

Engineering Physics I

Conrad A. Mearns

January 29, 2017

Significant Figures

When multiplying or dividing, the result is as precise as the least precise input to the number of digits.

Example: $54.3 * 6.8991 = 374.62113$, truncated to 374 or rounded to 375.

When adding or subtracting, the result is as precise as the least precise input to the number of digits past decimal place.

Example: $10.65 + 3.0 = 13.65$, truncated to 13.6 or rounded to 13.7.

As a general rule (from the professor), round up down to the nearest even number, as always rounding up will accumulate more error.

Variables of Movement and Position

1. Position: Location in space with respect to another object or coordinate system.

$$x, y, z$$

2. Displacement: Difference in position at two different times.

$$\Delta x, \Delta y, \Delta z, \Delta x = x_2 - x_1$$

3. Average Velocity: Displacement divided by time.

$$v_{avg}, v_{avg} = \frac{\Delta x}{\Delta t}$$

4. Speed: Total distance divided by time.

$$s, s \equiv \frac{d}{t}$$

5. Instantaneous Velocity: Velocity measured at a single time.

$$v, v = \lim_{t \rightarrow a} \frac{\Delta x}{\Delta t} = \lim_{t \rightarrow a} \frac{x_2 - x_1}{t_2 - t_1}$$

Motion at Constant Velocity

$x = x_0 + vt$ The following computes a new position of x according to an object's initial position (x_0), velocity (v) and the given time passed (t). The equation is a slope-intercept formula.

Velocity at Constant Acceleration

$v = v_0 + at$ The following computes a new velocity of v according to an object's initial velocity (v_0), acceleration (a) and the given time passed (t). The equation is a slope-intercept formula.

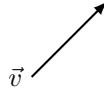
The following equations can be combined as a system to calculate constant acceleration with velocity, position and time. When given a final velocity v_f and an initial velocity v_0 one can deduce an average velocity (v or v_{avg})

$v_f = v_0 + at$ and $x = x_0 + vt \rightarrow x = x_0 + (\frac{v_0 + v_f}{2})t \rightarrow x = x_0 + \frac{1}{2}(v_0 + v_0 + at)t \rightarrow x = x_0 + v_0t + \frac{1}{2}at^2$ after simplification.

Vectors and Vector Math

- Scalar \equiv number, units \equiv magnitude
- Vector \equiv number, units, direction \equiv magnitude, direction

Vectors allow for easier representation of position, velocity, and acceleration. A vector of velocity looks like \vec{v} and can be drawn to look like the following.



Vector addition takes two vectors and aligns them tail to tip. For example, suppose the following vectors \vec{a} , \vec{b} and \vec{c} such that $\vec{a} + \vec{b} = \vec{c}$.



Vector addition is commutative. $\vec{a} + \vec{b} = \vec{b} + \vec{a}$ Vector addition is associative. $\vec{a} + (\vec{b} + \vec{c}) = (\vec{a} + \vec{b}) + \vec{c}$

Unit Vectors are vectors of magnitude of 1 that extend in only the x, y, or z direction alone a 3D cartesian system. The vectors are \hat{i} , \hat{j} and \hat{k} respectively. Notation for vectors, when expanded, looks like $\vec{A} = (A_x\hat{i} + A_y\hat{j} + A_z\hat{k})$ which could be $= (12\hat{i} - 7\hat{j} + 14\hat{k})$. Vector addition becomes standard addition, and multiplying vectors by scalars only needs to be distributed.