Physics Reference: Motion Equations

The description of motion in physics is referred to as "**kinematics**". These formulae and definitions provide a complete model of uniform and accelerated motions.

Symbols and their units

Quantity	Symbol	SI Units
Time	t	s
Position	x, y, etc.	m
Velocity	v	m/s
Acceleration	a	m/s^2

Subscripts and deltas (Δ)

In physics you will often see subscripts written onto symbols for other quantities. The most common subscripts to see are the letters "i" and "f" which stand for "initial" and "final". Examples: x_f is "final position", v_i is "initial velocity", and t_f is "final time".

The Greek letter delta, Δ, is sometimes put in front of other symbols. It means "the change in…". For example, Δx means "the change in position". These changes might be positive or negative. If an object with initial velocity 10 m/s changes to a velocity of 8 m/s, then Δv is −2 m/s.

$$\Delta x = x_f - x_i \qquad \Delta v = v_f - v_i \qquad \Delta t = t_f - t_i$$

Average velocity

During any timespan Δt, the *average* velocity is $\bar{v}=\frac{\Delta x}{\Delta t}$.

During uniform motion, v is constant, so $\bar{v}=v_f=v_i$. During accelerated motion, $\bar{v}=\frac{v_f+v_i}{2}$.

Acceleration

During any timespan Δt, the average acceleration is $\bar{a}=\frac{\Delta v}{\Delta t}$. It's rare to encounter a non-constant acceleration unless you are majoring in physics or engineering at the college level, so its safe to think of $\bar{a}$ as just being a.

Canonical motion equations

The following equations are true for any motion with a single value for a. If the motion has more than one "part" with different a values, the equations apply to each part separately.

Position Equation:	$x_f=\frac{1}{2}\cdot a\cdot\Delta t^2+v_i\cdot\Delta t+x_i$
Velocity Equation:	$v_f=a\cdot\Delta t+v_i$
V-Squared Equation:	$v_f^2=v_i^2+2\cdot a\cdot(x_f-x_i)$

Refer to §3.2 in your book for help with the motion equations!