```
> restart
> AA := array([[2,-7], [3, 6]])
```

$$AA := \begin{bmatrix} 2 & -7 \\ 3 & 6 \end{bmatrix} \tag{1}$$

```
> Xcero := array([-1, 6])
```

$$Xcero := \begin{bmatrix} -1 & 6 \end{bmatrix} \tag{2}$$

```
> with(linalg) :
> MatExp := exponential(AA, t) : evalf(MatExp[1, 1], 3); evalf(MatExp[1, 2], 3);
    evalf(MatExp[2, 1], 3); evalf(MatExp[2, 2], 3)
```

$$e^{4.\,t}\cos(4.12\,t) - 0.486\,e^{4.\,t}\sin(4.12\,t)$$

$$-1.70\,e^{4.\,t}\sin(4.12\,t)$$

$$0.725\,e^{4.\,t}\sin(4.12\,t)$$

$$e^{4.\,t}\cos(4.12\,t) + 0.486\,e^{4.\,t}\sin(4.12\,t) \tag{3}$$

```
> IdentidadUno := map(rcurry(eval, t='0'), MatExp)
```

$$IdentidadUno := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{4}$$

```
> InvMatExp := map(rcurry(eval, t='-t'), MatExp) :
> IdentidadDos := simplify(evalm(MatExp &* InvMatExp))
```

$$IdentidadDos := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \tag{5}$$

```
> DerMatExp := map(diff, MatExp, t) :
> ProdAAmatExp := evalm(AA &* MatExp) :
> Comprobar := simplify(evalm( DerMatExp - ProdAAmatExp))
```

$$Comprobar := \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix} \tag{6}$$

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

$$x_1(t) = -e^{4\,t}\cos\left(\sqrt{17}\,t\right) - \frac{40\,e^{4\,t}\sin\left(\sqrt{17}\,t\right)\sqrt{17}}{17}$$

$$x_2(t) = \frac{9\,e^{4\,t}\sin\left(\sqrt{17}\,t\right)\sqrt{17}}{17} + 6\,e^{4\,t}\cos\left(\sqrt{17}\,t\right) \tag{7}$$

```
> SolPartCero := simplify(map(rcurry(eval, t='0'), SolPart))
```

$$SolPartCero := \begin{bmatrix} -1 & 6 \end{bmatrix} \tag{8}$$

```
> Sistema := diff(x[1](t), t) = 2·x[1](t) - 7·x[2](t), diff(x[2](t), t) = 3·x[1](t) + 6·x[2](t) :
    Sistema[1]; Sistema[2];
```

$$\frac{d}{dt}x_1(t) = 2\,x_1(t) - 7\,x_2(t)$$

(9)

$$\frac{d}{dt}\,x_2(t) = 3\,x_1(t) + 6\,x_2(t) \tag{9}$$

```
> ComprobarUno := simplify(eval(subs(x[1](t) = SolPart[1], x[2](t) = SolPart[2],
      lhs(Sistema[1]) - rhs(Sistema[1]) = 0)))
```

$$ComprobarUno := 0 = 0 \tag{10}$$

```
> ComprobarDos := simplify(eval(subs(x[1](t) = SolPart[1], x[2](t) = SolPart[2],
      lhs(Sistema[2]) - rhs(Sistema[2]) = 0)))
```

$$ComprobarDos := 0 = 0 \tag{11}$$

```
> restart
> AA := array([[0, 1, 0], [0, -2, -5], [0, 1, 2]])
```

$$AA := \begin{bmatrix} 0 & 1 & 0 \\ 0 & -2 & -5 \\ 0 & 1 & 2 \end{bmatrix} \tag{12}$$

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

$$MatExp := \begin{bmatrix} 1 & \sin(t) + 2\cos(t) - 2 & 5\cos(t) - 5 \\ 0 & -2\sin(t) + \cos(t) & -5\sin(t) \\ 0 & \sin(t) & 2\sin(t) + \cos(t) \end{bmatrix} \tag{13}$$

```
> Xcero := array([0, 0, 1])
```

$$Xcero := \begin{bmatrix} 0 & 0 & 1 \end{bmatrix} \tag{14}$$

```
> BB := array([0, 3, 0])
```

$$BB := \begin{bmatrix} 0 & 3 & 0 \end{bmatrix} \tag{15}$$

```
> ParteUno := evalm(MatExp &* Xcero) : ParteUno[1]; ParteUno[2]; ParteUno[3]
```

$$5\cos(t) - 5$$
$$-5\sin(t)$$
$$2\sin(t) + \cos(t) \tag{16}$$

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

$$MatExpTau := \begin{bmatrix} 1 & \sin(t-\tau) + 2\cos(t-\tau) - 2 & 5\cos(t-\tau) - 5 \\ 0 & -2\sin(t-\tau) + \cos(t-\tau) & -5\sin(t-\tau) \\ 0 & \sin(t-\tau) & 2\sin(t-\tau) + \cos(t-\tau) \end{bmatrix} \tag{17}$$

```
> ProdTau := evalm(MatExpTau &* BB) : ProdTau[1]; ProdTau[2]; ProdTau[3]
```

$$3\sin(t-\tau) + 6\cos(t-\tau) - 6$$
$$-6\sin(t-\tau) + 3\cos(t-\tau)$$
$$3\sin(t-\tau) \tag{18}$$

```
> ParteDos := map(int, ProdTau, tau = 0..t) : ParteDos[1]; ParteDos[2]; ParteDos[3];
```

$$3 + 6\sin(t) - 3\cos(t) - 6t$$
$$-6 + 6\cos(t) + 3\sin(t)$$

$$3 - 3\cos(t) \tag{19}$$

```
> ComprobarTres := map(rcurry(eval, t='0'), ParteDos)
```

$$ComprobarTres := \begin{bmatrix} 0 & 0 & 0 \end{bmatrix} \tag{20}$$

```
> restart
> AA := array([[1, 2], [2, 4]])
```

$$AA := \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix} \tag{21}$$

```
> Xcero := array([_C1, _C2])
```

$$Xcero := \begin{bmatrix} \_C1 & \_C2 \end{bmatrix} \tag{22}$$

```
> BB := array([3·exp(t), 4·exp(−t)])
```

$$BB := \begin{bmatrix} 3\,e^{t} & 4\,e^{-t} \end{bmatrix} \tag{23}$$

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

$$MatExp := \begin{bmatrix} \frac{4}{5} + \frac{e^{5t}}{5} & \frac{2\,e^{5t}}{5} - \frac{2}{5} \\ \frac{2\,e^{5t}}{5} - \frac{2}{5} & \frac{1}{5} + \frac{4\,e^{5t}}{5} \end{bmatrix} \tag{24}$$

```
> ComprobarUno := det(AA)
```

$$ComprobarUno := 0 \tag{25}$$

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

$$\left(\frac{4}{5} + \frac{e^{5t}}{5}\right)\_C1 + \left(\frac{2\,e^{5t}}{5} - \frac{2}{5}\right)\_C2$$

$$\left(\frac{2\,e^{5t}}{5} - \frac{2}{5}\right)\_C1 + \left(\frac{1}{5} + \frac{4\,e^{5t}}{5}\right)\_C2 \tag{26}$$

```
> ComprobarDos := map(rcurry(eval, t='0'), ParteUno)
```

$$ComprobarDos := \begin{bmatrix} \_C1 & \_C2 \end{bmatrix} \tag{27}$$

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

$$MatExpTau := \begin{bmatrix} \frac{4}{5} + \frac{e^{5t-5\tau}}{5} & \frac{2\,e^{5t-5\tau}}{5} - \frac{2}{5} \\ \frac{2\,e^{5t-5\tau}}{5} - \frac{2}{5} & \frac{1}{5} + \frac{4\,e^{5t-5\tau}}{5} \end{bmatrix} \tag{28}$$

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

$$BBtau := \begin{bmatrix} 3\,e^{\tau} & 4\,e^{-\tau} \end{bmatrix} \tag{29}$$

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

$$3\left(\frac{4}{5} + \frac{e^{5t-5\tau}}{5}\right)e^{\tau} + 4\left(\frac{2\,e^{5t-5\tau}}{5} - \frac{2}{5}\right)e^{-\tau}$$

$$3\left(\frac{2\,e^{5t-5\tau}}{5}-\frac{2}{5}\right)e^{\tau}+4\left(\frac{1}{5}+\frac{4\,e^{5t-5\tau}}{5}\right)e^{-\tau} \tag{30}$$

> $ParteDos := map(int, ProdTau, \mathrm{tau}=0..t) : ParteDos[1]; ParteDos[2]$

$$-4+\frac{5\,e^{5t}}{12}+\frac{9\,e^{t}}{4}+\frac{4\,e^{-t}}{3}$$

$$2+\frac{5\,e^{5t}}{6}-\frac{4\,e^{-t}}{3}-\frac{3\,e^{t}}{2} \tag{31}$$

> $ComprobarTres := map(rcurry(eval, t='0'), ParteDos)$

$$ComprobarTres := \begin{bmatrix} 0 & 0 \end{bmatrix} \tag{32}$$

> $SolGral := evalm(ParteUno + ParteDos) : x[1](t)=SolGral[1]; x[2](t)=SolGral[2]$

$$x_1(t)=\left(\frac{4}{5}+\frac{e^{5t}}{5}\right)\_C1+\left(\frac{2\,e^{5t}}{5}-\frac{2}{5}\right)\_C2-4+\frac{5\,e^{5t}}{12}+\frac{9\,e^{t}}{4}+\frac{4\,e^{-t}}{3}$$

$$x_2(t)=\left(\frac{2\,e^{5t}}{5}-\frac{2}{5}\right)\_C1+\left(\frac{1}{5}+\frac{4\,e^{5t}}{5}\right)\_C2+2+\frac{5\,e^{5t}}{6}-\frac{4\,e^{-t}}{3}-\frac{3\,e^{t}}{2} \tag{33}$$

> $SolGralCero := map(rcurry(eval, t='0'), SolGral)$

$$SolGralCero := \begin{bmatrix} \_C1 & \_C2 \end{bmatrix} \tag{34}$$

>