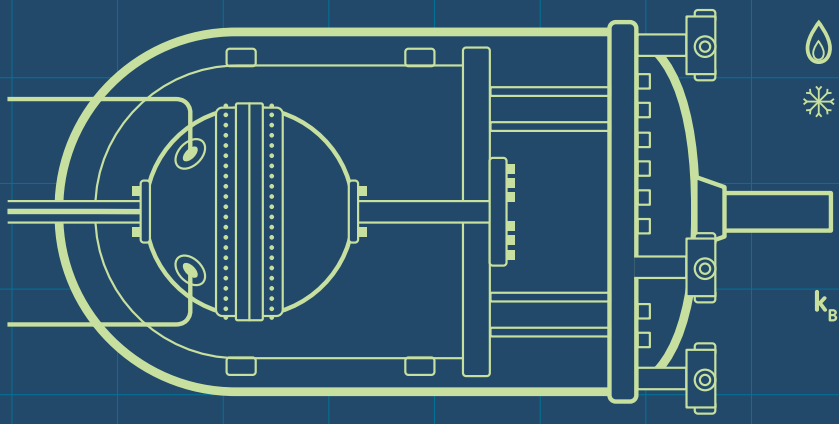
Physics law



Helium atoms

second meter kilogram

Units

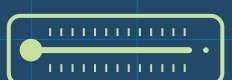


Laws of thermodynamics

Acoustic thermometer

k_B = 1.380 649 x 10^{-23} $J.K^{-1}$
Boltzmann's constant

Fundamental constant



MATERIAL TO BUILD A KELVIN

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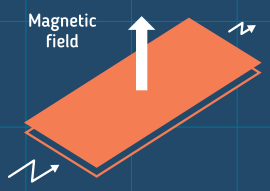
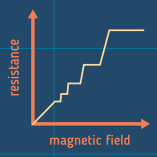
INSTRUCTION MANUAL TO BUILD AN AMPERE

A



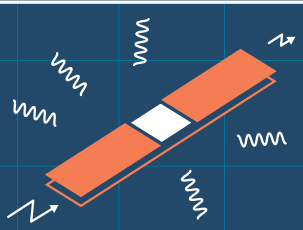
Mesure the résistance (R_H) observing the Quantum Hall effect accurate steps.



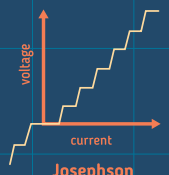
$$R_H = \frac{h}{e^2}$$

Hall

B



Mesure the voltage (V_J) observing the Josephson effect accurate steps.



$$V_J = \frac{h\nu}{2e}$$

Josephson

C Force the elementary charge of an electron e = 1.602 176 634 10^{-19} C and find a current (i) in ampere thanks to Ohm's Law.

$$i = \frac{V_J}{R_H} = \frac{e\nu}{2}$$

Quantum Hall effect, Von Klitzing 1985
Josephson effect, Josephson 1973

Nobel Prizes

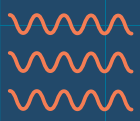
Ω

$U = R \times i$

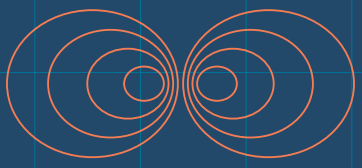
Ohm's law

second

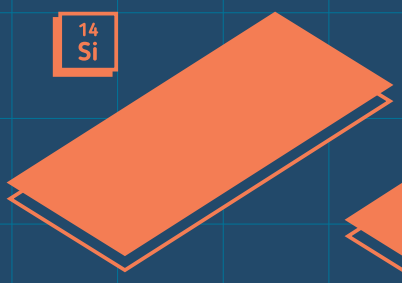
Unit



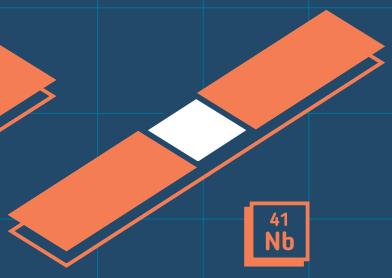
Electromagnetic waves



Magnetic field



Transistor



Supraconducting Josephson junction

e = 1.602 176 634 10^{-19} C
electric charge of the electron

Fundamental constant

$$R_H = \frac{h}{e^2} \qquad V_J = \frac{h\nu}{2e}$$

Physics formulas

MATERIAL TO BUILD AN AMPERE

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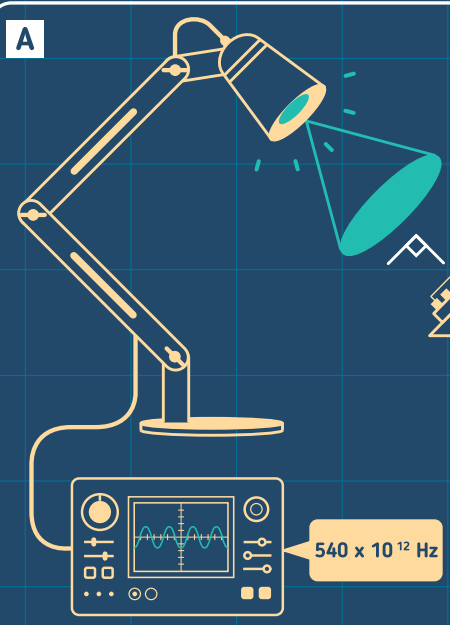
INSTRUCTION MANUAL TO BUILD A CANDELA

A



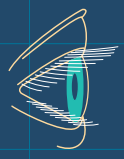
Build a green light lamp
at the specific frequency of 540 x 10^{12} Hz.

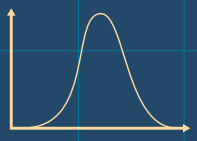
Build a light intensity detector

540 x 10^{12} Hz

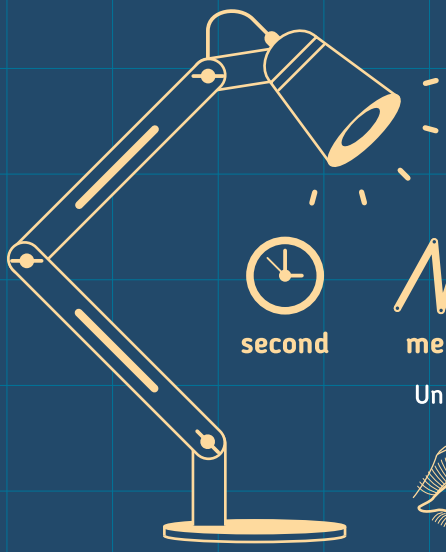
B Set the light so that its efficacy is equal to 683 lumens per Watt. Its luminous intensity is then worth 1 candela.

C To get the intensity of all other colors, apply a luminosity fonction linked to the human eye.

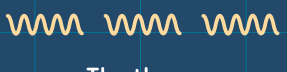




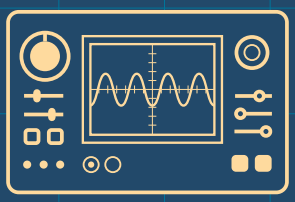
Wavelenght



Kcd = 683 lm.W^{-1}
luminous efficacy
Fundamental constant



The theory
of electromagnetism

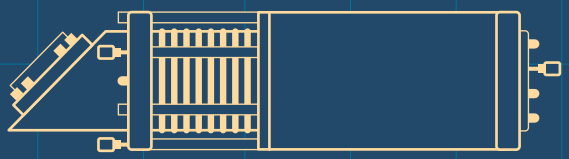


Oscilloscope

second meter kilogram

Units

Human eyes



Light intensity detector

Monochromatic light lamp at the frequency of 540 x 10^{12} Hz (green)

MATERIAL TO BUILD A CANDELA

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