```
> #solutions of Assignment First
> #****************************************
> restart;
> with(DEtools) :
> with(plots) :
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> # Question Number 1(a)solution
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> $ode1a := x^2 \cdot diff(y(x), x) + x \cdot y(x) - y(x)^2 = 0;$

$$ode1a := x^2 \left(\frac{d}{dx}\, y(x)\right) + x\, y(x) - y(x)^2 = 0 \quad (1)$$

> $sol1a := dsolve(ode1a, y(x));$

$$sol1a := y(x) = \frac{2\, x}{1 + 2\, x^2\, \_C1} \quad (2)$$

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> # Question Number 1(b)solution
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> $ode1b := diff(y(x), x) = \frac{(x \cdot y(x) + y(x)^2)}{x^2};$

$$ode1b := \frac{d}{dx}\, y(x) = \frac{x\, y(x) + y(x)^2}{x^2} \quad (3)$$

> $sol1b := dsolve(ode1b, y(x));$

$$sol1b := y(x) = -\frac{x}{\ln(x) - \_C1} \quad (4)$$

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> # Question Number 1(c)solution
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> $ode1c := diff(y(x), x\$2) + y(x) = x^2 + 2;$

$$ode1c := \frac{d^2}{dx^2}\, y(x) + y(x) = x^2 + 2 \quad (5)$$

> $sol1c := dsolve(ode1c, y(x));$

$$sol1c := y(x) = \sin(x)\, \_C2 + \cos(x)\, \_C1 + x^2 \quad (6)$$

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> # Question Number 1(d)solution
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> $ode1d := diff(y(x), x\$2) + 4 \cdot y(x) = 5 \cdot \exp(-x);$

$$ode1d := \frac{d^2}{dx^2}\, y(x) + 4\, y(x) = 5\, e^{-x} \quad (7)$$

> $sol1d := dsolve(ode1d, y(x));$

$$sol1d := y(x) = \sin(2\, x)\, \_C2 + \cos(2\, x)\, \_C1 + e^{-x} \quad (8)$$

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> # Question Number 2(a)solution
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> $sol2a := dsolve\left(\left\{ode1a, y(1) = \frac{1}{3}\right\}, y(x)\right);$

$$sol2a := y(x) = \frac{2\, x}{5\, x^2 + 1} \quad (9)$$

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> # Question Number 2(b)solution
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> $sol2b := dsolve\left(\left\{ode1b, y(1) = \frac{2}{3}\right\}, y(x)\right);$

(10)

$$sol2b := y(x) = -\frac{2\,x}{2\ln(x) - 3} \tag{10}$$

> # Question Number 2(c)solution

> $ode2c := diff(y(t), t) - t \cdot y(t) = \sin^2(t);$

$$ode2c := \frac{d}{dt}\,y(t) - t\,y(t) = \sin(t)^2 \tag{11}$$

> $sol2c := dsolve(\{ode2c, y(\mathrm{Pi}) = 5\}, y(t));$

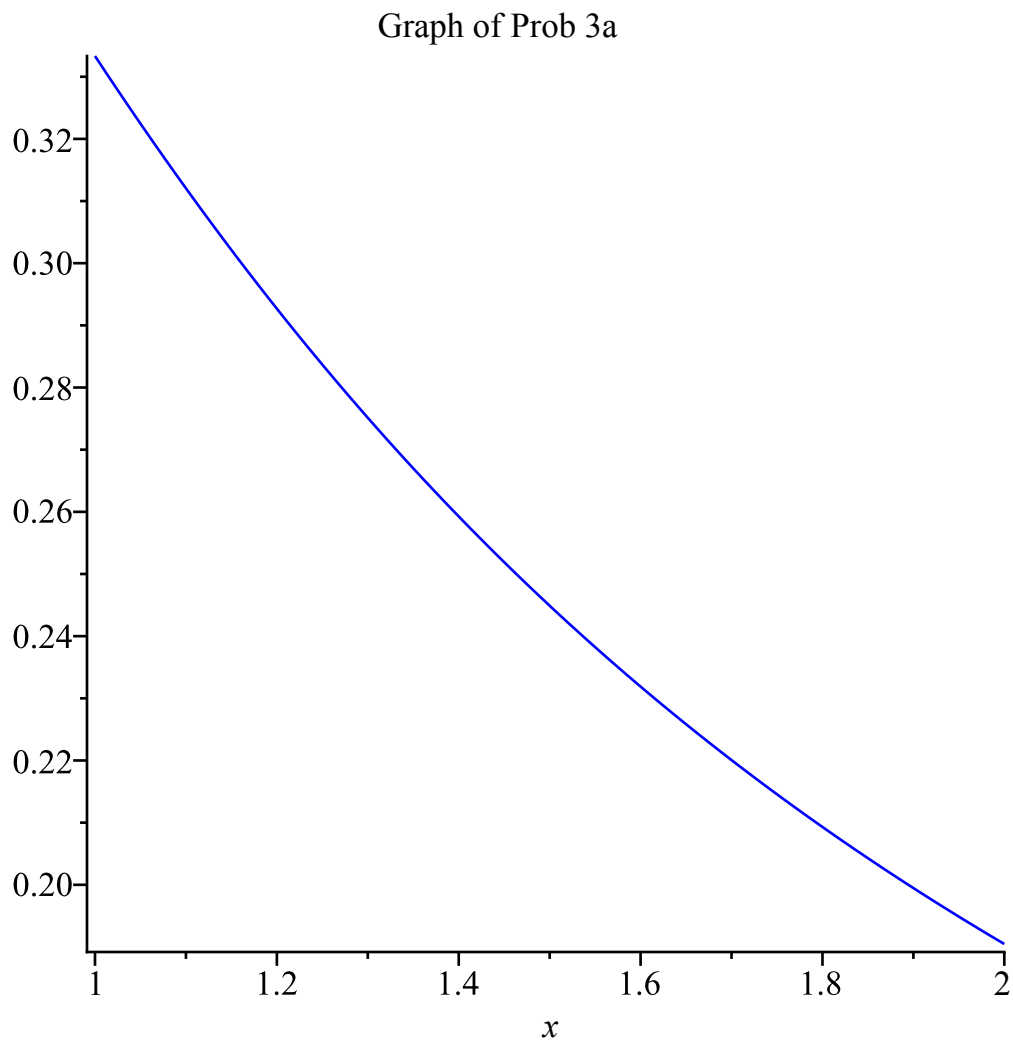
$$sol2c := y(t) = -\frac{1}{e^{\frac{1}{2}\pi^2}}\left(e^{\frac{1}{2}t^2}\left(-5 - \frac{1}{8}\,e^{\frac{1}{2}\pi^2}\sqrt{\pi}\,\sqrt{2}\left(e^{-2}\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,\pi - I\sqrt{2}\right) - 2\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,\pi\right) + e^{-2}\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,\pi + I\sqrt{2}\right)\right)\right) - \frac{1}{8}\,e^{\frac{1}{2}t^2}\sqrt{\pi}\,\sqrt{2}\left(e^{-2}\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,t - I\sqrt{2}\right) - 2\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,t\right) + e^{-2}\,\mathrm{erf}\left(\frac{1}{2}\sqrt{2}\,t + I\sqrt{2}\right)\right)\right) \tag{12}$$

> # Question Number 3(a)solution

> $eval(rhs(sol2a), x = 3)$

$$\frac{3}{23} \tag{13}$$

> $plot(rhs(sol2a), x = 1..2, title = [\text{"Graph of Prob 3a"}], color = blue);$

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> # Question Number 3(b)solution
```

> $sol3b := y(x)^2 + x - 3 = 0;$

$$sol3b := y(x)^2 + x - 3 = 0 \quad \textbf{(14)}$$

> $ode3b := diff(y(x), x) = -\frac{1}{2 \cdot y(x)};$

$$ode3b := \frac{d}{dx}\, y(x) = -\frac{1}{2\, y(x)} \quad \textbf{(15)}$$

> $odetest(sol3b, ode3b);$

$$0 \quad \textbf{(16)}$$

```
> # Question Number 3(c)solution
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> $sol3c := x^2;$

$$sol3c := x^2 \quad \textbf{(17)}$$

> $ode3c := x \cdot diff(y(x), x) = 2 \cdot y(x);$

$$ode3c := x \left(\frac{d}{dx}\, y(x) \right) = 2\, y(x) \quad \textbf{(18)}$$

> $eval(subs(y(x) = sol3c, ode3c));$

$$2\, x^2 = 2\, x^2 \quad \textbf{(19)}$$

> # Question Number 3(d) solution

> $sol3d := 2\cdot\cos(t) - 3\cdot\sin(t);$

$$sol3d := 2\cos(t) - 3\sin(t) \tag{20}$$

> $ode3d := diff(x(t), t\$2) + x(t) = 0;$

$$ode3d := \frac{d^2}{dt^2}\, x(t) + x(t) = 0 \tag{21}$$

> $eval(subs(x(t) = sol3d, ode3d));$

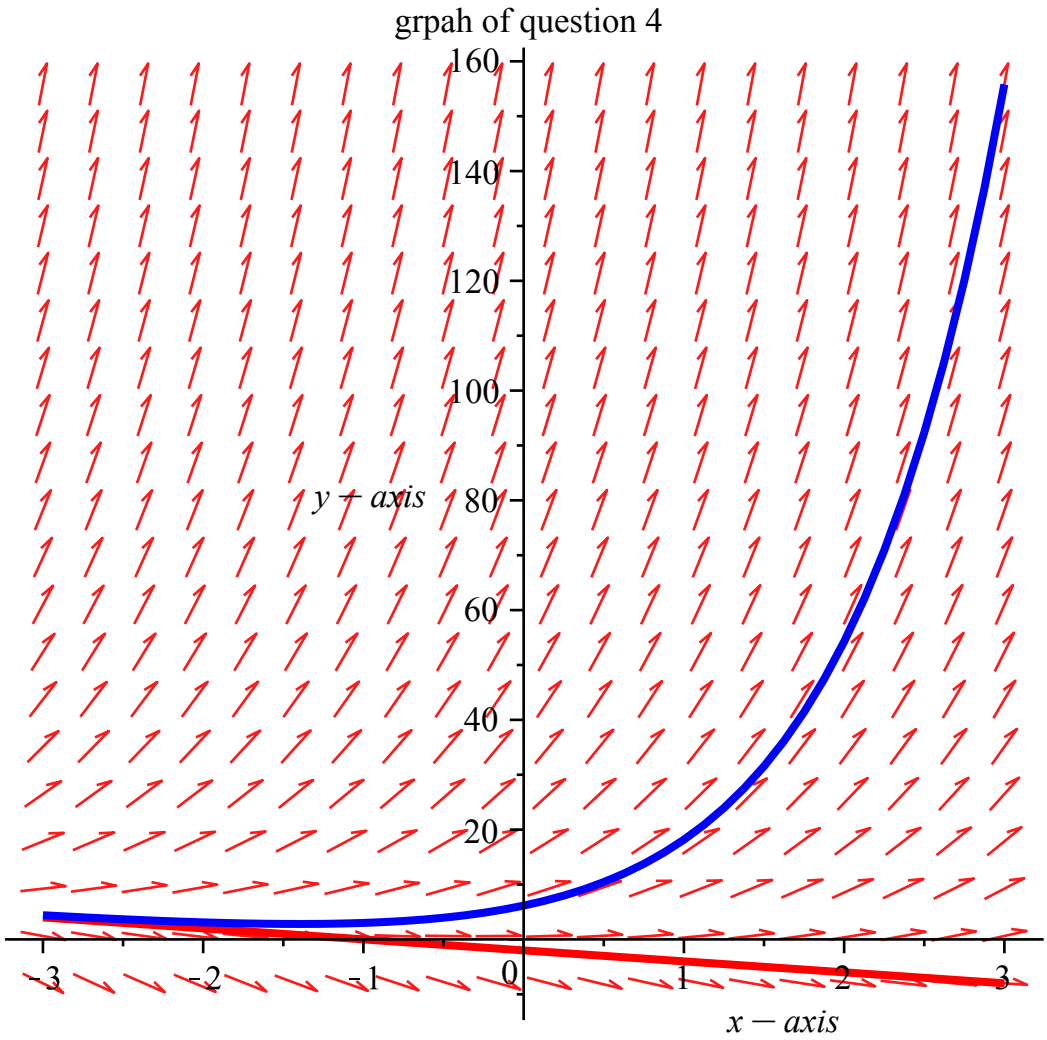
$$0 = 0 \tag{22}$$

> # Question Number 4 solution

> $ode4 := diff(y(x), x) = 2\cdot x + y(x);$

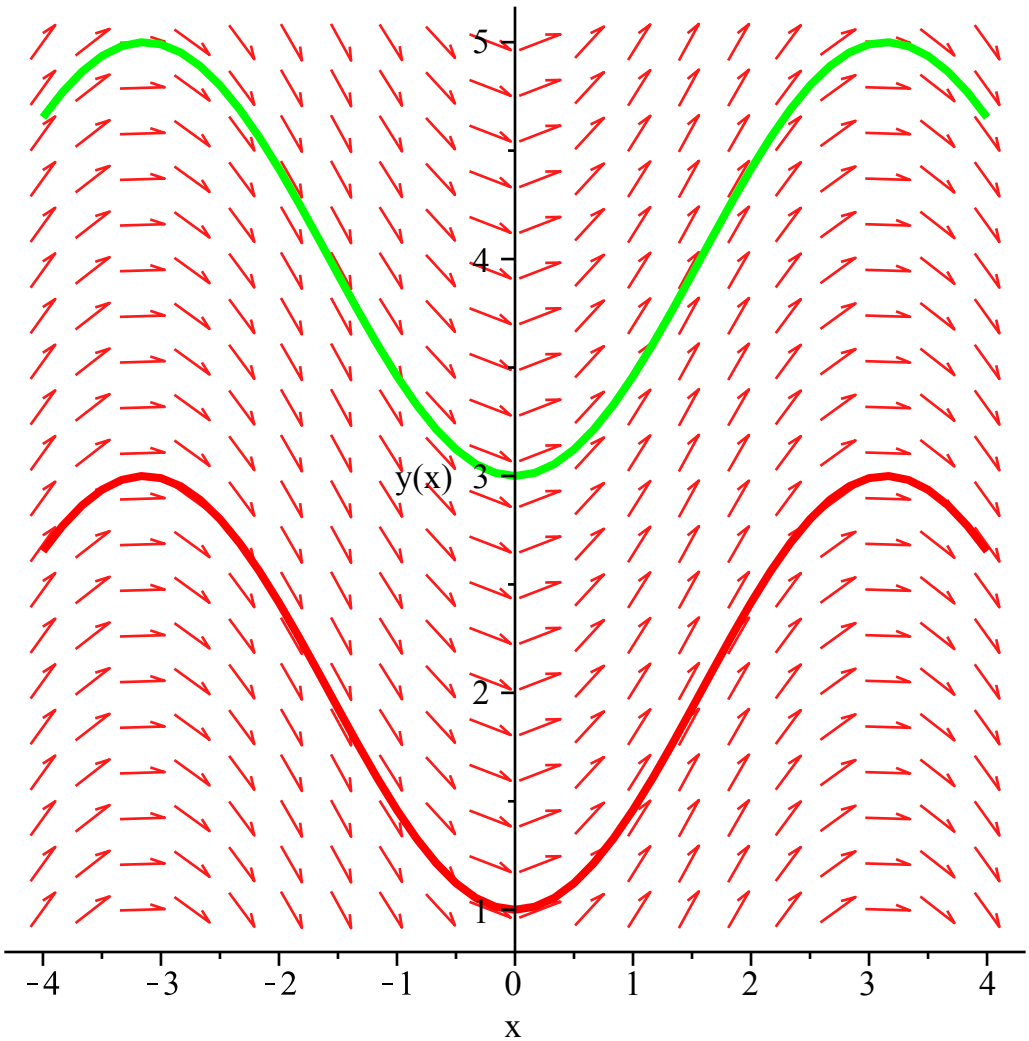
$$ode4 := \frac{d}{dx}\, y(x) = 2\,x + y(x) \tag{23}$$

> $DEplot(ode4, y(x), x = -3..3, [[0, -2], [-1, 3]], title = ["\text{grpah of question 4}"], linecolor = [red, blue], labels = [x - axis, y - axis])$



> # Question Number 5(a) solution

> $DEplot(diff(y(x), x) = \sin(x), y(x), x = -4..4, [[0, 1], [0, 3]], linecolor = [red, green])$

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> # Question Number 5(b)solution
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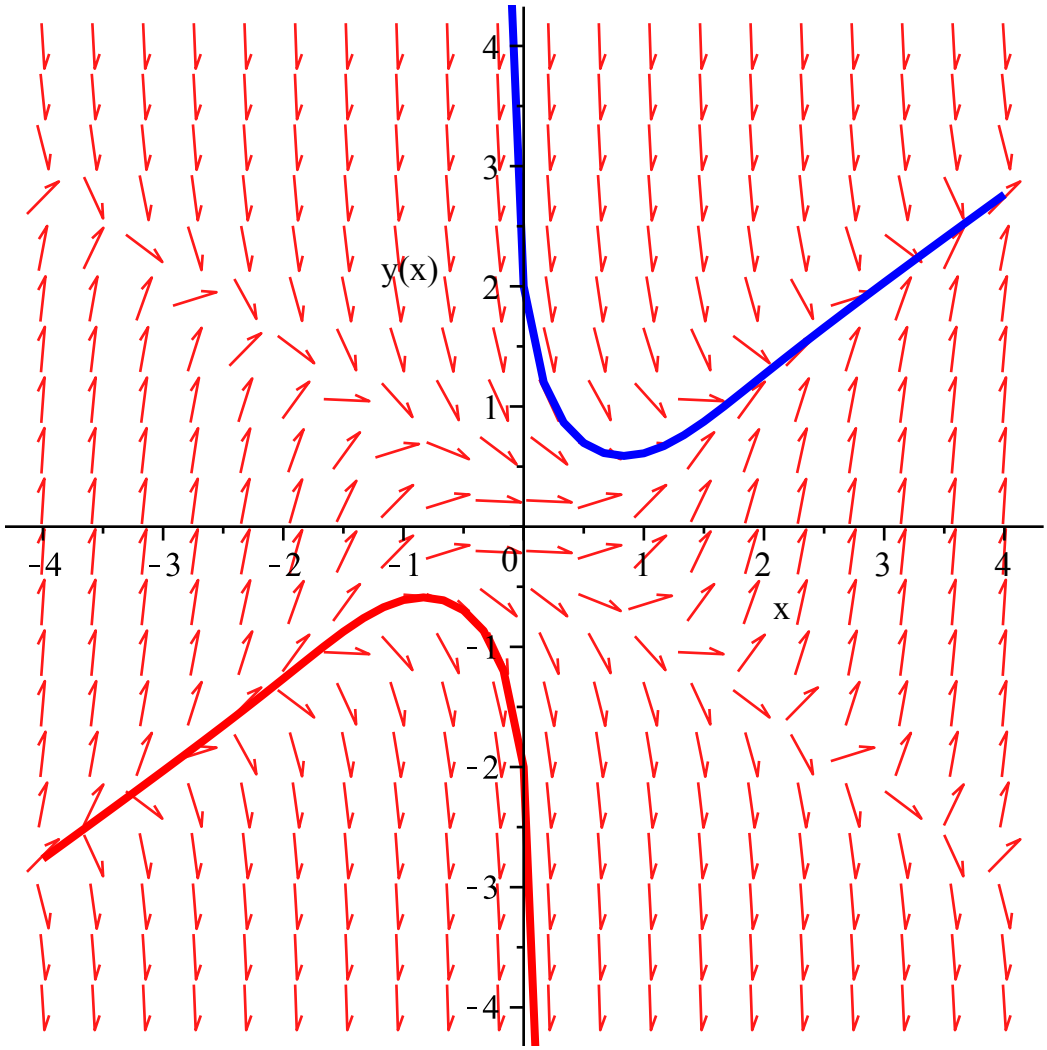
> $DEplot\left(diff\left(y(x), x\right) = x^2 - 2 \cdot y(x)^2, y(x), x = -4..4, y = -4..4, [[0, 2], [0, -2]], linecolor = [blue, red]\right)$

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> # Question Number 5(c)solution
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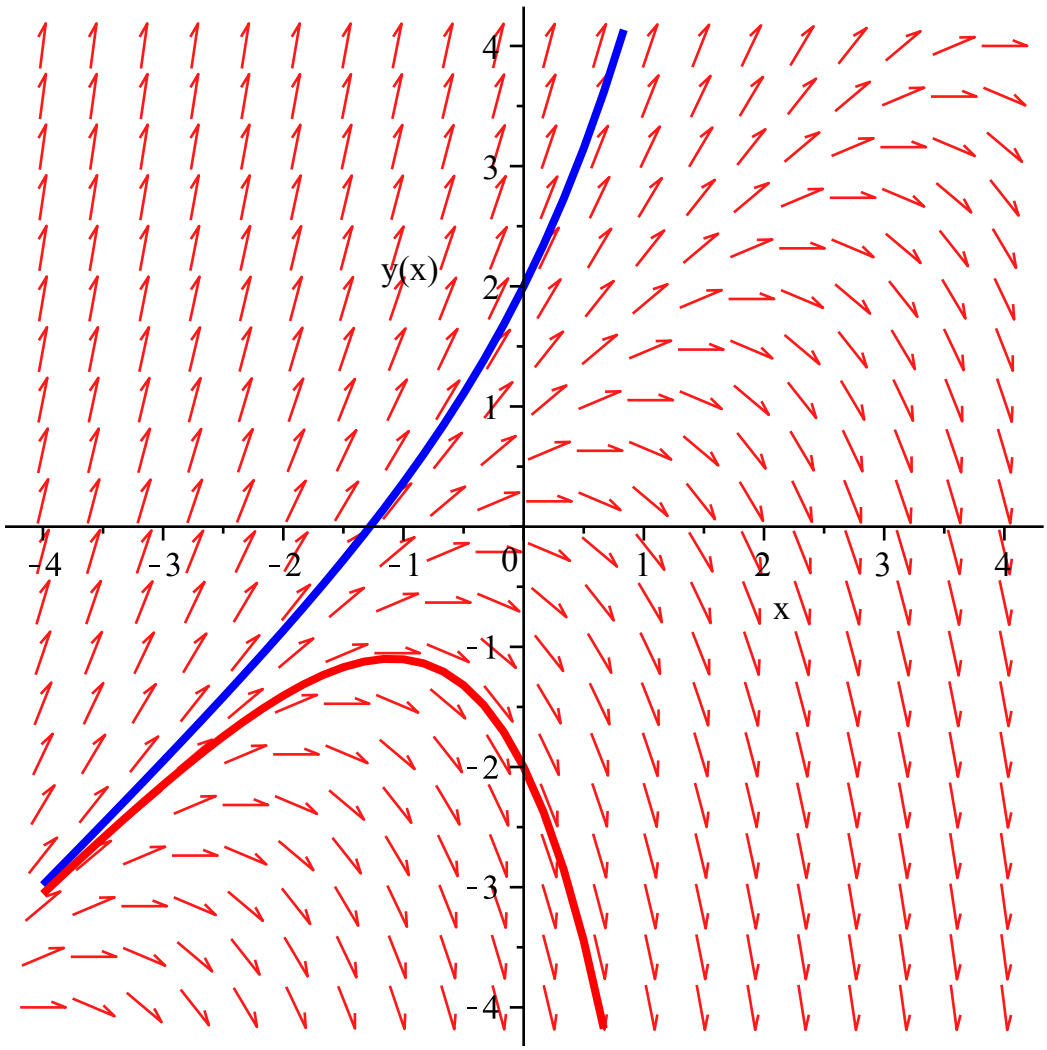
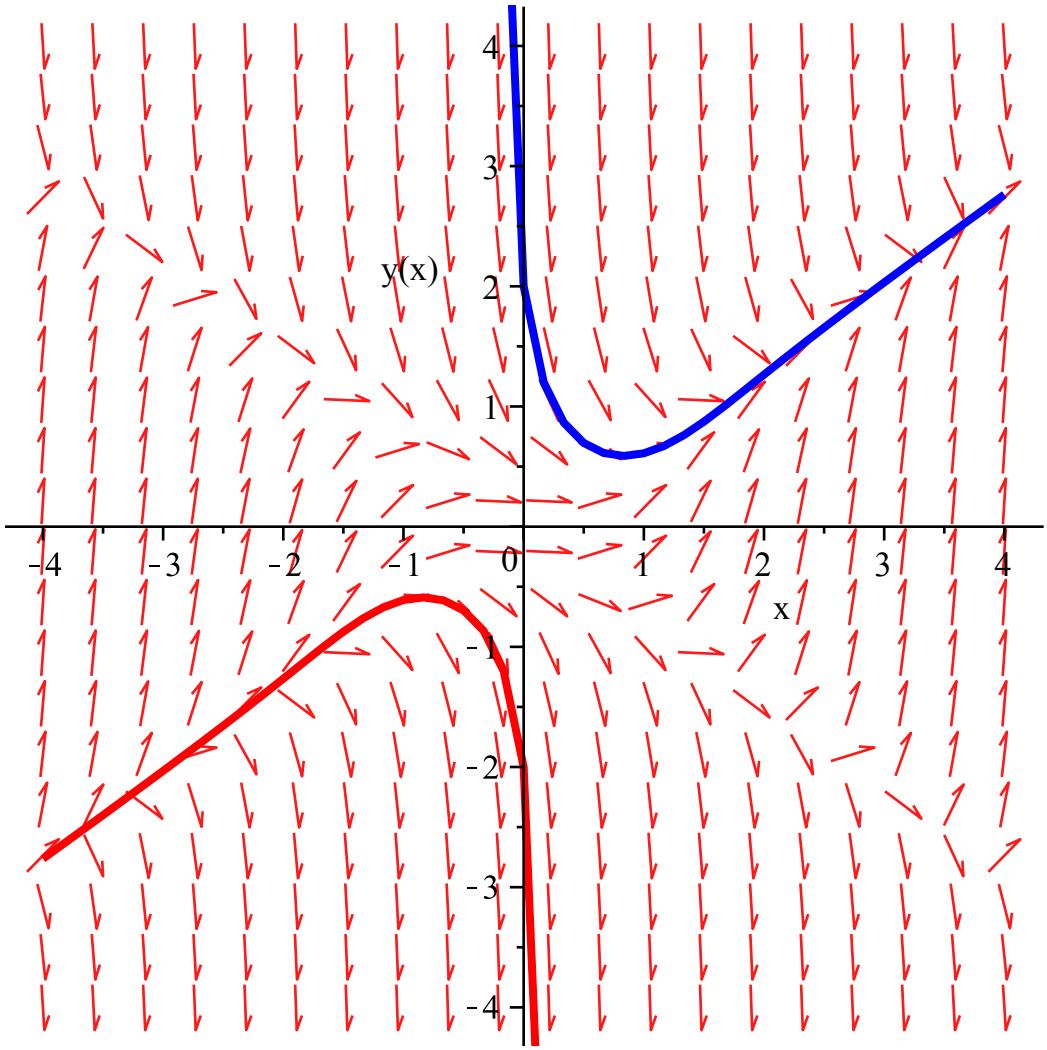
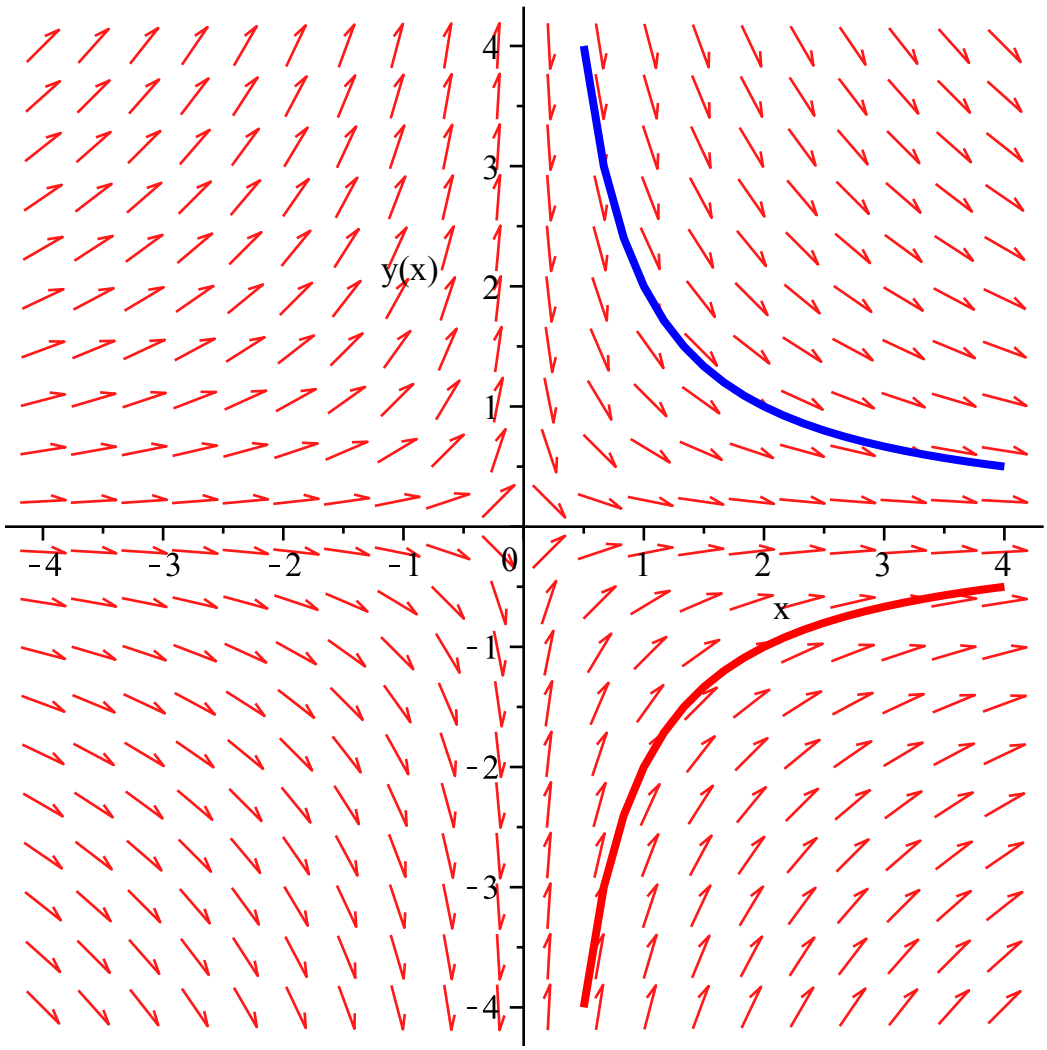
> $DEplot(diff(y(x), x) = y(x) - x, y(x), x = -4..4, y = -4..4, [[0, 2], [0, -2]], linecolor = [blue, red])$



> $DEplot\left(diff(y(x), x) = x^2 - 2 \cdot y(x)^2, y(x), x = -4..4, y = -4..4, [[0, 2], [0, -2]], linecolor = [blue, red]\right)$



> $DEplot\left(diff(y(x), x) = -\frac{y(x)}{x}, y(x), x = -4..4, y = -4..4, [[1, 2], [1, -2]], linecolor = [blue, red]\right)$


y(x)
x
4
3
2
1
0
-1
-2
-3
-4
-4
-3
-2
-1
1
2
3
4

>