Mechanical actions

Printable revision sheet — Galaxscia

LEVEL 1

What is a mechanical action?

Every time you push, pull, hit or press on an object, you exert a mechanical action. It is simply the effect that one object (or person) has on another. This action can:

change its motion (make it speed up, slow down, change direction),

or deform it (bend it, crush it, stretch it...).

For example, kicking a ball makes it move: that is an action which changes its motion. Crushing a metal can is an action which deforms it.

Two types of mechanical action

There are two main families of mechanical action:

Contact actions: the objects must be touching. Example: pushing a door, pulling a drawer, walking (your feet press on the ground).

Actions at a distance: the objects do not touch. Example: the Earth pulls objects towards it without touching them (weight), a magnet attracts a paper clip from a distance.

Representing a mechanical action

To understand actions better, scientists use two tools:

Forces: they represent an action with an arrow called a vector.

Interaction diagrams: they show all the interactions between an object and its surroundings.

Key points — revision questions

- A mechanical action can change a motion or deform an object.
- It can be a contact action or an action at a distance.
- It is represented by a force or by an interaction diagram.

LEVEL 2

What is weight?

Weight is an action at a distance exerted by a celestial body (such as the Earth) on objects near its surface. It is a particular case of gravitation.

When you let go of an object, it falls towards the ground: that is because the Earth attracts it. This force is what we call weight.

How is weight measured?

Weight (written P) is measured with a dynamometer and is expressed in newtons (N). It depends on two things:

the mass of the object (the heavier it is, the more it is attracted),
the strength of gravity, or gravitational field strength (g), which depends on the planet.

On Earth we take g ≈ 10 N/kg (more precisely, 9.81 N/kg). This quantity can also be written in m/s², an equivalent unit, because g is both a gravitational field strength and an acceleration.

The formula to know

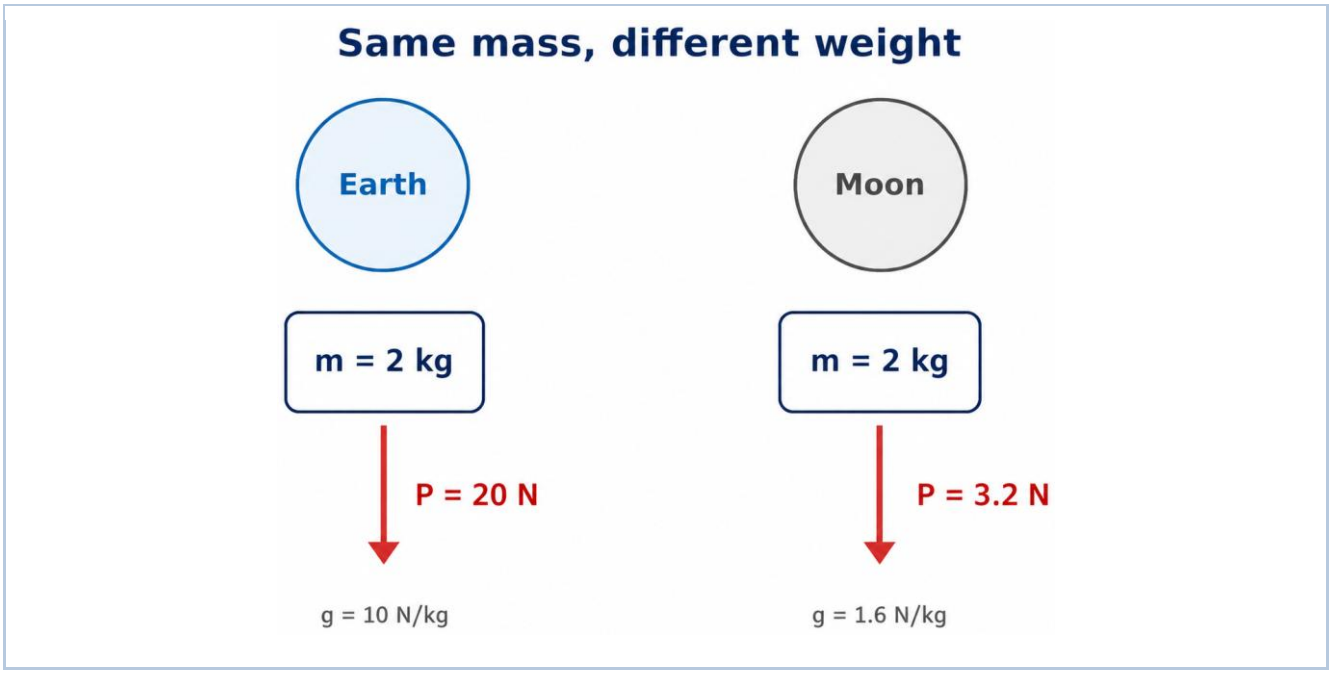
$$P = m \times g$$

With:

P: weight (in N),
m: mass (in kg),
g: gravitational field strength (in N/kg, or equivalently in m/s²).

Example: An object of 2 kg on Earth.

The gravitational field strength is g = 10 N/kg. The formula: P = m × g → P = 2 × 10 = 20 N The same object on the Moon (g ≈ 1.6 N/kg) → P = 2 × 1.6 = 3.2 N



Key points — revision questions

- Weight is an action at a distance linked to gravity.
- Weight depends on the mass and on the gravitational field strength.
- Formula: P = m × g
- Weight changes from one planet to another, but the mass stays the same.

LEVEL 3

A force found everywhere in the universe

Every object that has a mass exerts a force of attraction on every other one. This is universal gravitation. Even though we do not feel it between small objects, it is responsible for:

the weight we feel on Earth,

the motion of the planets around the Sun,

the fall of objects towards the ground.

Gravitation ≠ weight

Gravitation: force of attraction between two masses, whatever their size or position.

Weight: the effect of the gravitation of a celestial body on objects close to its surface.

Weight is therefore a particular case of gravitation.

What gravitation depends on

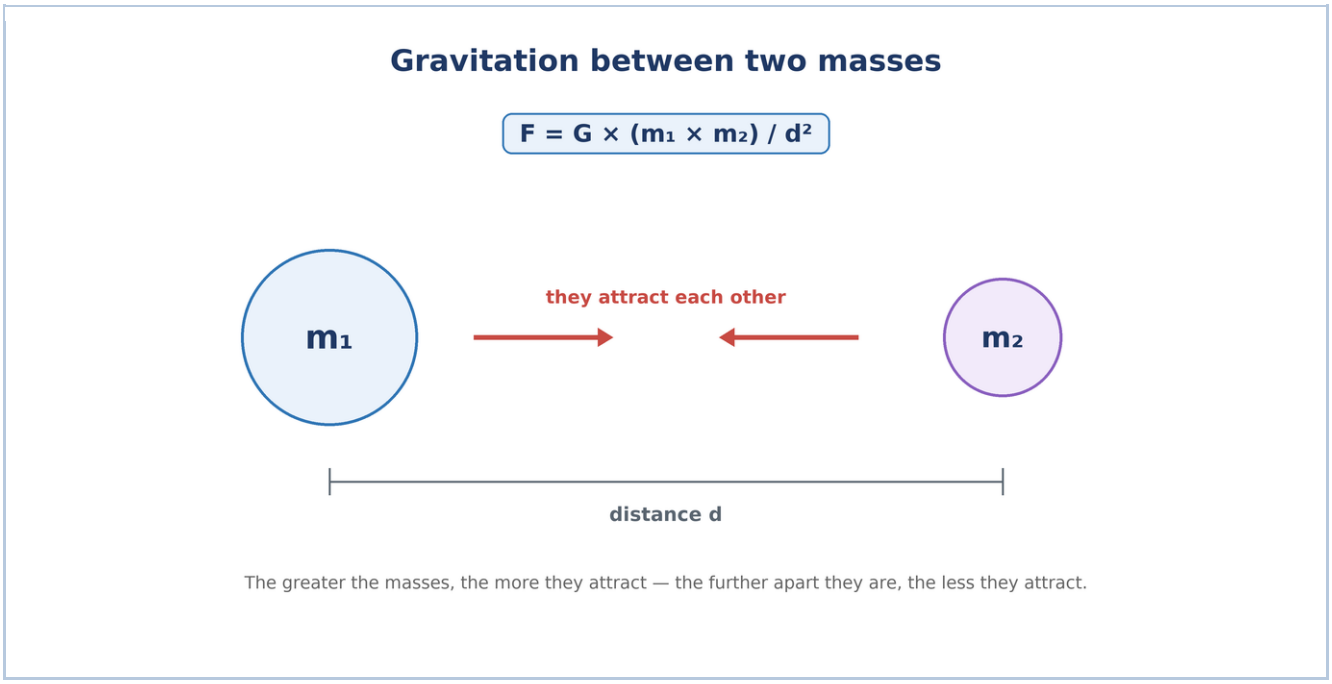
The strength of gravitation depends on:

the mass of the objects (the more massive they are, the stronger the attraction),

the distance between them (the further apart they are, the less they attract each other).

It is the law of universal gravitation (developed by Isaac Newton) that lets us calculate this gravitational force:

$$F = G\, m_1 \times m_2/d^2$$



Key points — revision questions

- Every object that has a mass attracts every other one: this is gravitation.
- Weight is a particular case of gravitation.
- The strength of the attraction depends on the masses and on the distance.