

Elementary maths

```
ans := expand((a+b)^3):
ans := factor(-2*x+2*x+a*x-x^2+a*x^2-x^3):
ans := {solve(x^2-4 = 0,x)}:
sol := solve(x^2-4 = 0,x):
ans := {x=sol[1],x=sol[2]}:
ans := solve({2*a-b = 3, a+b+c = 1,-b+c = 6},{a,b,c}):
ans := evalf[50](Pi):
ans := convert(1/((1 + x)*(5 + x)),parfrac):
ans := simplify((1/(1 + x) - 1/(5 + x))/4):
ans := simplify(tanh(ln(x))):
ans := simplify(tanh(I*x)):
ans := simplify(sinh(3*x) - 3*sinh(x) - 4*(sinh(x))^3):
ans := ''tanh(ln(x))'':
ans := ''tanh(I*x)'':
ans := ''sinh(3*x) - 3*sinh(x) - 4*(sinh(x))^3'':
```

```
# mpl (ans.101,ans)
# mpl (ans.102,ans)
# mpl (ans.103,ans) {...} avoids maple/latex syntax error
# multiple roots, can't use mpl(foo,bah) here
# mpl (ans.104,ans) fixes problem of multiple roots
# mpl (ans.105,ans)
# mpl (ans.106,ans)
# mpl (ans.107,ans)
# mpl (ans.108,ans)
# mpl (ans.109,ans)
# mpl (ans.110,ans)
# mpl (ans.111,ans)
# mpl (lhs.109,ans)
# mpl (lhs.110,ans)
# mpl (lhs.111,ans)
```

$$\text{ans.101} := a^3 + 3a^2b + 3ab^2 + b^3$$

$$\text{ans.102} := x(x+1)(-x+a)$$

$$\text{ans.103} := \{-2, 2\}$$

$$\text{ans.104} := \{x = -2, x = 2\}$$

$$\text{ans.105} := \left\{a = \frac{1}{5}, b = -\frac{13}{5}, c = \frac{17}{5}\right\}$$

$$\text{ans.106} := 3.1415926535897932384626433832795028841971693993751$$

$$\text{ans.107} := -\frac{1}{4}(5+x)^{-1} + \frac{1}{4}(x+1)^{-1}$$

$$\text{ans.108} := \frac{1}{(x+1)(5+x)}$$

$$\tanh(\ln(x)) = \frac{x^2 - 1}{x^2 + 1} \quad (\text{ans.109})$$

$$\tanh(ix) = i \tan(x) \quad (\text{ans.110})$$

$$0 = \sinh(3x) - 3 \sinh(x) - 4 (\sinh(x))^3 \quad (\text{lhs.111})$$

```
\begin{align*}
&\&\text{mpl}\{ans.101\}\\
&\&\text{mpl}\{ans.102\}\\
&\&\text{mpl}\{ans.103\}\\
&\&\text{mpl}\{ans.104\}\\
&\&\text{mpl}\{ans.105\}\\
&\&\text{mpl}\{ans.106\}\\
&\&\text{mpl}\{ans.107\}\\
&\&\text{mpl}\{ans.108\}\\
&\&\text{lhs.109} \&= \&\text{Mpl}\{ans.109\}\\
&\&\text{lhs.110} \&= \&\text{Mpl}\{ans.110\}\\
&\&\text{lhs.111} \&= \&\text{Mpl}\{lhs.111\}
\end{align*}
```

Linear Algebra

```

with(LinearAlgebra):
mat  := <<2|3>, <5|4>>:           # mpl (ans.201,mat)
ans  := Eigenvectors(mat,output='list'):
eig1 := ans[1][1]:                # 1st eigenvalue
eig2 := ans[2][1]:                # 2nd eigenvalue
v1   := ans[1][3][1]:             # 1st eigenvector
v2   := ans[2][3][1]:             # 2nd eigenvector
eig  := <eig1,eig2>:             # mpl (ans.202,eig)
ans  := <v1|v2>:                  # mpl (ans.203,ans)
ans  := CharacteristicPolynomial(mat,lambda): # mpl (ans.204,ans)
vec  := <3,7>:                    # mpl (ans.205,vec)
sol  := LinearSolve(mat,vec):      # mpl (ans.206,sol)

```

```

\begin{align*}
&\&\text{\texttt{mpl}}*\{\texttt{ans.201}\}\\
&\&\text{\texttt{mpl}}*\{\texttt{ans.202}\}\\
&\&\text{\texttt{mpl}}*\{\texttt{ans.203}\}\\
&\&\text{\texttt{mpl}}*\{\texttt{ans.204}\}\\
&\&\text{\texttt{mpl}}*\{\texttt{ans.205}\}\\
&\&\text{\texttt{mpl}}*\{\texttt{ans.206}\}
\end{align*}

```

$$\begin{aligned}
\texttt{ans.201} &:= \begin{bmatrix} 2 & 3 \\ 5 & 4 \end{bmatrix} \\
\texttt{ans.202} &:= \begin{bmatrix} -1 \\ 7 \end{bmatrix} \\
\texttt{ans.203} &:= \begin{bmatrix} -1 & \frac{3}{5} \\ 1 & 1 \end{bmatrix} \\
\texttt{ans.204} &:= \lambda^2 - 6\lambda - 7 \\
\texttt{ans.205} &:= \begin{bmatrix} 3 \\ 7 \end{bmatrix} \\
\texttt{ans.206} &:= \begin{bmatrix} \frac{9}{7} \\ \frac{1}{7} \end{bmatrix}
\end{aligned}$$

Limits

```
ans := limit(sin(4*x)/x,x=0):           # mpl (ans.301,ans)
ans := limit(2^x/x,x=infinity):         # mpl (ans.302,ans)
ans := limit(((x+dx)^2 - x^2)/dx, dx=0): # mpl (ans.303,ans)
ans := limit((4*n + 1)/(3*n - 1),n=infinity): # mpl (ans.304,ans)
ans := limit((1+(a/n))^n,n=infinity):    # mpl (ans.305,ans)
```

```
\begin{align*}
&\&\text{\texttt{mpl}}\{ans.301\}\\
&\&\text{\texttt{mpl}}\{ans.302\}\\
&\&\text{\texttt{mpl}}\{ans.303\}\\
&\&\text{\texttt{mpl}}\{ans.304\}\\
&\&\text{\texttt{mpl}}\{ans.305\}
\end{align*}
```

```
ans.301 := 4
ans.302 := ∞
ans.303 := 2 x
ans.304 :=  $\frac{4}{3}$ 
ans.305 := ea
```

Series

```
ans := series((1 + x)^(-2), x=1, 6):    # mpl (ans.401,ans)
ans := series(exp(x), x=0, 6):          # mpl (ans.402,ans)
ans := sum(1/n^2, n=1..50):             # mpl (ans.403,ans)
ans := sum(1/n^4, n=1..infinity):       # mpl (ans.404,ans)
```

```
\begin{align*}
&\&\text{\texttt{mpl}}\{ans.401\}\\
&\&\text{\texttt{mpl}}\{ans.402\}\\
&\&\text{\texttt{mpl}}\{ans.403\}\\
&\&\text{\texttt{mpl}}\{ans.404\}
\end{align*}
```

```
ans.401 :=  $\left(\frac{1}{4} - \frac{1}{4}(x-1) + \frac{3}{16}(x-1)^2 - \frac{1}{8}(x-1)^3 + \frac{5}{64}(x-1)^4 - \frac{3}{64}(x-1)^5 + O((x-1)^6)\right)$ 
ans.402 :=  $\left(1 + x + \frac{1}{2}x^2 + \frac{1}{6}x^3 + \frac{1}{24}x^4 + \frac{1}{120}x^5 + O(x^6)\right)$ 
ans.403 :=  $\frac{3121579929551692678469635660835626209661709}{1920815367859463099600511526151929560192000}$ 
ans.404 :=  $\frac{\pi^4}{90}$ 
```

Calculus

```
ans := diff(x*sin(x),x):           # mpl (ans.501,ans)
ans := eval(diff(x*sin(x),x),x=Pi/4): # mpl (ans.502,ans)
ans := int(2*sin(x)^2, x=a..b):     # mpl (ans.503,ans)
ans := int(2*exp(-x^2),x=0..infinity): # mpl (ans.504,ans)
ans := ''int(2*exp(-x^2),x=0..infinity)'' : # mpl (lhs.504,ans)
ans := int(int(x^2 + y^2, y=0..x),x=0..1): # mpl (ans.505,ans)
ans := ''int(int(x^2 + y^2, y=0..x),x=0..1)'' : # mpl (lhs.505,ans)
```

```
\begin{align*}
&\&\text{mpl}\{ans.501\}\&\&\\
&\&\text{mpl}\{ans.502\}\&\&\\
&\&\text{mpl}\{ans.503\}\&\&\\
&\text{mpl}\{lhs.504\}\&=\&\text{Mpl}\{ans.504\}\&\&\\
&\text{mpl}\{lhs.505\}\&=\&\text{Mpl}\{ans.505\}\\
\end{align*}
```

$$\text{ans.501} := \sin(x) + x \cos(x)$$

$$\text{ans.502} := \frac{1}{2} \sqrt{2} + \frac{1}{8} \pi \sqrt{2}$$

$$\text{ans.503} := \sin(a) \cos(a) - a - \sin(b) \cos(b) + b$$

$$\int_0^{\infty} 2e^{-x^2} dx = \sqrt{\pi} \quad (\text{ans.504})$$

$$\int_0^1 \int_0^x x^2 + y^2 dy dx = \frac{1}{3} \quad (\text{ans.505})$$

Differential equations

```
ode := diff(y(x),x) + y(x) = 2*a*sin(x):
ics := y(0) = 0:
ans := rhs(dsolve(ode)):                # mpl (ans.601,ans)
ans := rhs(dsolve([ics,ode])):          # mpl (ans.602,ans)

ode := diff(y(x),x,x) + y(x) = 0:
ics := y(0)=0, (D(y))(0) = 1:
ans := rhs(dsolve(ode)):                # mpl (ans.603,ans)
ans := rhs(dsolve([ics,ode])):          # mpl (ans.604,ans)

ode := diff(y(x),x,x) + 5*diff(y(x),x) - 6*y(x) = 0:
ans := rhs(dsolve(ode)):                # mpl (ans.605,ans)
sol := eval(ans,[_C1=2,_C2=3]):         # mpl (ans.606,sol)
```

```
\begin{align*}
&\&\text{\texttt{mpl}}\{ans.601\}\\
&\&\text{\texttt{mpl}}\{ans.602\}\\
&\&\text{\texttt{mpl}}\{ans.603\}\\
&\&\text{\texttt{mpl}}\{ans.604\}\\
&\&\text{\texttt{mpl}}\{ans.605\}\\
&\&\text{\texttt{mpl}}\{ans.606\}
\end{align*}
```

$$\text{ans.601} := -a \cos(x) + a \sin(x) + e^{-x} C_1$$

$$\text{ans.602} := -a \cos(x) + a \sin(x) + e^{-x} a$$

$$\text{ans.603} := C_1 \sin(x) + C_2 \cos(x)$$

$$\text{ans.604} := \sin(x)$$

$$\text{ans.605} := C_1 e^{-6x} + C_2 e^x$$

$$\text{ans.606} := 2 e^{-6x} + 3 e^x$$