Quick Review:

Position as a function of time: $f(t)$
Velocity = $f'(t)$
Acceleration = $f''(t)$

And for any general function:

First derivative:

If $f'(x) > 0$ over an interval, then $f(x)$ is increasing over that interval.
If $f'(x) < 0$ over an interval, then $f(x)$ is decreasing over that interval.
If $f'(x) = 0$ over an interval, then $f(x)$ is a constant over that interval

Second derivative:

If $f''(x) > 0$, then $f(x)$ is concave up.
If $f''(x) < 0$, then $f(x)$ is concave down.
If $f''(x) = 0$, then $f(x)$ is a line o $f(x)$ is a constant. (need to know $f'(x)$ also)

Short cuts to differentiation (sometimes called rules of differentiation).

<u>Constant:</u>

$f(x) = c$, $f'(x) = 0$.

<u>Power rule:</u>

$f(x) = x^n$, $f'(x) = nx^{n-1}$

<u>Constant multiple rule:</u>

$f(x) = cx^n$, $f'(x) = cf'(x) = c\, nx^{n-1}$

<u>Sum rule:</u>

Given that $f(x)$ and $g(x)$ are differentiable, then
ddxfx+ gx= ddxfx+ ddxgx= f'x+ g'(x)

<u>Difference rule:</u>

Given that $f(x)$ and $g(x)$ are differentiable, then
ddxfx- gx= ddxfx- ddxgx= f'x- g'(x)

<u>Exponential function rules:</u>

$f(x) = a^x$, $f'(x) = \ln(a)a^x$
$f(x) = e^x$, $f'(x) = \ln(e)e^x = (1)\, e^x$ thus $f'(x) = e^x$

Trig functions:

$f(x) = \sin(x)$, $f'(x) = \cos(x)$

$f(x) = \cos(x)$, $f'(x) = -\sin(x)$

$f(x) = \tan(x)$, $f'(x) = \sec^2(x)$

Logarithmic functions:

$f(x) = \ln(x)$, $f'(x) = 1/x$

$f(x) = \log(x)$, $f'(x) = 1/(x\ln(10))$

Product Rule:

If $f'(x)$ and $g'(x)$ exist and $h(x) = f(x) * g(x)$, then $(h)'(x)$ also exists and is given by:

$$h'(x) = f'(x)*g(x) + f(x) * g'(x).$$

Quotient rule:

If $f'(x)$ and $g'(x)$ exist and $h(x) = f(x) / g(x)$, then $(h)'(x)$ also exists and is given by:

$$h'(x) = [g(x)*f'(x) - f(x)*g'(x)]/g^2(x)$$

Chain Rule:

If $f'(x)$ and $g'(x)$ exist and $h(x) = f(x)g(x)$, then $h'(x)$ also exists as is given by:

$$h'(x) = f'(g(x))*g'(x)$$

if $h(x) = g(x)f(x)$ then

$$h'(x) = g'(f(x))*f'(x)$$