

Linear Motion

Planet Holloway Physics

Variables and simple definitions:

x – position (m).

Δx – displacement (m) this is the distance and direction from starting position to ending position.

d – distance (but sometimes we still use Δx for distance)

v – speed (m/s)

\mathbf{v} – velocity (m/s) remember bold means the variable is a vector

a – acceleration (m/s/s) or (m/s²)

There are 3 equations for kinematics that are crucial to memorize and 2 more that are less important but still come in handy for key situations.

$$1. \Delta x = v_0 t + \frac{1}{2} a t^2$$

displacement = initial velocity times time + one half the acceleration times time squared.

$$2. \Delta v = a t$$

the change in velocity = acceleration times time

$$3. v_f^2 = v_0^2 + 2a\Delta x$$

the final velocity squared = the initial velocity squared + two times the acceleration times the displacement.

$$4. v_{ave} = \Delta x/t$$

average velocity = the displacement divided by the time.

average speed (no direction, hence not a vector) = distance divided by time

$$5. v_{ave} = (v_0 + v_f)/2$$

average velocity = one half times the (initial velocity + the final velocity).

Direction is very important when dealing with vectors, so we need to pay special attention to including the proper direction into our problems. Typically, we call the original direction of motion of the object positive. All quantities that are in the

original direction of movement are listed then as positive and all that point the opposite direction are listed as negative.

For example, when a ball is thrown up, we say the original velocity (which is upward) is positive and the acceleration due to gravity is negative (because it always points down).

Some things to remember:

On a position vs. time graph, the slope of a section or point is the velocity. The steeper the slope, the greater the velocity. When the slope is positive, the velocity is positive and when the slope is negative, the velocity is negative.

On a velocity vs. time graph, the slope of a section or point is the acceleration. The steeper the slope, the greater the acceleration. When the slope is positive, the acceleration is positive and when the slope is negative, the acceleration is negative.

On an acceleration vs. time graph, the area under the curve is the change in velocity of the object. If the area is above the x axis, then the change is positive and if it is under the x axis, the change is negative. For the total change for a given interval, simply add the areas (both positive and negative).

On a velocity vs. time graph, the area under the curve is the change in position or displacement of the object. The conditions are the same as above.