

```

> restart
> ec:=x*diff(y(x),x)+k*y(x)=x^4

$$ec := x \left( \frac{d}{dx} y(x) \right) + k y(x) = x^4 \quad (1)$$

> sol:=dsolve(ec,y(x))

$$sol := y(x) = \frac{x^4}{4+k} + x^{-k} c_1 \quad (2)$$

> f:=unapply(rhs(sol),x,k,c_1)

$$f := (x, k, c_1) \mapsto \frac{x^4}{4+k} + x^{-k} \cdot c_1 \quad (4)$$

> solve(f(1,k,c_1)=1/(k+4),c_1)
0 \quad (5)
> solve(f(2,k,0)=16,k)
-3 \quad (6)
> f(x,-3,0)
x^4 \quad (7)

> restart
> with(plots)
[animate, animate3d, animatecurve, arrow, changecoords, complexplot, complexplot3d, conformal,
conformal3d, contourplot, contourplot3d, coordplot, coordplot3d, densityplot, display,
dualaxisplot, fieldplot, fieldplot3d, gradplot, gradplot3d, implicitplot, implicitplot3d, inequal,
interactive, interactiveparams, intersectplot, listcontplot, listcontplot3d, listdensityplot, listplot,
listplot3d, loglogplot, logplot, matrixplot, multiple, odeplot, pareto, plotcompare, pointplot,
pointplot3d, polarplot, polygonplot, polygonplot3d, polyhedra_supported, polyhedraplot,
rootlocus, semilogplot, setcolors, setoptions, setoptions3d, shadebetween, spacecurve,
sparsematrixplot, surfdata, textplot, textplot3d, tubeplot] \quad (8)

> ec:=x^2*diff(y(x),x$2)-4*x*diff(y(x),x)+4*y(x)=0

$$ec := x^2 \left( \frac{d^2}{dx^2} y(x) \right) - 4 x \left( \frac{d}{dx} y(x) \right) + 4 y(x) = 0 \quad (9)$$

> sol:=dsolve(ec,y(x))

$$sol := y(x) = c_2 x^4 + c_1 x \quad (10)$$

> cond:=y(1)=2,D(y)(1)=1
cond := y(1) = 2, D(y)(1) = 1 \quad (11)
> sol2:=dsolve({ec,cond},y(x))

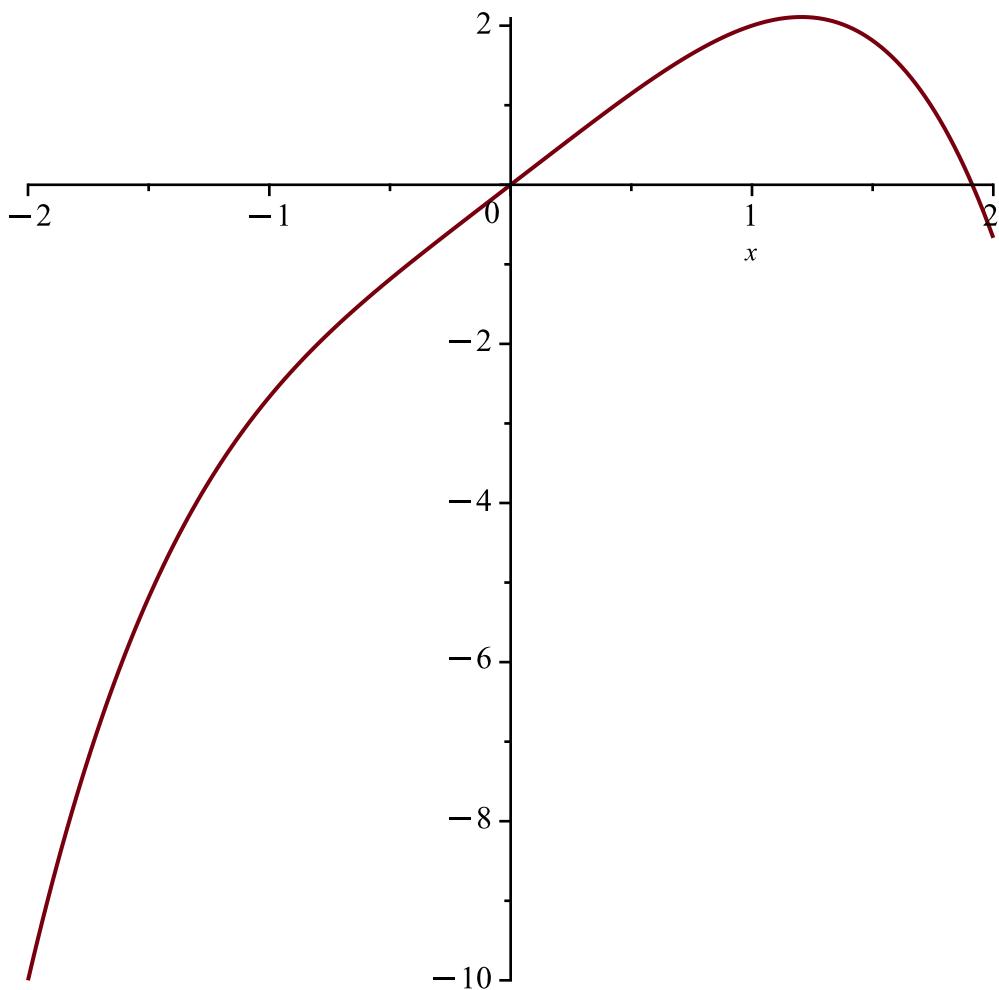
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$$sol2 := y(x) = -\frac{1}{3}x^4 + \frac{7}{3}x \quad (12)$$

```
> f:=unapply(rhs(sol2),x)
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$$f := x \mapsto -\frac{1}{3} \cdot x^4 + \frac{7}{3} \cdot x \quad (13)$$

```
> plot([f(x)],x=-2..2)
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> restart
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```
> with(DEtools)
```

[AreSimilar, Closure, DEnormal, DEplot, DEplot3d, DEplot_polygon, DFactor, DFactorLCLM, (14)

DFactorsols, Dchangevar, Desingularize, FindODE, FunctionDecomposition, GCRD, Gosper, Heunsols, Homomorphisms, IVPsol, IsHyperexponential, LCLM, MeijerGsols, MultiplicativeDecomposition, ODEInvariants, PDEchangecoords, PolynomialNormalForm, RationalCanonicalForm, ReduceHyperexp, RiemannPsols, Xchange, Xcommutator, Xgauge, Zeilberger, abelsol, adjoint, autonomous, bernoullisols, buildsol, buildsym, canoni, caseplot, casesplit, checkrank, chinisol, clairautsol, constcoeffsols, convertAlg, convertsys, dalembertsol, dcoeffs, de2diffop, dfieldplot, diff_table, diffop2de, dperiodic_sols, dpolyform,

`dsubs, eigenring, endomorphism_charpoly, equinv, eta_k, eulersols, exactsol, expsol,`
`exterior_power, firint, firtest, formal_sol, gen_exp, generate_ic, genhomosol, gensys,`
`hamilton_eqs, hypergeometricsols, hypergeomsols, hyperode, indicialeq, infgen, initialdata,`
`integrate_sols, intfactor, invariants, kovacicsols, leftdivision, liesol, line_int, linearsol,`
`matrixDE, matrix_riccati, maxdimsystems, moser_reduce, muchange, mult, mutest,`
`newton_polygon, normalG2, ode_int_y, ode_y1, odeadvisor, odepde, parametricsol,`
`particularsol, phaseportrait, poincare, polysols, power_equivalent, rational_equivalent,`
`ratsols, redode, reduceOrder, reduce_order, regular_parts, regularsp, remove_RootOf,`
`riccati_system, riccatisol, rifread, rifsimp, rightdivision, rtaylor, separablesol, singularities,`
`solve_group, super_reduce, symgen, symmetric_power, symmetric_product, symtest, transinv,`
`translate, untranslate, varparam, zoom]`

`> f:=x->-3*x^3+2*x^2+3*x`

$$f := x \mapsto -3 \cdot x^3 + 2 \cdot x^2 + 3 \cdot x \quad (15)$$

`> ec:=diff(x(t),t)=f(x(t))`

$$ec := \frac{d}{dt} x(t) = -3 x(t)^3 + 2 x(t)^2 + 3 x(t) \quad (16)$$

`> sol:=solve(f(x)=0)`

$$sol := 0, \frac{1}{3} + \frac{\sqrt{10}}{3}, \frac{1}{3} - \frac{\sqrt{10}}{3} \quad (17)$$

`> D(f)(sol[1])`

$$3 \quad (18)$$

`> rad2:=D(f)(sol[2])`

$$rad2 := -9 \left(\frac{1}{3} + \frac{\sqrt{10}}{3} \right)^2 + \frac{13}{3} + \frac{4\sqrt{10}}{3} \quad (19)$$

`> rad3:=D(f)(sol[3])`

$$rad3 := -9 \left(\frac{1}{3} - \frac{\sqrt{10}}{3} \right)^2 + \frac{13}{3} - \frac{4\sqrt{10}}{3} \quad (20)$$

`> evalf(rad2)`

$$-8.774851758 \quad (21)$$

`> evalf(rad3)`

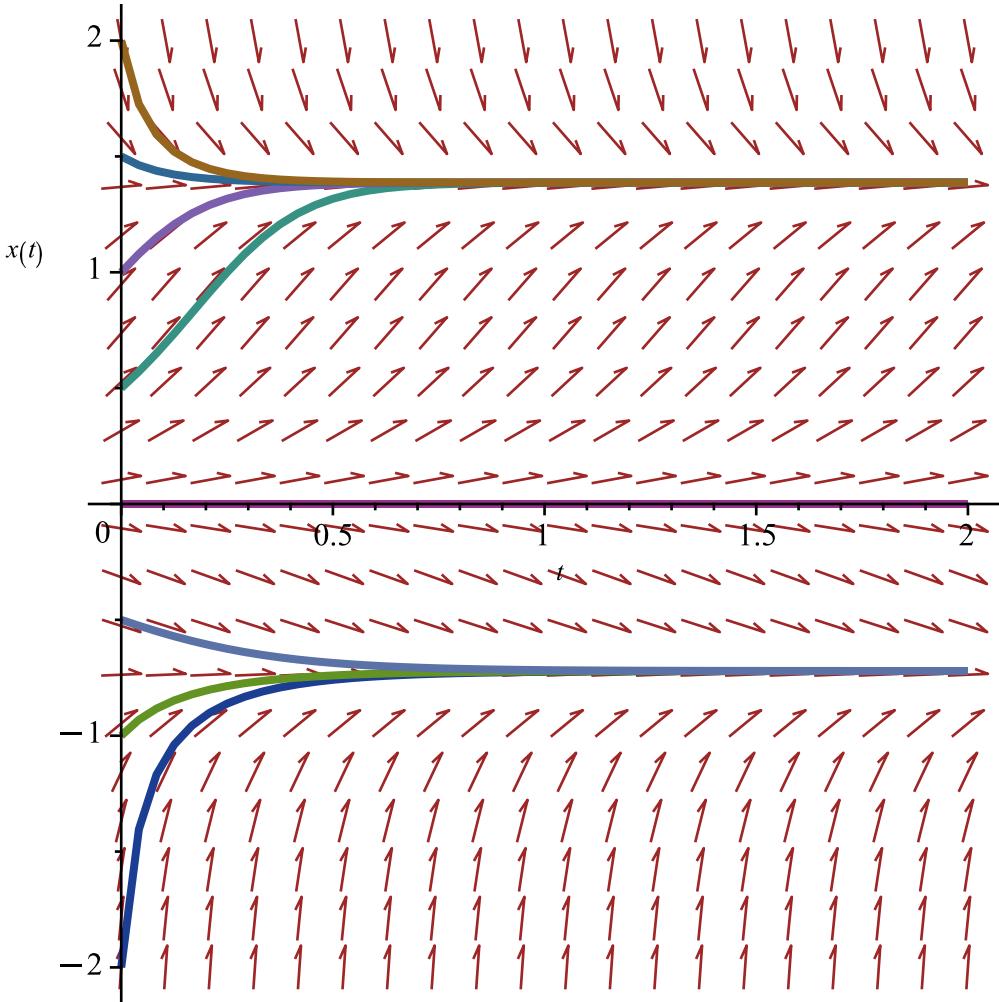
$$-4.558481554 \quad (22)$$

`> cond:=x(0)=-2, x(0)=-1, x(0)=-1/2, x(0)=0, x(0)=1/2, x(0)=1, x(0)=3/2, x(0)=2`

$$cond := x(0) = -2, x(0) = -1, x(0) = -\frac{1}{2}, x(0) = 0, x(0) = \frac{1}{2}, x(0) = 1, x(0) = \frac{3}{2}, x(0) \quad (23)$$

=2

```
> DEplot(ec,x(t),t=0..2,[cond])
```



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> restart
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```
> ec1:=diff(y1(x),x)=-5*y1(x)+9*y2(x)
```

$$ec1 := \frac{d}{dx} y1(x) = -5 y1(x) + 9 y2(x) \quad (24)$$

```
> ec2:=diff(y2(x),x)=-6*y1(x)+10*y2(x)
```

$$ec2 := \frac{d}{dx} y2(x) = -6 y1(x) + 10 y2(x) \quad (25)$$

```
> sist:=ec1,ec2
```

$$sist := \frac{d}{dx} y1(x) = -5 y1(x) + 9 y2(x), \frac{d}{dx} y2(x) = -6 y1(x) + 10 y2(x) \quad (26)$$

```
> dsolve({sist},{y1(x),y2(x)})
```

$$\left\{ y1(x) = c_1 e^{4x} + c_2 e^x, y2(x) = c_1 e^{4x} + \frac{2 c_2 e^x}{3} \right\} \quad (27)$$

```
> cond:=y1(0)=2,y2(0)=3
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$$cond := y1(0) = 2, y2(0) = 3 \quad (28)$$

$$\begin{aligned} > \text{dsolve}(\{\text{sist}, \text{cond}\}, \{y1(x), y2(x)\}) \\ \left\{ y1(x) = 5 e^{4x} - 3 e^x, y2(x) = 5 e^{4x} - 2 e^x \right\} \end{aligned} \quad (29)$$