Dynamics
Laws of Motion
More About Forces

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Overview

- Newton's first and second laws

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- mass and weight
- Newton's 3rd Law
- action-reaction pairs of forces
- fundamental forces

Mass

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It happens to be equal to *gravitational mass*, because the strength of gravitational interactions depends on mass. (More on this later...)

The Difference between Mass and Weight

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Mass is a measure of inertia. Weight is a force an object experience due to a gravitational interaction.

The Difference between Mass and Weight

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A measure of the amount of matter in an object. Also, a measure of the inertia of an object, that is, its resistance to changes in its motion.

weight

The force due to gravity on an object.

Objects in free-fall can be said to be weightless, but they still have mass.

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Weight F_g,

$$F_g = mg$$

Units: Newtons.

Newton's Third Law

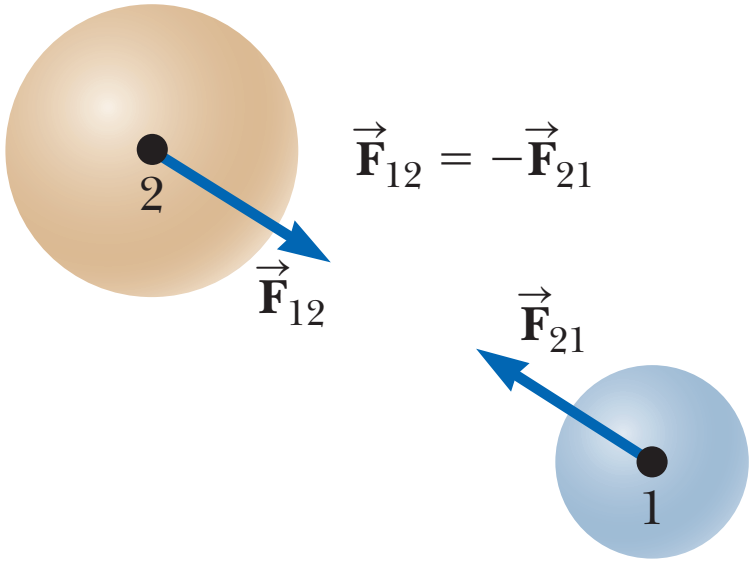
Newton III

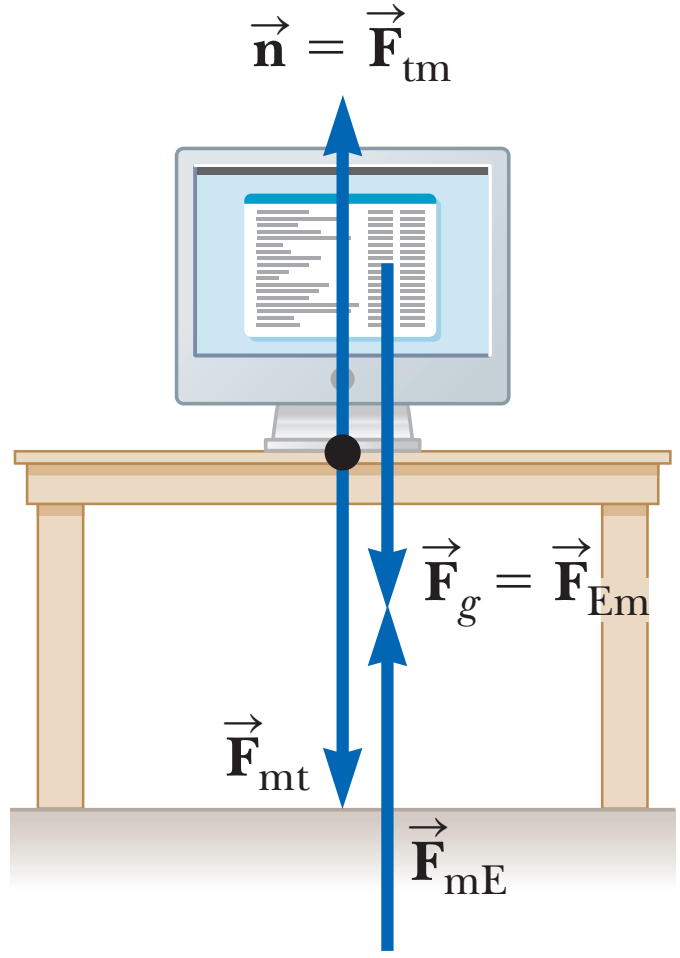
If two objects (1 and 2) interact the force that object 1 exerts on object 2 is equal in magnitude and opposite in direction to the force that object 2 exerts on object 1.

$$\vec{\mathbf{F}}_{1\to 2} = -\vec{\mathbf{F}}_{2\to 1}$$

Or, as commonly stated: "every action has an equal and opposite reaction."

Newton's Third Law: Action Reaction Pairs





Action-Reaction Pairs of Forces

Question. Do the two forces shown in the diagram that act on the monitor form an action-reaction pair under Newton's third law?

(A) Yes.

(B) No.

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Forces at a Fundamental Level

Previously, we talked about two kinds of forces: contact forces and field forces (*ie.* forces that act at a distance).

In mechanics problems, usually gravity is the only field force that we need to consider. The rest are all contact forces.

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In mechanics problems, usually gravity is the only field force that we need to consider. The rest are all contact forces.

However, at a fundamental level, *all* forces that we know of are field forces.

Forces at a Fundamental Level

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The fundamental forces (interactions):

Force	$\sim$ Rel. strength	Range (m)	Attract/Repel	Carrier
Gravitational	10^{-38}	∞	attractive	graviton
Electromagnetic	10^{-2}	∞	attr. & rep.	photon
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Gravity is actually quite a weak force, but it is the only one that (typically) matters on large scales.

Summary

- mass and weight
- Newton's 3rd law
- forces fundamentally

(Uncollected) Homework

Serway & Jewett,

- prev: Ch 5, onward from page 136. Obj Ques: 1; Problems 3, 5, 7, 9, 11, 15, 17, 19
- new: Ch 5, onward from page 136. Problems: 23