

Kinematics

Physics 20, Unit A: describing motion with displacement, velocity, acceleration and time

Learning Intentions and Success Criteria

- I can define displacement, velocity and acceleration qualitatively and quantitatively.
- I can compare and contrast scalar and vector quantities using operational definitions.
- I can explain uniform and uniformly accelerated motion from written, numerical and graphical data.
- I can interpret the motion of one object relative to another using displacement and velocity vectors.
- I can explain two-dimensional motion in a horizontal or vertical plane using vector components.
- This unit builds on Science 10 Unit B and prepares students for dynamics and Newton's laws.

Scalar vs. Vector Quantities

Scalar Quantities

A scalar quantity has magnitude only. Examples include distance and speed. Scalars are added using ordinary arithmetic, without regard to direction.

Vector Quantities

A vector quantity has both magnitude and direction. Examples include displacement, velocity and acceleration. Vector addition must account for direction, often using scale diagrams or components.

From Motion Diagram to Velocity-Time Graph

1

Collect position-time data

Use photogates or interval timers to record displacement at set time intervals.

2

Graph displacement vs. time

Plot data points and identify whether the motion is uniform or uniformly accelerated.

3

Determine slope

The slope of a position-time graph gives velocity; the slope of a velocity-time graph gives acceleration.

4

Determine area

The area under a velocity-time graph gives displacement.

5

Interpret the relationship

State the mathematical relationship among displacement, velocity, acceleration and time shown by the graph.

Applying Kinematics: Projectile Motion

Two-dimensional motion near Earth's surface

An aircraft launched from a carrier deck must reach a minimum velocity before leaving the ramp, an everyday application of acceleration and displacement calculations. In two-dimensional motion, horizontal and vertical components are treated independently: horizontal velocity stays constant while vertical velocity changes under gravitational acceleration. Students solve projectile motion problems near Earth's surface, ignoring air resistance, using vector components.

Bringing Kinematics Together

This unit develops the vocabulary and mathematical tools to describe motion: displacement, velocity, acceleration and time, treated as scalars or vectors depending on the quantity. Students construct and interpret graphs of uniform and uniformly accelerated motion, relate slope and area to physical quantities, and extend their analysis to relative motion and two-dimensional projectile motion. These skills prepare students for the study of dynamics and Newton's laws later in the course.

If you doubled an object's launch speed off a horizontal ramp, would its time in the air change? Would its horizontal range change? Justify your answer using vector components.