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King Saud University
College of Science
Physics & Astronomy Dept.

Phys 145 (General Physics)

Chapter 3: Newton's Law of Motion

Week n° 03

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Chapter 3: Newton's Laws of Motion

- **We will learn in this chapter 3:**

- Mass and Weight of an object
- Newton's first law (Equilibrium)
- Newton's third law (Action and reaction)
- Newton's second law
- Static and kinetic friction

Chapter 3: Newton's Laws of Motion (First part)

- **We will learn in this first part of chapter 3:**

- Mass and Weight of an object
- Newton's first law (Law of inertia)
- Equilibrium
- Newton's third law (Action and reaction)

Mass and weight of an object

- **Mass and Weight are completely different physical quantities:**
- **Mass** كتلة

It measure how much matter there is in an object.

In the Système International (SI) Mass is in kilogram (kg).

- **Weight** وزن

It measure the gravitational force acting in an object.

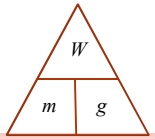
In the Système International (SI) Weight is in Newton (N).

g is the gravitational acceleration.

Near the Earth, we will consider g constant: g=9.8 m/s².

Weight = Mass x Gravity

$$W = m \times g$$



Newton's First Law

- Every object continues in a state of rest, or of uniform motion in a straight line, unless it is compelled to change that state by forces acting upon it.
- When there is no net force (total force) acting on the object, then an object at rest remains at rest, and an object in motion continues to move with constant velocity.

Object at rest Object at constant velocity

In both case the acceleration is zero.

Equilibium

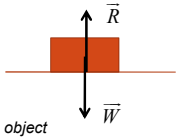
- The motion of an object remains unchanged whenever the net force on the object is zero.
- It can be happen if no forces act on an object,

  Or,
- It occurs because two or more forces acting on an object have as a sum zero. They are called *balanced* forces.

  The object is said to be in **equilibrium.**

Example 3.1

equilibium $\Leftrightarrow \vec{W} + \vec{R} = \vec{0}$

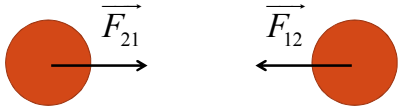


Note that:
*The origin of the vector **W** is the center of the object but the origin of **R** is between the object and the plane.*

Video 01 of week 03: Forces and first Newton law

Newton's Third Law

When one object exerts a force on a second object, the second object exerts an equal but opposite force on the first.



Object(1) *Object*(2)

$\vec{F}_{21}$ is the force excerced by (2) on (1)

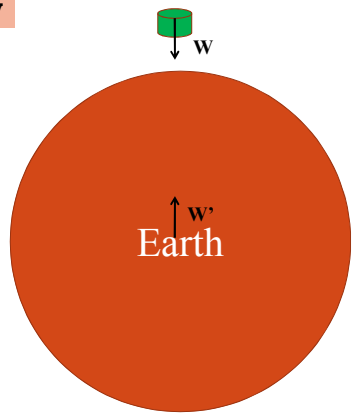
$\vec{F}_{21}$ is the force excerced by (1) on (2)

$$\vec{F}_{12} + \vec{F}_{21} = \vec{0}$$

Newton's Third Law

Example 3.2

The Earth exerts a force on an object (its weight **W**), so, this object exerts an opposite force on the Earth **W'**!!!!



Video 02 of week 03: Third Newton law

Summary of week 03

- **Mass and weight are defined.**
- **The Newton's first law is presented.**
- **Equilibrium of objects are explained.**
- **The Newton's third law is presented.**

Quiz for week 03