SEARS & ZEMANSKY'S

College Physics

9th edition

PowerPoint Lectures

2 Motion Along a Straight Line

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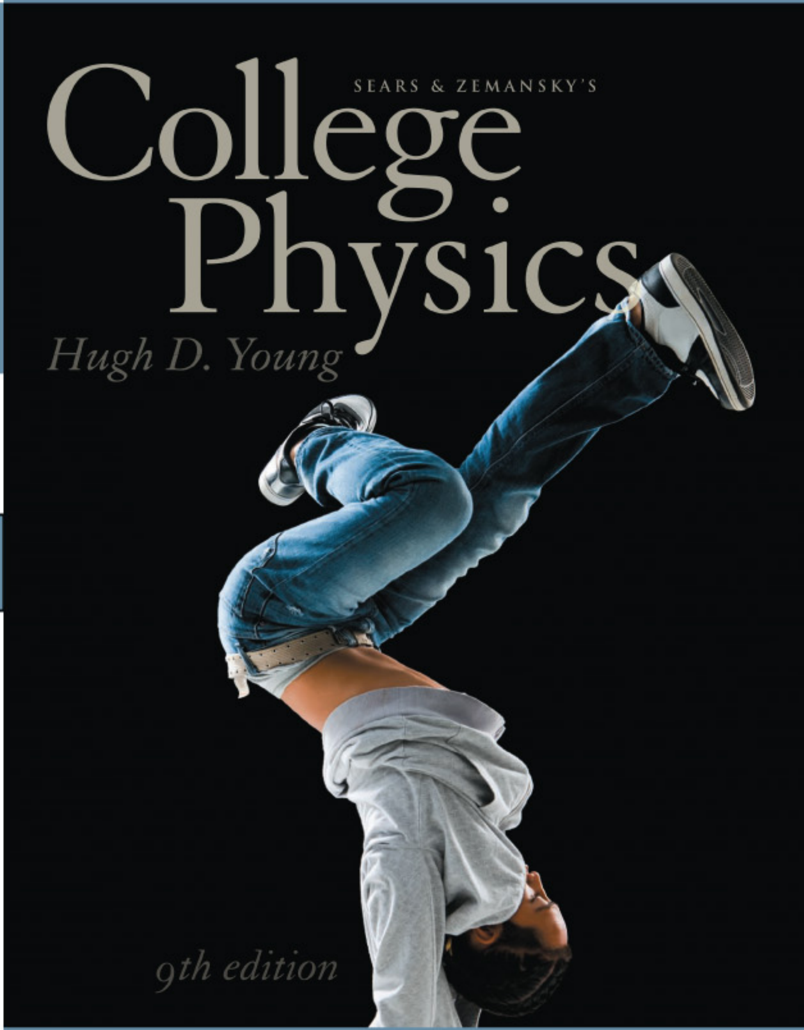
Young



Goals for Chapter 2

- Become comfortable with displacement, velocity, and acceleration.
- Explore motions at constant acceleration.
- Be able to graph and interpret graphs as they describe motion.
- Be able to reason proportionally.
- Examine the special case of freely falling bodies.
- Consider relative motion.

Motion

- Motion is divided into two areas of study:
  - Kinematics
    - This will be our focus in chapter 2.
    - Kinematics describes the movement of the object.
  - Dynamics
    - Will come in Chapter 4 and after.
    - Dynamics answers the “Why is this object moving?” question.

"Are we there yet?"

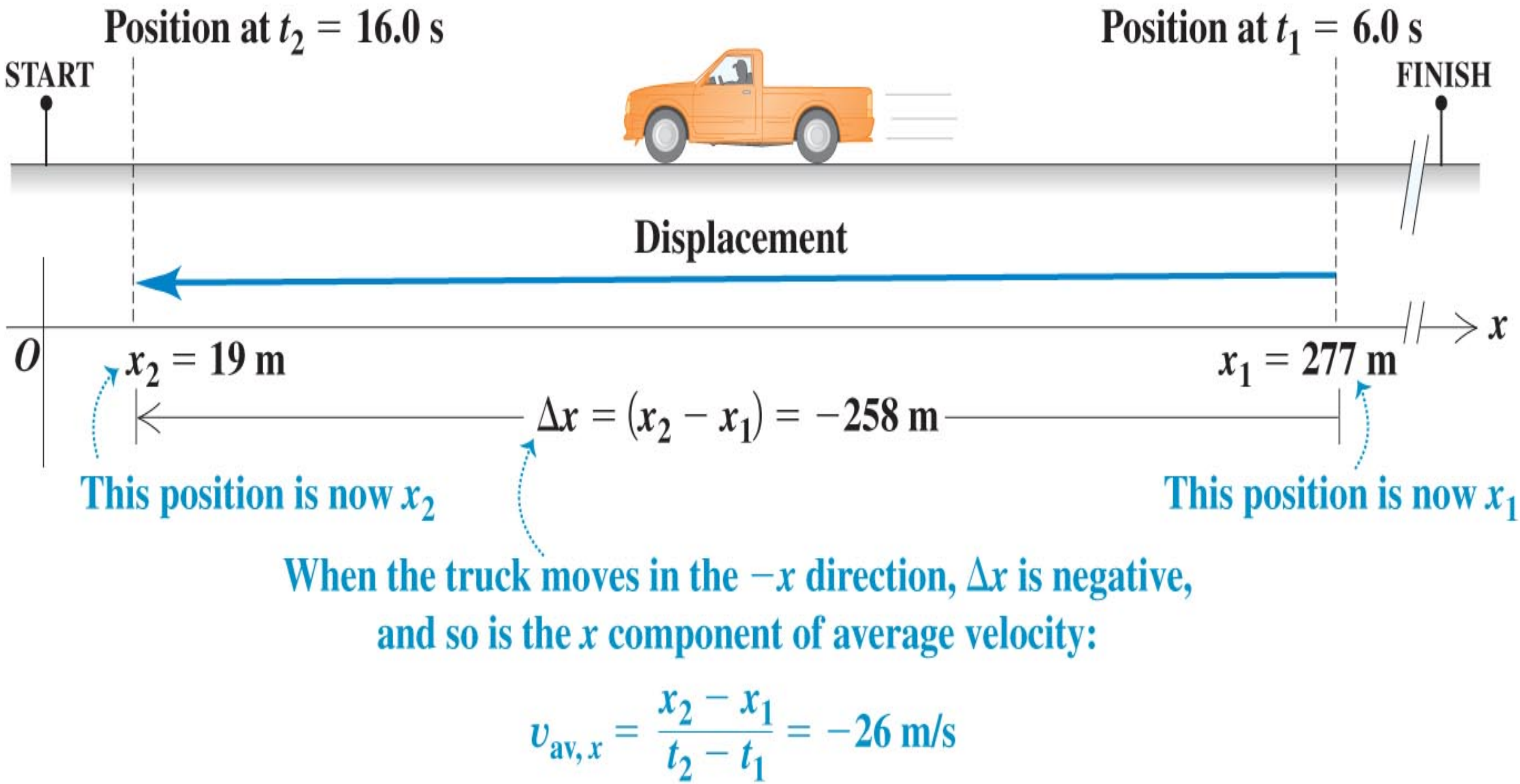
- Displacement, the distance from *here* to *there*

- Units

SI	Meters (m)
CGS	Centimeters (cm)
US Cust	Feet (ft)

- Average velocity
  - Stop, speed up, slow down
  - Focus on total time and total distance

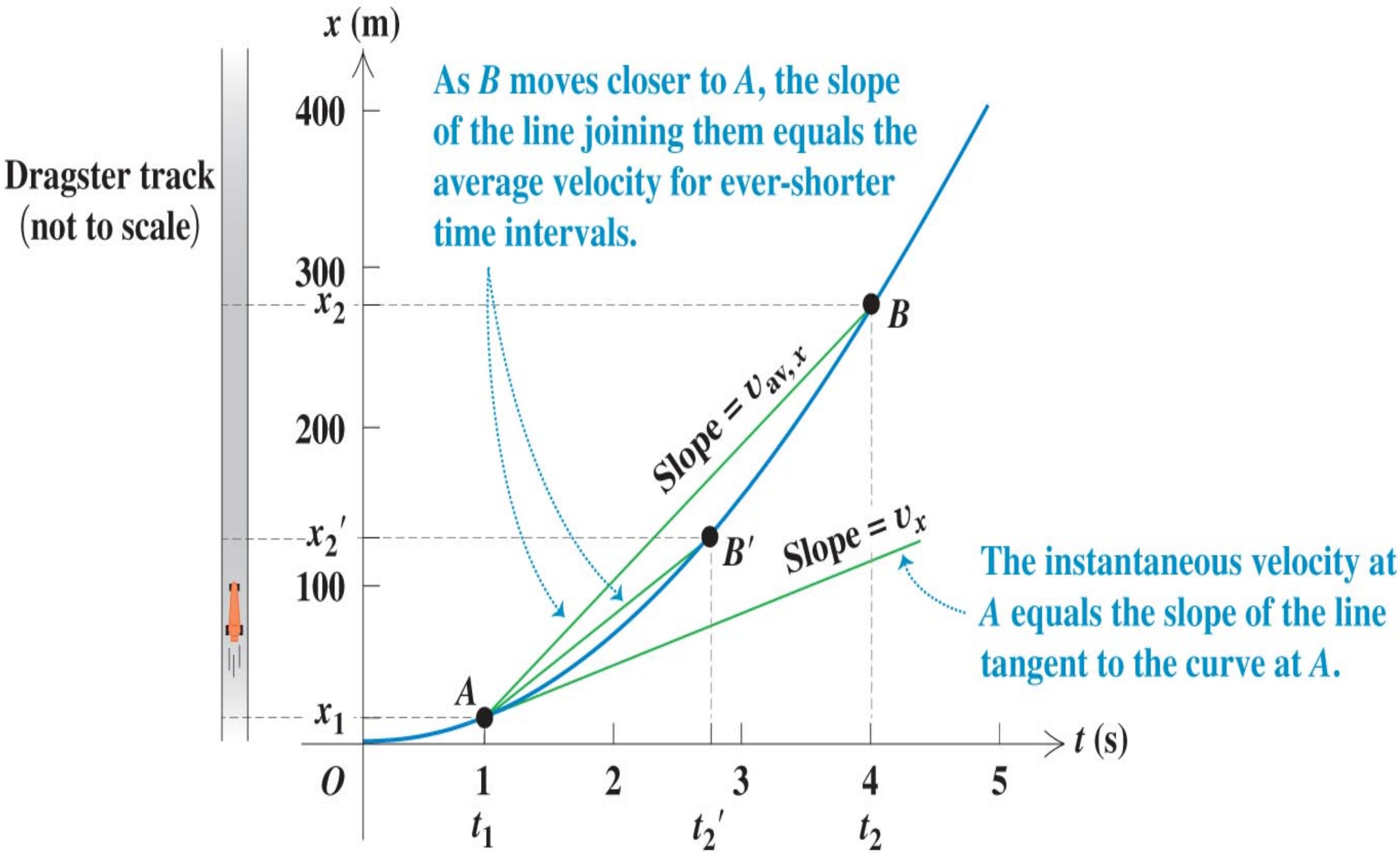
Average velocity - Figure 2.2



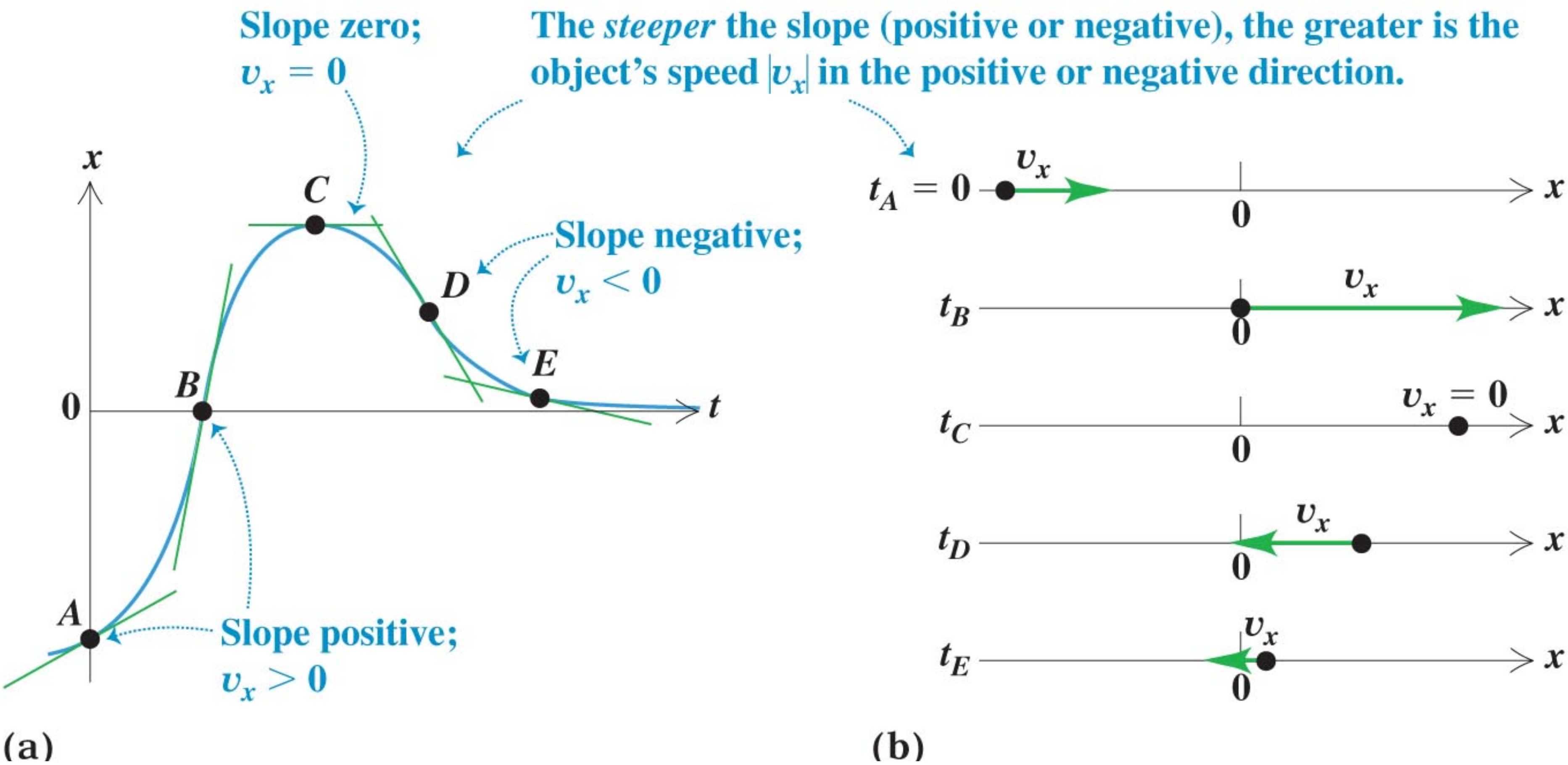
"What did the radar gun say?" … Instantaneous velocity

- Look on a digital dashboard.
- Instantaneous velocity is found with a tangent line to a position vs time graph.
- We need to be sure of sign conventions.
- What direction is the motion undergoing? Direction draws a distinction between scalars and vectors.

Motion of the dragster - Figure 2.7



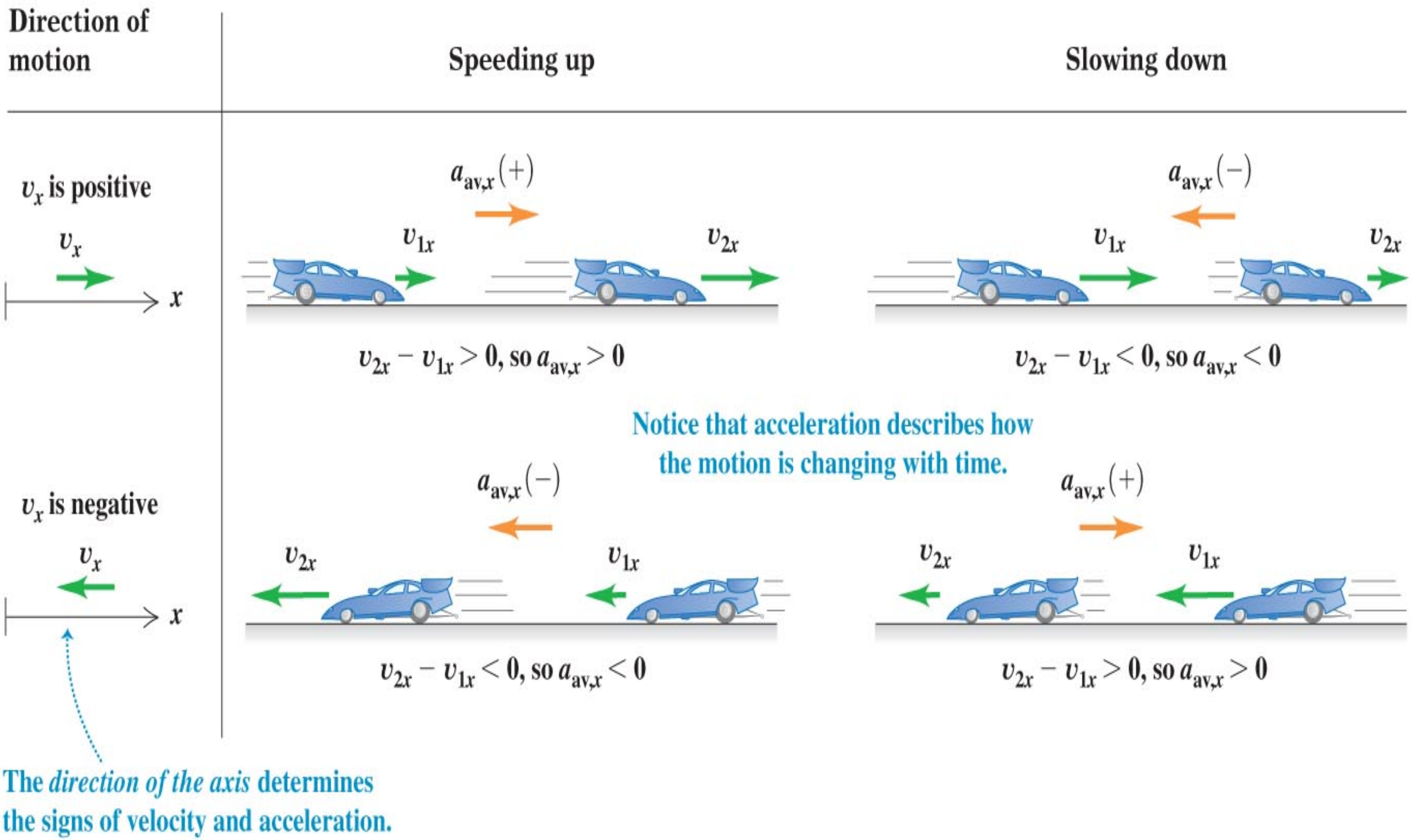
Interpretation of motion via graphing - Figure 2.8



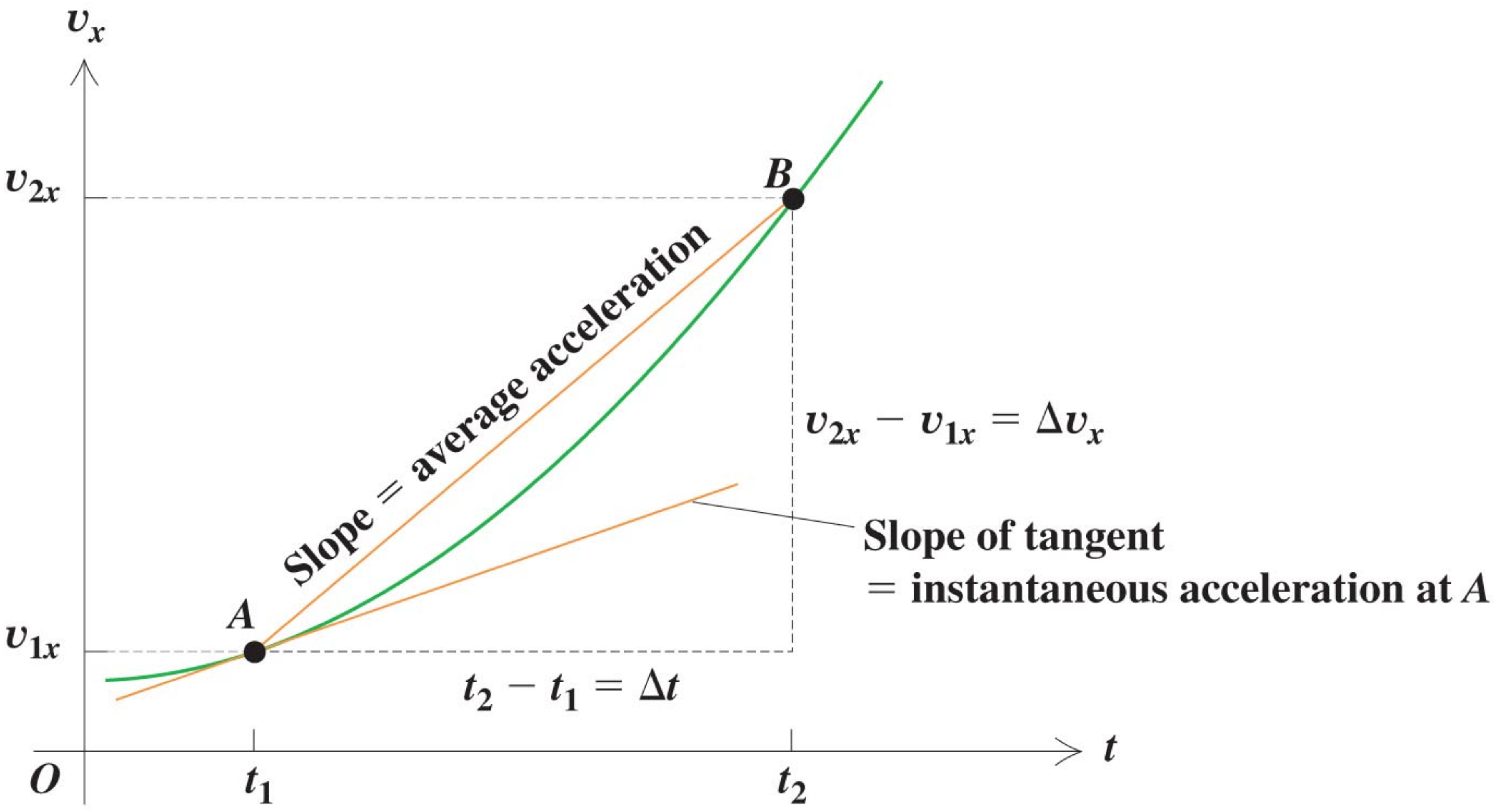
How is a "dragster" different from my car?

- The idea develops as it did with position vs time for velocity: now we plot velocity vs time.
- It is found as the tangent line to v vs t graph.
- We need to consider sign conventions and "braking" as a new idea and application of vectors.

Motion in pictures and graph - Figure 2.12



Acceleration from a velocity vs time plot - Figure 2.15

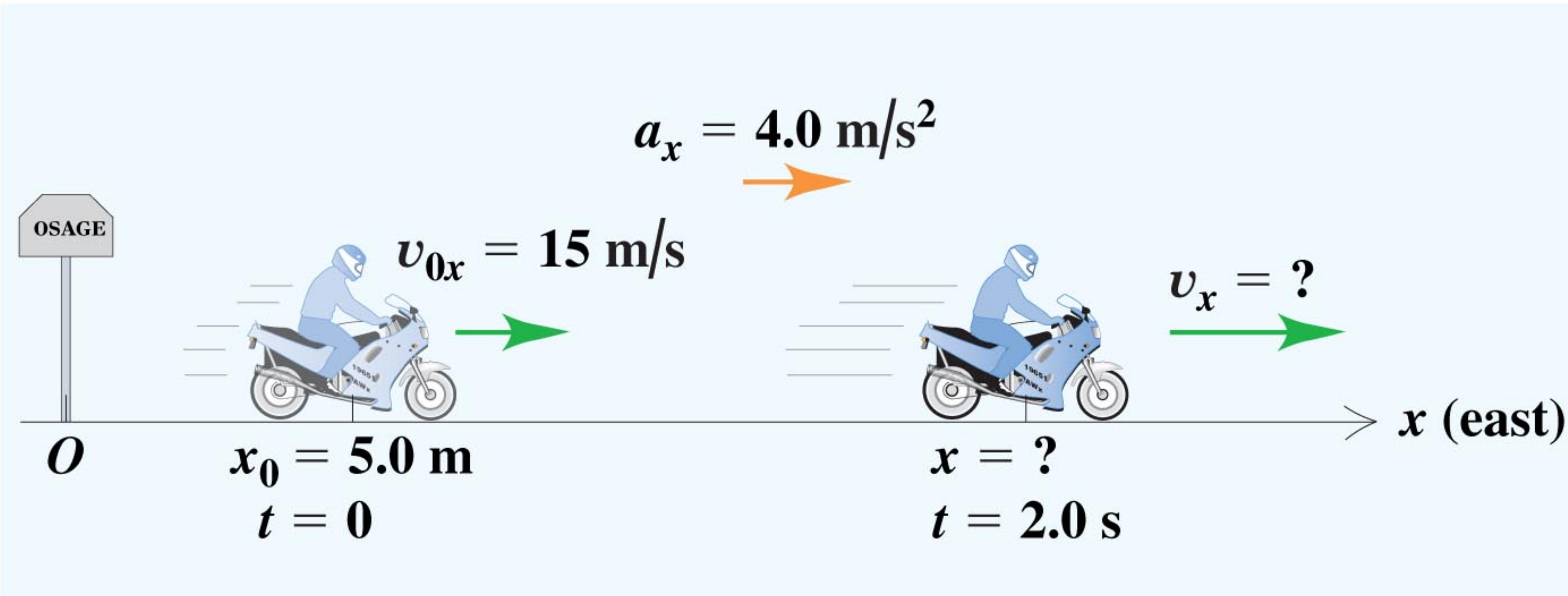


Describing motion at constant acceleration

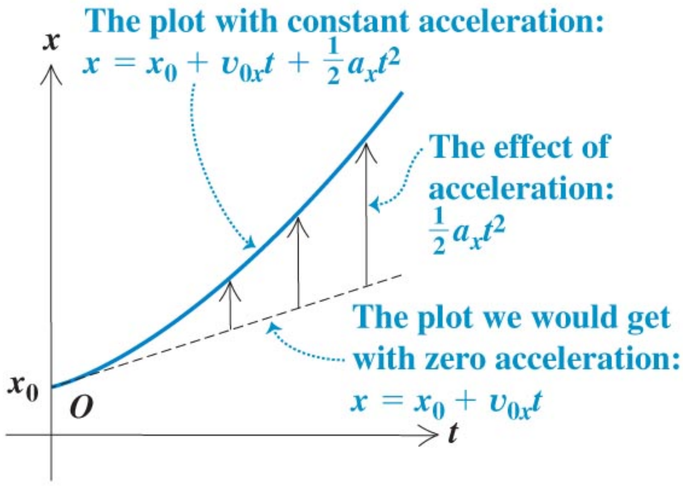
- "Can I stop before I hit the tree?"
- When will the police motorcycle overtake the speeding car?
- Relationship — Equation

Relationship	Equation
velocity-time	$v_x = v_{0x} + a_{xt}$
displacement-time	$x = x_0 + v_{0x}t + ½a_xt^2$
velocity-displacement	$v_x^2 = v_{0x}^2 + 2a_x(x - x_o)$

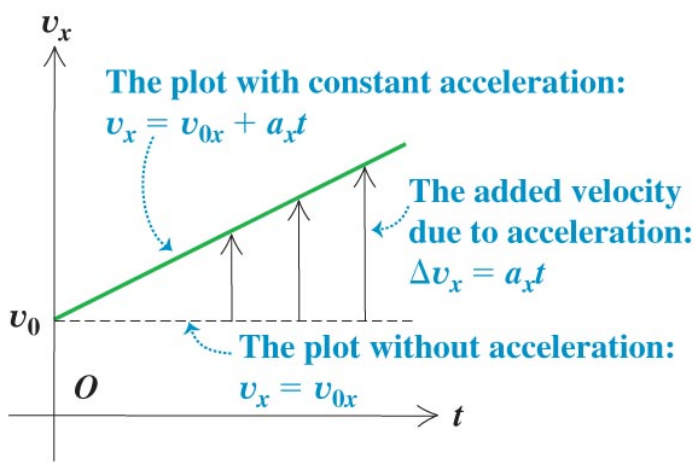
Total displacement? - Figure 2.21



Different plots featuring acceleration - Figure 2.20



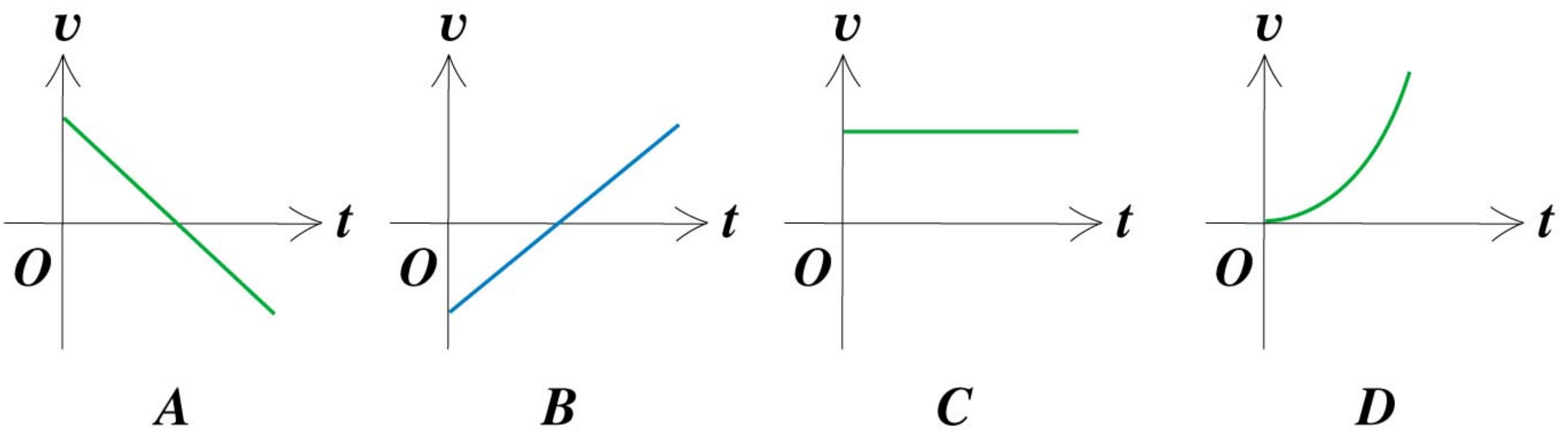
(a) Plot of x versus t for an object moving with positive constant acceleration



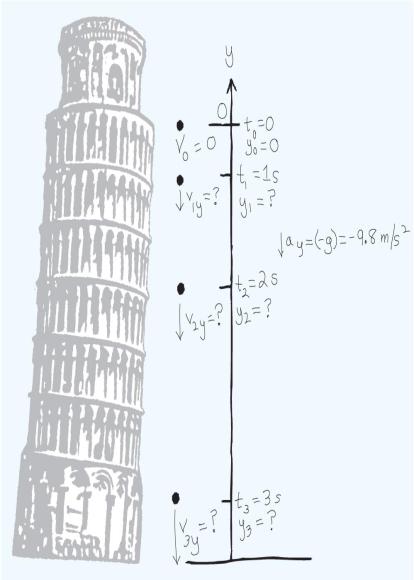
(b) Plot of v_x versus t for the same object

Thinking about your numbers

- Use proportional reasoning.
- There are linear, quadratic, inverse, proportions.

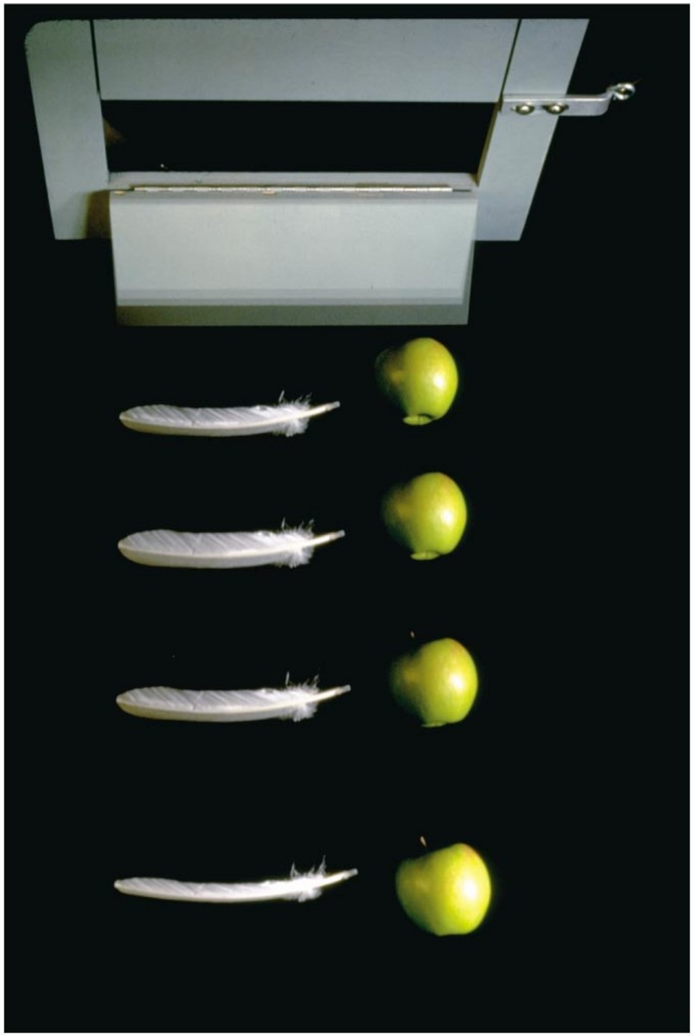


"Thank you Galileo" - Free fall and Figure 2.24



- As the story has it, he dropped objects from the Leaning Tower of Pisa; one heavy, one light. They hit simultaneously, disproving Aristotle's assertion that heavier objects fall faster.
- A feather and a hammer falling on the moon during the Apollo 15 mission by astronaut Dave Scott.
- The key is that Galileo is right for motion *in the absence of air resistance.*

Free fall in a vacuum - Figure 2.24



- The apple and the feather are in a vacuum chamber and the photograph taken with a strobe light.

"Against the wind" – Figure 2.29

- Good examples include:
- a plane and a head/tail wind,
- a boat on a river, and
- a cruel joke at a stop light.