mplODEsuolat

restart
with(*LinearAlgebra*) :

$A := \langle\langle -\frac{2}{25} | \frac{1}{50} \rangle, \langle \frac{2}{25} | -\frac{2}{25} \rangle\rangle$

$$\begin{bmatrix} -\frac{2}{25} & \frac{1}{50} \\ \frac{2}{25} & -\frac{2}{25} \end{bmatrix} \quad (1.1)$$

$(\mathrm{lambda}, ov) := Eigenvectors(A)$

$$\begin{bmatrix} -\frac{3}{25} \\ -\frac{1}{25} \end{bmatrix}, \begin{bmatrix} -\frac{1}{2} & \frac{1}{2} \\ 1 & 1 \end{bmatrix} \quad (1.2)$$

> lambda; *ov*;

$$\begin{bmatrix} -\frac{3}{25} \\ -\frac{1}{25} \end{bmatrix}$$

$$\begin{bmatrix} -\frac{1}{2} & \frac{1}{2} \\ 1 & 1 \end{bmatrix} \quad (1.3)$$

$x1 := ov[1..2, 1];$
$x2 := ov[1..2, 2]$

$$\begin{bmatrix} -\frac{1}{2} \\ 1 \end{bmatrix}$$

$$\begin{bmatrix} \frac{1}{2} \\ 1 \end{bmatrix} \quad (1.4)$$

$Y := C1 \cdot \exp(\mathrm{lambda}[1] \cdot t) \cdot x1 + C2 \cdot \exp(\mathrm{lambda}[2] \cdot t) \cdot x2$

$$\begin{bmatrix} -\frac{1}{2}\, C1\, \mathrm{e}^{-\frac{3}{25}\, t} + \frac{1}{2}\, C2\, \mathrm{e}^{-\frac{1}{25}\, t} \\ C1\, \mathrm{e}^{-\frac{3}{25}\, t} + C2\, \mathrm{e}^{-\frac{1}{25}\, t} \end{bmatrix} \tag{1.5}$$

$Y0 := subs(t = 0, Y)$

$$\begin{bmatrix} -\frac{1}{2}\, C1 + \frac{1}{2}\, C2 \\ C1 + C2 \end{bmatrix} \tag{1.6}$$

$AE := Y0[1] = 25, Y0[2] = 0$

$$-\frac{1}{2}\, C1 + \frac{1}{2}\, C2 = 25, C1 + C2 = 0 \tag{1.7}$$

$C12 := solve(\{AE\}, \{C1, C2\})$

$$\{C1 = -25, C2 = 25\} \tag{1.8}$$

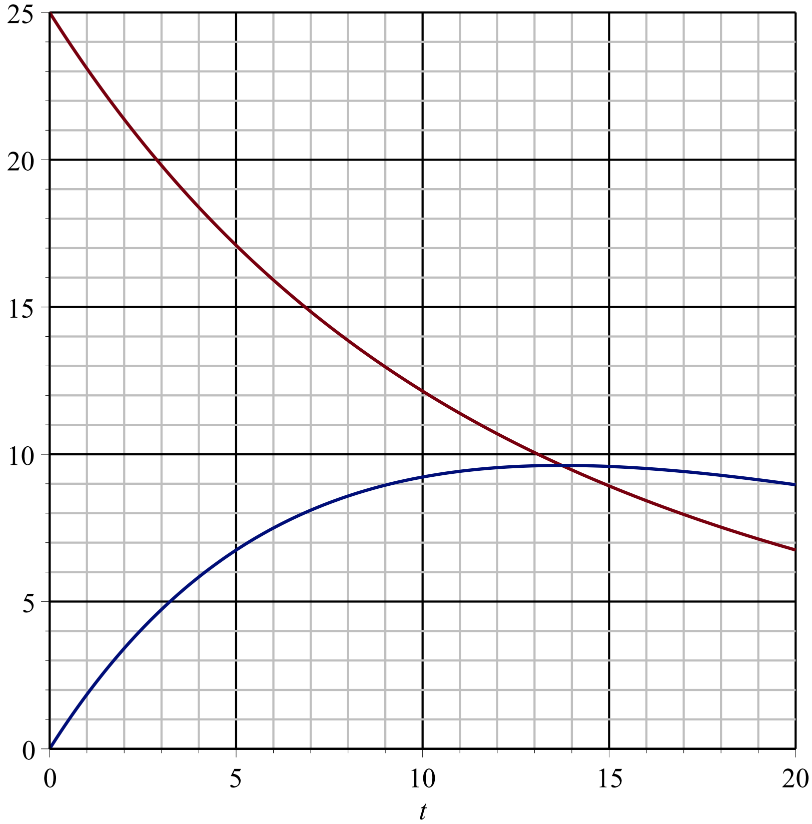
$assign(C12)$
$C1; C2$

$$-25$$
$$25 \tag{1.9}$$

$Y;$

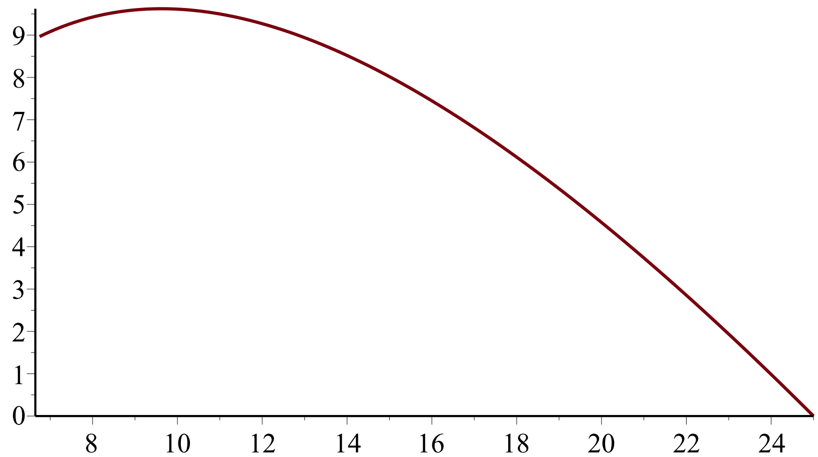
$$\begin{bmatrix} \frac{25}{2}\, \mathrm{e}^{-\frac{3}{25}\, t} + \frac{25}{2}\, \mathrm{e}^{-\frac{1}{25}\, t} \\ -25\, \mathrm{e}^{-\frac{3}{25}\, t} + 25\, \mathrm{e}^{-\frac{1}{25}\, t} \end{bmatrix} \tag{1.10}$$

> $plot([Y[1], Y[2]], t = 0..20)$



>

> $plot([Y[1], Y[2], t = 0 ..20])$



> $t0 := solve(Y[1] = Y[2], t);$

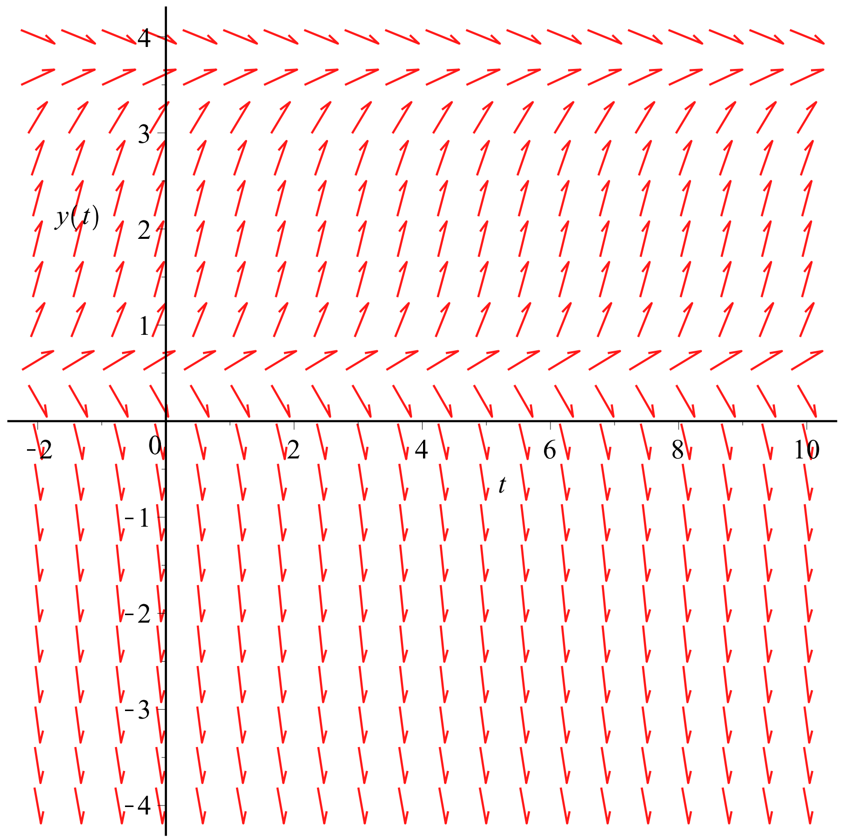
$$t0 := \frac{25}{2} \ln(3) \tag{1.11}$$

> $t0 = evalf(t0)$

$$\frac{25}{2} \ln(3) = 13.73265361 \tag{1.12}$$

$with(DEtools):$

$with(plots):$
$DEplot(diffy, y(t), t = -2 ..10, y = -4 ..4)$



$f := y \rightarrow 3 \cdot \sin(y) + y - 2$

$$y \rightarrow 3\ \sin(y) + y - 2 \quad \textbf{(1.13)}$$

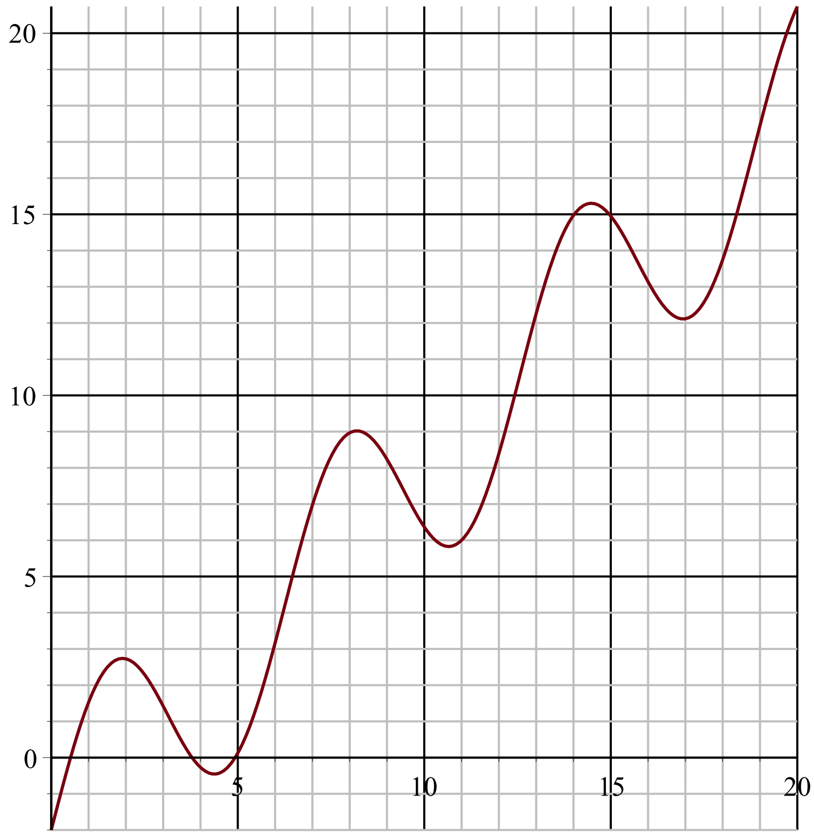
$y1 := fsolve(f(y) = 0, y = 0.5)$

$$0.5170489637 \quad \textbf{(1.14)}$$

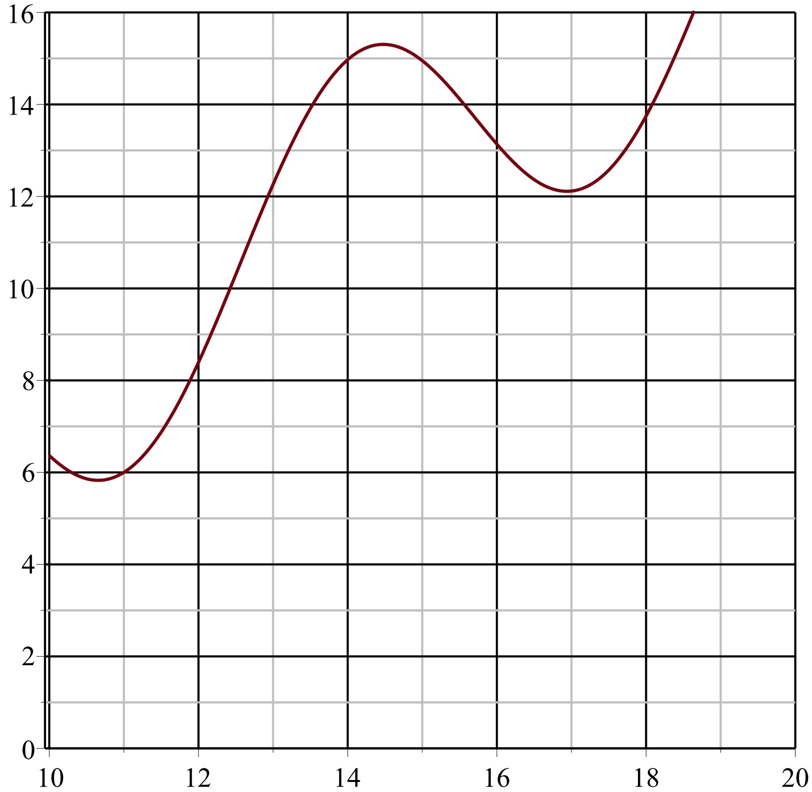
$y2 := fsolve(f(y) = 0, y = 3.8)$

$$3.774518012 \quad \textbf{(1.15)}$$

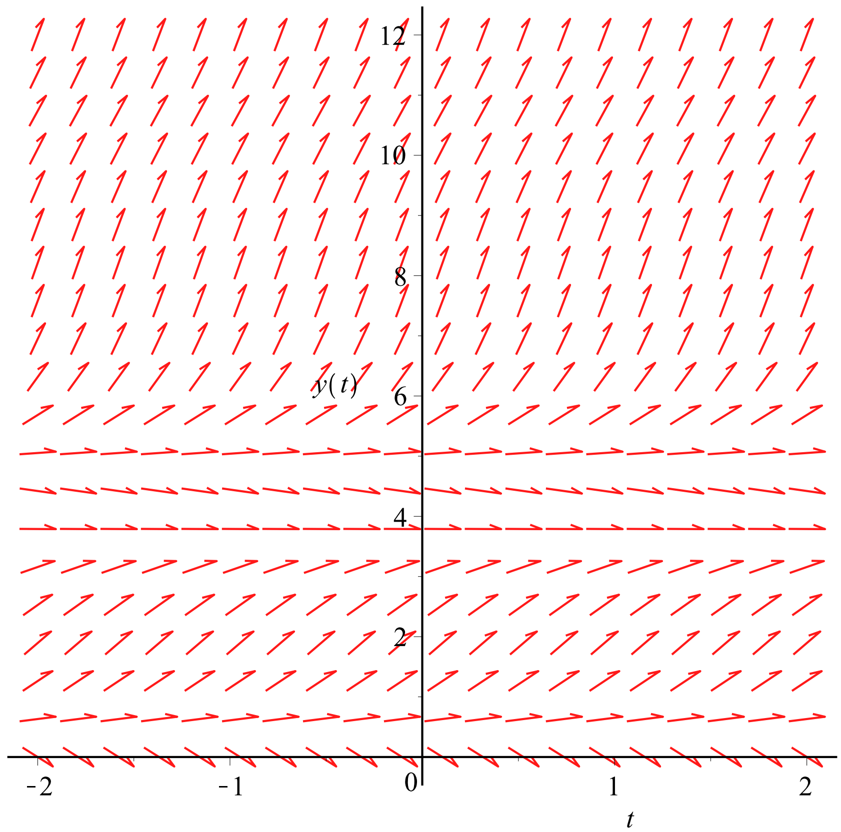
$plot(f, 0 ..20)$



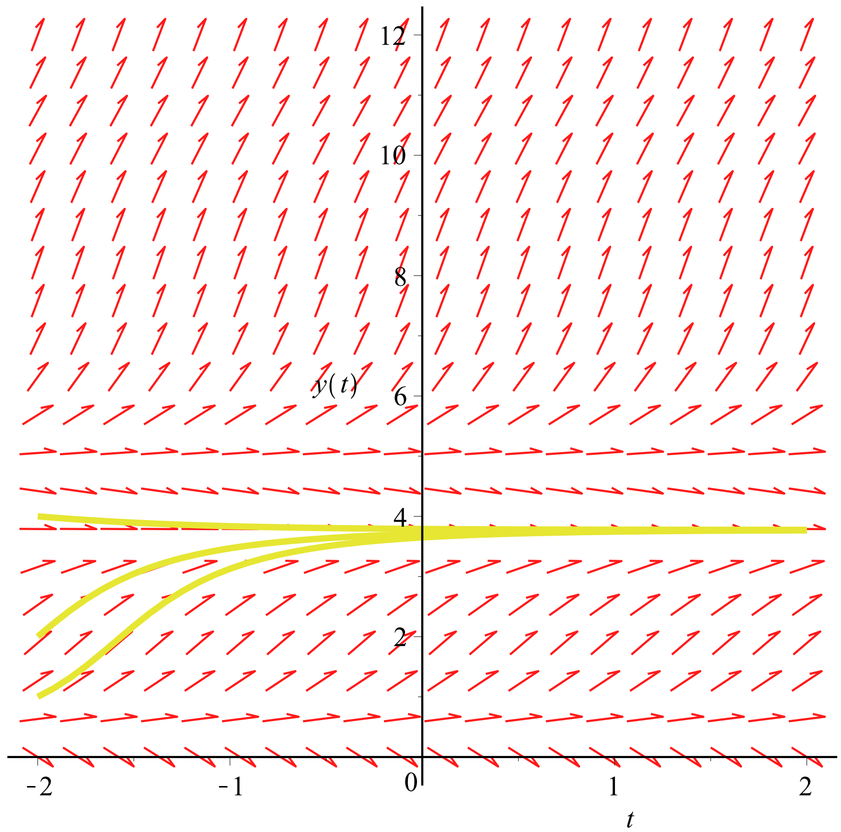
$plot(f, 10..20, 0..16)$



$DEplot(diffy, y(t), t=-2..2, y=0..12)$



$DEplot(diffy, y(t), t=-2..2, y=0..12, [[y(-2)=1], [y(-2)=2], [y(-2)=4]])$



$$y' = y^2 - t \cdot y$$

Ei − *autonominen*

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$dyht := y'(t) = y(t)^2 - t \cdot y(t)$

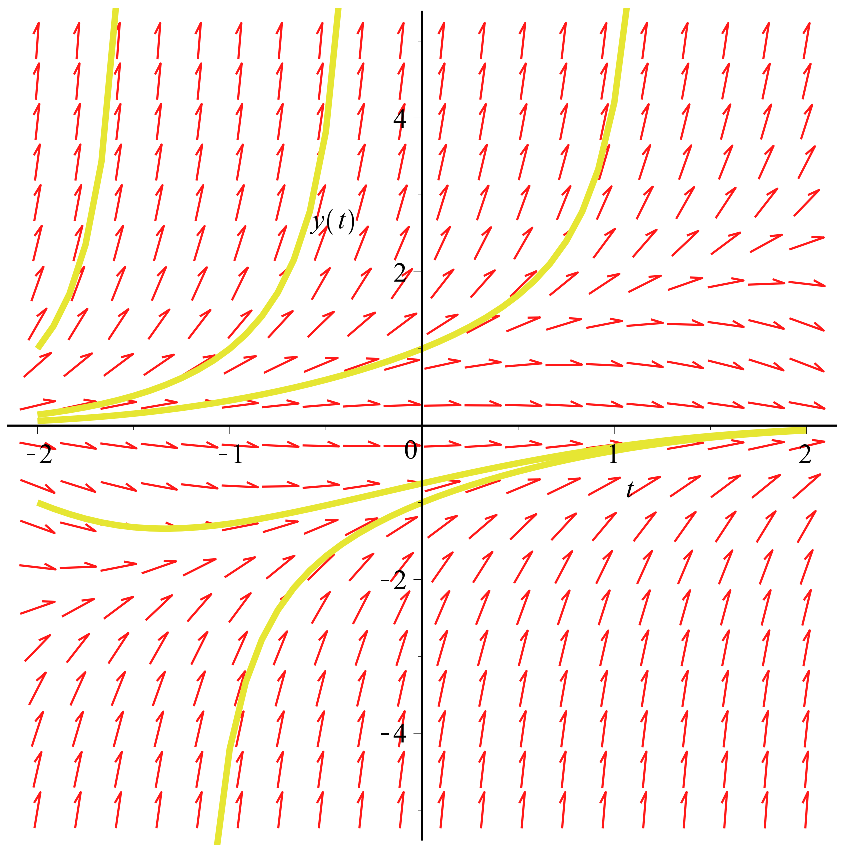
$$D(y)(t) = y(t)^2 - t\, y(t) \tag{2.1}$$

$dsolve(dyht, y(t))$

$$y(t) = -\frac{2\, e^{-\frac{1}{2} t^2}}{\sqrt{\pi}\, \sqrt{2}\, \mathrm{erf}\left(\frac{1}{2} \sqrt{2}\, t\right) - 2\, \_C1} \tag{2.2}$$

with(*DEtools*) : *with*(*plots*) :

DEplot(*dyht*, $y(t)$, $t = -2 ..2$, $y = -5 ..5$, [[$y(-2) = 1$], [$y(-1) = 1$], [$y(0) = 1$], [$y(0) = -1$], [$y(-2) = -1$]])


y(t)
4
2
-2
-1
0
1
2
t
-2
-4