

Kinematics

- Kinematics is describing motion.
- In your textbook, kinematics is in sections 2.3 and 3.1 (Chapter 2, Section 3 and Chapter 3, Section 1).
- When we describe motion, we are NOT concerned about the cause of the motion.
- We are concerned about measuring and predicting motion.

Components & Definitions

- To describe motion we need:
- Time (symbol is t)
- Displacement (many people say distance).
- Displacement means the change in position, there can be a distance without having displacement.
- The symbol for distance or position will be d

Graphing

- To describe motion we very commonly make use of graphs.
- The standard form of a 2 dimensional graph has an x axis and a y axis.
- The x axis – side to side, is the place for the independent variable.
- In almost every case in basic physics the x axis will be time.

Graphing

- The y axis is up and down – y to the sky.
- The y axis is for the dependent variable.
- In this unit of physics, the y axis will be for position (or displacement) or velocity.

Velocity

- Velocity is sometimes called speed.
- Velocity and speed are **NOT** the same but the difference is **NOT** important for this class.
- Velocity is speed with direction.
- Velocity is **defined** as the slope of position vs time.

Velocity

- Slope from math is $\frac{\textit{rise}}{\textit{run}}$
- The *rise* comes from the y axis, $y_2 - y_1$ or Δy
- The *run* comes from the x axis, $x_2 - x_1$ or Δx
- For the graph of position vs time, position is on the y axis and time is on the x axis.

Velocity

- Applying the definition of slope to the definition of velocity, the “formula” for velocity becomes:

$$v = \frac{x_2 - x_1}{t_2 - t_1}$$

- or $v = \frac{\Delta x}{\Delta t}$

Velocity

- In our equations:
- velocity will have the symbol v
- time will have the symbol t
- displacement (distance or position) will have the symbol x

Acceleration

- Acceleration is defined as the slope of velocity vs time.
- Acceleration means that the velocity is changing.
- What many people call deceleration, slowing down, is usually described in physics as a negative acceleration.

Acceleration

- Using the same math on acceleration as we did for velocity we get an equation for acceleration:

$$a = \frac{v_2 - v_1}{t_2 - t_1} \quad \text{or} \quad a = \frac{\Delta v}{\Delta t}$$

Equations

$$x_2 = x_1 + v_1 t + \frac{1}{2} a t^2$$

$$v_2 = v_1 + a t$$

$$v_2^2 = v_1^2 + 2a(x_2 - x_1)$$

Symbols & Units

| Quantity | Symbol | Common Metric Units |
|--|--------|---|
| time | t | seconds (s) |
| displacement (position or distance) | x | meters (m) |
| velocity (speed) | v | meters/second (m/s) |
| acceleration | a | meters/square second (m/s ²) |