PHYS11 CH:1-3

Foundations of Physics, Motion, and Kinematics

Mr. Gullo

July 23, 2025

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- Identify and apply the kinematic equations for motion with constant acceleration.

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  - **Quantum Mechanics:** Explains how very small particles behave.

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  - Electric Current: **ampere (A)**
- Unit conversions are essential for solving problems correctly.

Accuracy vs. Precision

Accuracy How close a measurement is to the correct or accepted value.

Precision How close repeated measurements are to each other, regardless of their accuracy.

An instrument can be precise without being accurate, or accurate without being precise. Our goal is to be both accurate and precise.

Concept Visualization: Accuracy & Precision

To understand the difference between accuracy and precision, we can use the analogy of a dartboard.

- **Accuracy** is hitting the bullseye.
- **Precision** is having all your darts land close together.

On the next slide, we will see four different scenarios.

Visualizing Accuracy & Precision

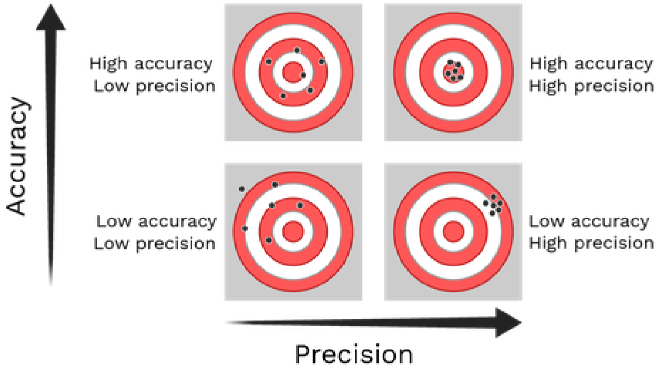

Figure: Four targets showing different combinations of accuracy and precision

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  - In the example above, your displacement is 0 m because you ended where you started.

Concept Visualization: Distance vs. Displacement

Imagine a person walking from their house to a store. The path they take might involve several turns.

- The **distance** is the full length of the winding path they walked.
- The **displacement** is the straight-line distance and direction from the house to the store.

The next slide shows a map illustrating this.

Visualizing Distance vs. Displacement

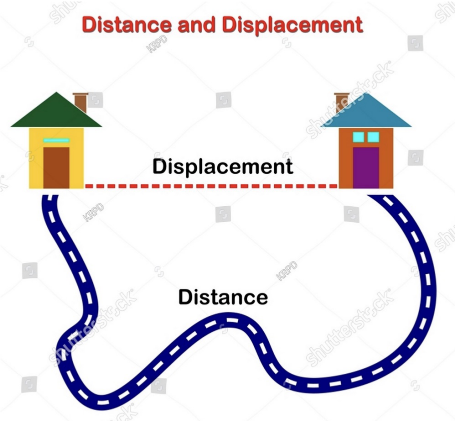

Figure: Map showing winding path (distance) vs. straight-line path (displacement)

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- **Instantaneous velocity** is the velocity at a specific moment in time.

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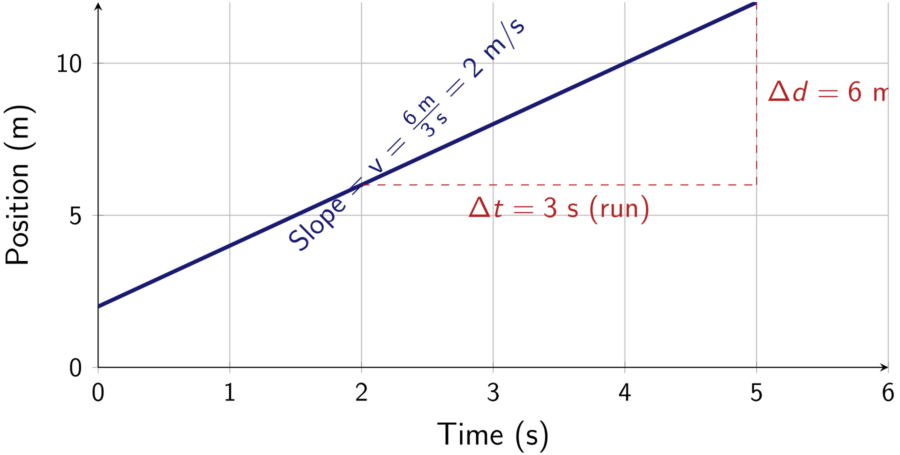
- Key Idea: The steeper the slope, the faster the object is moving.

Visualizing Constant Velocity (p-t Graph)

Let's visualize an object moving at a constant, positive velocity. The p-t graph will be a straight line with a positive slope. The value of that slope is the object's velocity.

Position vs. Time Graph (Constant Velocity)



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- Key Ideas: Slope gives acceleration, area gives displacement.

Visualizing Constant Acceleration (v-t Graph)

Let's visualize an object moving with constant, positive acceleration. The v-t graph will be a straight line with a positive slope.

- The **slope** of this line is the acceleration.
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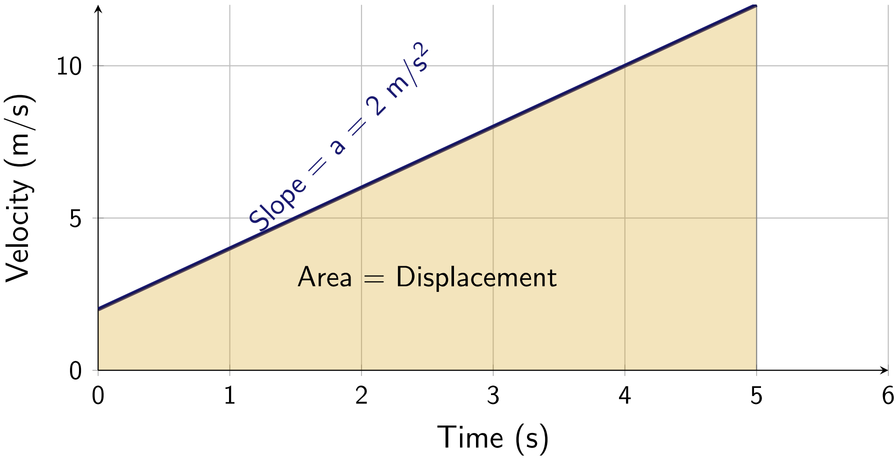

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- Slope = acceleration
- Example: slope = 2 m/s^2

Acceleration-Time Graph:

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Key Connection

For constant acceleration: v-t graph is a straight line, a-t graph is a horizontal line.

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- This means: acceleration = change in velocity ÷ time taken

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- **3. Changing direction** - even if speed stays the same
- Key Point: Any change in velocity (speed OR direction) means acceleration is happening.

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Variables:

$\Delta\vec{d}$: displacement (m)

t: time (s)

$\vec{a}$: acceleration (m/s^2)

$\vec{v}_0$: initial velocity (m/s)

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Note: We often write these without vector arrows in 1D problems, using +/- signs for direction.

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This structured approach helps prevent mistakes and makes your work easy to follow.

I Do: Calculating Average Acceleration

Problem (12, p. 6)

The driver of a sports car traveling at 10.0 m/s steps down hard on the accelerator for 5.0 s and the velocity increases to 30.0 m/s. What was the average acceleration of the car during the 5.0-s time interval?

I Do: Calculating Average Acceleration - Solution Part 1

Solution using GUESS Method

G - Givens:
- Initial velocity (v_i) = 10.0 m/s
- Final velocity (v_f) = 30.0 m/s
- Time interval (t) = 5.0 s

U - Unknown:
- Average acceleration (a) = ?

E - Equation:

$$a = \frac{\Delta v}{t} = \frac{v_f - v_i}{t}$$

I Do: Calculating Average Acceleration - Solution Part 2

Solution using GUESS Method (continued)

S - Substitute:

$$a = \frac{30.0\,\mathrm{m/s} - 10.0\,\mathrm{m/s}}{5.0\,\mathrm{s}}$$

S - Solve:

$$a = \frac{20.0\,\mathrm{m/s}}{5.0\,\mathrm{s}}$$

$$a = 4.0\,\mathrm{m/s^2}$$

We Do: Finding Initial Speed

Problem (8, p. 4)

A motorcycle moving at a constant velocity suddenly accelerates at a rate of 4.0 m/s^2 to a speed of 35 m/s in 5.0 s. What was the initial speed of the motorcycle?

We Do: Finding Initial Speed - Setup

Let's use the GUESS Method

G - Givens:

- Acceleration (a) $= 4.0$ m/s²
- Final velocity (v_f) $= 35$ m/s
- Time interval (t) $= 5.0$ s

U - Unknown:

- Initial velocity (v_i) $=$?

We Do: Finding Initial Speed - Equation

Let's use the GUESS Method

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We Do: Finding Initial Speed - Solution

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S - Substitute: Now we substitute our known values into the equation:

- $v_f = 35$ m/s, $a = 4.0$ m/s², $t = 5.0$ s

$$v_i = 35\,\mathrm{m/s} - (4.0\,\mathrm{m/s^2})(5.0\,\mathrm{s})$$

S - Solve:

$$v_i = 35\,\mathrm{m/s} - 20\,\mathrm{m/s}$$

$$v_i = 15\,\mathrm{m/s}$$

You Do: Practice Problem

Problem (24, p. 12)

How long does it take to accelerate from 8.0 m/s to 20.0 m/s at a rate of acceleration of 3.0 m/s^2?

Your Turn

Use the GUESS method to solve the problem.

- Identify your **Givens**.
- State the **Unknown**.
- Select the correct **Equation** and rearrange it.
- **Substitute** the values and **Solve**.

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  - The slope of a velocity-time graph is acceleration.
  - The area under a velocity-time graph is displacement.
- For motion with **constant acceleration**, we use the kinematic equations to relate displacement, velocity, acceleration, and time.