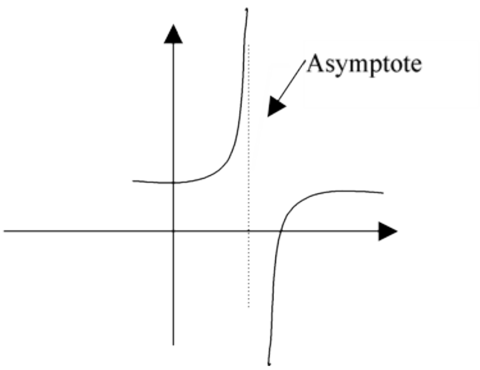
Calculus Key Terms

Acceleration: First derivative of velocity with respect to time: $\frac{dv}{dt}$;
second derivative of position or coordinate with respect to time: $\frac{d^2x}{dt^2}$

Antiderivative: The antiderivative of a function f(x) is another function F(x). Finding the antiderivative is (loosely) reversing the process of differentiation. It answers the question "What function do you differentiate to produce f(x)?" In other words, if we take the derivative of F(x) the result is f(x).

Asymptote: a vertical or horizontal line on a graph which a function approaches.



Critical number: a number, c, in the domain of a function f(x) where the derivative,

f '(c), is 0 or does not exist.

Cubic: a polynomial in which the highest power is the third power.
$f(x) = Ax^3 + Bx^2 + Cx + D$ where $A \neq 0$

Definite integral of f(x) on an interval (a,b): the result of evaluating the, F(x), at a and b and subtracting: F(b) - F(a).

Derivative: the limit of $\frac{f(x+h) - f(x)}{h}$

as h approaches 0. Also, the ratio of a change in the value of the function corresponding to a change in the x-coordinate at which it is evaluated.

See also Rules for Derivatives

Distance between points (x_1, y_1) and (x_2, y_2) is given by $\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

Extrema: plural for extreme point

Extreme point: any of the maxima or minima of a function; f '(x) = 0 at an extreme point.

Extremum: an extreme point

First derivative test: the use of f '(x) = 0 to determine the location of maxima, minima, or points of inflection

Indefinite integral: the notation

$$F(x) = \int f(x)dx$$

is called the indefinite integral and denotes the antiderivatives of f(x).

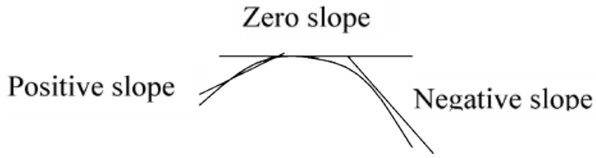
Inflection point: see point of inflection

Limit of f(x) at c: L is the value of f(x)approaches as x gets closer to c from either the right and the left.
Written as $\lim_{x \to c} f(x) = L$.
Said as "the limit of f(x), as x approaches c, is L".

Limits of integration: the values of x which determine the area involved in a definite interval. See the Fundamental Theorem of Calculus.

Maxima: plural of maximum

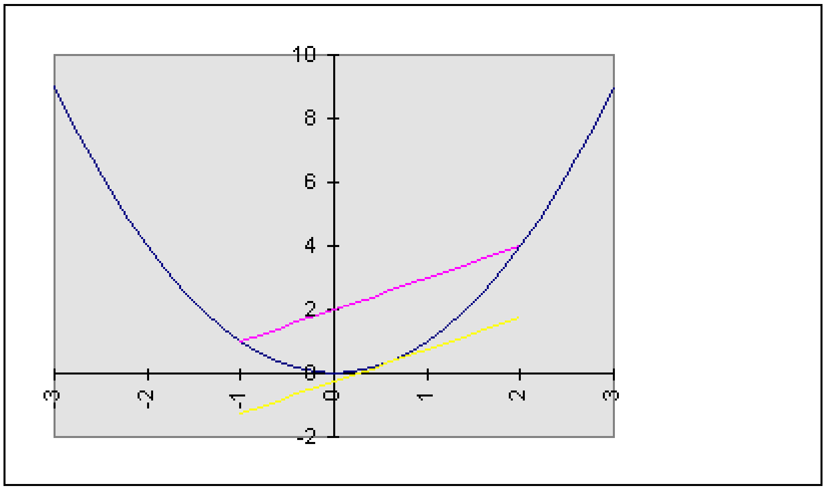
Maximum: a high point on a graph of a function, relative to nearby points; a point with zero slope, preceded by points with positive slope and followed by points with negative slope. The second derivative (= the rate of change in the slope) is negative at a maximum since the slope changes to less positive or more negative values as you move from left to right.



Mean value theorem: for two points (a, f(a)) and (b, f(b)), on a continuous curve, there is a point c in between where the slope f '(c) is the same as the slope, m, of the line joining the two points.

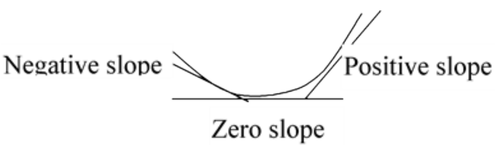
$$m = \frac{f(b) - f(a)}{b - a}$$

In the diagram, the two points are (-1,1) and (2,4). The slope, m, of the line connecting them is 1. The point c turns out to be x = 0.5.



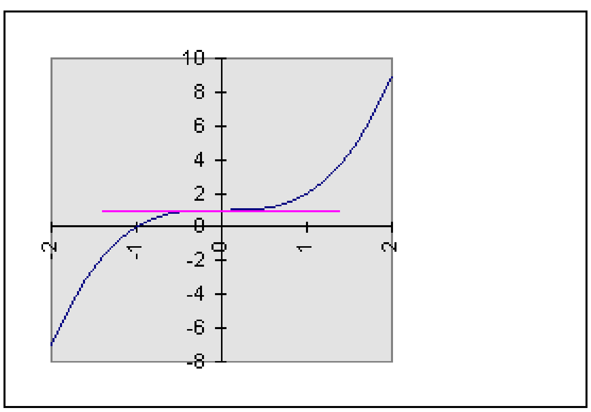
Minima: the plural of minimum

Minimum: a low point on a graph of a function, relative to nearby points; a point with zero slope, preceded by points with negative slope and followed by points with positive slope. The second derivative (= the rate of change in the slope) is positive at a maximum since the slope changes to less negative or more positive values as you move from left to right.



Point of inflection: a point on a curve where f '(x) and f ''(x) are both 0. The tangent line to the curve is horizontal at this point. In contrast to a maximum or minimum, the slope has the same sign just to the left and just to the right of the critical point.

In the diagram below, the tangent line is horizontal at (0,1), and the slope of the curve is positive on both sides of this point.



Polynomial: a sum of powers of x: $f(x) = a_n x^n + a_{n-1} x^{n-1} + \ldots + a_1 x + a_0$

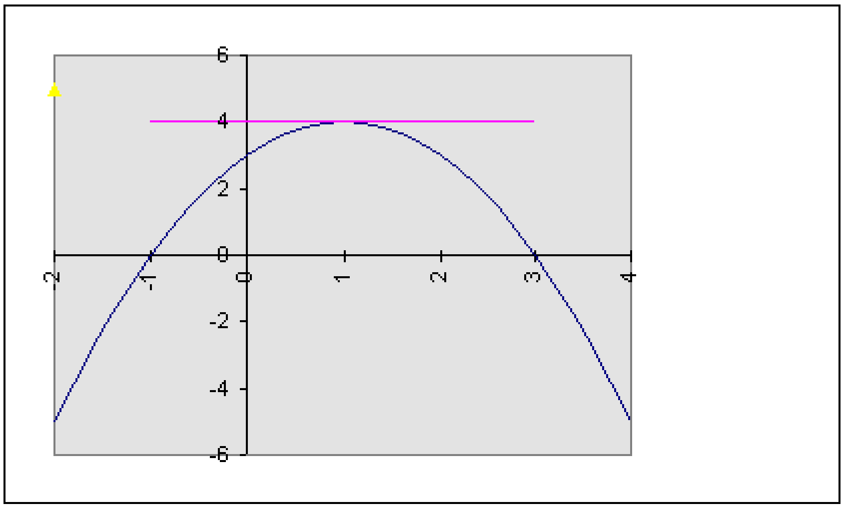
Quadrant: one of four regions in the coordinate plane defined by the x and y axes

Quadratic: a polynomial in which the highest power is 2: $f(x) = ax^2 + bx + c$, where a is not zero.

Quadratic formula: to find x in $ax^2 + bx + c = 0$ we use the formula

$$x_{1,2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Rolle's Theorem: Stated loosely, if a function crosses the x axis in two places, it must curve back in between, so that there must be at least one point where the first derivative is 0 and the tangent line is horizontal, as shown in the figure below. There, f(-1) is 0 and f(3) is zero. The point in between where the first derivative is 0 is x = 1. Note that this point won't always be halfway between the other two points.

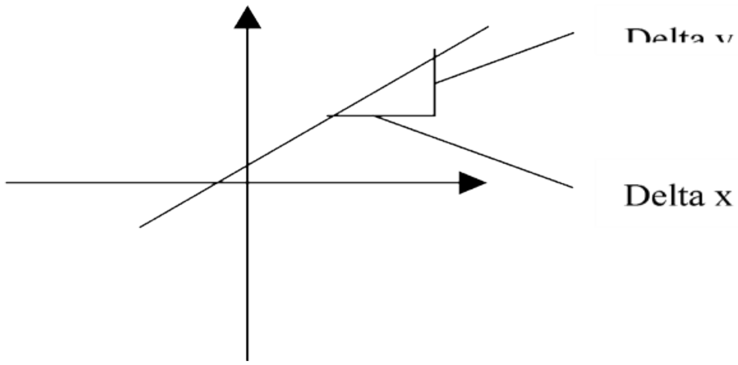


Secant line: a line joining two points on a curve, as in the figure 

Second derivative: the derivative of the first derivative: $\frac{d}{dx}\left(\frac{df}{dx}\right) = \frac{d^2 f}{dx^2}$

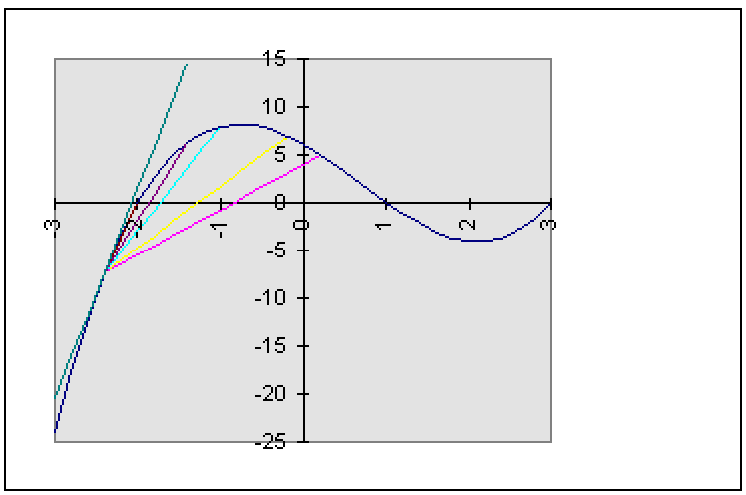
Second derivative test: the use of the sign of the second derivative to identify extrema. The first derivative is 0 and the second derivative is positive at a relative minimum. The first derivative is 0 and the second derivative is negative at a relative maximum.

Slope: for a line, the ratio $\frac{\Delta y}{\Delta x}$



for a curve, the slope of the tangent line

Tangent line: the steepest line in the diagram below



Velocity: first derivative of position with respect to time, $\frac{dx}{dt}$.

Also the integral of the acceleration: $v = \int a(t)dt$