

2.07 Newton's Second Law

Goal: To explain and solve problems involving the relationship between force and acceleration as expressed in Newton's second law

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Newton's Second Law
1. Explain Newton's Second Law a. Mathematically: b. With Words: 2. Simulation Practice: Play with the animation to see examples of net force.

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Definitions

3. Define the Terms:

- a. Acceleration
- b. Mass
- c. Directly Proportional
- d. Inversely Proportional
- e. Force
- f. Net Force

Exploring the Second Law

4. Open the simulation, follow the directions and fill out the table

Force (N)	Acceleration (m/s^2)
0	
150	
200	
250	
300	
400	

5. What do you notice about the acceleration of the box as you increase or decrease the force? Does the data show a direct or indirect relationship between force and acceleration?
6. Keeping all the same parameters, push different objects with a force of **300 Newtons** according to the table below. Record the acceleration for each object shown.

Object	Acceleration
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Refrigerator		
Large Bucket		
Box		
Man		
Girl		

7. What do you notice about the acceleration of a smaller object compared to a larger one? Does it take more or less force to move a more massive object? Does the data show a direct or indirect relationship between mass and acceleration?

8. Now it's time to add friction. Move friction to different levels as you push objects with different force. When the net force is unbalanced, in which direction does the object move?

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Practice Problems
Complete the practice problems and show work. Check your answers when finished 1. The 32,500 kg school jet is on the Orlando Executive runway. What net (unbalanced) force is necessary to accelerate the jet to its takeoff acceleration of 1.20 m/s²? 2. Gary, an online physics student, has a mass of 80.5 kg. His new bicycle has a mass of 13.7 kg. Gary is pedaling so that a net (unbalanced) force of 9.86 N accelerates him and his bicycle. What is the value of the acceleration?

3. Krista's new Porsche can accelerate from rest to 27.00 m/s in just 5.800 s. If the combined mass of Krista and her Porsche is 1452 kg, calculate the magnitude of the net (unbalanced) force that can cause the acceleration.
4. Chase hopes to make the school varsity baseball team. While participating in batting practice, Chase gets a big hit and accelerates the 0.150 kg baseball at a rate of $2.90 \times 10^4 \text{ m/s}^2$. How much force was exerted on the baseball to cause the acceleration?
5. Joe is known as the "Greatest Human Cannonball"! He has a mass of 75.0 kg, and is shot out of an 18.2 m cannon each performance. If Joe spends 0.97 s in the cannon barrel during firing, what is the net (unbalanced) force exerted on him? (Hint: You will first need to calculate the acceleration.)
6. A horizontal force of 100 N is required to push a crate across a factory floor at a constant speed.
 - A. What is the net (unbalanced) force acting on the crate?
 - B. What is the value of the force of friction acting on the crate?