

MATHCAD TUTORIAL

Assign a value to x. Type x:25 x := 25

Mathcad has assigned the value 25 to the variable x. Now evaluate x by typing x=

$$x = 25$$

Mathcad has displayed the current value of x. We can display functions, too, for example type $x^2=$ or $\sin(x^2+377\cdot t)=$

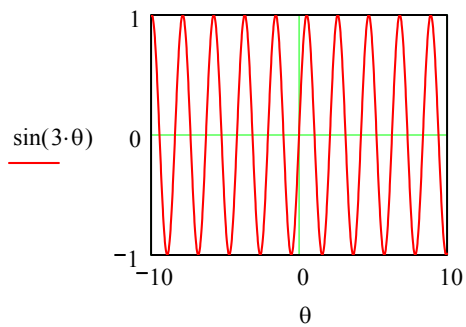
$$x^2 = 625$$

$$\sin(x^2 + 377\cdot t) = \blacksquare$$

The second function gives an error because t has not yet been defined.

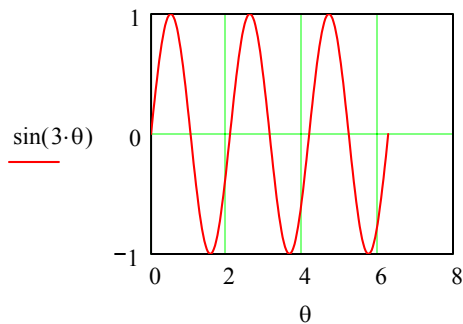
$$t := 0.25 \quad \sin(x^2 + 377\cdot t) = 0.174$$

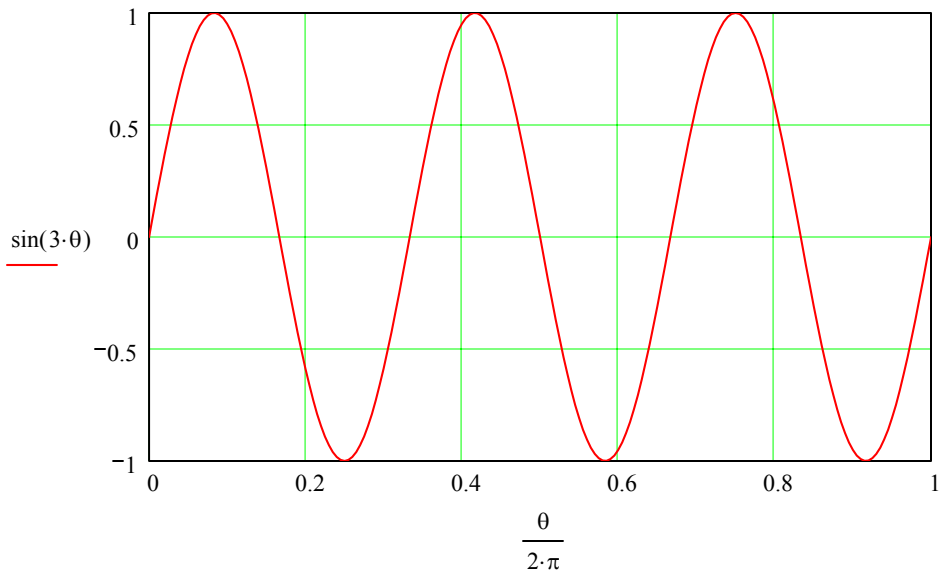
We can also plot functions, by clicking on the graph menu and selecting x-y plot



where the default range for θ was used, or define the range you want

$$\theta := 0, 0.01\cdot\pi .. 2\cdot\pi$$





MATRICES

Matrix calculation is available from the matrix menu

$$A := \begin{pmatrix} -1 & -2 & -3 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{pmatrix} \quad B := \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \quad C := (25 \ 26 \ 27)$$

$$A^2 = \begin{pmatrix} -1 & -1 & 3 \\ -1 & -2 & -3 \\ 1 & 0 & 0 \end{pmatrix} \quad A^3 = \begin{pmatrix} 0 & 5 & 3 \\ -1 & -1 & 3 \\ -1 & -2 & -3 \end{pmatrix}$$

$$h := 0.01 \quad I := \text{identity}(3) \quad I = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$\Phi_3 := I + A \cdot h + \frac{(A \cdot h)^2}{2!} + \frac{(A \cdot h)^3}{3!} \quad \Phi_3 = \begin{pmatrix} 0.99 & -0.02 & -0.03 \\ 9.95 \times 10^{-3} & 1 & -1.495 \times 10^{-4} \\ 4.983 \times 10^{-5} & 10 \times 10^{-3} & 1 \end{pmatrix}$$

$$\Phi_4 := \Phi_3 + \frac{(A \cdot h)^4}{4!} \quad \Phi_4 = \begin{pmatrix} 0.99 & -0.02 & -0.03 \\ 9.95 \times 10^{-3} & 1 & -1.495 \times 10^{-4} \\ 4.983 \times 10^{-5} & 10 \times 10^{-3} & 1 \end{pmatrix}$$

Mathcad also has a symbolic equals which is typed as ctrl= (displays as a bold equals)

$$e^x = I + \sum_{k=1}^{\infty} \frac{x^k}{k!} \quad e^{A \cdot h} = I + \sum_{k=1}^{\infty} \frac{(A \cdot h)^k}{k!}$$

This neither assign any values to the left side nor evaluate the right side, it just sets up an equation that can be manipulated symbolically. Highlight x below and chose collect from the symbolic menu

$$x^2 + 3 \cdot x + 4 - 3 \cdot x^2 + 25 = 0$$

by collecting terms, yields

$$-2 \cdot x^2 + 3 \cdot x + 29 = 0$$

Then, in the equation below, highlight x and choose variable then choose solve

$$-2 \cdot x^2 + 3 \cdot x + 29 = 0$$

has solution(s)

$$\left(\begin{array}{l} \frac{3}{4} + \frac{1}{4} \cdot \sqrt{241} \\ \frac{3}{4} - \frac{1}{4} \cdot \sqrt{241} \end{array} \right)$$

Now this solution can be assigned to the vector x

$$x := \left(\begin{array}{l} \frac{3}{4} + \frac{1}{4} \cdot \sqrt{241} \\ \frac{3}{4} - \frac{1}{4} \cdot \sqrt{241} \end{array} \right)$$

$$x_0 = 4.631 \quad x_1 = -3.131$$

Now, here we are using an array to represent the vector and arrays start at 0 in mathcad. Note that the subscript is obtained by typing [

Mathcad also has a "cosmetic" subscript which is obtained by typing a period

$$\mu_0 := 4 \cdot \pi \cdot 10^{-7} \cdot \frac{H}{m}$$

Note in the above equation, the subscript 0 is not associated with any array, it's just for notational purposes. The Greek letters are available from the Greek menu. Also note that mathcad has units, which is handy but can also be more trouble than help sometimes.

UNITS

An automobile uses 15 gallons of gasoline to travel 325 miles, calculate the gas mileage in miles/gal

$$\frac{325 \cdot \text{mi}}{15 \cdot \text{gal}} = 9.211 \times 10^6 \frac{1}{\text{m}^2}$$

Obviously mathcad is set for SI units.

$$1 \cdot \text{mi} = 1.609 \times 10^3 \text{ m} \quad 1 \cdot \text{gal} = 3.785 \times 10^{-3} \text{ m}^3$$

override the units

$$\frac{325 \cdot \text{mi}}{15 \cdot \text{gal}} = 21.667 \frac{\text{mi}}{\text{gal}}$$

This would have been easier:

$$\frac{325}{15} = 21.667$$

Also look at this

$$f := 1.25 \cdot \text{kHz} \quad \omega := 2 \cdot \pi \cdot f \quad \omega = 7.854 \times 10^3 \text{ Hz}$$

Again we need to override the units

$$\omega = 7.854 \times 10^3 \frac{\text{rad}}{\text{sec}}$$

Some units have the proper prefixes but others are missing:

$$R := 56 \cdot \text{k}\Omega \quad C := 0.22 \cdot \mu\text{F} \quad R \cdot C = 0.012 \text{ s}$$

$$R \cdot C = \blacksquare \text{ ms} \quad R \cdot C = \blacksquare \mu\text{s} \quad \text{it does not have millisecc or microsec}$$

$$R := 5.6 \cdot \text{k}\Omega \quad C := 22 \cdot \text{pF} \quad R \cdot C = 1.232 \times 10^{-7} \text{ s}$$

$$\mu\text{s} := 10^{-6} \cdot \text{s} \quad \text{define the unknown unit}$$

$$R \cdot C = 0.123 \mu\text{s}$$

AC POWER

Redefine A to amps (it was originally, but has now been overridden by a matrix)

$$A := \text{amp} \quad \text{kVA} := \text{kV} \cdot A \quad \text{MVA} := \text{kV} \cdot \text{kA} \quad \text{MVA} = 1 \times 10^6 \text{ W}$$

$$\text{MW} := \text{MVA}$$

$$V_a := 2400 \cdot V \quad I_a := 100 \cdot A \quad S_a := V_a \cdot I_a \quad S_a = 240 \text{ kVA}$$

$$\text{pf} := 0.8 \quad P_a := S_a \cdot \text{pf} \quad P_a = 192 \text{ kW}$$

You need to keep kW and kVA straight manually, since mathcad thinks that VA=W.

$$\text{kVAr} := \text{kVA} \quad Q_a := S_a \cdot \sqrt{1 - \text{pf}^2} \quad Q_a = 144 \text{ kVAr}$$

$$\sqrt{P_a^2 + Q_a^2} = 240 \text{ kVA} \quad S_a = 240 \text{ kVA}$$

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