$EX1eq1 := 2 \cdot x - x^2 - x \cdot y;$

$$-x^2 - x\,y + 2\,x \tag{1}$$

$eq2 := -y + x \cdot y;$

$$x\,y - y \tag{2}$$

$solve(\{eq1, eq2\}, \{x, y\});$

$$\{x = 0, y = 0\}, \{x = 2, y = 0\}, \{x = 1, y = 1\} \tag{3}$$

#b)

$f1 := (x, y) \rightarrow 2 \cdot x - x^2 - x \cdot y;$

$$(x, y) \rightarrow 2\,x - x^2 - y\,x \tag{4}$$

$f2 := (x, y) \rightarrow -y + x \cdot y;$

$$(x, y) \rightarrow -y + y\,x \tag{5}$$

$$(x, y) \rightarrow -y + y\,x \tag{6}$$

$with(linalg):$
$with(VectorCalculus):$

$Jm := Jacobian([f1(x, y), f2(x, y)], [x, y]);$

$$\begin{bmatrix} -2\,x - y + 2 & -x \\ y & x - 1 \end{bmatrix} \tag{7}$$

$A := subs([x = p1, y = p2], Jm);$

$$\begin{bmatrix} -2\,p1 - p2 + 2 & -p1 \\ p2 & p1 - 1 \end{bmatrix} \tag{8}$$

$eigenvalues(A);$

$$-\frac{1}{2}\,p1 - \frac{1}{2}\,p2 + \frac{1}{2} + \frac{1}{2}\sqrt{9\,p1^2 + 2\,p1\,p2 + p2^2 - 18\,p1 - 6\,p2 + 9}, -\frac{1}{2}\,p1 - \frac{1}{2}\,p2 + \frac{1}{2} - \frac{1}{2}\sqrt{9\,p1^2 + 2\,p1\,p2 + p2^2 - 18\,p1 - 6\,p2 + 9} \tag{9}$$

$A := subs([x = 0, y = 0], Jm);$

$$\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix} \tag{10}$$

$eigenvalues(A);$

$$2, -1 \tag{11}$$

$B := subs([x = 2, y = 0], Jm);$

$$\begin{bmatrix} -2 & -2 \\ 0 & 1 \end{bmatrix} \tag{12}$$

$eigenvalues(B);$

$$-2, 1 \tag{13}$$

$A := subs([x = 0, y = 0], Jm);$

$$\begin{bmatrix} 2 & 0 \\ 0 & -1 \end{bmatrix} \tag{14}$$

$eq1 := 'eq1';$

$$eq1 \tag{15}$$

$eq2 := 'eq2'$

$$eq2 \tag{16}$$

$eq1 := diff(x(t), t) = A[1].\langle x, y\rangle;$

$$\frac{d}{dt} x(t) = 2\,x \tag{17}$$

$eq2 := diff(y(t), t) = A[2].\langle x, y\rangle;$

$$\frac{d}{dt} y(t) = -y \tag{18}$$

$eq3 := diff(x(t), t) = B[1].\langle x, y\rangle$

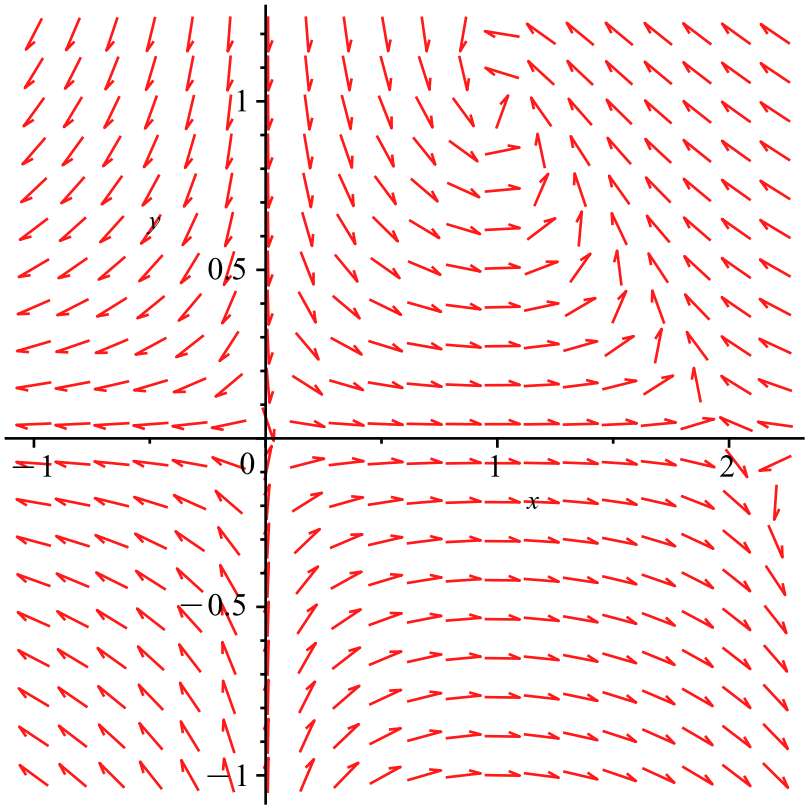
$$\frac{d}{dt} x(t) = -2\,x - 2\,y \tag{19}$$

$eq4 := diff(y(t), t) = B[2].\langle x, y\rangle;$

$$\frac{d}{dt} y(t) = y \tag{20}$$

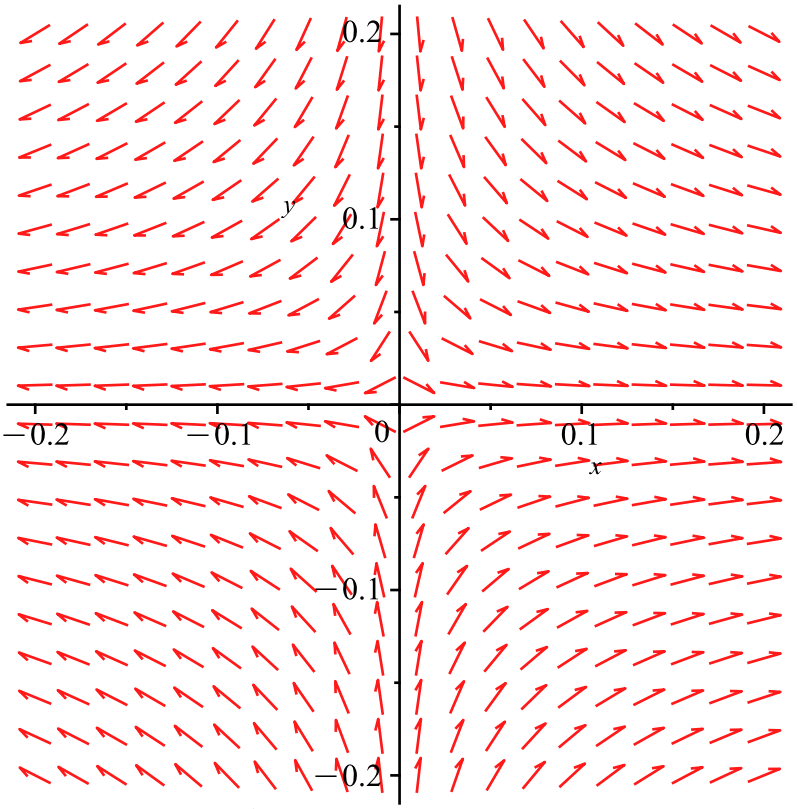
$with(DEtools):$

$dfieldplot([diff(x(t), t) = 2\cdot x(t) - x(t)^2 - x(t)\cdot y(t), diff(y(t), t) = -y(t) + x(t)\cdot y(t)], [x(t), y(t)],$
$t = -3 ... 3, x = -1 .. 2.2, y = -1 .. 1.2);$

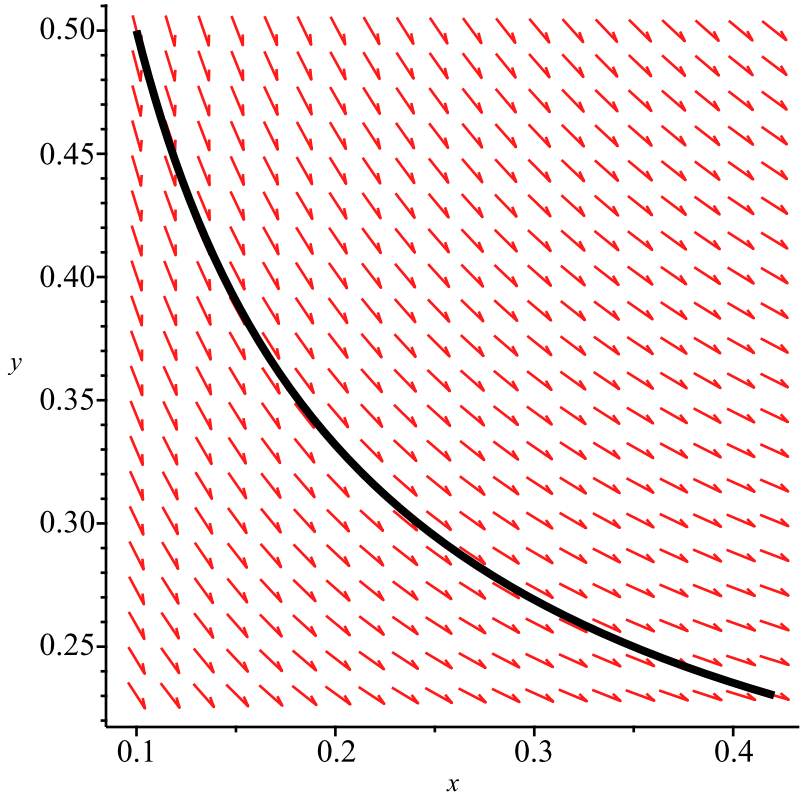



$dfieldplot([diff(x(t), t) = 2\cdot x(t) - x(t)^2 - x(t)\cdot y(t), diff(y(t), t) = -y(t) + x(t)\cdot y(t)], [x(t), y(t)],$

$t = -3 \ldots 3, x = -0.2 \ldots 0.2, y = -0.2 \ldots 0.2)$;

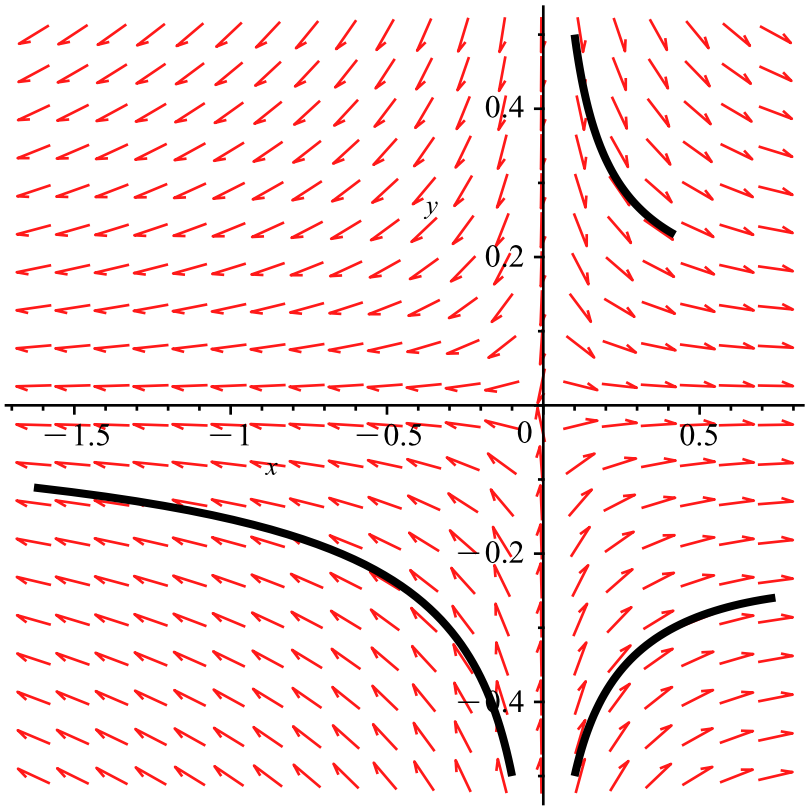



$DEplot([diff(x(t), t) = 2 \cdot x(t) - (x(t))^2 - x(t) \cdot y(t), diff(y(t), t) = -y(t) + x(t) \cdot y(t)], [x(t), y(t)], t = 0 \ldots 1, [[x(0) = 0.1, y(0) = 0.5]], linecolor = black)$




$DEplot([diff(x(t), t) = 2 \cdot x(t) - (x(t))^2 - x(t) \cdot y(t), diff(y(t), t) = -y(t) + x(t) \cdot y(t)], [x(t),$

$y(t)], t=0..1, [[x(0)=0.1, y(0)=0.5], [x(0)=-0.1, y(0)=-0.5], [x(0)=0.1, y(0)=-0.5]],$
$linecolor=black)$




"Exercise 2"

"Exercise 2" **(21)**

"a)Find its equilibria"

"a)Find its equilibria" **(22)**

$f1 := 'f1'$

$f1$ **(23)**

$f2 := 'f2'$

$f2$ **(24)**

$f1 := x - 2 \cdot x \cdot y;$

$-2\,x\,y + x$ **(25)**

$f2 := \frac{x^2}{2} - y;$

$\frac{1}{2}\,x^2 - y$ **(26)**

$solve(\{f1, f2\}, \{x, y\});$

$\{x=0, y=0\}, \left\{x=1, y=\frac{1}{2}\right\}, \left\{x=-1, y=\frac{1}{2}\right\}$ **(27)**

$f1 := (x, y) \to x - 2 \cdot x \cdot y;$

$(x, y) \to x + VectorCalculus:-`-`(2\,y\,x)$ **(28)**

f1 := (x, y) → x − 2·x·y

$$(x, y) \rightarrow x + \mathit{VectorCalculus}\text{:-`-`}(2\, y\, x) \tag{29}$$