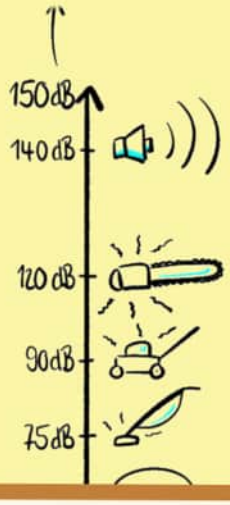
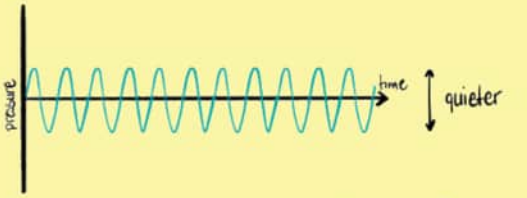


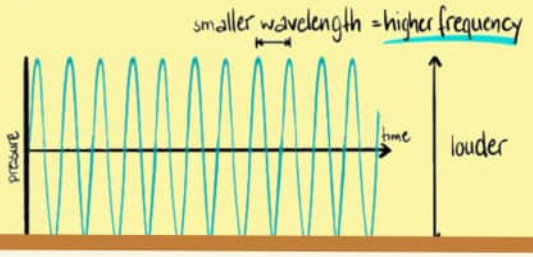
Sound is vibrations that are transitted in a medium



Speed of sound

the speed depends on the medium it's travelling in

rubber	60 $\frac{m}{s}$



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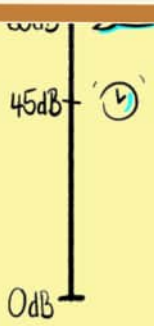
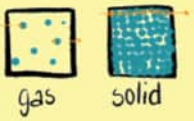
Physics Sketchnotes



air at 20°C	343 $\frac{m}{s}$
water	1480 $\frac{m}{s}$
aluminum	6320 $\frac{m}{s}$

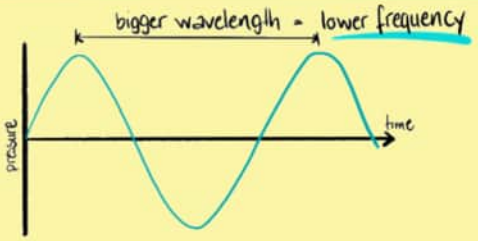
5s = 1mile distance

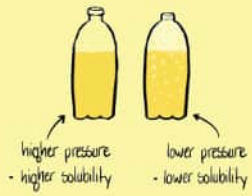


$\frac{m}{s} \leftrightarrow \frac{mi}{h}$

$\frac{m}{s} \cdot 2.24 = \frac{mi}{h}$

$\frac{mi}{h} \div 2.24 = \frac{m}{s}$





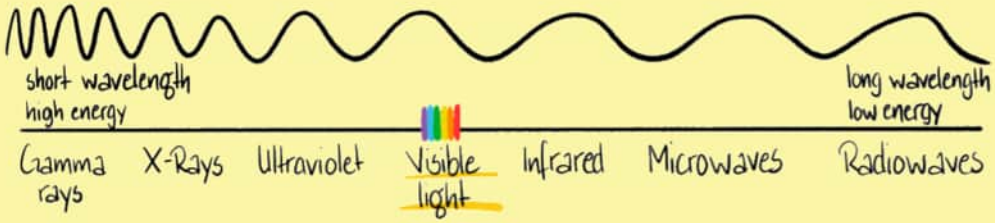
Light is packets of electromagnetism that are called photons. It can be waves or particles

Speed of light

- in a vacuum -

~ 300,000,000 $\frac{m}{s}$

~ 300,000 $\frac{km}{s}$



light travels 7.5 times around the earth in 1s

Greg Landry's

Physics Sketchnotes

Table of Contents

Note - Taking

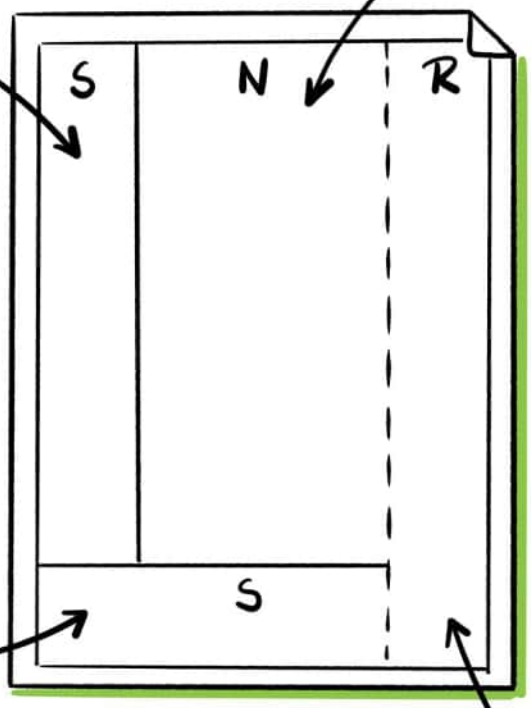
NSSR
Notes Sketches Summary Retrieval

1 Take Notes

While class write every-thing down. You can use your own abbreviations because they are your notes.

2 Draw Sketches

Draw what was most important in this class. It's best to do it on the same day. Remember. it's not about art! You'll get better at it with more practise.



3 Write Summary

Write 2-4 sentences that summarize the notes above.

4 Retrieval

You can practise different types of retrieval:

- let somebody ask you questions
- teach others
- make a test & solve it
- use flashcards or use the folded back retrieval column as flashcard

Learning for a test

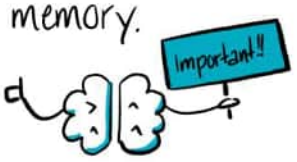
Learning & retrieving takes time! Your brain is like an athlete training for a competition.

You need your notes to go back to the content

Make sketches from memory or Write down from memory

Why is retrieval important?

By pulling pieces of information often from your brain, you tell your brain that they are important. This way they are saved in the long term memory.



Physics Notes

Measurements

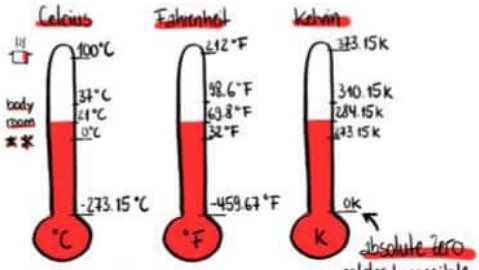
Base units

Mole – quantity of substance

Candela – light

Ampere – electric current

Kelvin – temperature



1°C ≙ 1K same scale

Second – time

Liter – volume

Volume = how much space something takes up

1l is a little more than a quart

Gram – mass

Meter – length

1m is a little less than a yard

Mass ↔ weight (like pound)

Is the same everywhere

Depends on the gravity & changes

1g = 🍇 or 🍒

454 g = 1 Pound

Metric Prefixes

They are put before a base unit to change the amount of it

Name	Symbol	Factor	
Mega	M	1,000,000	10^6
Kilo	k	1,000	10^3
Hecto	h	100	10^2
Deka	da	10	10^1
Base unit		1	10^0
Deci	d	0.1	10^{-1}
Conti	c	0.01	10^{-2}
Milli	m	0.001	10^{-3}
Micro	μ	0.000.001	10^{-6}
Nano	n	0.000.000.001	10^{-9}

Statistics

Example: 2, 2, 5, 6, 8, 13

Mean = average $\bar{x}$ — Mean $\bar{x} = \frac{2+2+5+6+8+13}{6} = \frac{36}{6} = 6$

Median = middle number or average of two middle numbers — Median $\frac{5+6}{2} = \frac{11}{2} = 5.5$

Mode = the most often number — Mode 2

Probability

likelyhood of something happening

each individual event stands on its own & has the same probability

Combining events means combining individual probabilities

5 times head in 5 flips:

1 × 50 % = 50%
2 × 50% · 50% = 25%
3 × 50% · 25% = 12.5%
4 × 50% · 12.5% = 6.25%
5 × 50% · 6.25% = 3.12%

Accuracy & Precision

Accuracy: the closeness of a measured value to a know or standard value

Precision: the closeness of two or more measured values to each other

Accuracy & Precision can occur together but they don't have to!

Physics Notes

This is how research is done!

Scientific Method & Lab Report

Scientific Method

Purpose → Why is the experiment done?
What question should be answered?

Research → Learn about the topic of the experiment, do the background research

Hypothesis → The educated guess about the outcome of the experiment

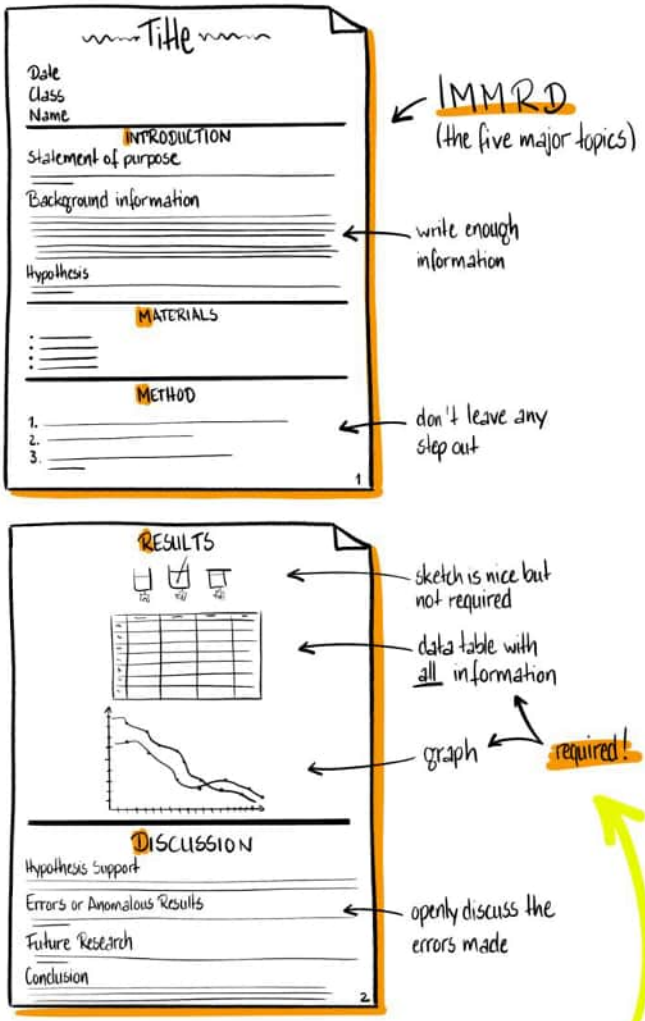
Experiment → Develop a method to test the hypothesis & do the experiment

Analysis → Record the results & analyze them

Discussion → Is the hypothesis supported?
Errors
Future research
Conclusions

Lab Report

The written version of the scientific method



Scientific Theory: a hypothesis that is supported by repeated experiments

Scientific Law: a very specific statement that has been tested very often

Physics Notes

Forces & Newton's Laws

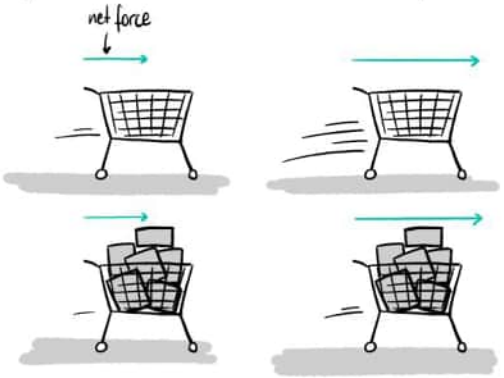
Newton's laws

① Inertia

An object will remain in rest or in uniform motion in a straight line unless acted upon by an outside force.

② Force, Mass & Acceleration

The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force & inversly proportional to the mass of the object.



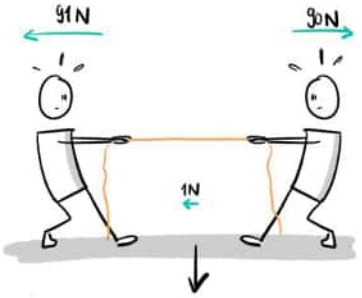
③ Action & Reaction

For every action, there is an equal & opposite reaction.

Force

the unit is Newton (N)

the still ball is in an equilibrium of forces → net force = 0N



the forces are not in an equilibrium because the net force = 1N to the left side → the left person will win

Significant figures

1. Non zero figures 1 - 9
2. Sandwiched zeros (4005)
3. Zeros left of non zero digits are not significant (0.0034)
4. Zeros right of a decimal point & at the end of a number (657.700)
5. Zeros right of a number & left of a decimal point are not significant (900)
6. Anything counted (3,270,313) pens

Physics Notes

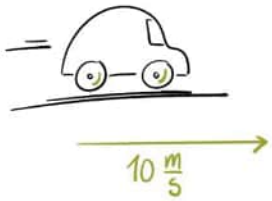
Velocity & Speed

often used interchangeably, but that is not correct in science

Speed

the rate of movement along a path

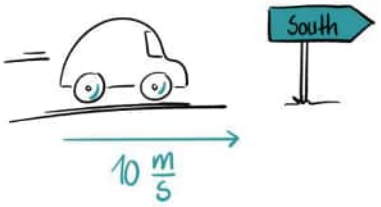
→ speed is a scalar quantity



Velocity

the rate of movement in addition to the direction of the movement

→ velocity is a vector quantity



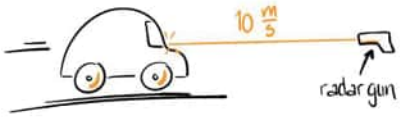
$\frac{m}{s} \leftrightarrow \frac{mi}{h}$

$\frac{m}{s} \cdot 2.24 = \frac{mi}{h}$

$\frac{mi}{h} : 2.24 = \frac{m}{s}$

Instantaneous Speed

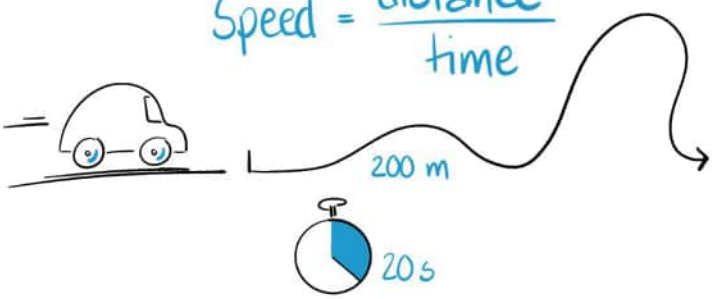
the speed in a moment



Average Speed

the speed that is measured by taking time & distance → the instantaneous speeds can vary!

$$\text{Speed} = \frac{\text{distance}}{\text{time}}$$



Physics Notes

Atoms, Matter & Magnitude Perspective

plasma
gas + energy
liquid + energy
solid + energy

Matter

has mass & takes up space, consists of atoms

consist of

protons (+) neutrons electrons (-)

nucleus
95% of atom mass
<5% of space

Pure Substances

Elements: O_2 H_2

Compounds: H_2O

Mixtures

Heterogeneous Mixtures
→ can be separated
Cereals

Homogeneous Mixtures
→ can't be separated
most chemicals
air

Models of atoms

nuclear model | planetary model | electron cloud model

off → on

Can you tell I think this is important?

Professor Landry

Standard temperature

0°C
273.15 K

Standard pressure

1 atmosphere (atm)
101.3 kilopascals (kPa) ← most common
760 mm Hg
760 Torr

Magnitudes

1nm = 10^{-9} m = 1 billionth of a meter

virus	100 nm
bacteria	950 nm
human cell	50,000 nm
hair	100,000 nm

linear scale

+1 +1 +1 +1 +1 +1 +1

1 2 3 4 5 6 7 8

Logarithmic scale

×10 ×10 ×10 ×10 ×10 ×10 ×10

1 10 100 1,000 10,000 100,000 1,000,000 10,000,000

"by an order of magnitude."

Physics Notes

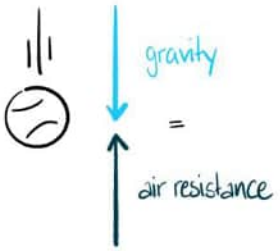
Gravity & Free Fall

Free fall

Something falling to the surface of the earth because of gravity, without any resistance

Terminal velocity

the end velocity with air resistance,
no more acceleration



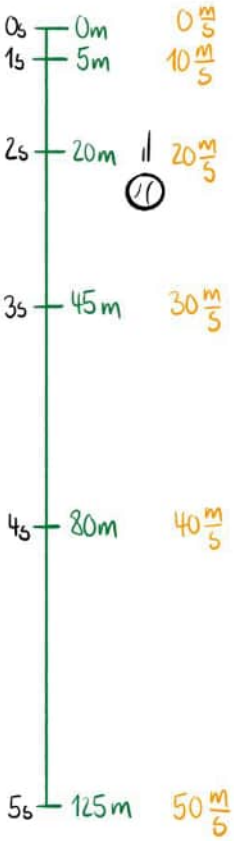
acceleration due to gravity

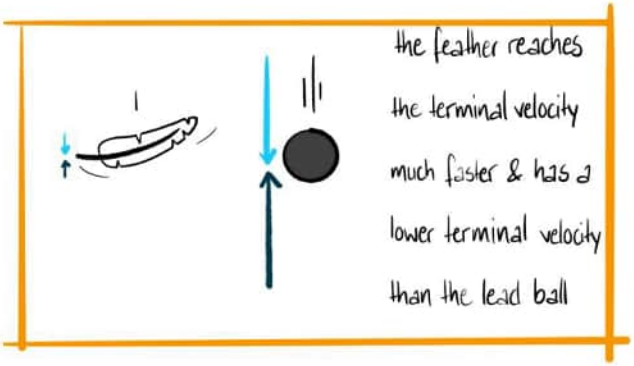
increase of speed

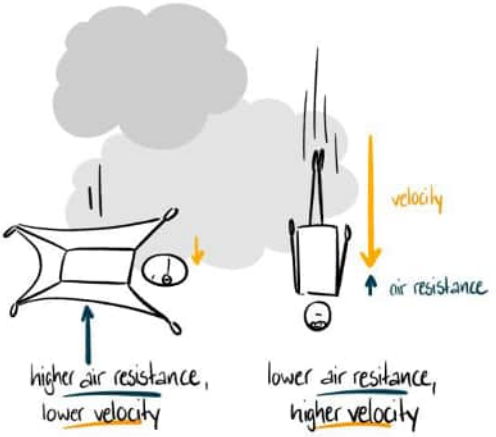
$$g = 9.81 \frac{m}{s^2} \approx 10 \frac{m}{s^2}$$

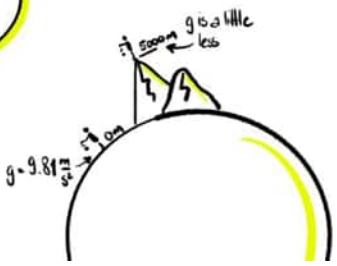
on earth

time	instantaneous speed	distance
0s	$0 \frac{m}{s}$	0m
1s	$10 \frac{m}{s}$	5m
2s	$20 \frac{m}{s}$	20m
3s	$30 \frac{m}{s}$	45m
4s	$40 \frac{m}{s}$	80m
5s	$50 \frac{m}{s}$	125m
t	$g \cdot t$	$\frac{1}{2} g \cdot t^2$









Physics Notes

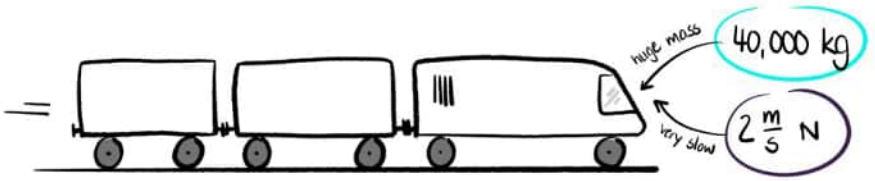
Momentum

has normally a direction

in g or kg

in $\frac{m}{s}$ with a direction

$$\text{Momentum} = \text{Mass} \cdot \text{Velocity}$$

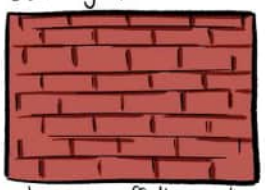


$$\rightarrow 40{,}000\ \text{kg} \cdot 2\ \tfrac{m}{s} = 80{,}000\ \tfrac{\text{kg} \cdot m}{s}\ \text{N}$$

$$\rightarrow 1{,}500\ \text{kg} \cdot 25\ \tfrac{m}{s} = 37{,}500\ \tfrac{\text{kg} \cdot m}{s}\ \text{S}$$

high momentum

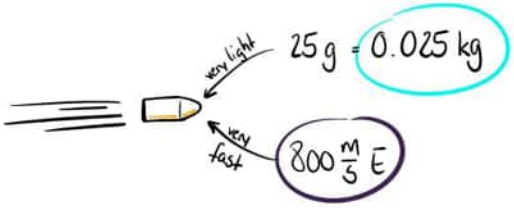
crashing on the wall



bouncing off the wall

$$\rightarrow 60\ \text{kg} \cdot 5\ \tfrac{m}{s} = 300\ \tfrac{\text{kg} \cdot m}{s}\ \text{W}$$

low momentum



$$\rightarrow 0.025\ \text{kg} \cdot 800\ \tfrac{m}{s} = 20\ \tfrac{\text{kg} \cdot m}{s}\ \text{E}$$

Physics Notes

Work, Power & Energy

Energy

Needed to be able to do work, a property of an object

Work

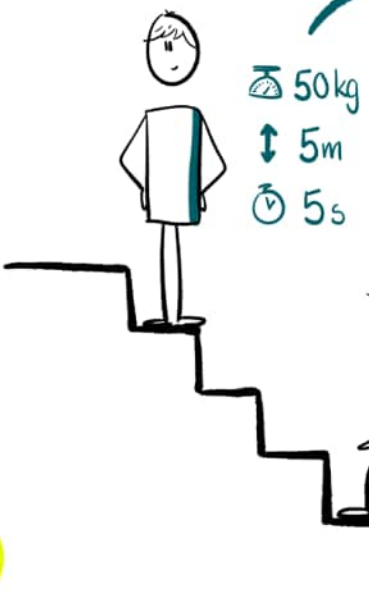
When a force acts on an object and moves it in the direction of the force

Work (J) = Force (N) · Distance (m)

Power

The amount of work done in a period of time. Same work in less time → more power

$$\text{Power (W)} = \frac{\text{Work (J)}}{\text{Time (s)}}$$



50 kg = 490.5 N

Work: 490.5 N · 5 m = 2452.2 J

2452.2 J · 0.00024 = 0.59 cal

Power: $\frac{2452.2\ J}{5s} = 490.5\ W$

1 kg = 9.81 N

1 J = 0.00024 cal

40 kg = 392.4 N

Work: 392.4 N · 4 m = 1569.6 J

1596.6 J · 0.00024 = 0.38 cal

Power: $\frac{1596.6\ J}{6s} = 261.6\ W$

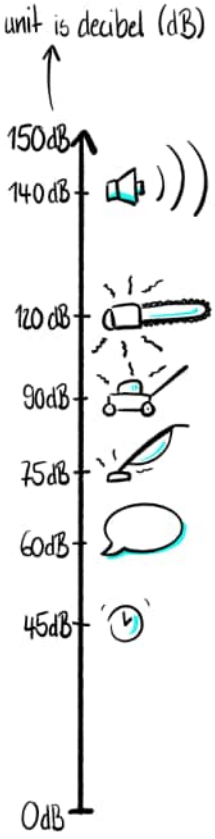
Physics Notes

Sound & Light

Sound

Sound is vibrations that are transitted in a medium

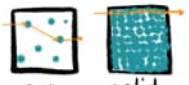
$\frac{\#\text{ of waves}}{\text{second}}$ = frequency (Hz)

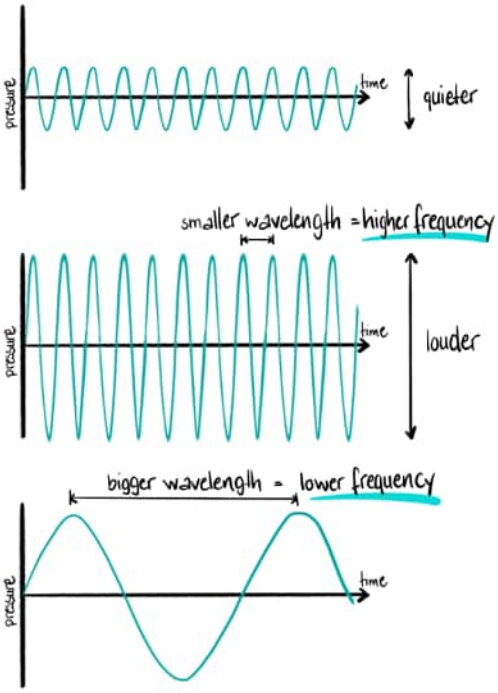


Speed of sound

the speed depends on the medium it's travelling in

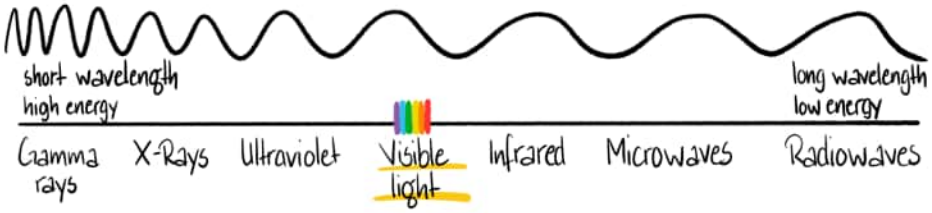
rubber	60 $\frac{m}{s}$
air at 20°C	343 $\frac{m}{s}$
water	1480 $\frac{m}{s}$
aluminum	6320 $\frac{m}{s}$





Light

Light is packets of electromagnetism that are called photons. It can be waves or particles



Speed of light

- in a vacuum -

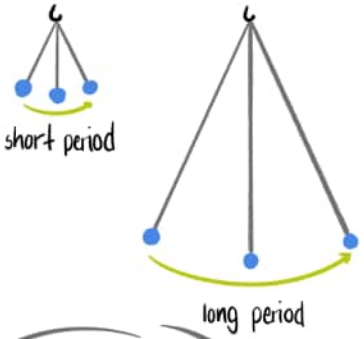
~ 300,000,000 $\frac{m}{s}$

~ 300,000 $\frac{km}{s}$

light travels 7.5 times around the earth in 1s

Physics Notes

Pendular Motion



single point of suspension

string

the length of the string affects the period!

length

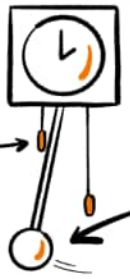
the mass of the bob does not affect the period!

mass at the end = bob

Count 10 periods to be more precise!

Professor Landry

1 period is 1 complete motion of the pendulum



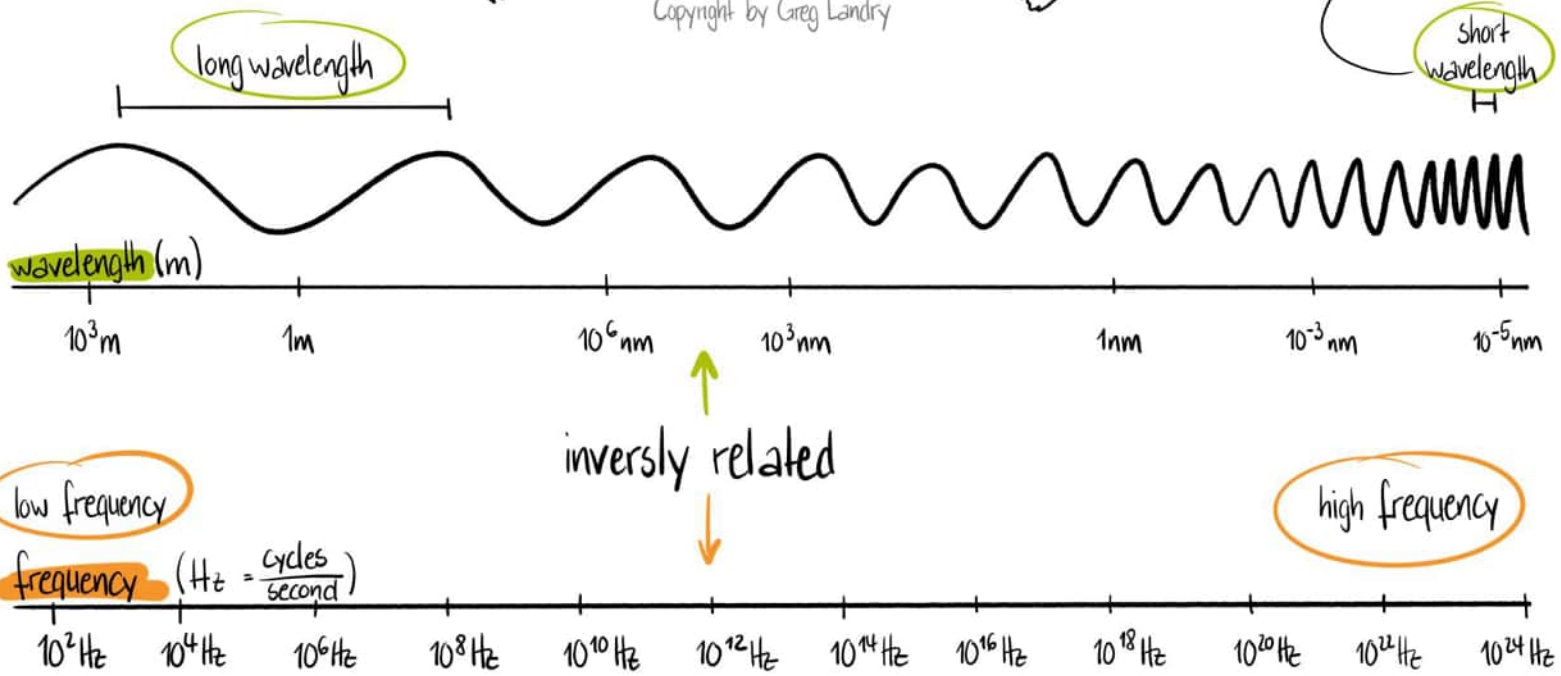
the weight is the "motor" of the clock

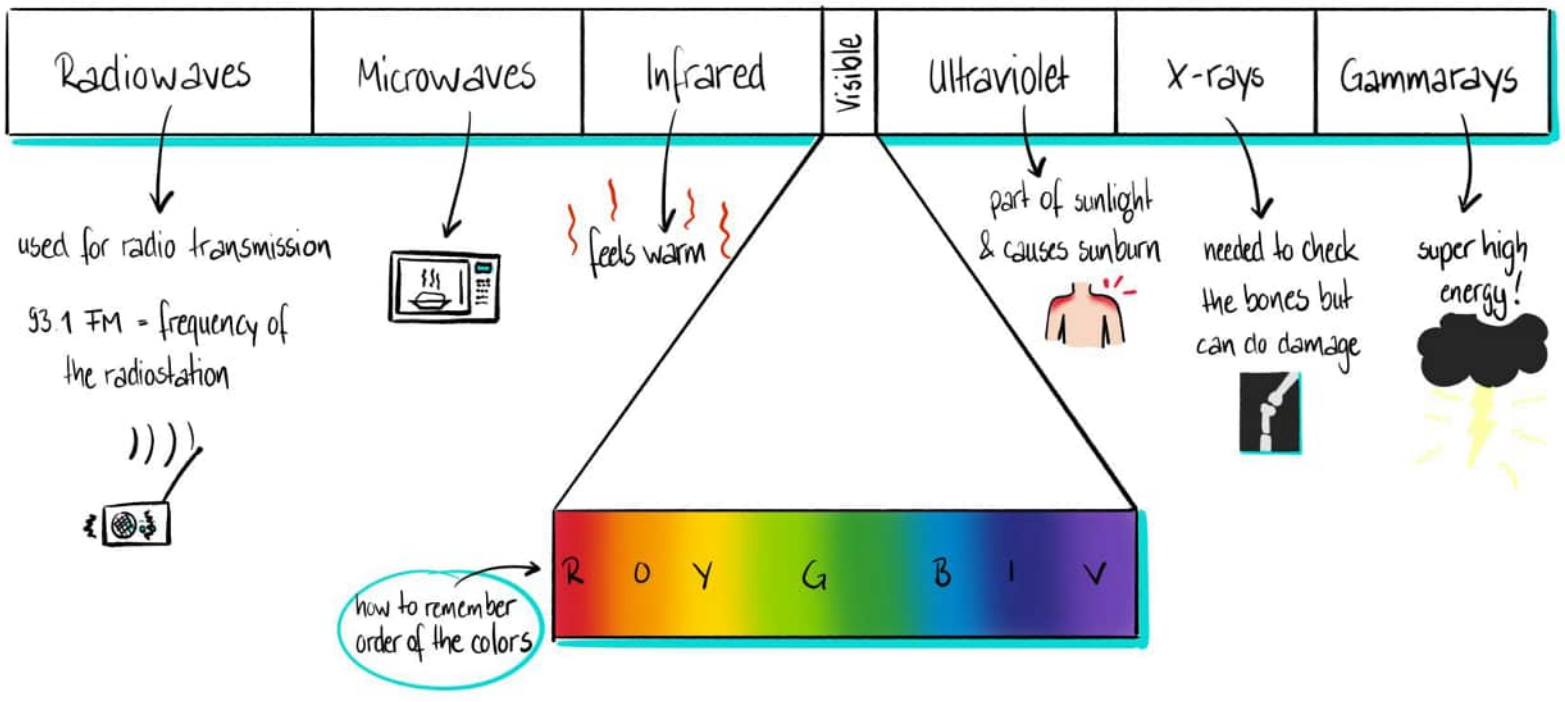
the speed of the clock is adjusted by the length of the pendulum

shorter - faster / longer - slower

Physics Notes

Electromagnetic Spectrum





Physics Notes

Viscosity, Liquids & Buoyancy

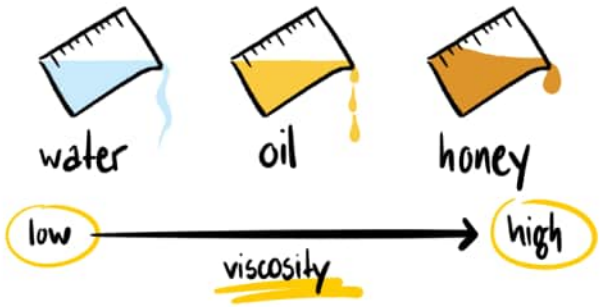
Viscosity

A higher viscosity means an increased internal friction. You could say, the viscosity is the resistance to changing the shape

The viscosity depends on the temperature:

colder = higher viscosity
warmer = lower viscosity

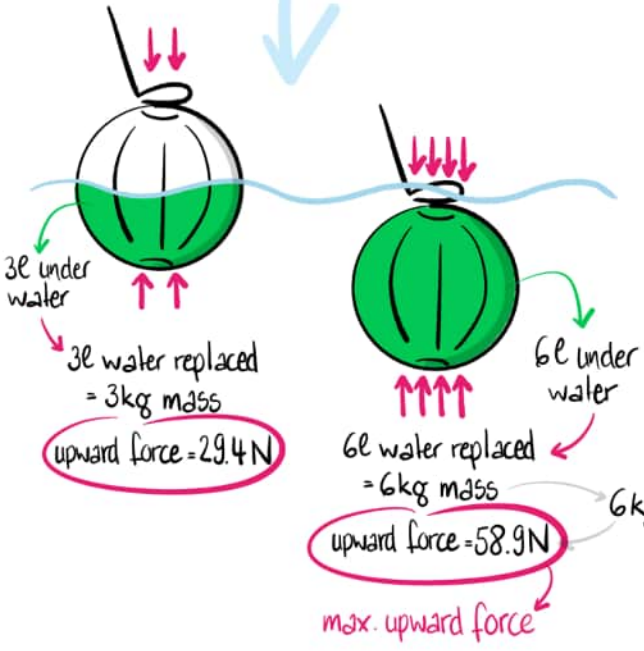
Viscosity is determined by the measurement of the speed of the movement

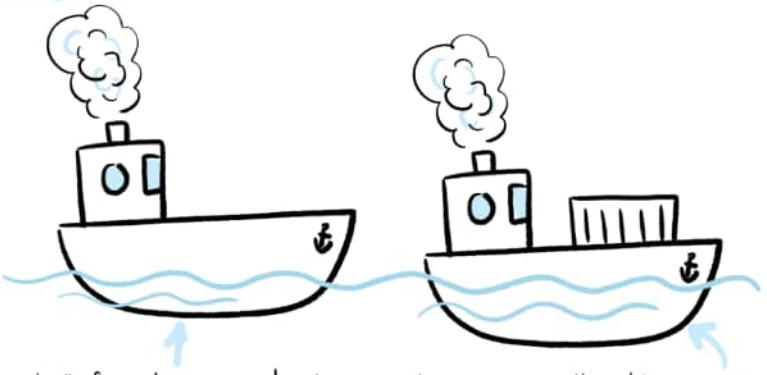


Buoyancy

Archimedes principle

The upward buoyant force on an object is equal to the mass of the fluid replaced by that object





The hull of a ship is replacing exactly the amount of water of its own mass.

More mass on the ship means it's pushed deeper into the water, replacing the additional mass.

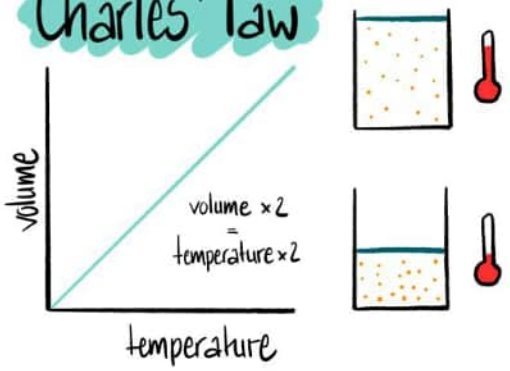
Physics Notes

Gas laws

Volume of a gas depends on:

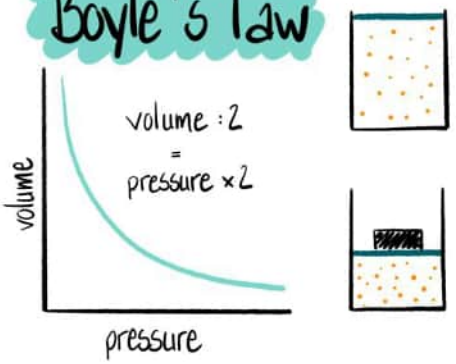
- temperature
- pressure
- amount of gas

Charles' law



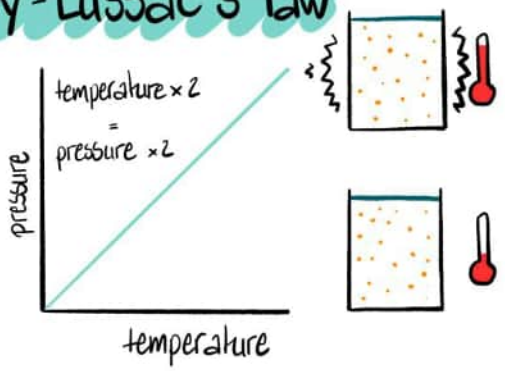
pressure & mass of gas constant

Boyle's law



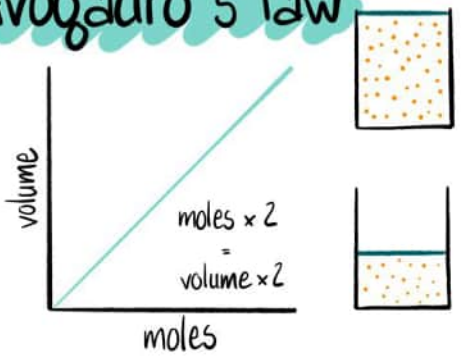
temperature & mass of gas constant

Gay-Lussac's law



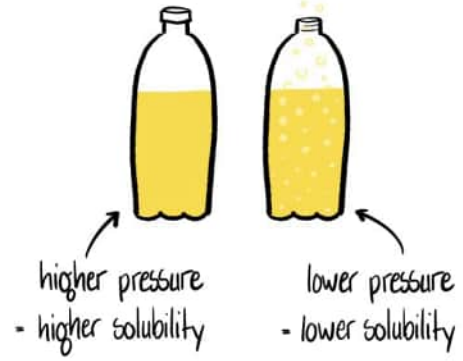
volume & mass of gas constant

Avogadro's law



temperature & pressure constant

Gas solubility



Buoyancy

Metric units: 1ℓ - 1kg = 9.81 N

English units: 1ℓ = 2.2 lb - 2.2 pound-force

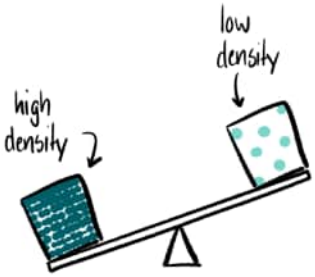
Physics Notes

Density

Water expands when frozen
= lower density

Density of the elements

Density is expressed by mass per volume



$$D = \frac{m\ (g)}{V\ (ml\ or\ cc)}$$

Gases: $\frac{g}{\ell}$

Hydrogen	0.09 $\frac{g}{\ell}$
Helium	0.18 $\frac{g}{\ell}$
Nitrogen	1.25 $\frac{g}{\ell}$
Oxygen	1.43 $\frac{g}{\ell}$
Radon	9.73 $\frac{g}{\ell}$

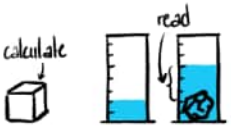
Fluids / solids: $\frac{g}{ml}$

Lithium	0.534 $\frac{g}{ml}$
Water	1.0 $\frac{g}{ml}$
Iron	7.9 $\frac{g}{ml}$
Lead	11.35 $\frac{g}{ml}$
Mercury	13.55 $\frac{g}{ml}$
Gold	19.3 $\frac{g}{ml}$
Platinum	21.45 $\frac{g}{ml}$
Osmium	22.6 $\frac{g}{ml}$

How to measure density

1. 

determine the mass

2. 

determine the volume by fluid displacement

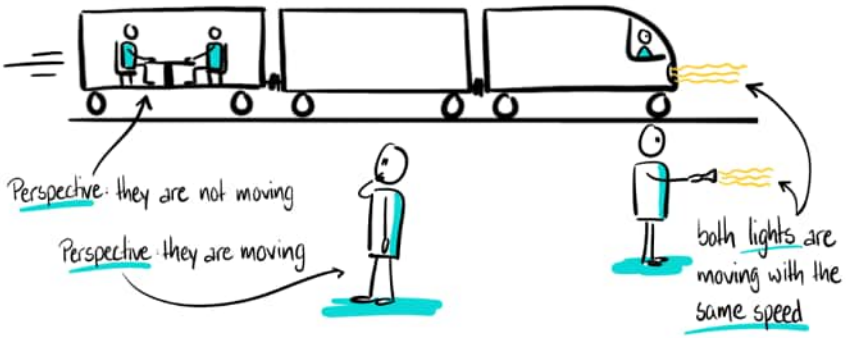
3. 
calculate

Physics Notes

Einstein's Theory of Relativity

Special Relativity

It's about relativity & perspective



Time slows down as we approach the speed of light

10% of speed of light (30.000 $\frac{km}{s}$)

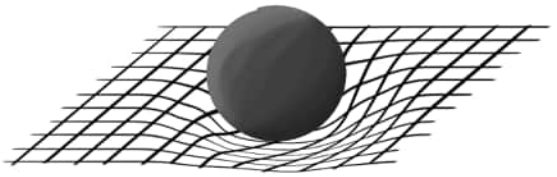
↓

1% time slow down

General Relativity

Gravity is warping space around a mass.

The bigger the mass, the bigger the warping



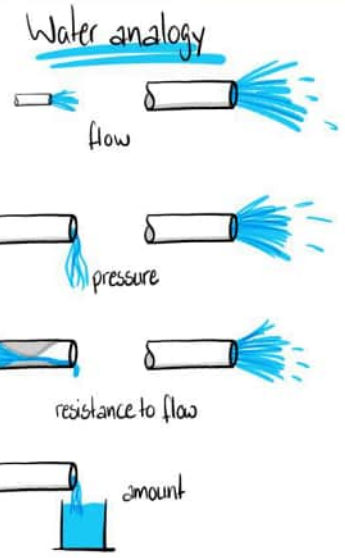
$$E = mc^2$$

Energy Mass Speed of light

Physics Notes

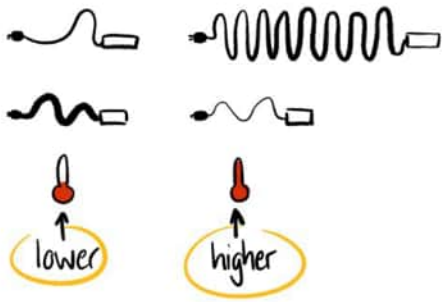
Electricity

Current	I	Ampere (A)	$I = \frac{P}{V} = \frac{V}{R}$
Voltage	V	Volt (v)	$V = \frac{P}{I}$
Resistance	R	Ohm (Ω)	$R = \frac{V}{I}$
Power	P	Watt (w)	$P = V \cdot I$



What affects resistance?

- Material
- Length
- Diameter
- Temperature



Ohm's law

$$\text{Current} = \frac{\text{Voltage}}{\text{Resistance}} \qquad \frac{100\,V}{20\,\Omega} = 5A$$

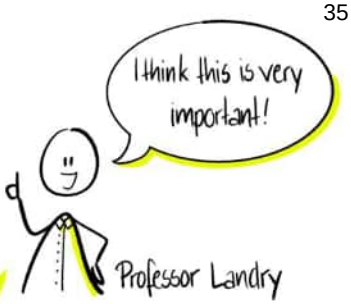
$$\text{Power} = \text{Current} \cdot \text{Voltage} \qquad 20A \cdot 110\,V = 2200\,W$$

"Breaker box"

It cuts the power off with a switch if it gets too much to handle & gets dangerous

Physics Notes

Radioactivity

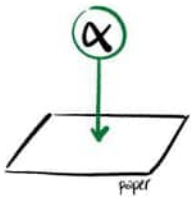


α-particles

alpha

positively charged +

2 protons, 2 neutrons

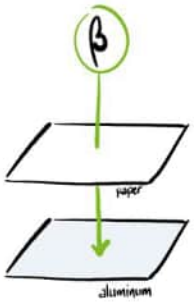


β-particles

beta

negatively charged −

1 electron



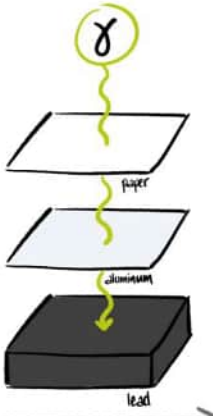
γ-rays

gamma

neutral

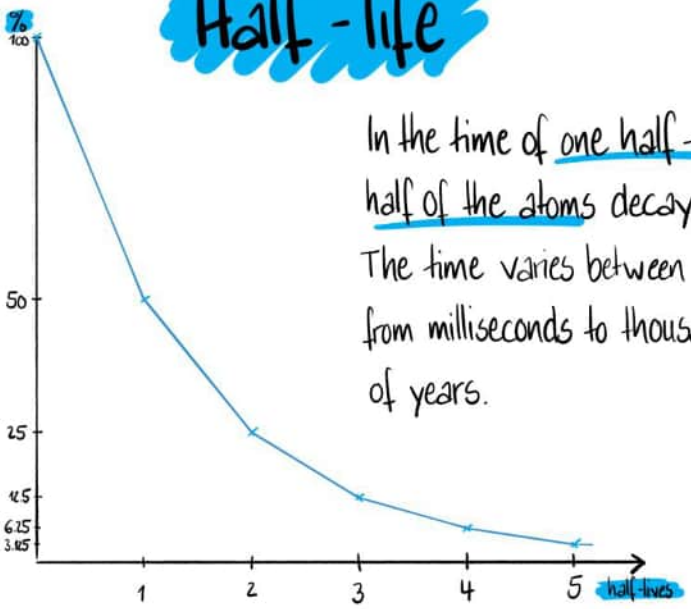
massless energy

high frequency photons



less harmful → harmful

Half-life



In the time of one half-life, half of the atoms decay. The time varies between atoms from milliseconds to thousands of years.

Radioactivity

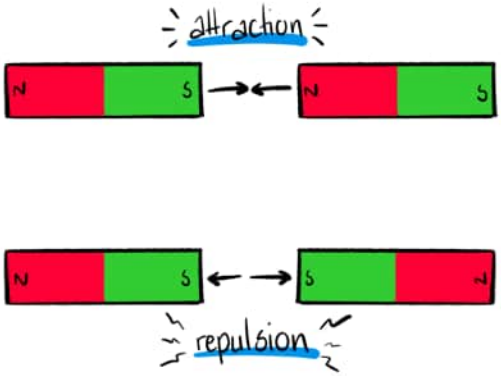
or radioactive decay

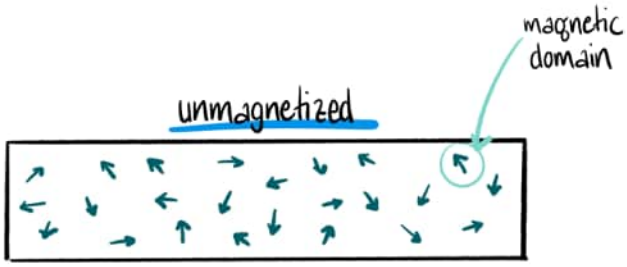
The "lighter atoms" are typically stable. Above 80 they get less stable & parts are leaving the atom at some point. This leaving is called radioactivity!

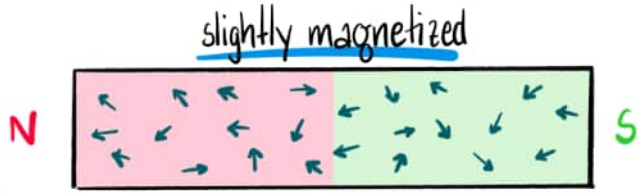
Physics Notes

Magnetism

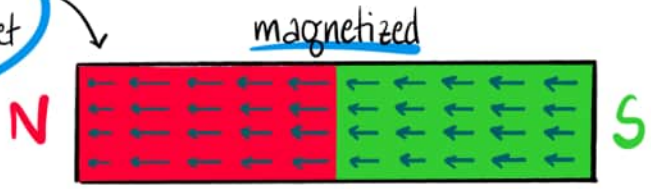
- Some materials keep the magnetism for a long time, some lose it quickly

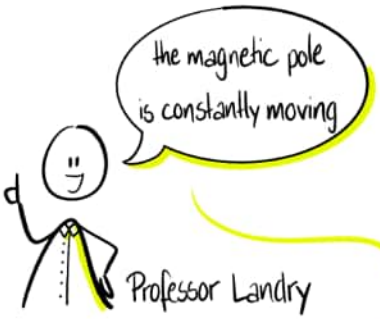




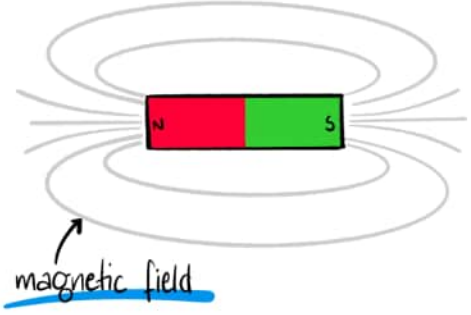


A piece of iron can be magnetized with a magnet





If a magnet is split, the new halves are still magnets

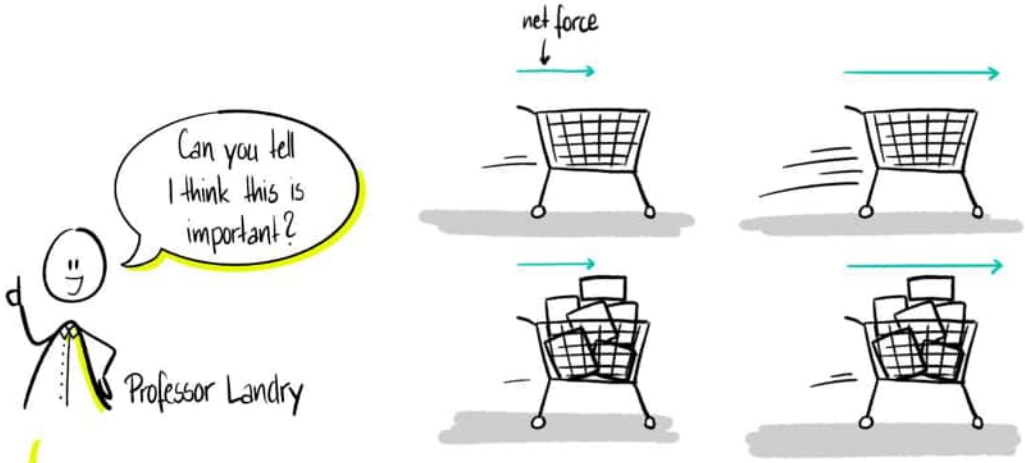


Physics Notes

Newtons 2nd law

Force, Mass & Acceleration

The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force & inversly proportional to the mass of the object.



$$\text{Acceleration}\left(\frac{m}{s^2}\right) = \frac{\text{Force}\left(N \text{ or } \frac{m \cdot kg}{s^2}\right)}{\text{Mass (kg)}}$$

Force	Mass	Acceleration
10 N	15 kg →	0.7 $\frac{m}{s^2}$
10 N +	25 kg →	0.4 $\frac{m}{s^2}$ −
10N	50kg →	0.2 $\frac{m}{s^2}$

mass & acceleration are inversly proportional

Force	Mass	Acceleration
2N	15kg →	0.13 $\frac{m}{s^2}$
+ 12N	15 kg →	0.8 $\frac{m}{s^2}$ +
42N	15 kg →	2.8 $\frac{m}{s^2}$

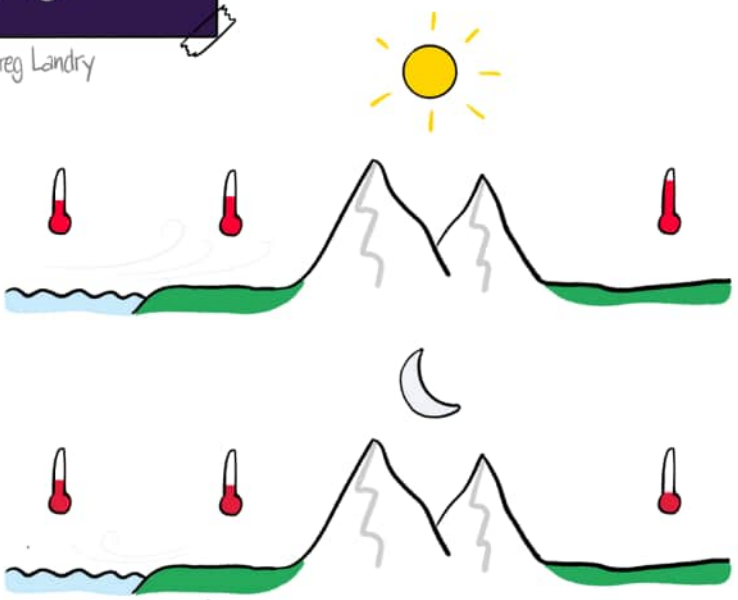
force & acceleration are proportional

Physics Notes

Water

Water properties

- high specific heat
  - it resists the change of temperatures & it takes longer for it to adapt
    - important as a climate buffer
    - important to keep the body temperature stable



the water keeps the temperatures on the coast stable, compared to the areas away from the coast

- high surface tension

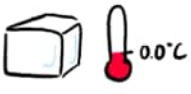
- expands when frozen

Density of water

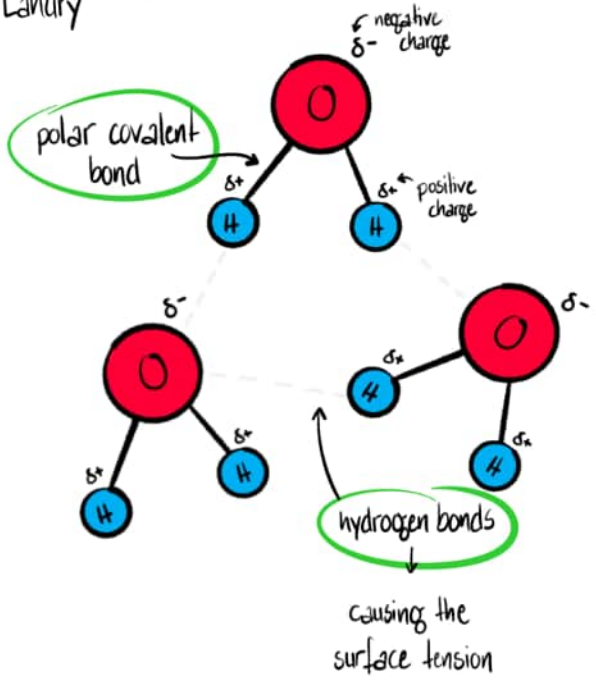
liquid: 1 $\frac{g}{ml}$ frozen: 0.9 $\frac{g}{ml}$

- a good solvent

- pure water freezes at 0.0°C



- solvents lower the freezing temperature

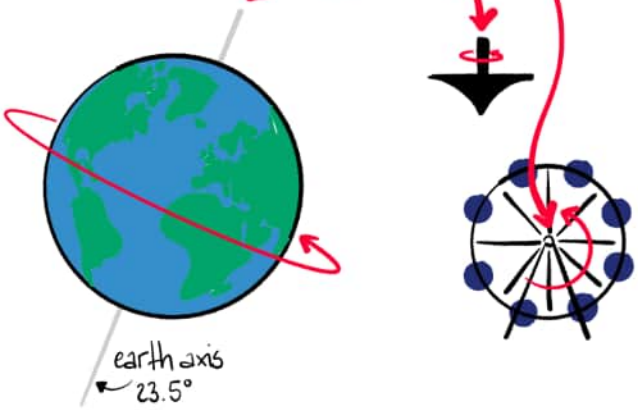


Physics Notes

Circular Motion

Rotation

turning around an internal axis



Revolution

turning around another object

Solstice: Sunlight max in one hemisphere & min in the other
→ Mid June & Mid December

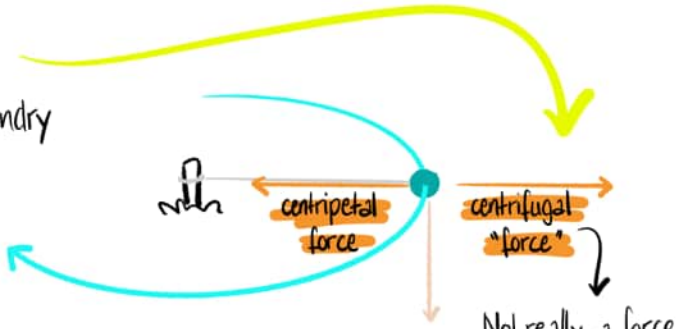
Equinox: Sunlight equally on both hemispheres
→ Mid March & Mid Septemper

Speeds

linear speed: $\frac{m}{s}$

rotational speed: rpm (rounds per minute)

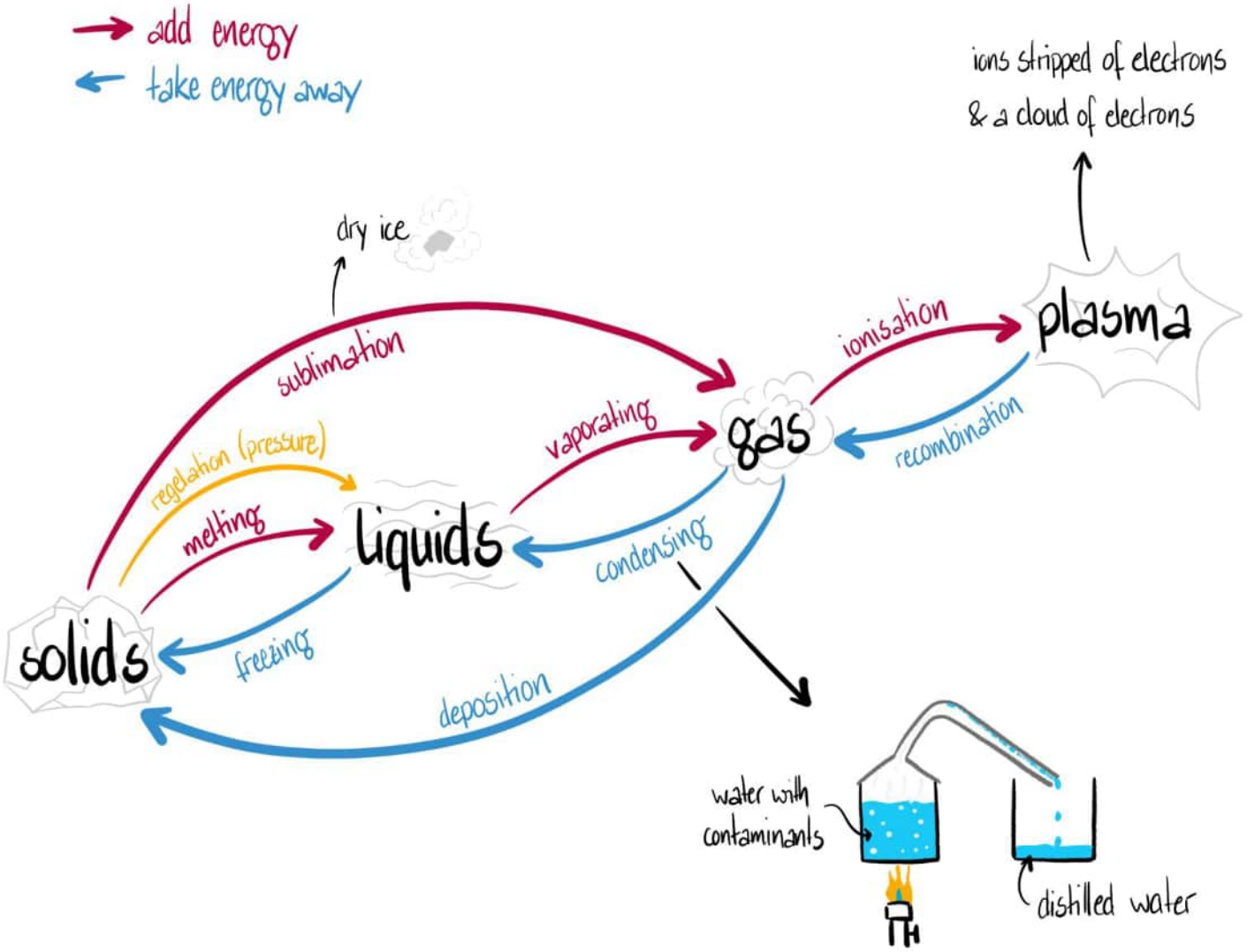
tangential speed: tangential



Not really a force but the feeling of inertia.
The motion would continue tangential

Physics Notes

Phase changes



Water

melting : 0.0°C for pure water
up to -15°C for contaminated water

vaporating : 100°C

Physics Notes

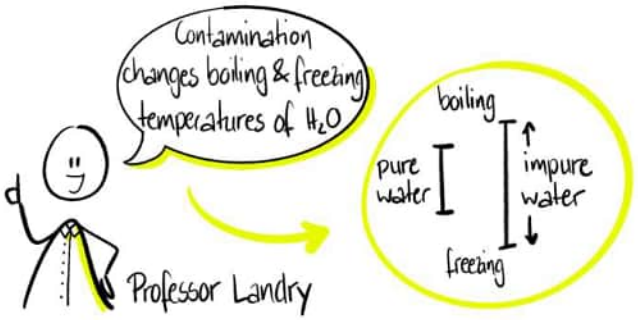
Thermodynamics

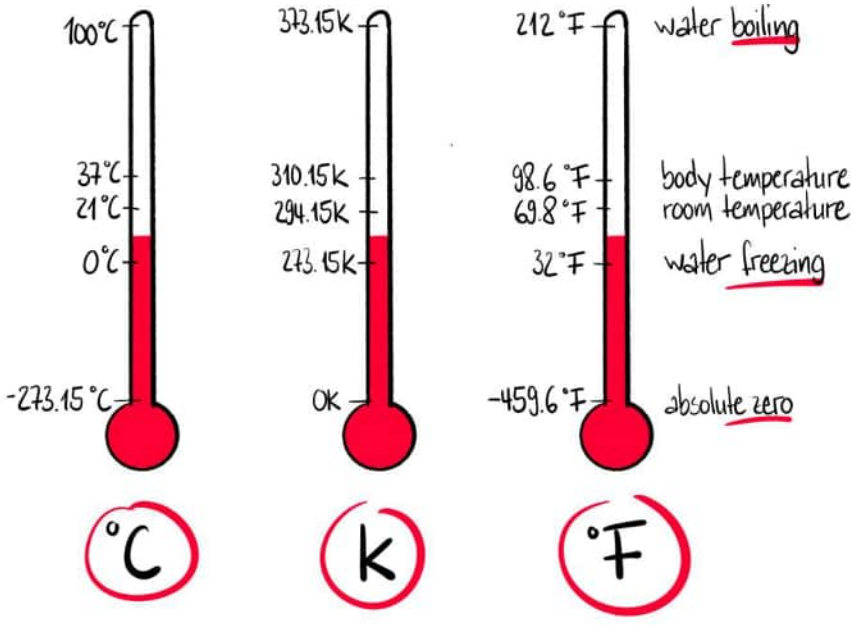
Energy laws

1. Energy cannot be created or destroyed. It can only change form.

2. Entropy (randomness & disorder) in a system stay the same or increase, but not decrease

3. When the temperature reaches absolute zero (0K / -273.15°C), entropy nears zero





20,000,000 K — center of the sun

20,000 K — plasma

6000 K — surface of the sun

373.15 K / 100 °C — pure water boils

273.15 K / 0 °C — pure ice melts

-90 °C — dry ice vaporizes

-273 °C — Helium boils

0K / -273.15 °C — absolute zero

Physics Notes