

## Lecture 2.3: Newton's second law of motion

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## Introduction

### Newton's 2nd law of motion

$$F = ma. \text{ (Force = mass} \times \text{acceleration)}$$

## Falling objects with air resistance

### Differential equation

We just derived the following ODE:  $v' = -g - \frac{r}{m}v$ , where  $v(t)$  is velocity,  $g \approx 9.81m/s^2$ ,  $m$  is mass, and  $r > 0$  is a constant.

## An example

### Example 1 (exponential decay to a value)

A 70kg object falls from rest, and its terminal velocity is  $-20$  m/s.

- (a) Find its velocity and distance traveled after 2 seconds.
- (b) How long does it take to reach 80% of its terminal velocity?

An example:  $v(t) = -20 + 20e^{-\frac{1}{20}gt}$

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