

$$\begin{aligned} &> \text{dsolve}(\text{diff}(u(x), x\$2) + 5 \cdot \text{diff}(u(x), x) - 7 \cdot u(x) = x^2 + 5 \cdot x - 7, u(x)) \\ &u(x) = e^{\frac{(-5 + \sqrt{53})x}{2}} c_2 + e^{-\frac{(5 + \sqrt{53})x}{2}} c_1 - \frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \end{aligned} \quad (1)$$

$$\begin{aligned} &> eq1 := \text{diff}(u(x), x\$2) + 5 \cdot \text{diff}(u(x), x) - 7 \cdot u(x) = x^2 + 5 \cdot x - 7 \\ &eq1 := \frac{d^2}{dx^2} u(x) + 5 \frac{d}{dx} u(x) - 7 u(x) = x^2 + 5x - 7 \end{aligned} \quad (2)$$

$$\begin{aligned} &> eq1 := \text{dsolve}(eq1, u(x)) \\ &eq1 := u(x) = e^{\frac{(-5 + \sqrt{53})x}{2}} c_2 + e^{-\frac{(5 + \sqrt{53})x}{2}} c_1 - \frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \end{aligned} \quad (3)$$

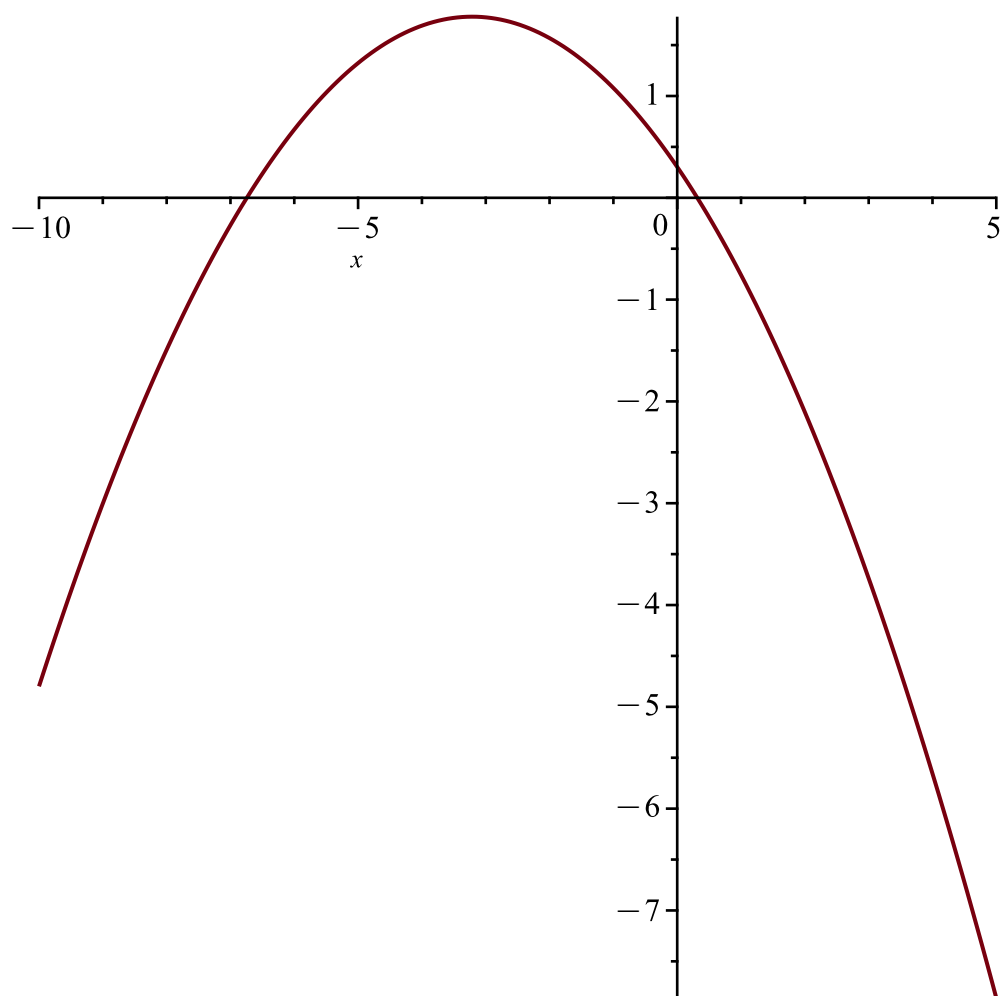
$$\begin{aligned} &> eq1 \\ &u(x) = e^{\frac{(-5 + \sqrt{53})x}{2}} c_2 + e^{-\frac{(5 + \sqrt{53})x}{2}} c_1 - \frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \end{aligned} \quad (4)$$

$$\begin{aligned} &> eq1 := \text{rhs}(eq1) \\ &eq1 := e^{\frac{(-5 + \sqrt{53})x}{2}} c_2 + e^{-\frac{(5 + \sqrt{53})x}{2}} c_1 - \frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \end{aligned} \quad (5)$$

$$\begin{aligned} &> eq1 \\ &e^{\frac{(-5 + \sqrt{53})x}{2}} c_2 + e^{-\frac{(5 + \sqrt{53})x}{2}} c_1 - \frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \end{aligned} \quad (6)$$

$$\begin{aligned} &> eq1 := -\frac{x^2}{7} - \frac{45x}{49} + \frac{104}{343} \\ &eq1 := -\frac{1}{7} x^2 - \frac{45}{49} x + \frac{104}{343} \end{aligned} \quad (7)$$

$$> \text{plot}(eq1, x = -10..5)$$



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```
> f := x -> - x^2/7 - 45 x/49 + 104/343
```

$$f := x \mapsto -\frac{1}{7}x^2 - \frac{45}{49}x + \frac{104}{343} \quad (8)$$


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```
> f(x)
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$$-\frac{1}{7}x^2 - \frac{45}{49}x + \frac{104}{343} \quad (9)$$


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```
> f(1)
```

$$-\frac{260}{343} \quad (10)$$


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```
> val := Pi*sqrt(2)
```

$$val := \pi\sqrt{2} \quad (11)$$


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```
> f(val)
```

$$-\frac{2\pi^2}{7} - \frac{45\pi\sqrt{2}}{49} + \frac{104}{343} \quad (12)$$


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```
> evalf(f(val))
```

$$-6.596878591 \quad (13)$$


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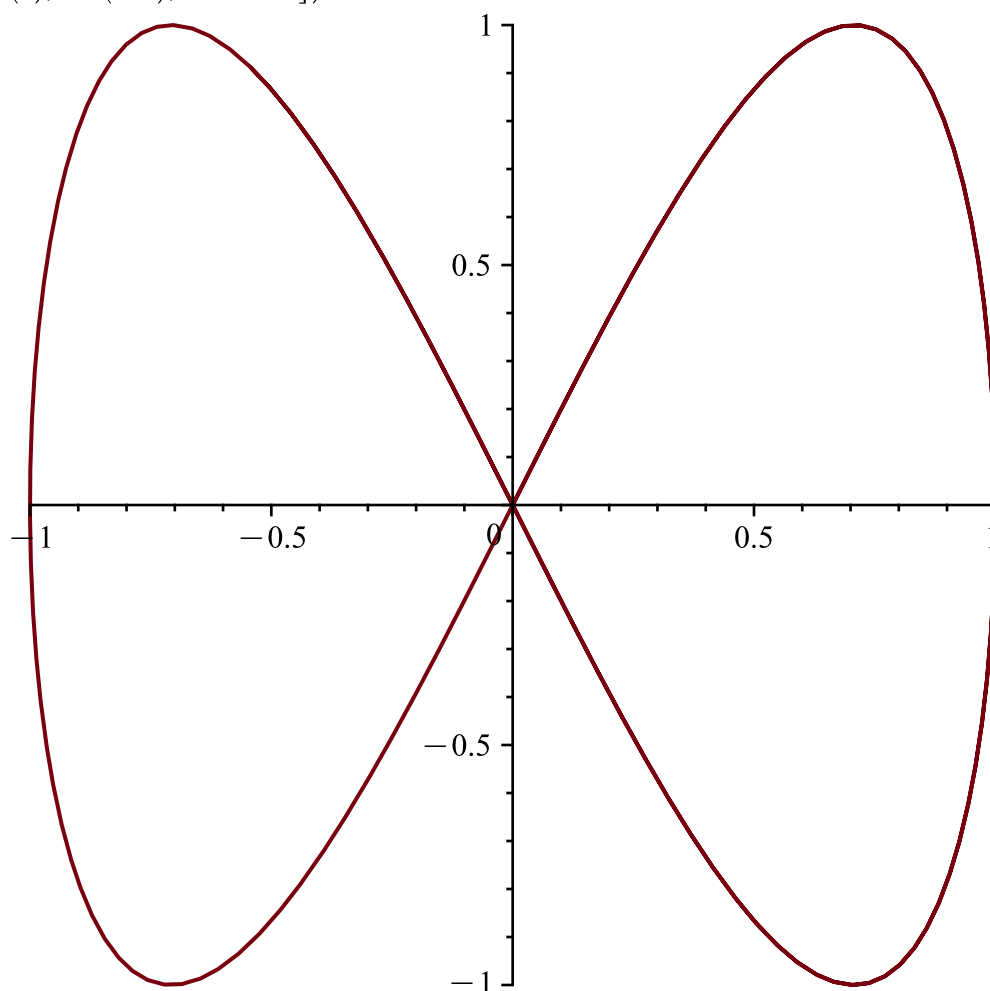
```
> evalf(D(f)(val))
```

...

−2.187762472

(14)

> `plot([sin(t), sin(2·t), t=0..10])`



> `with(LinearAlgebra) : with(VectorCalculus)`

`[&x, `*`, `+`, `·`, `·`, <, >, <|>, About, AddCoordinates, ArcLength, BasisFormat, Binormal, ConvertVector, CrossProduct, Curl, Curvature, D, Del, DirectionalDiff, Divergence, DotProduct, Flux, GetCoordinateParameters, GetCoordinates, GetNames, GetPVDDescription, GetRootPoint, GetSpace, Gradient, Hessian, IsPositionVector, IsRootedVector, IsVectorField, Jacobian, Laplacian, LineInt, MapToBasis, ∇, Norm, Normalize, PathInt, PlotPositionVector, PlotVector, PositionVector, PrincipalNormal, RadiusOfCurvature, RootedVector, ScalarPotential, SetCoordinateParameters, SetCoordinates, SpaceCurve, SurfaceInt, TNBFrame, TangentLine, TangentPlane, TangentVector, Torsion, Vector, VectorField, VectorPotential, VectorSpace, Wronskian, diff, eval, evalVF, int, limit, series]`

(15)

> `A := Matrix([[−7, 0], [1, 7]])`

$$A := \begin{bmatrix} -7 & 0 \\ 1 & 7 \end{bmatrix}$$

(16)

> `Determinant(A)`

−49

(17)

$$\begin{aligned} &> \text{Eigenvalues}(A) \\ &\quad \begin{bmatrix} 7 \\ -7 \end{bmatrix} \end{aligned} \tag{18}$$

$$\begin{aligned} &> \text{MatrixExponential}(t \cdot A) \\ &\quad \begin{bmatrix} e^{-7t} & 0 \\ \frac{e^{7t}}{14} - \frac{e^{-7t}}{14} & e^{7t} \end{bmatrix} \end{aligned} \tag{19}$$

$$\begin{aligned} &> eq2 := x - 17 \cdot y + 3 \cdot y^2 - 2 \cdot x \cdot y \\ &\quad eq2 := -2xy + 3y^2 + x - 17y \end{aligned} \tag{20}$$

$$\begin{aligned} &> eq3 := 17 \cdot x + y \\ &\quad eq3 := 17x + y \end{aligned} \tag{21}$$

$$\begin{aligned} &> \text{solve}(\{eq2, eq3\}, \{x, y\}) \\ &\quad \{x=0, y=0\}, \left\{x = -\frac{290}{901}, y = \frac{290}{53}\right\} \end{aligned} \tag{22}$$

$$\begin{aligned} &> f1 := (x, y) \rightarrow x - 17 \cdot y + 3 \cdot y^2 - 2 \cdot x \cdot y \\ &\quad f1 := (x, y) \mapsto x + (-17 \cdot y) + 3 \cdot y^2 + (-2 \cdot x \cdot y) \end{aligned} \tag{23}$$

$$\begin{aligned} &> f2 := (x, y) \rightarrow 17 \cdot x + y \\ &\quad f2 := (x, y) \mapsto 17 \cdot x + y \end{aligned} \tag{24}$$

$$\begin{aligned} &> Jacob := \text{Jacobian}([f1(x, y), f2(x, y)], [x, y]) \\ &\quad Jacob := \begin{bmatrix} -2y + 1 & -2x + 6y - 17 \\ 17 & 1 \end{bmatrix} \end{aligned} \tag{25}$$

$$\begin{aligned} &> MRes := \text{subs}([x=0, y=0], Jacob) \\ &\quad MRes := \begin{bmatrix} 1 & -17 \\ 17 & 1 \end{bmatrix} \end{aligned} \tag{26}$$

$$\begin{aligned} &> \text{Eigenvalues}(MRes) \\ &\quad \begin{bmatrix} 1 + 17I \\ 1 - 17I \end{bmatrix} \end{aligned} \tag{27}$$

$$\begin{aligned} &> x := 'x'; eq5 := 0.02 \cdot x \cdot (100 - x) = 0 \\ &\quad x := x \\ &\quad eq5 := 0.02x(100 - x) = 0 \end{aligned} \tag{28}$$

$$\begin{aligned} &> \text{solve}(eq5, x) \\ &\quad 0., 100. \end{aligned} \tag{29}$$

$$\begin{aligned} &> func := x \rightarrow 0.02 \cdot x \cdot (100 - x) \\ &\quad func := x \mapsto 0.02 \cdot x \cdot (100 + (-x)) \end{aligned} \tag{30}$$

$$\begin{aligned} &> x := 10 \\ &\quad x := 10 \end{aligned} \tag{31}$$

```
> for i from 1 to 30 do x := func(x) : psi(i) := x : print(x);od:
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18.00
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29.520000
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41.61139200
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48.59262512
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49.96038592
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49.99996861
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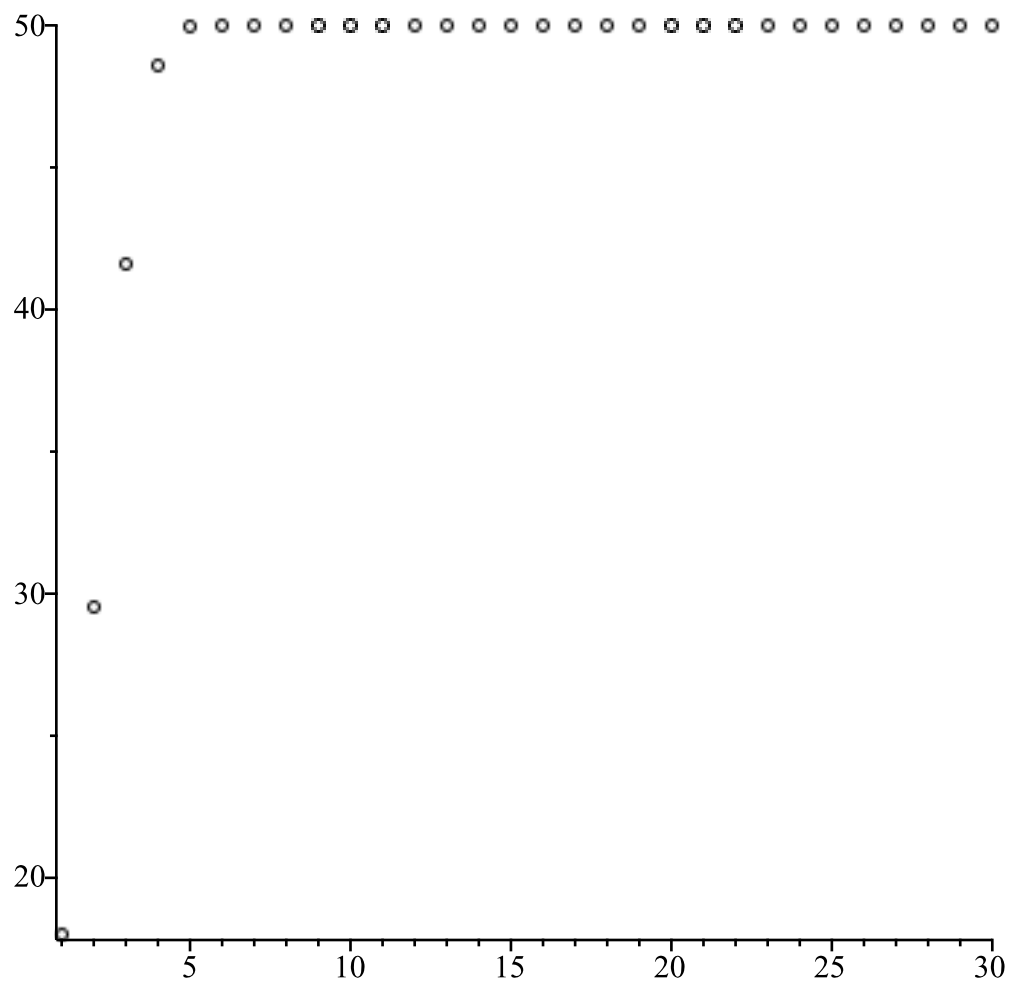
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50.00000000
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(32)

```
> points := [[n, psi(n)]$n = 1 ..30] : with(plots) : pointplot(points, symbol=circle);
```



```
> x := 80
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```
x := 80
```

(33)

```
> for i from 1 to 30 do x := func(x) : psi(i) := x : print(x); od:
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32.00
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43.520000
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49.98589445
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(34)

>  $eqIVP := \text{diff}(v(t), t\$2) - 16 \cdot v(t) = 0$

$$eqIVP := \frac{d^2}{dt^2} v(t) - 16 v(t) = 0$$

(35)

>  $ic1 := v(\exp(1)) = 1, D(v)(\exp(1)) = 1$

$$ic1 := v(e) = 1, D(v)(e) = 1$$

(36)

>  $dsolve(\{eqIVP, ic1\}, v(t))$

$$v(t) = \frac{5 e^{-4e} e^{4t}}{8} + \frac{3 e^{4e} e^{-4t}}{8}$$

(37)

>  $evalf(\text{subs}(t=0, dsolve(\{eqIVP, ic1\}, v(t))))$

$$v(0) = 19777.45749$$

(38)

>  $eqSol := dsolve(\{eqIVP, ic1\}, v(t))$

$$eqSol := v(t) = \frac{5 e^{-4e} e^{4t}}{8} + \frac{3 e^{4e} e^{-4t}}{8}$$

(39)

>  $\text{plot}(rhs(eqSol), t=1..4.4)$

