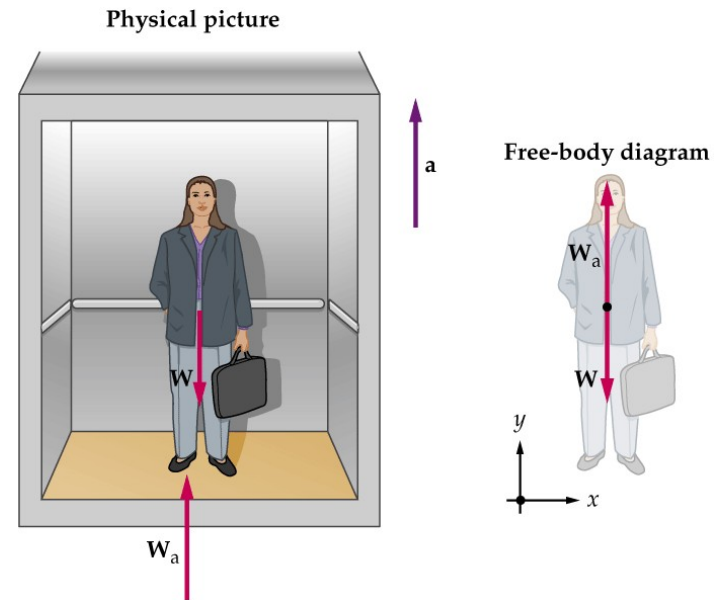


Lecture 8: Newtonian DYNAMICS

(Newton's Weight Loss Clinic)



Isaac Newton's work represents one of the greatest contributions to science ever made by an individual. Most notably, Newton derived the law of universal gravitation, invented the branch of mathematics called calculus, and performed experiments investigating the nature of light and color.

Lecture Outline and Outcomes

Lecture outline:

- Comparison between **kinematics and dynamics**
- **Newton's 1st law:** the Law of Inertia
- **Newton's 2nd law:** cause and effect law
- **Newton's 3rd law** of motion
- **Application of Newton's laws to problem solving**
- Developing physics intuitions: thinking about Newton's laws

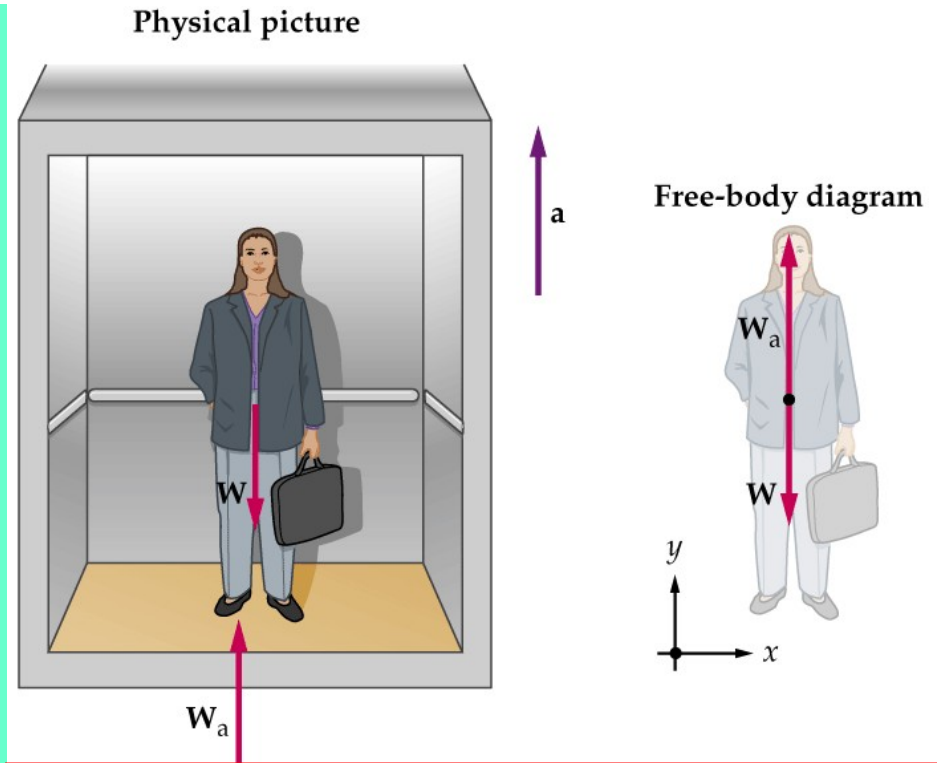
Lecture outcomes:

- You will learn how to:
 - **Identify and denote forces** acting on an object
 - Draw a **Free Body Diagram (FBD)**
 - **Use a FBD to write an equation of motion**
- You will understand the meaning of Newton's 1st, 2nd, and 3rd laws:
 - via making everyday life connections
 - via doing testing experiments (making predictions)
- You will practice **problem solving** applied to:
 - **Applications of Newton's 1st and 2nd and 3rd laws** of motion.

Apparent Weight in an Elevator

Most of the time the normal force a floor exerts on you has the same magnitude as your weight. It is the normal force you are measuring while standing on a regular bathroom scale. Therefore, we often refer to it as our weight (which is technically wrong).

However, sometimes this normal force does not equal our weight. In these special cases we call this normal force apparent weight.



$$\text{Second Law : } \vec{F}_{net} = m\vec{a}$$

$$\text{Notation : } N = W_a$$

Physics Weight Loss Clinic...

Given:

$a = 2 \text{ m/s}^2$
downwards

$m = 60 \text{ kg}$

$W_a - ?$

$$\vec{F}_{net} = m\vec{a}$$

$$\vec{W}_a = \vec{N}$$

$$\vec{N} + \vec{W} = m\vec{a}$$

$$\vec{N} = -\vec{W} + m\vec{a}$$

$$\vec{W}_a = -\vec{W} + m\vec{a}$$

$$\vec{W}_a = -\vec{W} + m\vec{a}$$

$$x: W_a = -(-mg) + ma$$

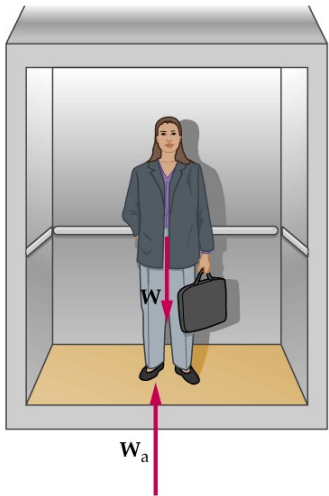
$$x: W_a = 600N + (60kg)(-2m/s^2)$$

$$x: W_a = 600N - 120N = 480N$$

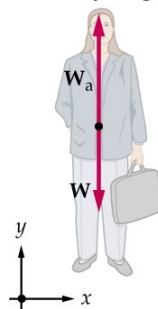
$$W = 600N = 132lbs$$

$$W_a = 106lbs$$

X Physical picture



Free-body diagram



The bad news is that whenever an elevator stops accelerating your apparent weight comes back to 600 N. And when an elevator accelerates upwards your apparent weight will increase to 720N (158lbs). BTW, you mass doesn't change during this trip 😊

References and HW Resources

- Chapter 4, textbook: *Physics* by D. Giancoli
- Related activities: Tutorial 3, HW Problems posted on the website: Set 3.
- Use *ActivPhysics* software (www.aw.com/young11) and sign up for Mastering Physics (www.masteringphysics.com) if you want to practice more and get instantaneous feedback.
- Voltaire's (1694-1778) letters on Newton:
<http://www.fordham.edu/halsall/mod/1778voltaire-newton.html>
- Isaac Newton: <http://www.newton.cam.ac.uk/newtlife.html>

