

# Elementary maths

```

ans = Expand[(a+b)^3] (* mma (ans.101,ans) *)
ans = Factor[-2*x+2*x+a*x-x^2+a*x^2-x^3] (* mma (ans.102,ans) *)
ans = Solve[x^2-4 == 0,x] (* mma (ans.103,ans) *)
ans = Solve[{2*a-b == 3, a+b+c == 1,-b+c == 6},{a,b,c}][[1]] (* mma (ans.104,ans) *)
ans = N[Pi,50] (* mma (ans.105,ans) *)
ans = Apart[1/((1 + x) (5 + x))] (* mma (ans.106,ans) *)
ans = Together[(1/(1 + x) - 1/(5 + x))/4] (* mma (ans.107,ans) *)
ans = Simplify[Tanh[Log[x]]] (* mma (ans.108,ans) *)
ans = Simplify[Tanh[I x]] (* mma (ans.109,ans) *)
ans = Simplify[Sinh[3 x] - 3 Sinh[x] - 4 (Sinh[x])^3] (* mma (ans.110,ans) *)
ans = HoldForm[Tanh[Log[x]]] (* mma (lhs.108,ans) *)
ans = HoldForm[Tanh[I x]] (* mma (lhs.109,ans) *)
ans = HoldForm[Sinh[3 x] - 3 Sinh[x] - 4 (Sinh[x])^3] (* mma (lhs.110,ans) *)

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```

\begin{align*}
&\&\text{mma}\{ans.101\}\\
&\&\text{mma}\{ans.102\}\\
&\&\text{mma}\{ans.103\}\\
&\&\text{mma}\{ans.104\}\\
&\&\text{mma}\{ans.105\}\\
&\&\text{mma}\{ans.106\}\\
&\&\text{mma}\{ans.107\}\\
\text{mma}\{lhs.108\} &= \text{Mma}\{ans.108\}\\
\text{mma}\{lhs.109\} &= \text{Mma}\{ans.109\}\\
\text{mma}\{lhs.110\} &= \text{Mma}\{ans.110\}
\end{align*}

```

$$ans.101 := a^3 + 3a^2b + 3ab^2 + b^3$$

$$ans.102 := x(x+1)(a-x)$$

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

$$ans.104 := \left\{ a \rightarrow \frac{1}{5}, b \rightarrow -\frac{13}{5}, c \rightarrow \frac{17}{5} \right\}$$

$$ans.105 := 3.1415926535897932384626433832795028841971693993751$$

$$ans.106 := \frac{1}{4(x+1)} - \frac{1}{4(x+5)}$$

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

$$\tanh(\log(x)) = \frac{x^2 - 1}{x^2 + 1} \quad (ans.108)$$

$$\tanh(ix) = i \tan(x) \quad (ans.109)$$

$$\sinh(3x) - 3 \sinh(x) - 4 \sinh^3(x) = 0 \quad (ans.110)$$

# Linear Algebra

```

mat = {{2, 3}, {5, 4}}
ans = Eigenvalues[mat]
ans = Eigenvectors[mat]
ans = CharacteristicPolynomial[mat, x]
rhs = {3, 7}
foo = rhs//MatrixForm
sol = LinearSolve[mat,rhs]

```

```

(* mma (ans.201,mat) *)
(* mma (ans.202,ans) *)
(* mma (ans.203,ans) *)
(* mma (ans.204,ans) *)
(* mma (ans.205,foo) *)
(* mma (ans.206,sol) *)

```

```

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

```

$$\begin{aligned}
 \text{ans.201} &:= \begin{pmatrix} 2 & 3 \\ 5 & 4 \end{pmatrix} \\
 \text{ans.202} &:= \{7, -1\} \\
 \text{ans.203} &:= \begin{pmatrix} 3 & 5 \\ -1 & 1 \end{pmatrix} \\
 \text{ans.204} &:= x^2 - 6x - 7 \\
 \text{ans.205} &:= \begin{pmatrix} 3 \\ 7 \end{pmatrix} \\
 \text{ans.206} &:= \left\{ \frac{9}{7}, \frac{1}{7} \right\}
 \end{aligned}$$

# Limits

```
ans = Limit[Sin[4 x]/x,x->0] (* mma (ans.301,ans) *)
ans = Limit[2^x/x,x->Infinity] (* mma (ans.302,ans) *)
ans = Limit[((x+dx)^2 - x^2)/dx, dx -> 0] (* mma (ans.303,ans) *)
ans = Limit[(4 n + 1)/(3 n - 1),n->Infinity] (* mma (ans.304,ans) *)
ans = Limit[(1+(a/n))^n,n->Infinity] (* mma (ans.305,ans) *)
```

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

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

# Series

```
ans = Series[(1 + x)^(-2), {x, 1, 5}] (* mma (ans.401,ans) *)
ans = Series[Exp[x], {x, 0, 5}] (* mma (ans.402,ans) *)
ans = Sum[1/i^2, {i, 1, 50}] (* mma (ans.403,ans) *)
ans = Sum[1/i^4, {i, 1, Infinity}] (* mma (ans.404,ans) *)
```

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

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

# Calculus

```
ans = D[x Sin[x],x] (* mma (ans.501,ans) *)
ans = D[x Sin[x],x]/.x -> Pi/4 (* mma (ans.502,ans) *)
ans = Integrate[2 Sin[x]^2, {x, a, b}] (* mma (ans.503,ans) *)
ans = Integrate[2 Exp[-x^2],{x, 0, Infinity}] (* mma (ans.504,ans) *)
ans = HoldForm[Integrate[2 Exp[-x^2], {x, 0, Infinity}]] (* mma (lhs.504,ans) *)
ans = Integrate[x^2 + y^2, {x, 0, 1}, {y, 0, x}] (* mma (ans.505,ans) *)
ans = HoldForm[Integrate[x^2 + y^2, {x, 0, 1}, {y, 0, x}]] (* mma (lhs.505,ans) *)
```

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

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

$$\text{ans.502} := \frac{1}{\sqrt{2}} + \frac{\pi}{4\sqrt{2}}$$

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

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

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

# Differential equations

```
sol = DSolveValue[y'[x] + y[x] == 2 a Sin[x], y[x], x] (* mma (ans.601,sol) *)
sol = DSolveValue[{y'[x] + y[x] == 2 a Sin[x], y[0] == 0}, y[x], x] (* mma (ans.602,sol) *)
sol = DSolveValue[{y''[x] + y[x] == 0}, y[x], x] (* mma (ans.603,sol) *)
sol = DSolveValue[{y''[x] + y[x] == 0, y[0] == 0, y'[0] == 1}, y[x], x] (* mma (ans.604,sol) *)
ans = DSolveValue[y''[x] + 5 y'[x] - 6 y[x] == 0, y[x], x] (* mma (ans.605,ans) *)
foo = ans /. {C[1] -> 2, C[2] -> 3} (* mma (ans.606,foo) *)
```

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

```
ans.601 := a(sin(x) - cos(x)) + c1 e-x
ans.602 := -a e-x (-ex sin(x) + ex cos(x) - 1)
ans.603 := c2 sin(x) + c1 cos(x)
ans.604 := sin(x)
ans.605 := c1 e-6x + c2 ex
ans.606 := 2 e-6x + 3 ex
```