```
> restart
```

```
> EcuaOriginal := x^2·y'' + x·y' + (x^2 - 1/4)·y = x^(3/2)
```

$$EcuaOriginal := x^2 \left(\frac{d^2}{dx^2} y(x) \right) + x \left(\frac{d}{dx} y(x) \right) + \left(x^2 - \frac{1}{4} \right) y(x) = x^{3/2} \quad (1)$$

```
> EcuaNormal := expand( EcuaOriginal / x^2 )
```

$$EcuaNormal := \frac{d^2}{dx^2} y(x) + y(x) + \frac{\frac{d}{dx} y(x)}{x} - \frac{y(x)}{4 x^2} = \frac{1}{\sqrt{x}} \quad (2)$$

```
> yy[1] := x^(-1/2)·cos(x); yy[2] := x^(-1/2)·sin(x)
```

$$yy_1 := \frac{\cos(x)}{\sqrt{x}}$$

$$yy_2 := \frac{\sin(x)}{\sqrt{x}} \quad (3)$$

```
> EcuaHom := lhs(EcuaNormal) = 0
```

$$EcuaHom := \frac{d^2}{dx^2} y(x) + y(x) + \frac{\frac{d}{dx} y(x)}{x} - \frac{y(x)}{4 x^2} = 0 \quad (4)$$

```
> ComprobarUno := simplify(eval(subs(y(x) = yy[1], EcuaHom)))
```

$$ComprobarUno := 0 = 0 \quad (5)$$

```
> ComprobarDos := simplify(eval(subs(y(x) = yy[2], EcuaHom)))
```

$$ComprobarDos := 0 = 0 \quad (6)$$

```
> EcuacionOriginalNoHom := lhs(EcuaOriginal) = x^(3/2)
```

$$EcuacionOriginalNoHom := x^2 \left(\frac{d^2}{dx^2} y(x) \right) + x \left(\frac{d}{dx} y(x) \right) + \left(x^2 - \frac{1}{4} \right) y(x) = x^{3/2} \quad (7)$$

```
> EcuaNoHomNormal := expand( EcuacionOriginalNoHom / x^2 )
```

$$EcuaNoHomNormal := \frac{d^2}{dx^2} y(x) + y(x) + \frac{\frac{d}{dx} y(x)}{x} - \frac{y(x)}{4 x^2} = \frac{1}{\sqrt{x}} \quad (8)$$

```
> Q := rhs(EcuaNoHomNormal)
```

$$Q := \frac{1}{\sqrt{x}} \quad (9)$$

```
> with(linalg) :
> WW := wronskian([yy[1], yy[2]], x)
```

$$WW := \begin{bmatrix} \frac{\cos(x)}{\sqrt{x}} & \frac{\sin(x)}{\sqrt{x}} \\ -\frac{\cos(x)}{2\,x^{3/2}} - \frac{\sin(x)}{\sqrt{x}} & -\frac{\sin(x)}{2\,x^{3/2}} + \frac{\cos(x)}{\sqrt{x}} \end{bmatrix} \quad (10)$$

> $BB := array([0, Q])$

$$BB := \begin{bmatrix} 0 & \frac{1}{\sqrt{x}} \end{bmatrix} \quad (11)$$

> $ParaVar := simplify(linsolve(WW, BB))$

$$ParaVar := \begin{bmatrix} -\sin(x) & \cos(x) \end{bmatrix} \quad (12)$$

> $Aprima := ParaVar[1]; Bprima := ParaVar[2]$

$$Aprima := -\sin(x)$$
$$Bprima := \cos(x) \quad (13)$$

> $SolGral := y(x) = simplify((int(Aprima, x) + \_C1)\cdot yy[1] + (int(Bprima, x) + \_C2)\cdot yy[2])$

$$SolGral := y(x) = \frac{1 + \cos(x)\ \_C1 + \sin(x)\ \_C2}{\sqrt{x}} \quad (14)$$

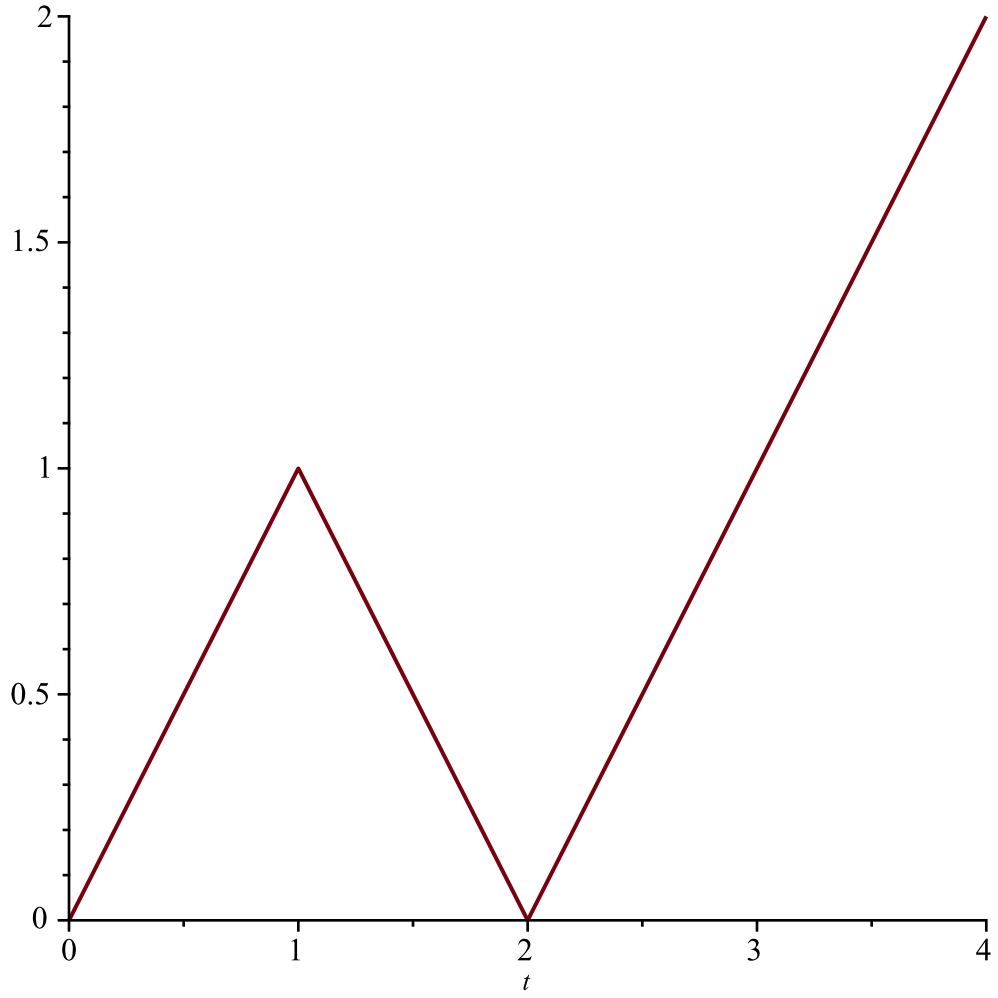
> $ComprobarTres := simplify(eval(subs(y(x) = rhs(SolGral), EcuacionOriginalNoHom)))$

$$ComprobarTres := x^{3/2} = x^{3/2} \quad (15)$$

> $restart$

> $f := t\cdot \text{Heaviside}(t) - 2\cdot(t-1)\cdot \text{Heaviside}(t-1) + 2\cdot(t-2)\cdot \text{Heaviside}(t-2); plot(f, t = 0..4)$

$$f := t\ \text{Heaviside}(t) - 2\ (t-1)\ \text{Heaviside}(t-1) + 2\ (t-2)\ \text{Heaviside}(t-2)$$




```
> restart
> Ecua := diff(x(t), t$2) + 2·x(t) = 4·Dirac(t − 2·Pi)
```

$$Ecua := \frac{d^2}{dt^2} x(t) + 2\,x(t) = 4\,\mathrm{Dirac}(t - 2\,\pi) \tag{16}$$

```
> CondIni := x(0) = 3, D(x)(0) = 0
```

$$CondIni := x(0) = 3,\ D(x)(0) = 0 \tag{17}$$

```
> with(inttrans) :
> EcuaTL := subs(CondIni, laplace(Ecua, t, s))
```

$$EcuaTL := s^2\,\mathcal{L}(x(t), t, s) - 3\,s + 2\,\mathcal{L}(x(t), t, s) = 4\,e^{-2\,s\,\pi} \tag{18}$$

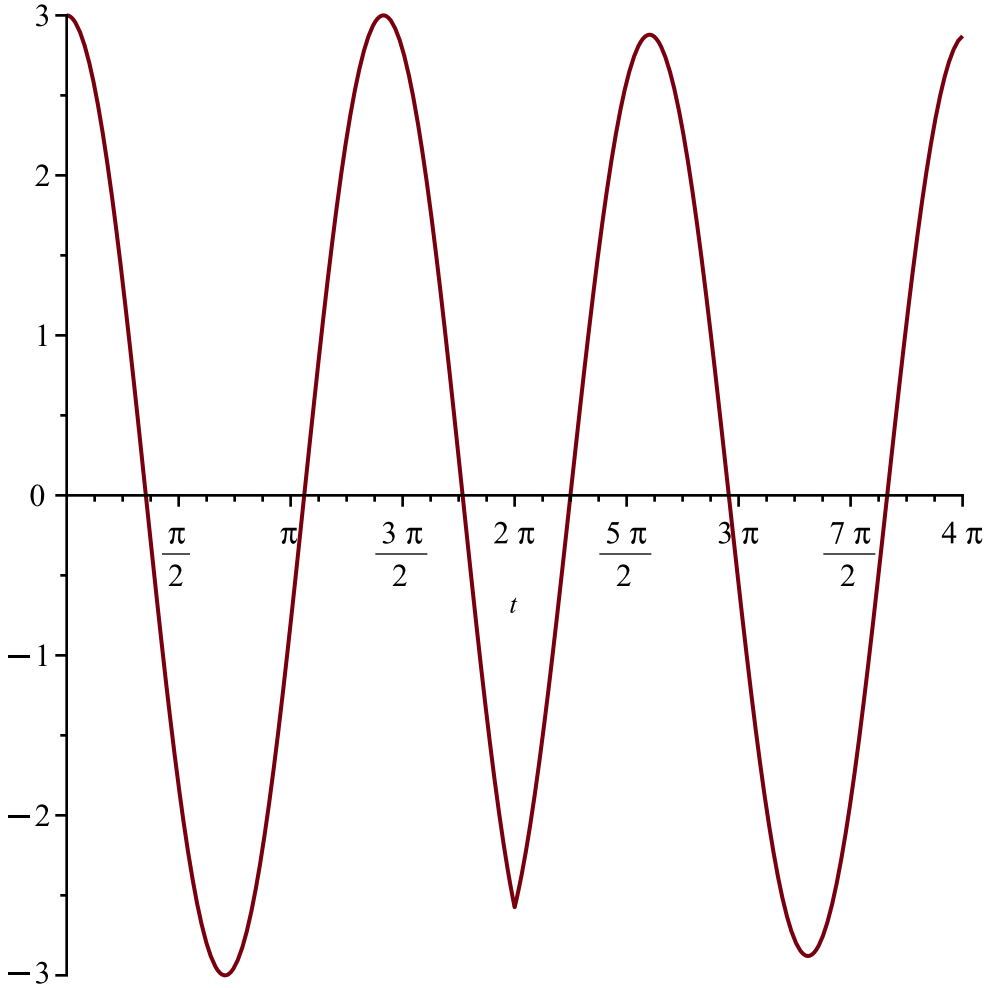
```
> SolPartTL := isolate(EcuaTL, laplace(x(t), t, s))
```

$$SolPartTL := \mathcal{L}(x(t), t, s) = \frac{4\,e^{-2\,s\,\pi} + 3\,s}{s^2 + 2} \tag{19}$$

```
> SolPart := invlaplace(SolPartTL, s, t)
```

$$SolPart := x(t) = 2\,\mathrm{Heaviside}(t - 2\,\pi)\,\sin\left(\sqrt{2}\,(t - 2\,\pi)\right)\sqrt{2} + 3\cos\left(\sqrt{2}\,t\right) \tag{20}$$

```
> plot(rhs(SolPart), t = 0..4·Pi)
```



> $Comprobar := simplify(eval(subs(x(t) = rhs(SolPart), lhs(Ecua) - rhs(Ecua) = 0)))$

$$Comprobar := 0 = 0 \quad \textbf{(21)}$$

> *restart*

> $Sistema := diff(x[1](t), t) = x[2](t), diff(x[2](t), t) = -9 \cdot x[1](t) + \sin(2\,t) : Sistema[1];$
$Sistema[2]$

$$\frac{d}{dt} x_1(t) = x_2(t)$$

$$\frac{d}{dt} x_2(t) = -9\,x_1(t) + \sin(2\,t) \quad \textbf{(22)}$$

> $Xcero := array([0, 0])$

$$Xcero := \begin{bmatrix} 0 & 0 \end{bmatrix} \quad \textbf{(23)}$$

> $BB := array([0, \sin(2 \cdot t)])$

$$BB := \begin{bmatrix} 0 & \sin(2\,t) \end{bmatrix} \quad \textbf{(24)}$$

> $AA := array([[0, 1], [-9, 0]])$

$$AA := \begin{bmatrix} 0 & 1 \\ -9 & 0 \end{bmatrix} \quad \textbf{(25)}$$

> *with(linalg) :*

```
> MatExp := exponential(AA, t)
```

$$MatExp := \begin{bmatrix} \cos(3\,t) & \frac{\sin(3\,t)}{3} \\ -3\sin(3\,t) & \cos(3\,t) \end{bmatrix} \tag{26}$$

```
> MatExpTau := map(rcurry(eval, t='t - tau'), MatExp)
```

$$MatExpTau := \begin{bmatrix} \cos(3\,t-3\,\tau) & \frac{\sin(3\,t-3\,\tau)}{3} \\ -3\sin(3\,t-3\,\tau) & \cos(3\,t-3\,\tau) \end{bmatrix} \tag{27}$$

```
> BBtau := map(rcurry(eval, t='tau'), BB)
```

$$BBtau := \begin{bmatrix} 0 & \sin(2\,\tau) \end{bmatrix} \tag{28}$$

```
> ProdTau := evalm(MatExpTau &* BBtau) : ProdTau[1]; ProdTau[2]
```

$$\frac{\sin(3\,t-3\,\tau)\,\sin(2\,\tau)}{3}$$

$$\cos(3\,t-3\,\tau)\,\sin(2\,\tau) \tag{29}$$

```
>
> SolFinalHom := evalm(MatExp &* Xcero) : x[1](t) = SolFinalHom[1]; x[2](t)
    = SolFinalHom[2]
```

$$x_1(t) = 0$$

$$x_2(t) = 0 \tag{30}$$

```
> SolFinalNoHom := map(int, ProdTau, tau = 0..t) : x[1](t) = SolFinalNoHom[1]; x[2](t)
    = SolFinalNoHom[2]
```

$$x_1(t) = -\frac{2\sin(3\,t)}{15} + \frac{\sin(2\,t)}{5}$$

$$x_2(t) = -\frac{2\cos(3\,t)}{5} + \frac{2\cos(2\,t)}{5} \tag{31}$$

```
> EcuaOriginal := diff(x(t), t$2) + 9·x(t) = sin(2 t)
```

$$EcuaOriginal := \frac{d^2}{dt^2}x(t) + 9\,x(t) = \sin(2\,t) \tag{32}$$

```
> ComprobarOriginal := simplify(eval(subs(x(t) = SolFinalNoHom[1], EcuaOriginal)))
```

$$ComprobarOriginal := \sin(2\,t) = \sin(2\,t) \tag{33}$$

```
> ComprobarDos := diff(SolFinalNoHom[1], t) = SolFinalNoHom[2]
```

$$ComprobarDos := -\frac{2\cos(3\,t)}{5} + \frac{2\cos(2\,t)}{5} = -\frac{2\cos(3\,t)}{5} + \frac{2\cos(2\,t)}{5} \tag{34}$$

```
>
```