

PhyzGuide: Algebraic Kinematics

I. DEFINITIONS

ENGLISH

EQUATIONS

Δ (Delta) means “change in,” so Δn means “change in n .” Given two values of the quantity n , Δn is calculated by subtracting the **first** value from the **second**.

$$\Delta n = n_2 - n_1$$

$$\Delta n = n - n_0$$

Velocity is defined as the rate at which a particle’s position changes with respect to time. Therefore the velocity of a particle is the change in its position divided by the amount of time that passed during the particle’s change in position.

$$v \equiv \Delta x / \Delta t$$

Acceleration is defined as the rate at which a particle’s velocity changes with time. Therefore the acceleration of a particle is the **change** in its velocity divided by the amount of time that passed during the particle’s change in velocity.

$$a \equiv \Delta v / \Delta t$$

II. ALGEBRAIC MANIPULATIONS

A. UM: Uniform Motion (no acceleration)

$$v = x/t$$



For a motion that involves *no* acceleration, this equation is sufficient. **DO NOT USE THIS EQUATION FOR ANY MOTION INVOLVING ACCELERATION.** If you do, you will promptly dry up and blow away, or perhaps turn into a pumpkin.

B. UAM: Uniform Accelerated Motion

These equations are valid when there is acceleration, and even when there **isn't**.

EQUATION	“WHO CARES” QUANTITY					
$v = v_0 + at$	x					THE “WHO CARES” QUANTITY tells you which equation to use. For example, suppose you know a , x , and v_0 but not v or t . If you are looking for t , then you don't care about v , so use the equation whose “WHO CARES” quantity is v . If, however, you need to find v , use the equation whose “WHO CARES” quantity is t .
$x = v_0 t + \frac{1}{2}at^2$		v				
$x = \frac{1}{2}(v_0 + v)t$			a			
$v^2 = v_0^2 + 2ax$				t		
$x = vt - \frac{1}{2}at^2$					v₀	

The Small Print

The equations above are written as they are usually used. But they leave room for some confusion. The t 's above represent Δt 's—the time **interval**, and not a specific **point** in time. And the x 's above represent Δx 's. When one is involved in heavy kinematics work, most Δ 's become “understood” and unwritten. An alternate way of writing some of the above equations is

$$v = v_0 + a\Delta t \quad \Delta x = \frac{1}{2}(v_0 + v)\Delta t \quad \Delta x = v_0\Delta t + \frac{1}{2}a(\Delta t)^2 \quad v^2 = v_0^2 + 2a(\Delta x)$$