EXAMPLES USING MATHCAD 14

Basic Operations:

$2 + 2 = 4$ Type the = sign to get a result.

$58 - 96 = -38$

$123 \cdot 567.58 = 69812.34$

$$\frac{144}{12} = 12$$

Note that you may use parenthesis in the usual ways. Many operators are available in the calculator menu.

Assigning variables use : to get the assignment operator. Use = to get a result.

$\mathbf{a} := 4$ $\mathbf{b} := 56$ $\mathbf{a} \cdot \mathbf{b} = 224$

$$\sqrt{\mathbf{a}^2 + \mathbf{b}^2} = 56.143$$

Greek letters can be used from the "Greek" menu.

$\lambda := 12$ $\mathbf{r} := 10$

$$\mathbf{Area} := \pi \cdot \mathbf{r}^2$$

$$\mathbf{Area} = 314.159$$

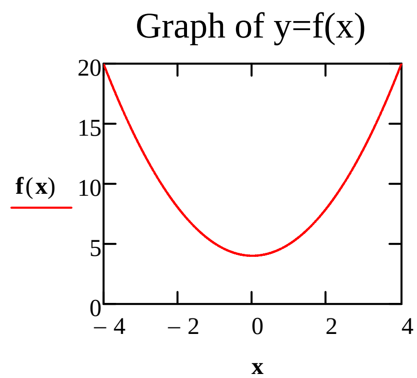
A simple assignment statement can be use to create a function.

$$\mathbf{f}(\mathbf{x}) := \mathbf{x}^2 + 4$$

$$\mathbf{f}(4) = 20$$

$$\mathbf{f}(-3) = 13$$

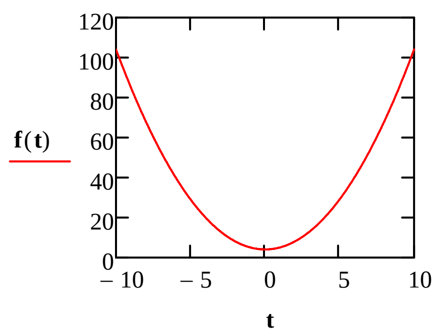
The graph of f:

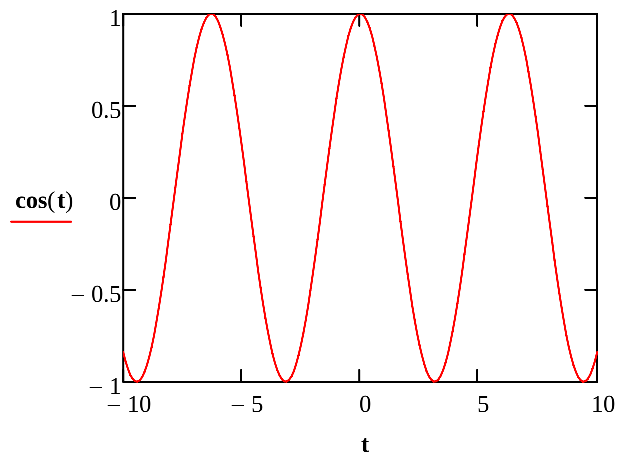


The range of x was specified on the graph as [-4,4].

You may have better control by specifying the range of a graphing variable.

$\mathbf{t} := -10, -9.9 .. 10$





Summation Examples

$$\sum_{i=1}^{n} i \rightarrow \frac{n \cdot (n+1)}{2}$$

$$\sum_{i=1}^{10} i = 55$$

$$\frac{1}{2} \cdot (n+1)^2 - \frac{1}{2} \cdot n - \frac{1}{2} \text{ simplify } \rightarrow \frac{n \cdot (n+1)}{2}$$

$$\sum_{i=1}^{n} i^2 \rightarrow \frac{n \cdot (n+1) \cdot (2 \cdot n + 1)}{6}$$

$$\sum_{i=1}^{10} i^2 = 385$$

Infinite sums must be evaluated symbolically.

$$\left(\sum_{k=0}^{\infty} 0.5^k \right) = \blacksquare$$

Mathcad cannot evaluate this without overflow.

$$\sum_{k=0}^{\infty} 0.5^k \rightarrow 2.0$$

BUT...Mathcad can evaluate this symbolically..

$$\sum_{k=0}^{\infty} p^k \to \begin{cases} \infty & \text{if } 1 \le p \\ -\frac{1}{p-1} & \text{if } p \ne 1 \wedge |p| < 1 \end{cases}$$

Must have |p|<1 for convergence.

$$\sum_{k=0}^{\infty} \frac{z^k}{k!} \to e^z$$

$$\sum_{k=1}^{\infty} \frac{z^k}{k} \to \begin{cases} \infty & \text{if } 1 \le z \\ -\ln(1-z) & \text{if } z \ne 1 \wedge |z| \le 1 \end{cases}$$

$$\sum_{k=1}^{n} k^3 \to \frac{n^2 \cdot (n+1)^2}{4}$$

Or evaluate a specific case:

$$\sum_{k=1}^{100} k^3 = 25502500$$

Finite Harmonic Sum:

$$\sum_{k=1}^{10} \frac{1}{k} = 2.929$$

Next

$$\sum_{k=1}^{n} [k\cdot(k+1)] \rightarrow \frac{n\cdot(n+1)\cdot(n+2)}{3}$$

Usually with Mathcad we don't use the formula. We would evaluate:

$$\sum_{k=1}^{20} [k\cdot(k+1)] = 3080$$

Use symbollic evaluation for infinite sums and numerical evaluation for finite sums unless you are trying to get a "formula" in the finite case.

Power Series

Consider the power series

$$\sum_{k=1}^{\infty} \left[\left(\frac{1}{k}\right)\cdot\left(\frac{x}{3}\right)^{k}\right] \rightarrow -\ln\left(1 - \frac{1}{3}\cdot x\right)$$

To determine the radius of convergence:

$$\lim_{k \to \infty} \frac{\left(\frac{1}{k+1}\right)\cdot\left(\frac{x}{3}\right)^{k+1}}{\left(\frac{1}{k}\right)\cdot\left(\frac{x}{3}\right)^{k}} \rightarrow \frac{x}{3}$$

thus, converges for |x|<3.

Permutations

Click on f(x) in the toolbar to find the permut function. permut(n,k) is the number of orderings of n things taken k at a time when n and k are both positive with k<= n.

$\mathbf{permut}(5,1) = 5$ same as 5 to the 1 falling

$\mathbf{permut}(5,2) = 20$ same as 5 to the 2 falling

$\mathbf{permut}(5,4) = 120$ same as 5 to the 4 falling

$\mathbf{permut}(5,5) = 120$ same as 5 to the 5 falling or 5 factorial.

Combinations

Click on f(x) in the toolbar to find the combin function. combin(n,k) is the number of ways that k things can be chosen from n things when 0<=k<=n.

$\mathbf{combin}(5,0) = 1$

$\mathbf{combin}(5,1) = 5$

$\mathbf{combin}(5,2) = 10$

$\mathbf{combin}(5,3) = 10$

$\mathbf{combin}(5,4) = 5$

$\mathbf{combin}(5,5) = 1$

$\mathbf{combin}(52,5) = 2598960$

which is the number of ways to draw 5 cards from 52.

Expansion

$(y + z)^5 \rightarrow (y + z)^5$ As symbolic evaluation Mathcad cannot improve on this.

The expand command produces the binomial expansion **in this instance**. See the symbolic table.

$$(y + z)^5 \ \textbf{expand} \ \rightarrow y^5 + 5 \cdot y^4 \cdot z + 10 \cdot y^3 \cdot z^2 + 10 \cdot y^2 \cdot z^3 + 5 \cdot y \cdot z^4 + z^5$$

Mathcad 13 required a variable to be primary:

$$(y + z)^5 \ \textbf{expand}, z \ \rightarrow y^5 + 5 \cdot y^4 \cdot z + 10 \cdot y^3 \cdot z^2 + 10 \cdot y^2 \cdot z^3 + 5 \cdot y \cdot z^4 + z^5$$

Derivative at a particular value of the dependent variable.

$$x := 3$$

$$\frac{d}{dx} f(x) = 6$$

A symbolic derivative using shift+F9.

$$\frac{d}{dx}\left(x^2 + 4\right)$$

$2 \cdot x$ Notice the answer appears below with NO equal sign or arrow.

A symbolic derivative using evaluation menu arrow.

$$\frac{d}{dx}\left(x^2 + 4\right) \rightarrow 6$$

Gives a particular value because x is already defined.
Will evaluate symbollically if x not defined.

Examples of symbolic derivatives using arrow operator.

$$\frac{d}{dz}\left(z^2 + 4\right) \rightarrow 2 \cdot z$$

$$\frac{d}{dz}\sin(z) \rightarrow \cos(z)$$

$$\frac{d}{dz}\tan(z) \rightarrow \tan(z)^2 + 1$$

$$\frac{d}{dz}e^z \rightarrow e^z$$

$$\frac{d}{dz}e^{\sin(z)} \rightarrow e^{\sin(z)} \cdot \cos(z)$$

Evaluate indefinite integrals (add a constant).

$$\int x\,dx \rightarrow \frac{9}{2} + C$$

$$\int 3\cos(x)\sin(x)\,dx \rightarrow \frac{3 \cdot \sin(3)^2}{2} + C$$

Notice that you must type sin(x) as a funciton - not sinx.

$$\int e^{x^2}\,dx \rightarrow -\frac{\sqrt{\pi} \cdot \mathrm{erf}(3i) \cdot i}{2} + C$$

You can get "complex" answers, but not in problems for this class.

Evaluate definite integrals.

$$\int_{1}^{5} x\sqrt{x}\,dx = 21.961$$

Answer obtained with standard = sign.

$$\int_{2}^{7} \frac{x+1}{x^2+8}\,dx = 0.981$$

Solve a quadratic equation.

Given

$$2x^2 + 4x - 30 = 0$$

Note that you MUST use the boolean = sign.

$\mathbf{Find}(x) \rightarrow (3 \quad -5)$ Values given in matrix row.

Notice that Find(x) is a function listed under f(x) above.

Now try a cubic.

Given

$$2x^3 - 2x^2 - 28x + 48 = 0$$

$$\mathbf{Find}(x) \rightarrow (2 \quad -4 \quad 3)$$

As an alternative you can use the solve function from the symbolic toolbar.

$2x^3 - 2x^2 - 28x + 48 = 0$ **solve**, $x \rightarrow$

Notice this approach does not work if x has been previously defined to have a value. (It's ok to use x within a given block, however.) So we'll change the variable.

$2w^3 - 2w^2 - 28w + 48 = 0$ **solve**, $w \rightarrow \begin{pmatrix} 2 \\ -4 \\ 3 \end{pmatrix}$

Polynomial multiplication:

$(w - 1)\cdot(w - 2)\cdot(w - 3)$ **expand** $\rightarrow w^3 - 6\cdot w^2 + 11\cdot w - 6$

Factoring:

$w^3 - 6w^2 + 11w - 6$ **factor** $\rightarrow (w - 3)\cdot(w - 1)\cdot(w - 2)$

$(w - 5)\cdot(w - 7)$ **expand** $\rightarrow w^2 - 12\cdot w + 35$

$w^2 - 12\cdot w + 35$ **factor** $\rightarrow (w - 5)\cdot(w - 7)$

Integer factoring:

1024 **factor** $\rightarrow 2^{10}$

1935 **factor** $\rightarrow 3^2\cdot 5\cdot 43$

17 **factor** $\rightarrow 17$ This one is prime.