College Physics A - PHY 2053C

Motion and Forces

01/06/2025

My Office Hours:

Monday 1:00 - 3:00 PM

212 Keen Building

College Physics A

College Physics

UPL 101: Monday, Wednesday 9:20 - 10:10 AM

Instructor: Prof. Volker Credé

Office: 212 Keen Building

Office Hours: Monday 1:00 - 3:00 PM

Phone: 644-2423

Email: crede@fsu.edu

Recitation Instructors: Prof. Vladimir Dobrosavljevic

Prof. Todd Adams

Outline

Syllabus

Course WEB Address:

`hadron.physics.fsu.edu/~crede/TEACHING/PHY2053C/index.html`

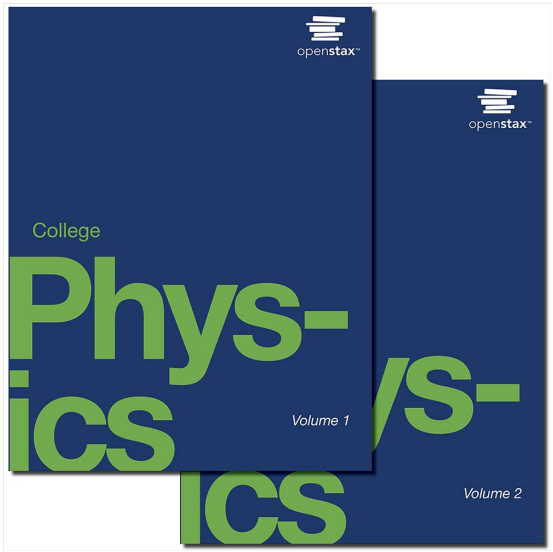
or

Canvas ➜ Syllabus

Textbook:

College Physics:

OpenStax



First Day Attendance

Log on to course website on Canvas:

Take "First Day Attendance Survey"

under Quizzes ➜ Surveys

by the end of this class (10:10 AM).

Course Organization

Lectures: 101 UPL

Monday & Wednesday 9:20 - 10:10 AM

We'll use iClicker System for in-class questions.

Homework Assignments (ExpertTA)

Three Mini-Exams, Final Exam (see Syllabus)

Note that OAS exams must be scheduled at the same time as the regular exams.

Make-up exams typically a week after the regular exam at 10:30 AM (after the Wednesday lecture).

Laboratories: Monday - Thursday

Recitations: Thursday

Be prepared and participate!

ExpertTA Assignments

There will be one ExpertTA assignment every week.

Assignment 1 due on 01/12/2025 (Sunday).
(access to ExpertTA through Canvas)

- Course Name: PHY2053C (Spring 2025 - Crede)

  Registration for ExpertTA through Assignments on Canvas.
- Assignments are due on Sunday night at 11:59 PM; usually open from Saturday the week before.

  `~/PHY2053C/Calendar/index.html`
- The answers can be saved and resumed later.
  You have to SUBMIT your answers to receive credit.
- They will be graded automatically upon completion.

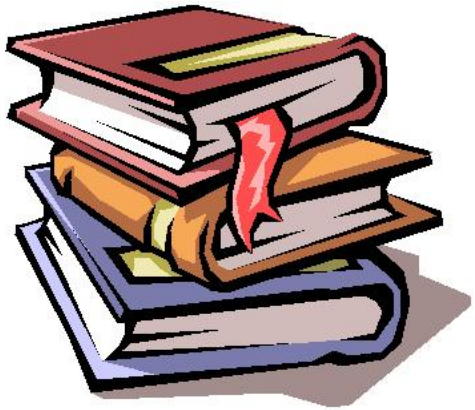
Recitation Hand-In Assignments

- Each week selected ExpertTA problems will be assigned as “hand-in” problems.

  (This week’s “Introduction to ...” problems are exempt.)

  ➜ It is important that you attempt the problems NOT that you solve them.
- The hand-in assignments are neatly hand-written solutions of the assigned problems **showing all of your work**, including a description of the problems and the use of proper units.
- Hand-in assignments must be turned in during your recitation period on Canvas.
- Hand-in assignments are considered *Preparation* work and account for half your recitation credit.

Audience Response System



Register your remote (or use the digital app).
Deadline: Sunday, January 12th.

All questions are worth one participation point.

I do expect that you will attend class, read the text, and ASK QUESTIONS.

Laboratories

The lab is a required component of the course!

- Attend the laboratory section which you are registered for!
- Labs begin later in the semester in the week of Monday, January 13th.
- Missing a lab session will automatically result in a course grade of "F".

If you miss a lab, attend another lab in the same week! This is your responsibility. And you have to inform your lab TA, the new lab TA, and Dr. Adams.

Do not switch lab sections on a permanent basis.

Course Grading

Your grade is calculated based on

- Homework Assignments 10 %
- In-class questions: i>clickers * 5 %

  * 1 pt for participation (review and general questions)
- Class Mini-Exams 3×12 %
- Final Exam 24 %
- Laboratories 15 %
- Recitations 5 % + 5 %

  (preparation and participation)

Attendance Policy

We expect you to attend all classes (lectures, recitations, labs).

In accordance with university policy, excused absences include

documented illness,
deaths in the immediate family and other documented family crises,
calls to active military duty or jury duty,
religious holy days,
and official University activities.

Each student is responsible for any missed material.

PRE Program

FLORIDA STATE UNIVERSITY

Proactive Referral & Engagement (PRE)

at Academic Center for Excellence (ACE)

What is PRE?

- Early support for students to achieve their academic goals
- Provide supplemental course-based tutoring and other services
- Trained Peer tutors with personal experience in your course (They get it!)
- Various appointment options
- Private Faculty Consultations

Self-referrals Welcome:

www.report.fsu.edu

PRE Program Contacts

Dr. Samantha Tackett at stackett@fsu.edu

Call: 850-645-4047

S 2-9pm, M-R 10am-9pm, F 10am-5pm

Visit: WJB G015B

Ace.Fsu.Edu

Some Sensible Advice

- Physics is (mostly) based on understanding, and not memorizing. We will do all we can to help you, but only you know if you really understand something or not! Work in groups and discuss physics problems.
- Test yourself on additional problems!
- When you prepare for the exams, make sure you understand and can do all the homework problems. You are strongly encouraged to do extra problems. Again, do not just memorize the solutions.
- Attend all classes and the recitation sessions! There happens to be a strong correlation between lecture attendance and student performance.
- Tutoring will cost you a lot of money! Stay away from Skoolers and greetings to Michael Underwood!!

PHY2054C

1. First ExpertTA homework Assignment is available.
   ➜ Check HW deadlines on course website/schedule.
2. Problems to prepare for this week's recitations:
   ExpertTA 1.1, 1.3, 1.7, 1.8
3. No labs this week, first-day attendance is NOT required.
4. Lecture Highlights and Semester Schedule at:
   `~/PHY2053C/Calendar/index.html`

Math Review

- Basic trigonometry
- Vectors:
  Component-wise addition, scalar & cross products, ...
- Standard equations:
  Sets of linear equations & quadratic equations
- Basic geometry
- Units: 1 m = 100 cm = 10^{-3} km, ...

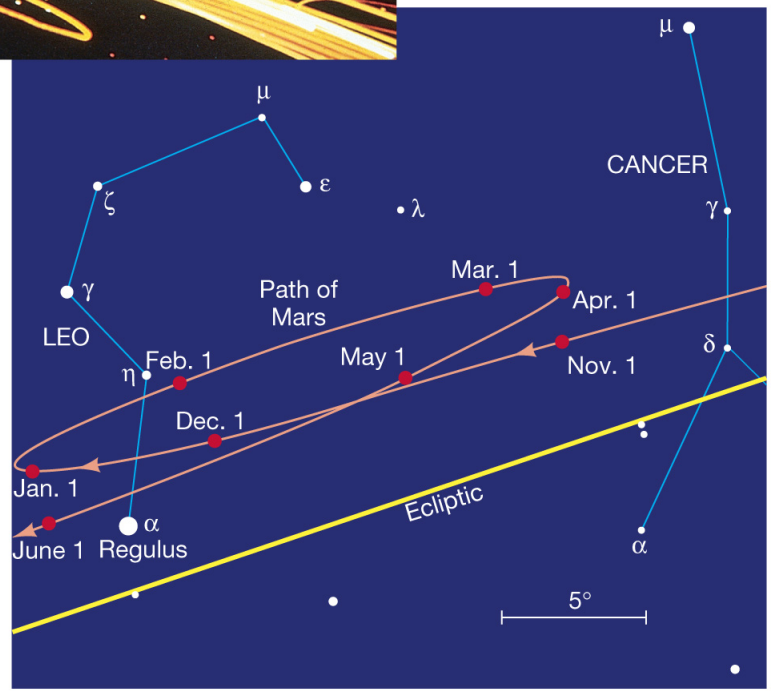
Outline

The Motions of the Planets

Sun, Moon, and stars all have simple movements in the sky, consistent with an earth-centered system:

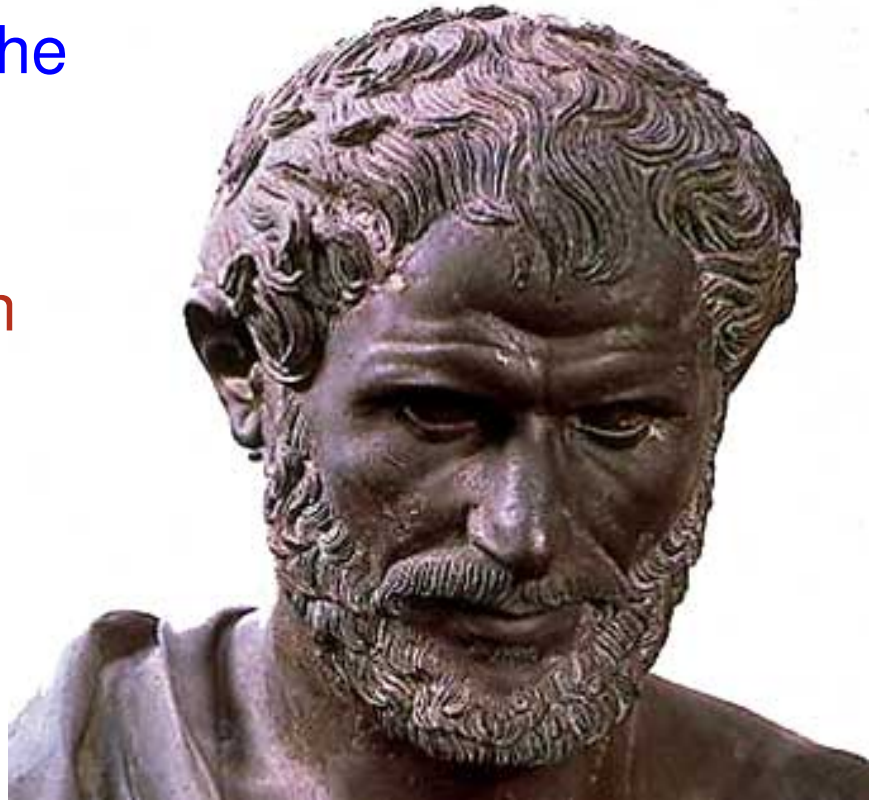
Moon moves smoothly and steadily.

Sun progresses along ecliptic at (almost) constant rate, varying little in brightness.



Aristotle: 384 - 322 B.C.

- At age 17, he entered Academy of Plato
  ➜ Later founded his own school.
- His systematic approach became method from which Western science arose.
- Knowledge got lost in the Dark (Medieval) Ages.



Two main classes of motion

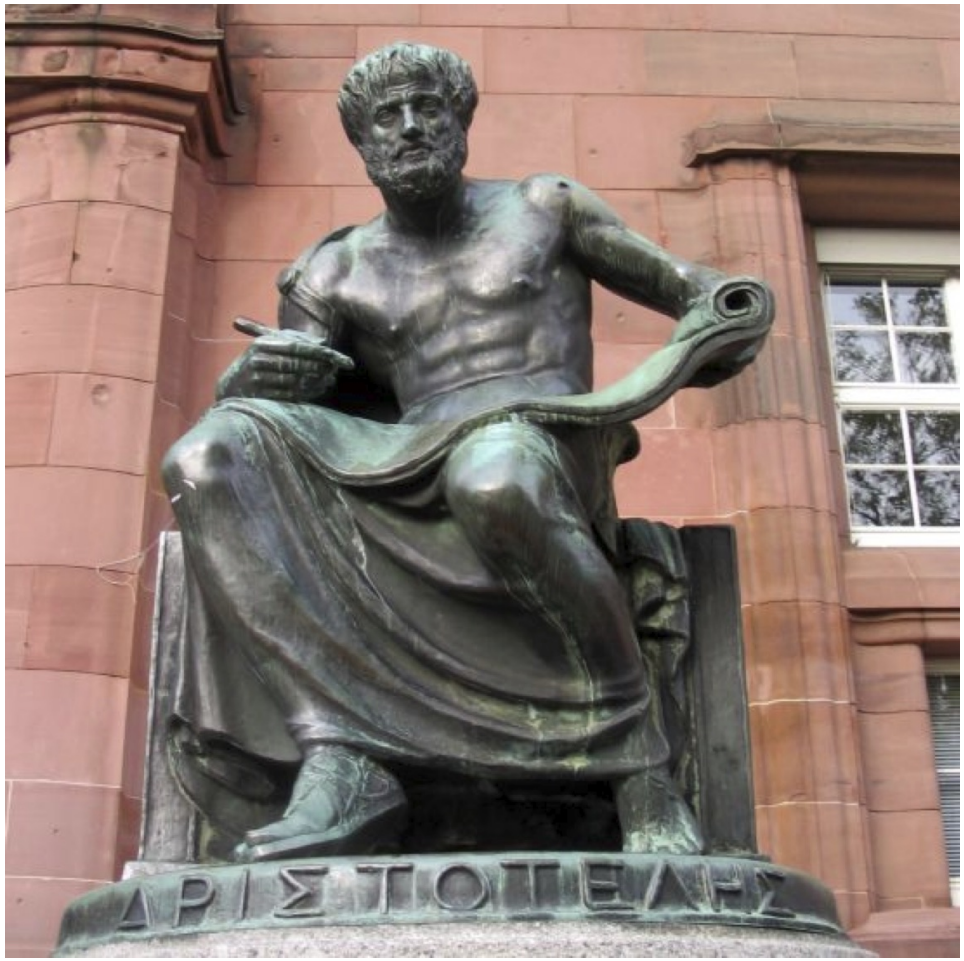
1. Natural Motion
2. Violent Motion

Natural state is one of rest.

Aristotle: 384 - 322 B.C.

55 rotating spheres with Earth at center:

- Air
- Fire
- ...
- Moon
- Mercury
- Venus
- Sun
- ...



Mechanics

Mechanics is concerned with the motion of objects.

Two questions need to be answered to understand mechanics:

1. What causes motion or a change in motion?
2. Given a particular situation, how will an object move?

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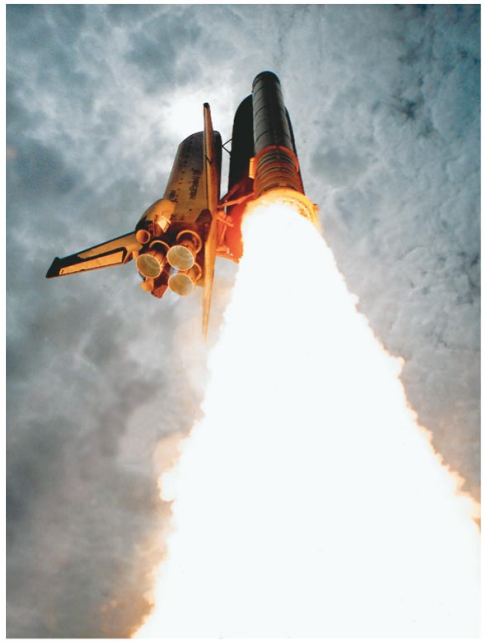
Motion

One way to think about motion is in terms of velocity.

Velocity is a vector quantity:

- The magnitude is the distance traveled in one second.
- The direction is the direction of motion.



Question 1

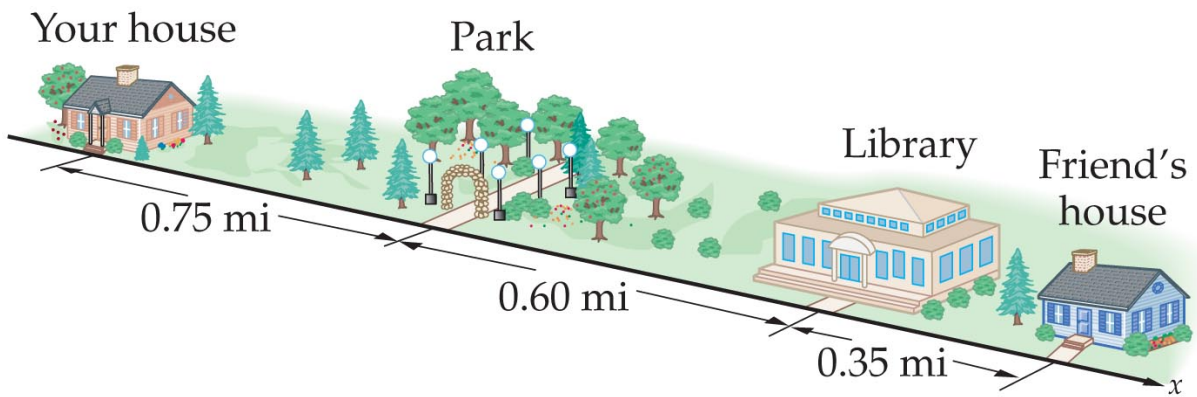
In one-dimensional motion, the average speed of an object that moves from one place to another and then back to its original place has which of the following properties?

A It is positive.

B It is negative.

C It is zero.

D It can be positive, negative, or zero.



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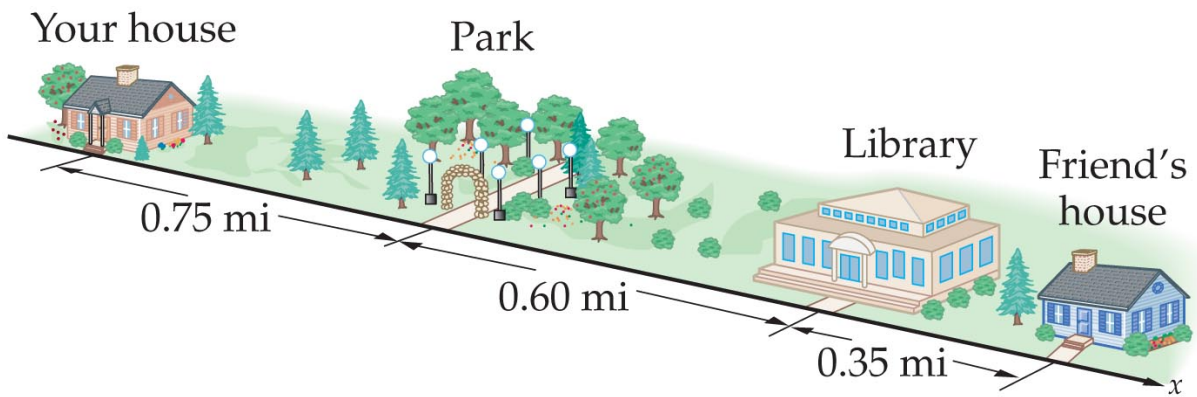


Question 2

In one-dimensional motion where the direction is indicated by a plus or minus sign, the average velocity of an object has which of the following properties?

A It is positive.

B It is negative.

C It is zero.

D It can be positive, negative, or zero.

Question 2

In one-dimensional motion where the direction is indicated by a plus or minus sign, the average velocity of an object has which of the following properties?

A It is positive.

B It is negative.

C It is zero.

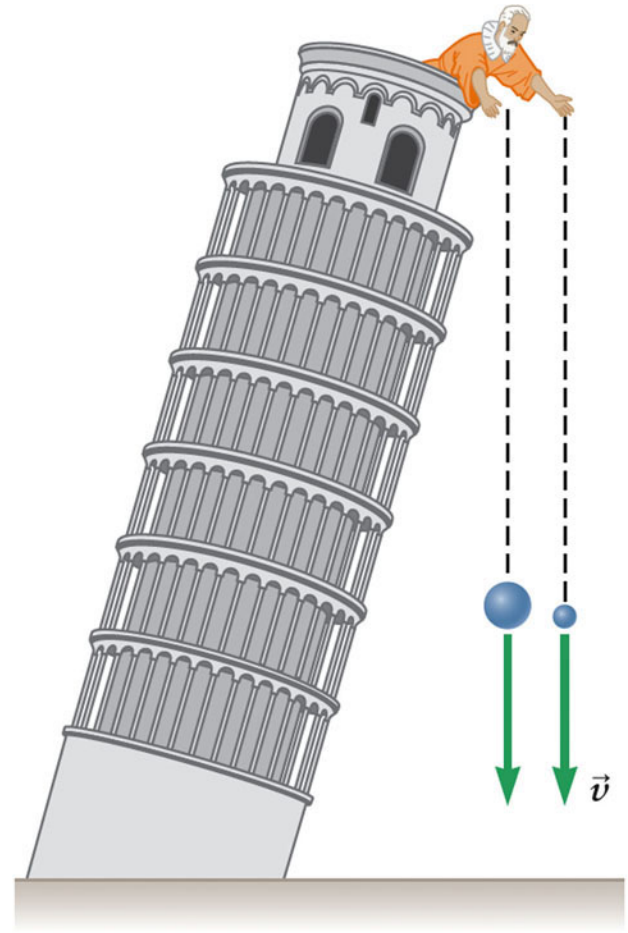
D It can be positive, negative, or zero.

The magnitude of the velocity is called the speed and is a scalar quantity. The speed cannot be negative.

Remember that speed and velocity are not the same!

Failure of Aristotle's Laws

Aristotle thought the velocity of the object was proportional to the force acting on it.



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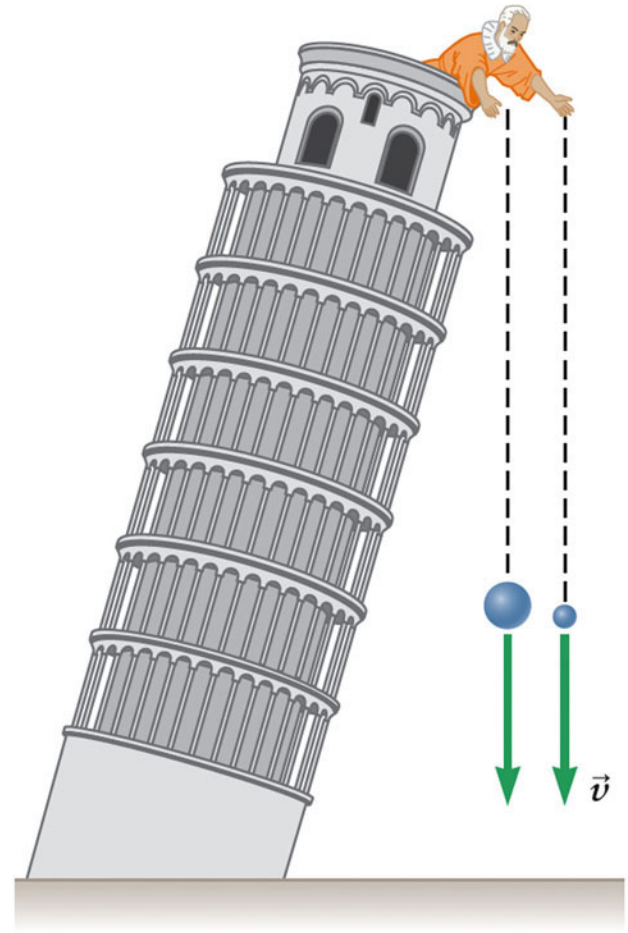
Question

Which object will fall faster?

1. The heavy object.
2. The light object.
3. Light objects fall at the same rate as heavy objects.



Failure of Aristotle's Laws

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1. The heavy object
   ➜ according to Aristotle
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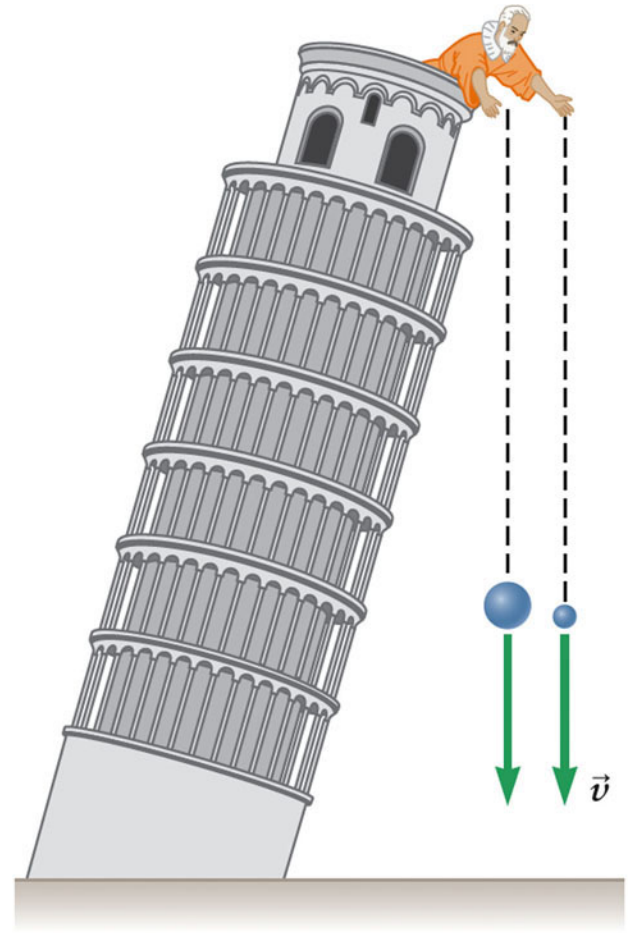
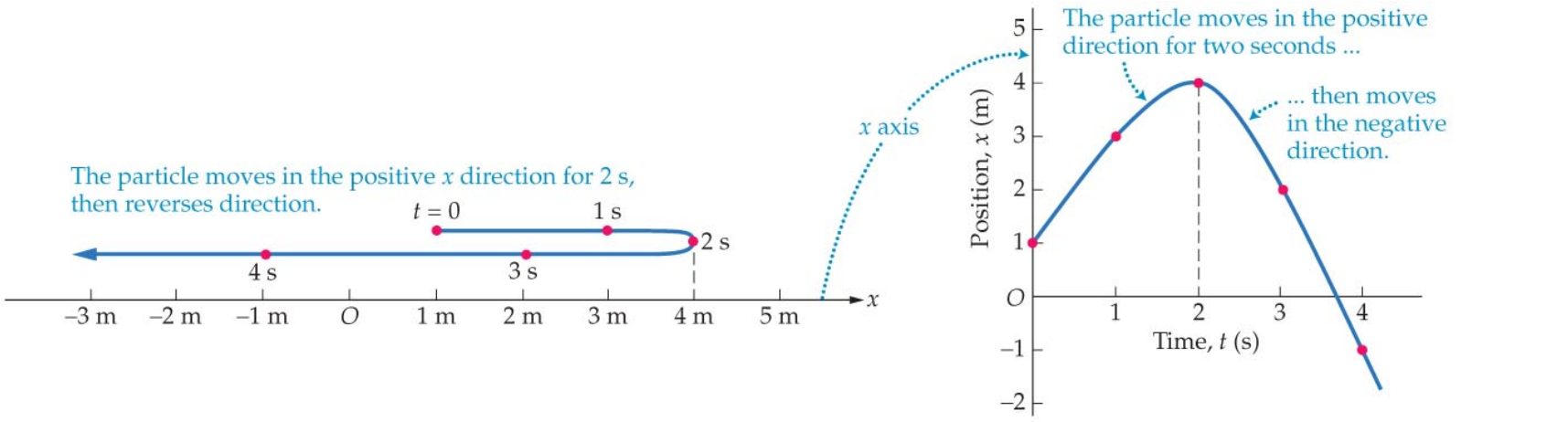


What is Motion?

Motion is defined in terms of various concepts:

- Position
- Velocity
- Acceleration

Motion can be illustrated by a *motion diagram*.



(a) The particle's path shown on a coordinate axis

(b) The same path as a graph of position x versus time t

What is Motion?

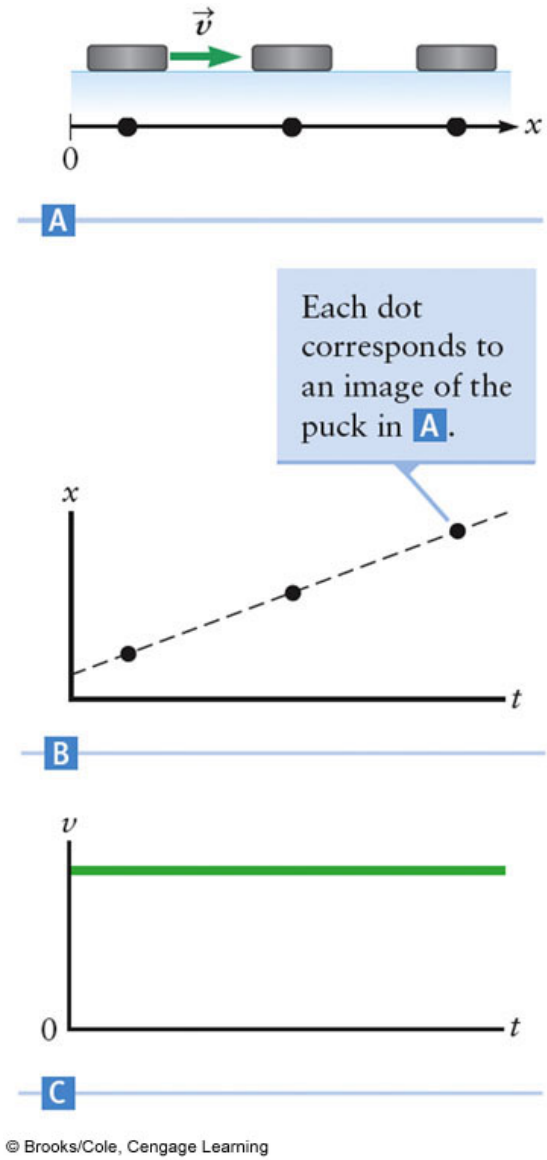
A shows a motion diagram

➜ Multiple images of a hockey puck traveling across an icy surface.

B shows a position – time graph of the motion

➜ The dots correspond to the images of the puck.

C shows a velocity – time graph of the motion.



Outline

Position and Displacement

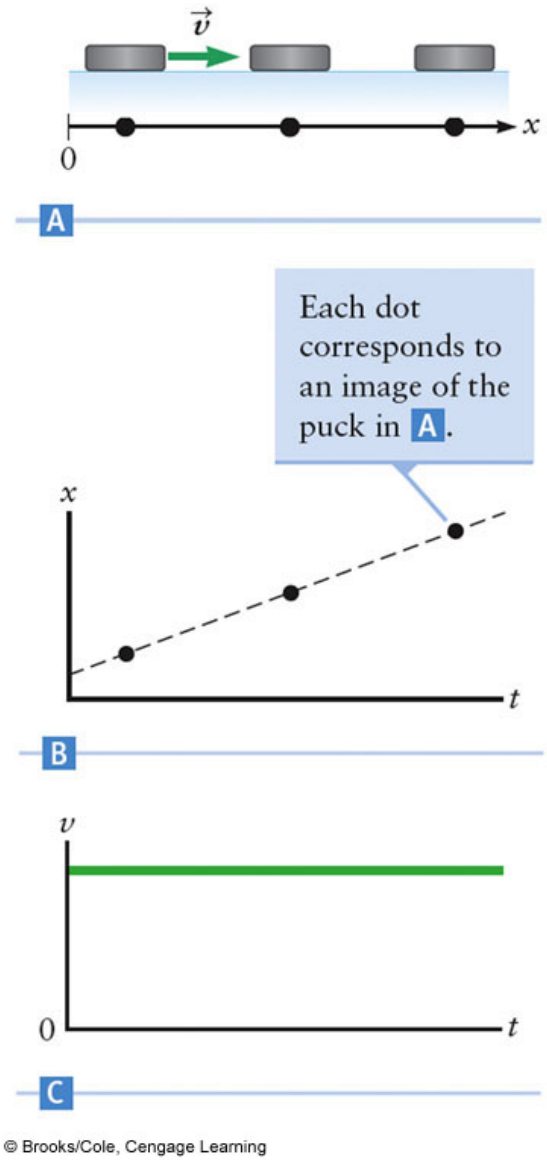
An object's change in position is its *displacement*:

$$\Delta x = x_{\text{final}} - x_{\text{initial}}$$

Average velocity is the displacement per unit time:

$$v_{\text{ave}} = \frac{x_{\text{final}} - x_{\text{initial}}}{t_{\text{final}} - t_{\text{initial}}} = \frac{\Delta x}{\Delta t}$$

If an object moves with a constant speed, then the average velocity is constant throughout the motion.



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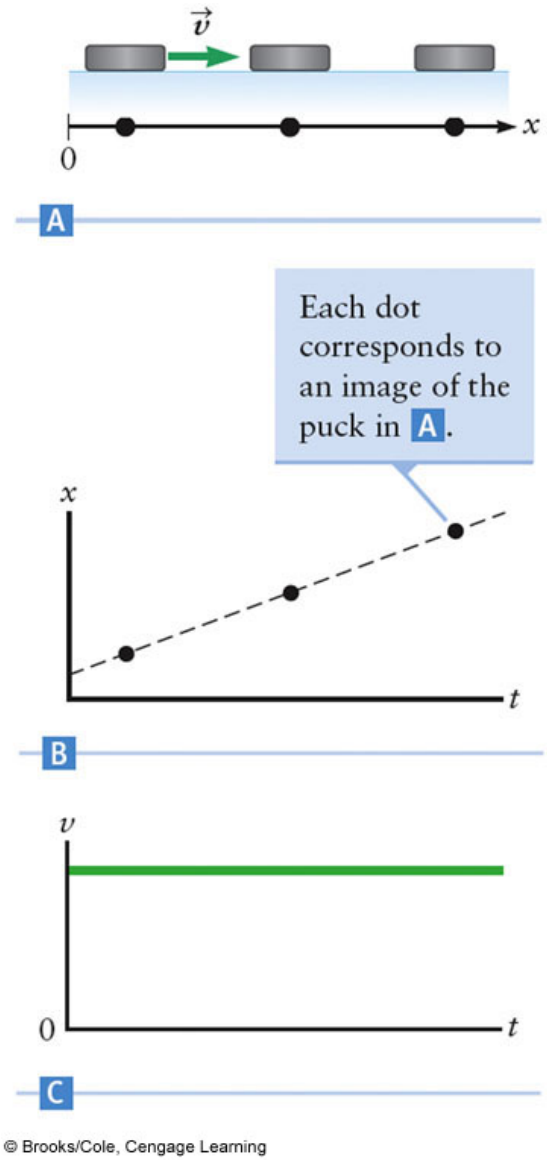
Examples ($\Delta t = 1$ s):

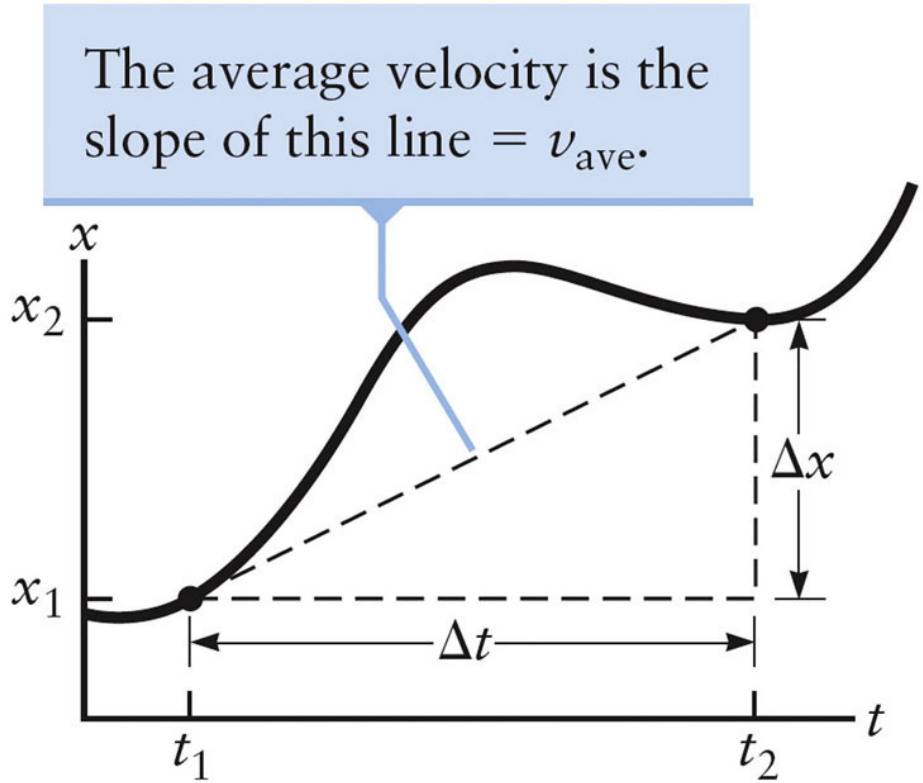
1. $x_{\text{f}} = 5$ m, $x_{\text{i}} = 1$ m: $v_{\text{ave}} = 4$ m/s
2. $x_{\text{f}} = 1$ m, $x_{\text{i}} = 5$ m: $v_{\text{ave}} = -4$ m/s



Outline

Velocity and Position

In general, the average velocity is the slope of the line segment that connects the positions at the beginning and end of the time interval.



$$v_{ave} = \frac{\Delta x}{\Delta t} = \frac{x_2 - x_1}{t_2 - t_1}$$

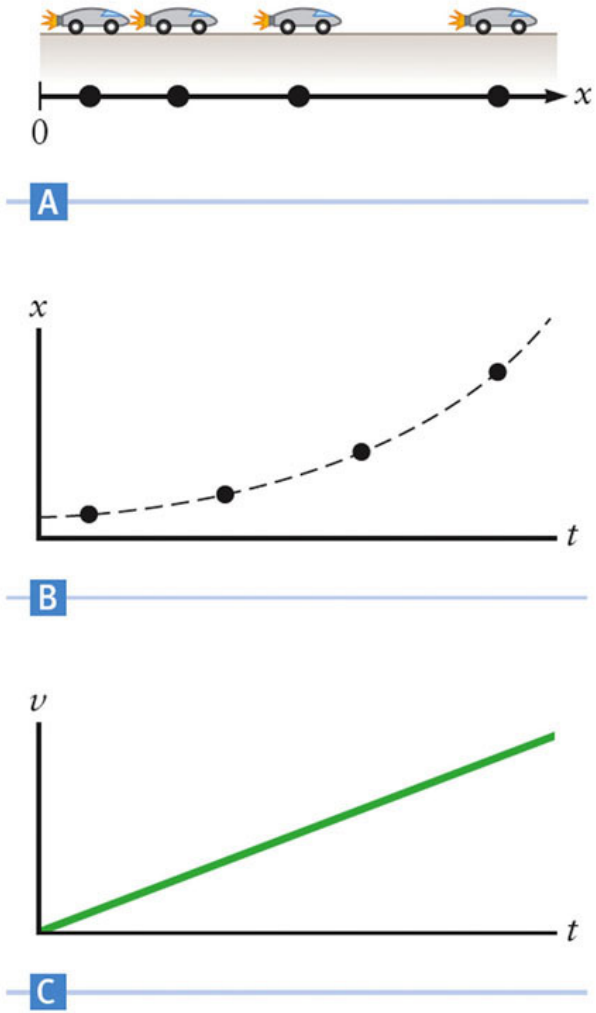
Example of Velocity

A shows a multiple exposure sketch of a rocket powered car.

B shows the position – time graph.

C shows the velocity – time graph.

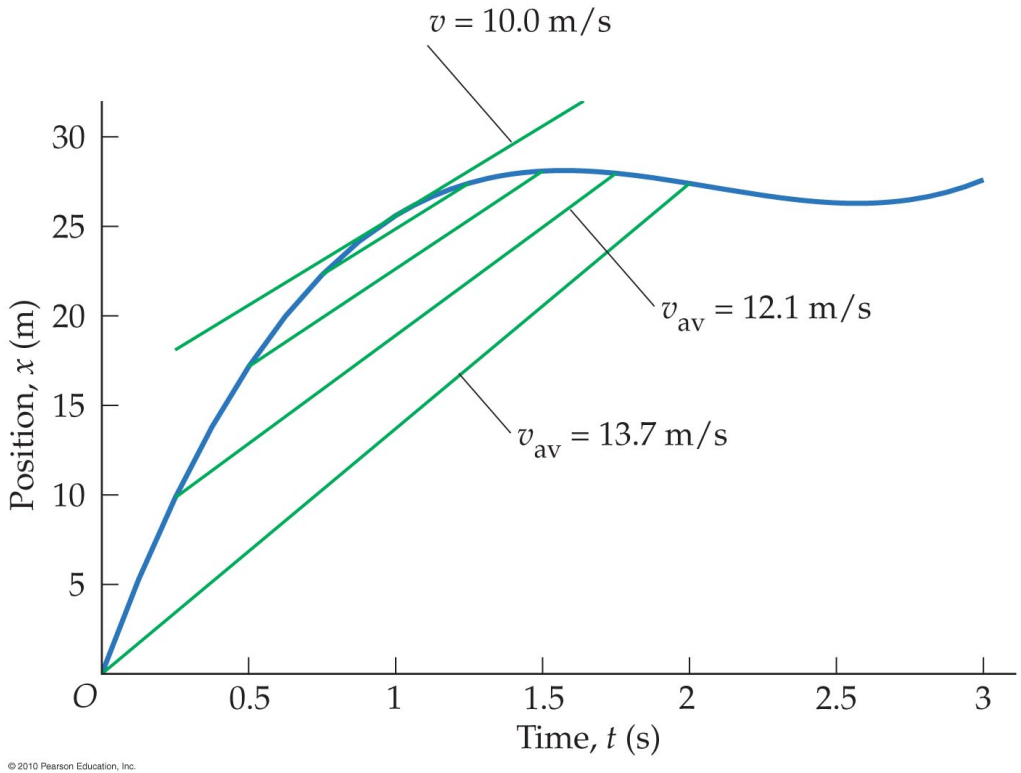
In this case, the speed of the car increases with time.



Instantaneous Velocity

Average velocity does not tell us anything about details during the time interval. The slope of the curve at the time of interest will give the instantaneous velocity at that time:

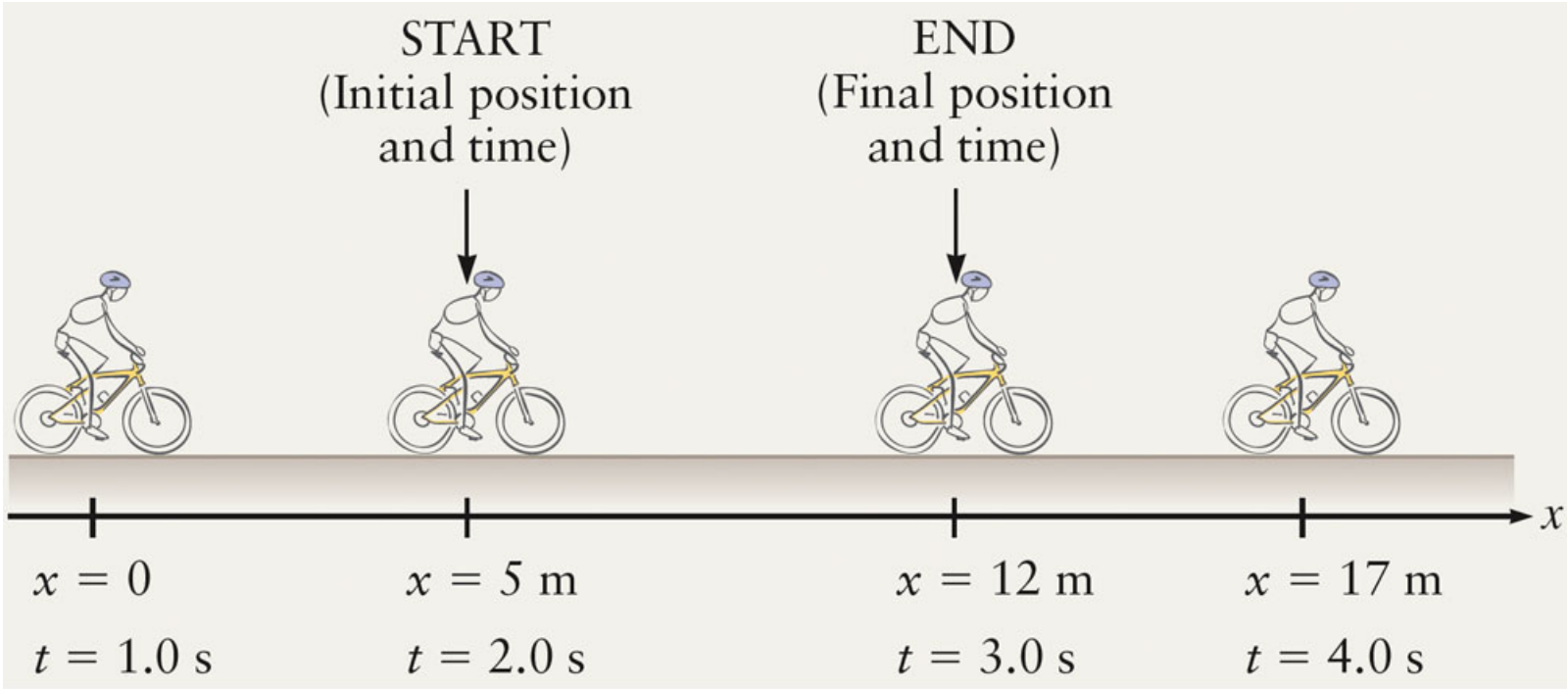
$$v = \lim_{\Delta t \to 0} \frac{\Delta x}{\Delta t}$$



Velocity of a Bicycle

Find average velocity from 2.0 to 3.0 seconds.

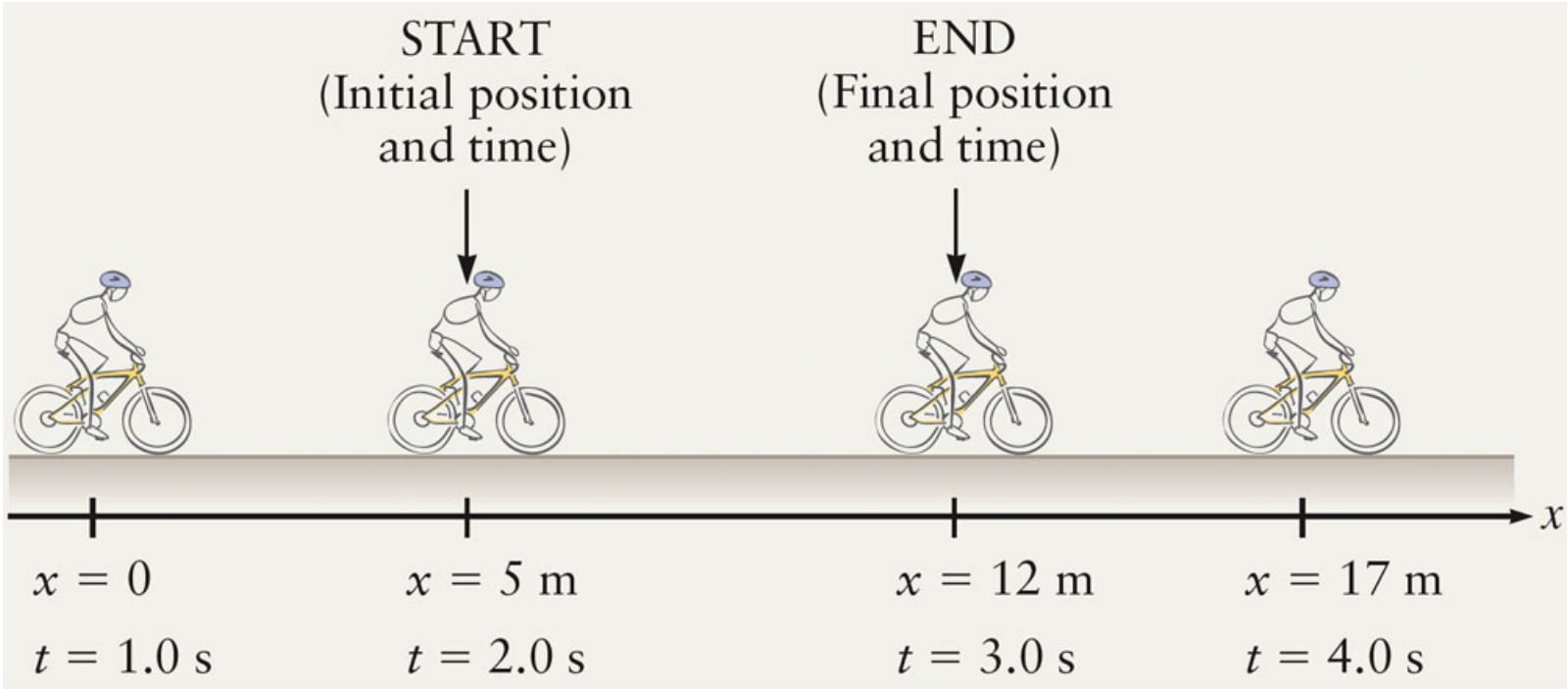
- Find displacement: $\Delta x =$



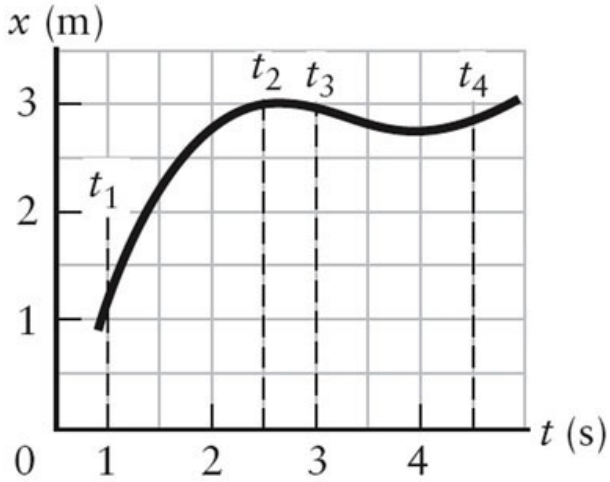
Velocity of a Bicycle

Find average velocity from 2.0 to 3.0 seconds.

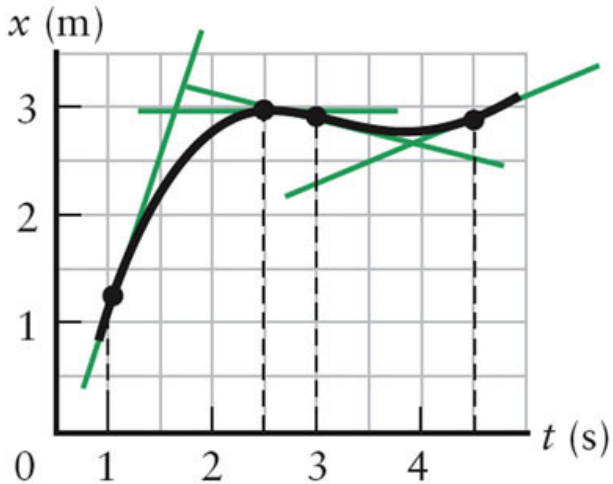
- Find displacement: $\Delta x = 12\ \text{m} - 5\ \text{m} = 7\ \text{m}$
- Find average velocity: $v_{\text{ave}} = \Delta x / \Delta t$
- Solve



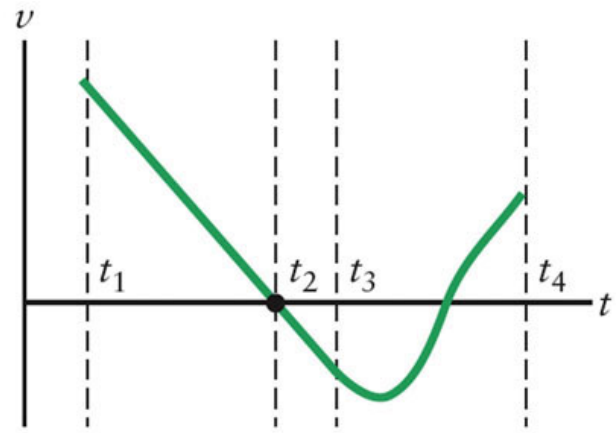
Graphical Analysis of Velocity



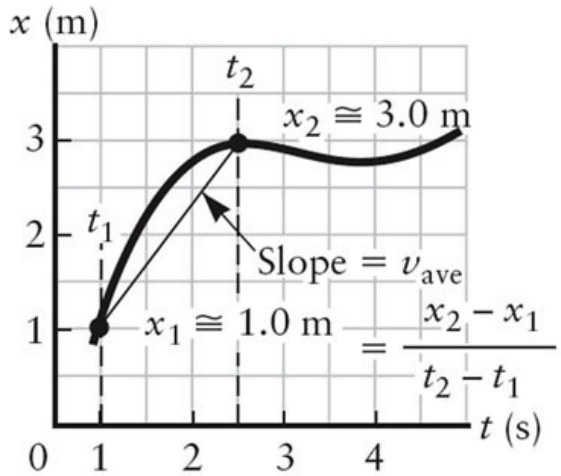
A



B



A



B