state that mass is a measure of the amount of substance in a body

Mass

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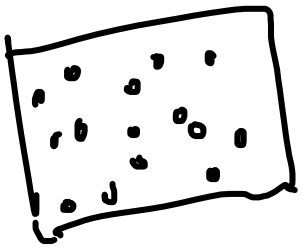
- a number that tells us how much substance is in a body.



What substance?, atoms, electrons, protons, --- ?

Maybe - but don't need to know if just want to compare mass.

Measure mass in 2 ways:

1. weight

2. inertia - tendency to resist change to motion

state that the mass of a body resists a change in the state of rest or motion of the body (inertia)

Inertia

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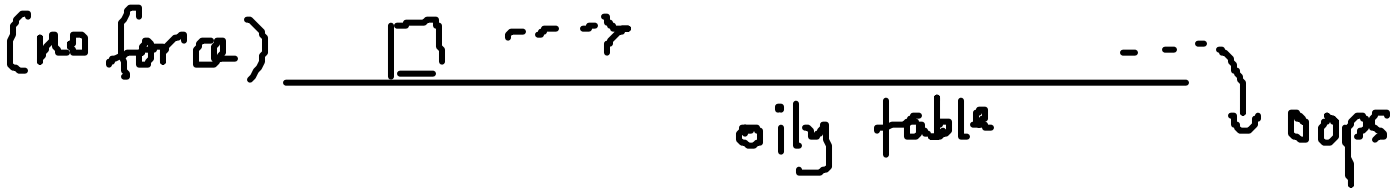
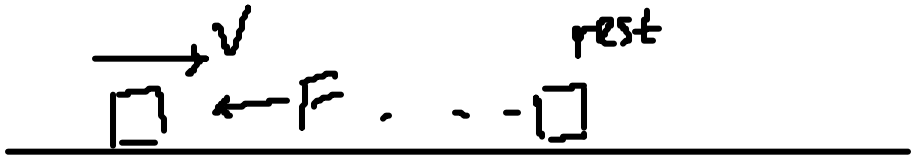
Needs force to move a body.

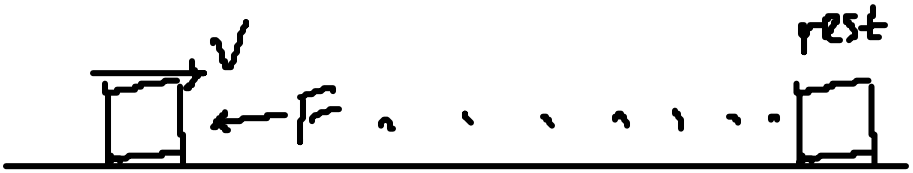
Keeps going if not stopped ...



Needs force to stop it.



Harder to stop --> more mass



e.g. so distance to stop - one way to measure mass

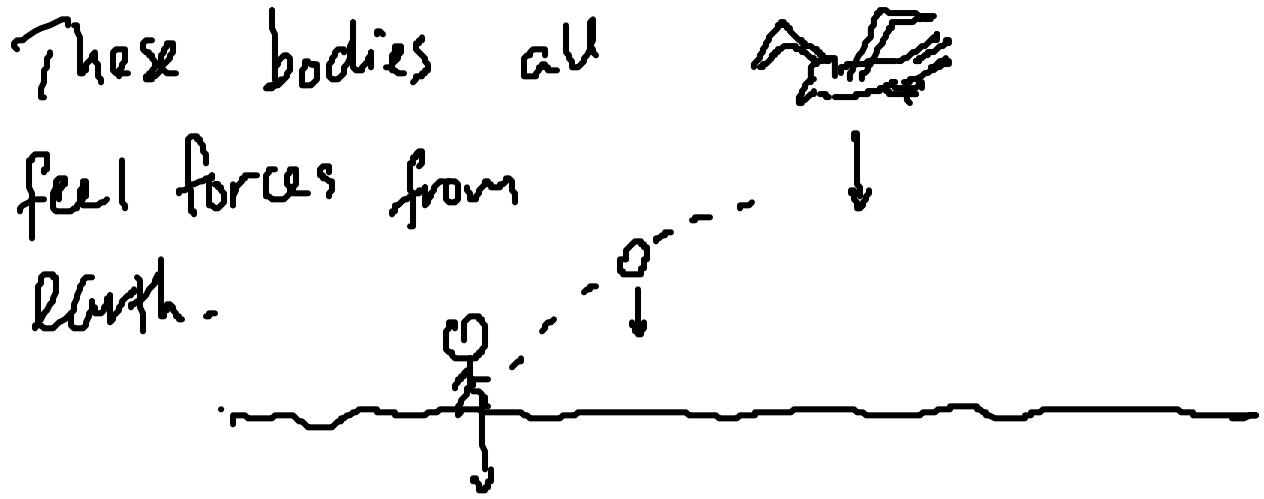
Inertia:

Body stays at rest , or keeps going in straight line - unless there is a force.

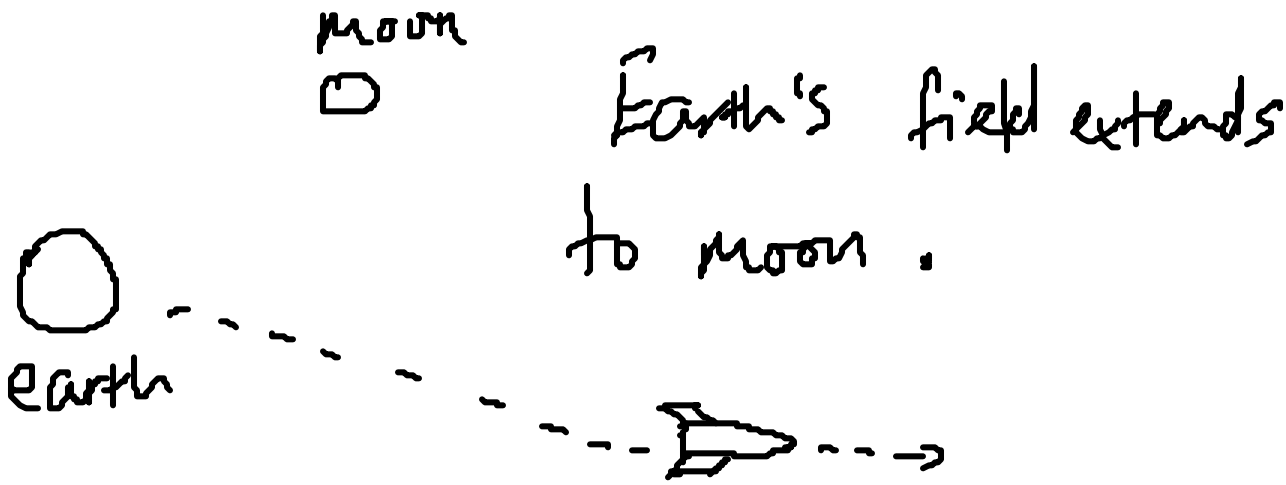
state that a gravitational field is a region in which a mass experiences a force due to gravitational attraction

Gravitational Field

Dr K M Hock



Gravitational field - a region where a mass feels a force of gravity.



define gravitational field strength g as gravitational force per unit mass

Gravitational Field Strength

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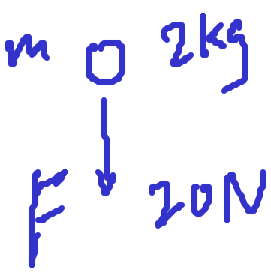
e.g. 

What is the force per unit mass?

Ans. $\frac{20\ N}{2\ kg} = 10\ N/kg.$

e.g. 

$\frac{30\ N}{3\ kg} = 10\ N/kg$

On earth, gravitation force per unit mass is always ~10 N/kg. (9.81 m/s^2)

– called gravitational field strength.

$$g = \frac{F}{m}$$

It is also called the acceleration due to gravity.

recall and apply the relationship weight = mass × gravitational field strength to new situations or to solve related problems

Weight

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Since force of gravity is weight (W),

rewrite as $g = \frac{W}{m}$, or $W = mg$.

weight = mass × gravitational field strength

or

weight = mass × acceleration due to gravity

e.g. Find the weight of a 2 kg brick.

$W = mg = 2 \times 10 = 20$ N.

e.g. Weight of a book is 5N. Find its mass.

$m = \frac{W}{g} = \frac{5}{10} = 0.5$ kg

e.g. On moon the weight of the same book is 1 N. Find the gravitational field strength there.

$g = \frac{W}{m} = \frac{1}{0.5} = 2$ N/kg

Mass and Weight

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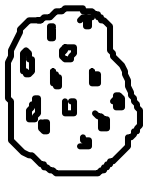
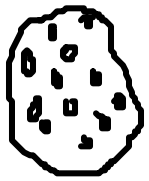
On Earth

1kg 

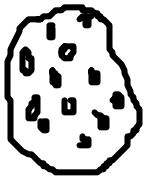
On Moon

same body  1kg

Same amount of substance,

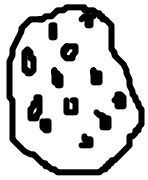
so mass is same on moon.

On Earth



10N ↓

On Moon

same body 

↓ 1.7N

Weight is a force - it can move a body

- different from mass

Weight is smaller on moon for same body.

recall and apply the relationship density = mass / volume to new situations or to solve related problems

Density

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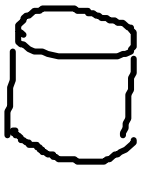
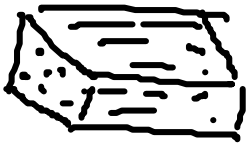
Which is heavier - iron or wood?





Must compare for same volume, e.g. $1\ cm^3$.

To find mass per unit volume:

$$\text{density} = \frac{\text{mass}}{\text{volume}} \qquad \rho = \frac{m}{V}$$

e.g. $2\ cm^3$ of a wood is 1.4 g.

$$\text{Density} = \frac{1.4}{2} = 0.7\ g/cm^3$$

	g/cm^3
helium	0.00018
air	0.0012
cork	0.24
wood	0.7
sodium	0.97
ice	0.92
water	1.0
concrete	2.0
aluminium	2.7
iron	7.9
copper	8.9
lead	11
mercury	13.5
gold	19

e.g. Why does wood float on water?

Because it is less dense than water.

e.g. Why does helium balloon fly upwards?

Because it is less dense than air

e.g. Why is an iron pot so much heavier than an aluminium ibe if the same size?