Information to memorize: Acceleration and Kinematics

Acceleration

Acceleration tells how much an object's speed changes in one second.

When an object speeds up, its acceleration is in the direction of motion.

When an object slows down, its acceleration is opposite the direction of motion.

Objects in free fall gain or lose 10 m/s of speed every second

Algebraic kinematics – You must follow these steps to solve an algebraic kinematics calculation.

1. Define a positive direction, i.e. the direction "away from the detector. Label that direction.

2. Indicate in words what portion of motion your are considering, e.g. "motion from launch to the peak of the flight."

3. Fill out a chart, *including signs and units*, of the five kinematics variables:
   v_o [initial velocity]
   v_f [final velocity]
   Δx [displacement]
   a [acceleration]
   t [time for the motion to happen]

4. If three of the five variables are known, the problem is solvable; use the kinematics equations to solve.

   $v_f = v_o + at$
   $\Delta x = v_o t + \frac{1}{2}at^2$
   $v_f^2 = v_o^2 + 2a\Delta x$

   A fourth equation may occasionally be useful:

   $\Delta x = \frac{1}{2}t(v_o + v_f)$

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Definitions

Displacement indicates how far an object ends up from its initial position, regardless of its total distance traveled.

Average velocity is displacement divided by the time interval over which that displacement occurred.

Instantaneous velocity is how fast an object is moving at a specific moment in time.

Position-time graphs

To determine how far from the detector an object is located, look at the vertical axis of the position-time graph.

To determine how fast an object is moving, look at the steepness (i.e. the slope) of the position-time graph.

To determine which way the object is moving, look at which way the position-time graph is sloped.

A position-time slope like a front slash / means the object is moving away from the detector.

A position-time slope like a back slash \ means the object is moving toward the detector.

Velocity-time graphs

To determine how fast an object is moving, look at the vertical axis of the velocity-time graph.

To determine which way the object is moving, look at whether the velocity-time graph is above or below the horizontal axis.

An object is moving away from the detector if the velocity-time graph is above the horizontal axis.

An object is moving toward the detector if the velocity-time graph is below the horizontal axis.

To determine how far an object travels, determine the area between the velocity-time graph and the horizontal axis.

On a velocity-time graph it is not possible to determine how far from the detector the object is located.

Most everyday motion can be represented with straight segments on a velocity-time graph.