# 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) *)
```

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

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

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

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

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

$$\texttt{ans.105} := 3.1415926535897932384626433832795028841971693993751$$

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

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

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

$$\tanh(ix) = i \tan(x) \tag{ans.109}$$

$$\sinh(3x) - 3\sinh(x) - 4\sinh^3(x) = 0 \tag{ans.110}$$

# Linear Algebra

```
mat = {{2, 3}, {5, 4}}                       (* mma (ans.201,mat) *)
ans = Eigenvalues[mat]                        (* mma (ans.202,ans) *)
ans = Eigenvectors[mat]                       (* mma (ans.203,ans) *)
ans = CharacteristicPolynomial[mat, x]        (* mma (ans.204,ans) *)
rhs = {3, 7}
foo = rhs//MatrixForm                         (* mma (ans.205,foo) *)
sol = LinearSolve[mat,rhs]                    (* mma (ans.206,sol) *)
```

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

$$\texttt{ans.201} := \begin{pmatrix} 2 & 3 \\ 5 & 4 \end{pmatrix}$$

$$\texttt{ans.202} := \{7, -1\}$$

$$\texttt{ans.203} := \begin{pmatrix} 3 & 5 \\ -1 & 1 \end{pmatrix}$$

$$\texttt{ans.204} := x^2 - 6x - 7$$

$$\texttt{ans.205} := \begin{pmatrix} 3 \\ 7 \end{pmatrix}$$

$$\texttt{ans.206} := \left\{ \frac{9}{7}, \frac{1}{7} \right\}$$

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

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

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

$$\text{ans.401} := \frac{1}{4} - \frac{x-1}{4} + \frac{3}{16}(x-1)^2 - \frac{1}{8}(x-1)^3 + \frac{5}{64}(x-1)^4 - \frac{3}{64}(x-1)^5 + O\left((x-1)^6\right)$$

$$\text{ans.402} := 1 + x + \frac{x^2}{2} + \frac{x^3}{6} + \frac{x^4}{24} + \frac{x^5}{120} + O\left(x^6\right)$$

$$\text{ans.403} := \frac{3121579929551692678469635660835626209661709}{1920815367859463099600511526151929560192000}$$

$$\text{ans.404} := \frac{\pi^4}{90}$$

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

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

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

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

$$\int_0^\infty 2\exp\left(-x^2\right)\,dx = \sqrt{\pi} \tag{ans.504}$$

$$\int_0^1 \int_0^x \left(x^2 + y^2\right)\,dy dx = \frac{1}{3} \tag{ans.505}$$

# 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) *)
```

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

$$\texttt{ans.601} := a(\sin(x) - \cos(x)) + c_1 e^{-x}$$

$$\texttt{ans.602} := -ae^{-x}\left(-e^x \sin(x) + e^x \cos(x) - 1\right)$$

$$\texttt{ans.603} := c_1 \cos(x) + c_2 \sin(x)$$

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

$$\texttt{ans.605} := c_1 e^{-6x} + c_2 e^x$$

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