**Maple’s dsolve procedure**

The procedure in Maple that solves differential equations is named *dsolve*. To obtain the general solution simply make an entry like this.

```
dsolve(y'' + y = sin(x))
```

\[ y(x) = \sin(x) \cdot C2 + \cos(x) \cdot C1 - \frac{1}{2} \cos(x) \cdot x \] (1)

To obtain the solution satisfying specific initial conditions put the ode and the inits inside set brackets.

```
dsolve( { y'' + y = sin(x), y(0) = 1, y'(0) = 2 } )
```

\[ y(x) = \frac{5}{2} \sin(x) + \cos(x) - \frac{1}{2} \cos(x) \cdot x \] (2)

**Using dsolve to obtain a series solution**

The next entry shows how to use *dsolve* to generate the series solution satisfying \( y(0) = a \) and \( y'(0) = b \). Enter the ode and inits inside set brackets, then the unknown function \( y(x) \), and the keyword *series*.

```
dsolve( { y'' + y = sin(x), y(0) = a, y'(0) = b, y(x), series } )
```

\[ y(x) = a + b \cdot x - \frac{1}{2} \cdot a \cdot x^2 + \left( -\frac{1}{6} \cdot b + \frac{1}{6} \right) \cdot x^3 + \frac{1}{24} \cdot a \cdot x^4 + \left( \frac{1}{120} \cdot b - \frac{1}{60} \right) \cdot x^5 + O(x^6) \] (3)

The default solution contains all terms up to power 5. The expression \( O(x^6) \) appearing in the solution represents the error term.

**The convert and collect procedures**

Convert the solution formula in output (3) to a polynomial using the *convert* procedure like this.

```
convert(rhs(3), polynom)
```

\[ a + b \cdot x - \frac{1}{2} \cdot a \cdot x^2 + \left( -\frac{1}{6} \cdot b + \frac{1}{6} \right) \cdot x^3 + \frac{1}{24} \cdot a \cdot x^4 + \left( \frac{1}{120} \cdot b - \frac{1}{60} \right) \cdot x^5 \] (4)

Then collect terms that go with \( a \) and \( b \) using the *collect* procedure as shown below.

```
collect(4, [a, b])
```

\[ \left( 1 - \frac{1}{2} \cdot x^2 + \frac{1}{24} \cdot x^4 \right) \cdot a + \left( x - \frac{1}{6} \cdot x^3 + \frac{1}{120} \cdot x^5 \right) \cdot b + \frac{1}{6} \cdot x^3 - \frac{1}{60} \cdot x^5 \] (5)

The next three entries use *dsolve*, *convert*, and *collect* to generate the first 10 terms of the general series solution to

\[ y'' + x \cdot y = 0, y(0) = y0, y'(0) = y1. \]

Output for the first two entries is suppressed.

```
dsolve( { y'' + x \cdot y = 0, y(0) = y0, y'(0) = y1 }, y(x), series, order = 11 ) : convert(rhs(%), polynom) :
collect(%, [y0, y1])
```

\[ \left( 1 - \frac{1}{6} \cdot x^3 + \frac{1}{180} \cdot x^6 - \frac{1}{12960} \cdot x^9 \right) \cdot y0 + \left( x - \frac{1}{12} \cdot x^4 + \frac{1}{504} \cdot x^7 - \frac{1}{45360} \cdot x^{10} \right) \cdot y1 \] (6)

Each partial solution in output (6) can also be obtained as follows.

```
dsolve( { y'' + x \cdot y = 0, y(0) = 1, y'(0) = 0 }, y(x), series, order = 11 ) : convert(rhs(%), polynom)
```

\[ 1 - \frac{1}{6} \cdot x^3 + \frac{1}{180} \cdot x^6 - \frac{1}{12960} \cdot x^9 \] (7)

```
dsolve( { y'' + x \cdot y = 0, y(0) = 0, y'(0) = 1 }, y(x), series, order = 11 ) : convert(rhs(%), polynom)
```

\[ x - \frac{1}{12} \cdot x^4 + \frac{1}{504} \cdot x^7 - \frac{1}{45360} \cdot x^{10} \] (8)