Describing motion

New word list:

Weight, gravity, balanced, unbalanced, equilibrium, impulse, pulse, momentum, conservation, collision, normal force, upthrust, tension, friction, fluid, drag, air resistance, scale diagram, strike, racket,

Force

Why do we have **acceleration**? Think about **free fall & rocket**

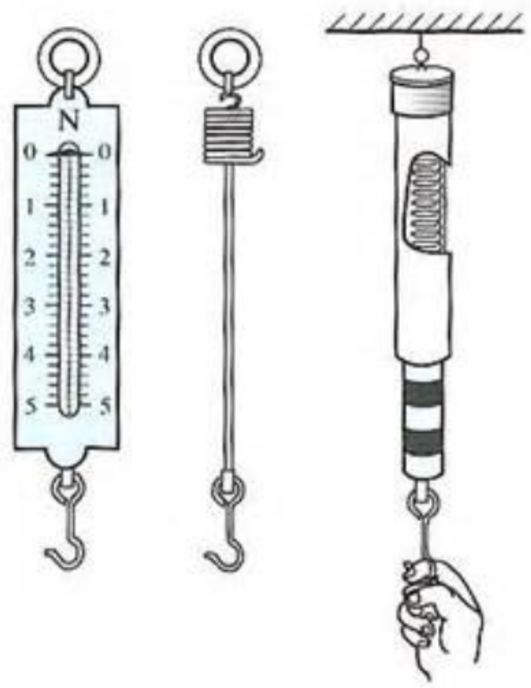
Force: interaction

Force is a **vector**: Force has both magnitude and **direction**

Representation: F

Unit: **N**(Newton)

Measuring tool: Spring balance



Weight

Weight: **W= mg**

Direction: **vertically downwards**

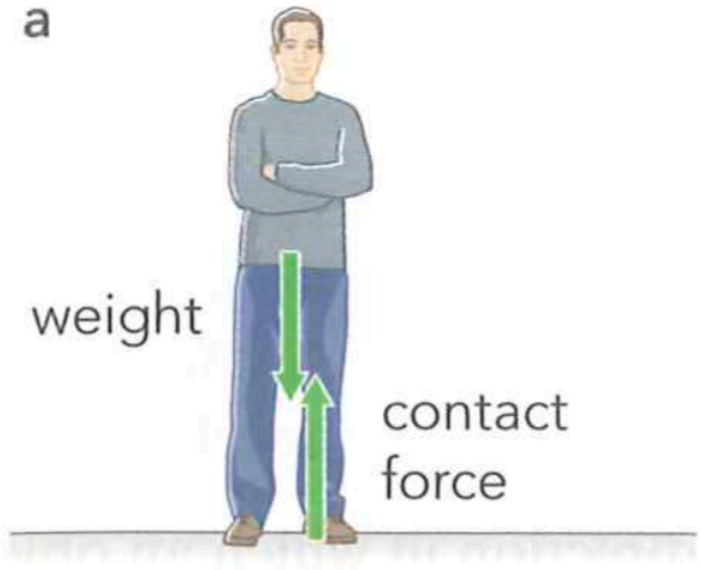
Mass vs weight vs gravity
mass: the quantity of matter in an object at rest to the observer
weight: downward force due to gravity
gravity: a fundamental interaction which causes mutual attraction between all things with mass or energy

Weight

The force that causes free fall is: gravity/weight

gravitational field strength = acceleration of free fall/ acceleration due to gravity g

g on Earth surface =



Exercise

A 5kg ball and a 1kg ball, what are their weights respectively?

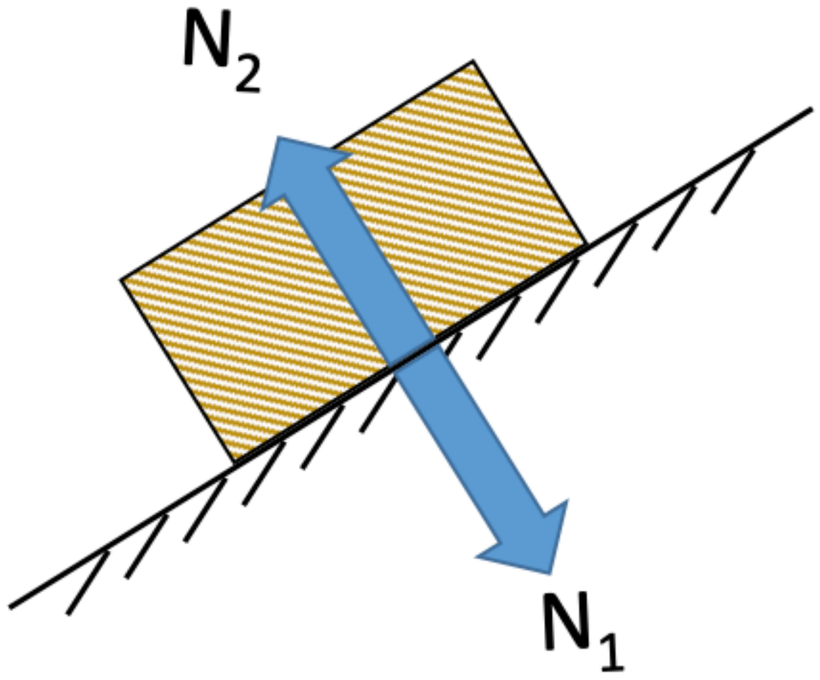
Exercise

Will your weight change when you are in the moon? In the deep space?

Normal Force

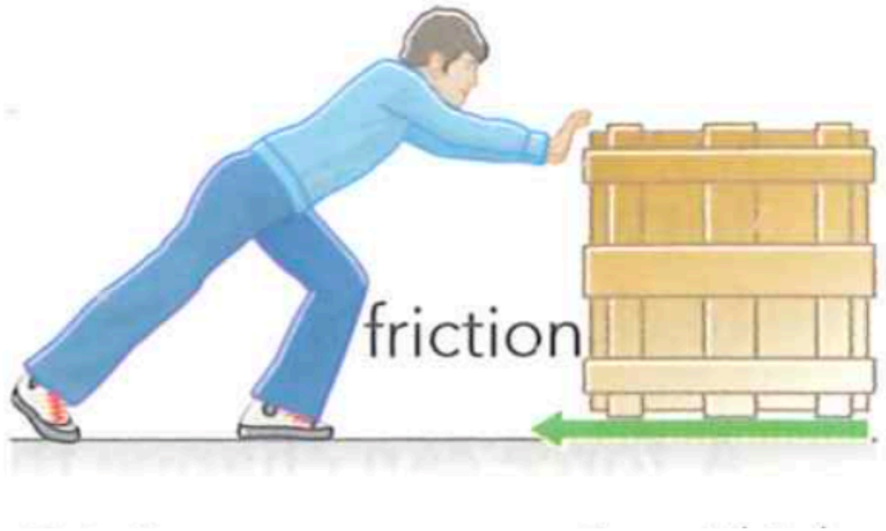
N/F_N

Perpendicular to contact surface



Friction

f/F_f

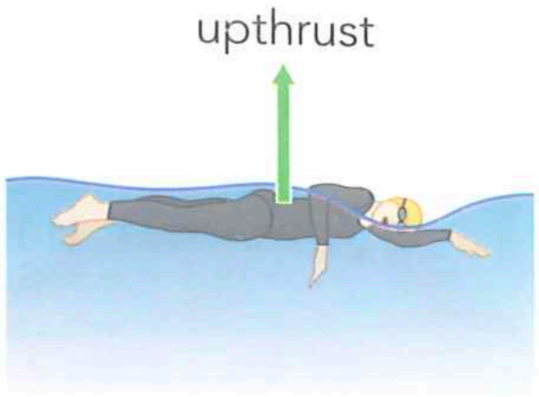


Air Resistance/Drag

Direction: opposite to relative motion

Depends on: speed, contact surface area, air density

Other Forces



Buoyancy/upthrust (F_B)

Elasticity (F_e)

TensionT/F_T

Force Classification

Free Body Diagram

Step 1: draw weight

Step 2: check each contact object, see if they exert forces

Exercise

Draw the free body diagram of following objects:

A ball falling in vacuum

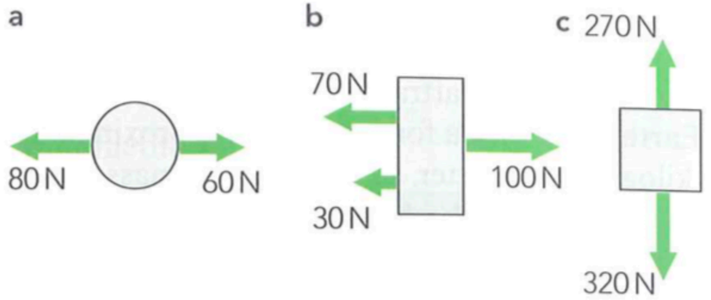
A ball falling in air

An object at rest on a flat surface

An object on a ramp with friction

Resultant Force

1. vector addition (paralleled):



2. Vector addition (unparalleled): scale diagram

e.g. an object experiences two force: weight 10N, friction along the ramp 8N

Newton's Law

Unbalanced force produces acceleration

Newton's second law:

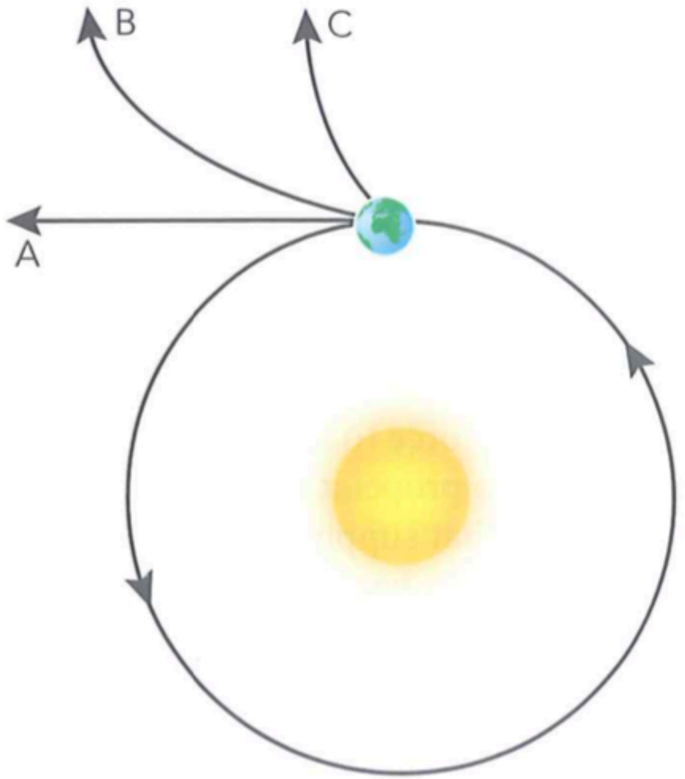
non-zero resultant force

No resultant force/balanced force

Mass:

Exercise

The earth orbiting the sun. Which of the paths would earth follow if the sun suddenly stopped existing?



Exercise

Throw a 5kg ball and a 1kg ball, when ignoring air resistance, when will first fall to the ground?

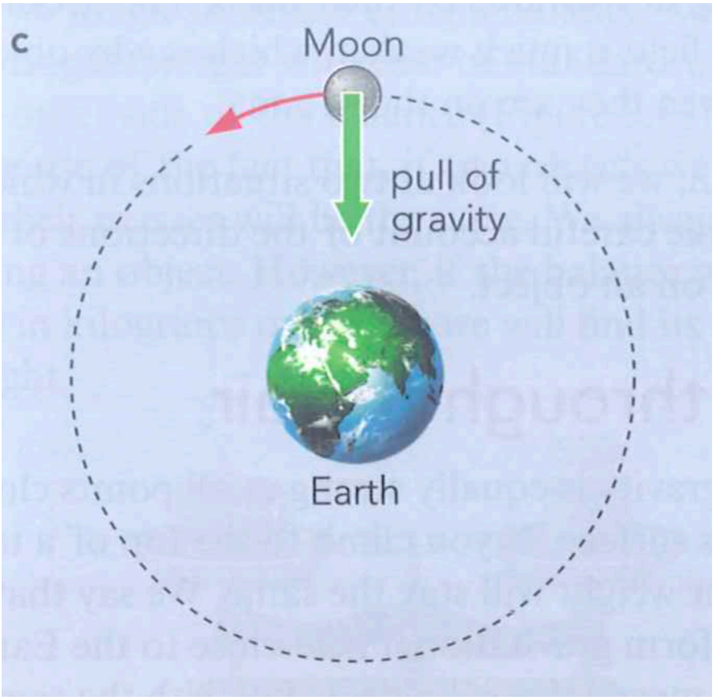
Falling with air resistance (e.g. parachutists)

Free body diagram

Speed-time graph

How to change directions during the movement?

Force F =



Exercise

When you strike a tennis ball that another player has hit towards you, you provide a large force to reverse its direction of travel and send it back towards your opponent. You give the ball a large acceleration. What force is needed to give a ball of mass 0.10kg an acceleration of 500m/s/s?

Exercise

An Airbus A380 aircraft has four jet engines. Each capable of providing 320000N of thrust. The mass of the aircraft is 560000kg when loaded. What is the greatest acceleration that the aircraft can achieve?