```
eq := diff(x(t), t$2) + t^2*x(t) = 0;
```

$$\frac{d^2}{dt^2} x(t) + t^2 x(t) = 0 \tag{1}$$

```
dsolve(eq, x(t));
```

$$x(t) = \_C1 \sqrt{t}\ \mathrm{BesselJ}\left(\frac{1}{4}, \frac{1}{2} t^2\right) + \_C2 \sqrt{t}\ \mathrm{BesselY}\left(\frac{1}{4}, \frac{1}{2} t^2\right) \tag{2}$$

```
infolevel[dsolve] := 3
```

$$3 \tag{3}$$

```
dsolve(eq, x(t));
```

$$x(t) = \_C1 \sqrt{t}\ \mathrm{BesselJ}\left(\frac{1}{4}, \frac{1}{2} t^2\right) + \_C2 \sqrt{t}\ \mathrm{BesselY}\left(\frac{1}{4}, \frac{1}{2} t^2\right) \tag{4}$$

```
ic1 := x(0) = 0;
```

$$x(0) = 0 \tag{5}$$

```
dsolve({eq, ic1}, x(t));
```

$$x(t) = \begin{cases} \_C1 \sqrt{t}\ \mathrm{BesselJ}\left(\frac{1}{4}, \frac{1}{2} t^2\right) & t < 0 \\ 0 & t = 0 \\ \_C1 \sqrt{t}\ \mathrm{BesselJ}\left(\frac{1}{4}, \frac{1}{2} t^2\right) & 0 < t \end{cases} \tag{6}$$

```
ic1 :='ic1'
```

$$ic1 \tag{7}$$

```
ic1 := x(0) = 0. D(x)(0) = 0;
```

$$false \tag{8}$$

```
ic1 := x(0) = 0, D(x)(0) = 0;
```

$$x(0) = 0, D(x)(0) = 0 \tag{9}$$

```
dsolve({eq, ic1}, x(t));
```

$$x(t) = 0 \tag{10}$$

```
ic1 :='ic1'
```

$$ic1 \tag{11}$$

```
ic1 := x(0) = 0, D(x)(0) = 0, (D@@2)(x)(0) = 1;
```

$$x(0) = 0, D(x)(0) = 0, D^{(2)}(x)(0) = 1 \tag{12}$$

```
dsolve({eq, ic1}, x(t));
Methods for second order ODEs:
--- Trying classification methods ---
trying a quadrature
checking if the LODE has constant coefficients
checking if the LODE is of Euler type
trying a symmetry of the form [xi=0, eta=F(x)]
checking if the LODE is missing 'y'
-> Trying a Liouvillian solution using Kovacic's algorithm
<- No Liouvillian solutions exists
```

```
-> Trying a solution in terms of special functions:
   -> Bessel
   <- Bessel successful
<- special function solution successful
```

$$expand(x^i);$$

$$x^i \tag{13}$$

$$expand(e^{3\,i});$$

$$(e^i)^3 \tag{14}$$

$$simplify(e^{3\cdot i})$$

$$e^{3\,i} \tag{15}$$

$$expand(e^{3\cdot i});$$

$$(e^i)^3 \tag{16}$$

$$eq := 'eq';$$

$$eq \tag{17}$$

$$eq := diff(x(t), t) - 2\cdot x(t) = 0;$$

$$\frac{d}{dt} x(t) - 2\,x(t) = 0 \tag{18}$$

$$dsolve(eq, x(t));$$

$$x(t) = \_C1\, e^{2\,t} \tag{19}$$

$$eq := 'eq'$$

$$eq \tag{20}$$

$$eq := diff(x(t), t) - x(t) = e^{(t-1)};$$

Error, invalid power

$$eq := diff(x(t), t) - x(t) = e^{(t-1)};$$

$$eq := diff(x(t), t) - x(t) = e^{(t-1)};$$

$$\frac{d}{dt} x(t) - x(t) = e^{t-1} \tag{21}$$

$$dsolve(eq, x(t));$$

$$x(t) = \frac{e^{t-1}}{\ln(e) - 1} + e^t\, \_C1 \tag{22}$$

$$eq := diff(x(t), t) - x(t) = \exp(1)^{t-1};$$

$$\frac{d}{dt} x(t) - x(t) = (e)^{t-1} \tag{23}$$

$$dsolve(eq, x(t));$$

$$x(t) = \left(e^{-1}\, t + \_C1\right) e^t \tag{24}$$

$$eq := 'eq';$$

$$eq \tag{25}$$

$$eq := diff(x(t), t\$2) - 2\cdot diff(x(t), t) + 2\cdot x(t) = 0;$$

$$\frac{d^2}{dt^2} x(t) - 2\left(\frac{d}{dt} x(t)\right) + 2\,x(t) = 0 \tag{26}$$

$dsolve(eq, x(t))$;

$$x(t) = \_C1\, e^{t} \sin(t) + \_C2\, e^{t} \cos(t) \tag{27}$$

$eq := eq$;

$$eq \tag{28}$$

$eq := diff(x(t), t\$4) + 2 \cdot diff(x(t) + t\$3) + diff(x(t), t\$2) = 0$;

Error, invalid input: diff received x(t)+t, which is not valid for its 2nd argument

$eq := diff(x(t), t\$4) + 2 \cdot diff(x(t), t\$3) + diff(x(t), t\$2) = 0$;

$$\frac{d^4}{dt^4} x(t) + 2 \left(\frac{d^3}{dt^3} x(t) \right) + \frac{d^2}{dt^2} x(t) = 0 \tag{29}$$

$dsolve(eq, x(t))$;

$$x(t) = \_C1\, e^{-t} + \_C2\, e^{-t}\, t + \_C3 + \_C4\, t \tag{30}$$

$eq := 'eq'$;

$$eq \tag{31}$$

$eq := k \cdot (21 - x(t)) = diiff(x(t), t)$;

$$k\,(21 - x(t)) = diiff(x(t), t) \tag{32}$$

$eq := k \cdot (21 - x(t)) = diff(x(t), t)$;

$$k\,(21 - x(t)) = \frac{d}{dt} x(t) \tag{33}$$

$dsolve(eq, x(t))$;

$$x(t) = 21 + e^{-k\,t}\, \_C1 \tag{34}$$

$ic1 := x(0) = \eta$;

$$x(0) = \eta \tag{35}$$

$dsolve(\{eq, ic1\}, x(t))$;

$$x(t) = 21 + e^{-k\,t}\,(\eta - 21) \tag{36}$$

$eq := diff(x(t), t\$2) - x(t) = t \cdot e$;

$$\frac{d^2}{dt^2} x(t) - x(t) = t\, e \tag{37}$$

$dsolve(eq, x(t))$;

$$x(t) = e^{t}\, \_C2 + \_C1\, e^{-t} - t\, e \tag{38}$$

$ic1 := x(0) = 0.\ D(x)(0) = 0$;

$$false \tag{39}$$

$dsolve(\{ec, ic1\}, x(t))$;

Error, (in dsolve) not a system with respect to the unknowns [x(t)]

$dsolve(\{eq, ic1\}, x(t))$;

Error, (in dsolve) found the following equations not depending on the unknowns of the input system: {false}

$ic1 := x(0) = 0, D(x)(0) = 0$;

$$x(0) = 0, D(x)(0) = 0 \tag{40}$$

$dsolve(\{eq, ic1\}, x(t))$;

$$x(t) = \frac{1}{2}\, e^{t}\, e - \frac{1}{2}\, e\, e^{-t} - t\, e \tag{41}$$

$eq := diff(x(t), t\$2) - x(t) = t \cdot (\exp)^{(-2 \cdot t)};$

$$\frac{d^2}{dt^2} x(t) - x(t) = t \exp^{-2\,t} \tag{42}$$

$eq := diff(x(t), t\$2) - x(t) = t \cdot \exp(1)^{(-2 \cdot t)}$

$$\frac{d^2}{dt^2} x(t) - x(t) = t\, (e)^{-2\,t} \tag{43}$$

$dsolve(\{eq, ic1\}, x(t));$

Error, (in dsolve) found the following equations not depending on the unknowns of the input system: {ic1}

$dsolve(eq, x(t));$

$$x(t) = e^{t}\, \_C2 + e^{-t}\, \_C1 + \frac{1}{9}\, (3\,t + 4)\, e^{-2\,t} \tag{44}$$

$dsolve(\{eq, ic1\}, x(t));$

Error, (in dsolve) found the following equations not depending on the unknowns of the input system: {ic1}

$eq := diff(x(t), t\$2) - x(t) = t \cdot e^{(-2 \cdot t)}$

$$\frac{d^2}{dt^2} x(t) - x(t) = t\, e^{-2\,t} \tag{45}$$

$dsolve(\{eq, ic1\}, x(t));$

Error, (in dsolve) found the following equations not depending on the unknowns of the input system: {ic1}

$eq := diff(x(t), t\$2) - 2 \cdot diff(x(t), t) + x(t) = 0;$

$$\frac{d^2}{dt^2} x(t) - 2 \left(\frac{d}{dt} x(t) \right) + x(t) = 0 \tag{46}$$

$dsolve(eq, x(t));$

$$x(t) = \_C1\, e^{t} + \_C2\, e^{t}\, t \tag{47}$$

$eq := diff(x(t), t\$2) - 2 \cdot diff(x(t), t) + x(t) = \cos(2 \cdot t);$

$$\frac{d^2}{dt^2} x(t) - 2 \left(\frac{d}{dt} x(t) \right) + x(t) = \cos(2\,t) \tag{48}$$

$dsolve(eq, x(t));$

$$x(t) = e^{t}\, \_C2 + e^{t}\, t\, \_C1 - \frac{3}{25} \cos(2\,t) - \frac{4}{25} \sin(2\,t) \tag{49}$$

$eq := diff(x(t), t\$2) - 2 \cdot diff(x(t), t) + x(t) = 3 \cdot e^{(2 \cdot t)} - 5 \cdot e^{(-2 \cdot t)};$

$$\frac{d^2}{dt^2} x(t) - 2 \left(\frac{d}{dt} x(t) \right) + x(t) = 3\, e^{2\,t} - 5\, e^{-2\,t} \tag{50}$$

$dsolve(eq, x(t));$

$$x(t) = e^{t}\_C2 + e^{t}\,t\,\_C1 + \frac{-20\left(\ln(e) - \frac{1}{2}\right)^{2} e^{-2t} + 12\,e^{2t}\left(\ln(e) + \frac{1}{2}\right)^{2}}{16\ln(e)^{4} - 8\ln(e)^{2} + 1} \tag{51}$$

$eq := diff(x(t), t\$2) - 2\cdot diff(x(t), t) + x(t) = 3\cdot\exp(1)^{(2\cdot t)} - 5\cdot e^{xp(1)(-2\cdot t)}$

$$\frac{d^2}{dt^2}x(t) - 2\left(\frac{d}{dt}x(t)\right) + x(t) = 3\,(e)^{2t} - 5\,e^{xp(1)(-2t)} \tag{52}$$

$eq := diff(x(t), t\$2) - 2\cdot diff(x(t), t) + x(t) = 3\cdot\exp(1)^{(2\cdot t)} - 5\cdot\exp(1)^{(1)(-2\cdot t)}$

$$\frac{d^2}{dt^2}x(t) - 2\left(\frac{d}{dt}x(t)\right) + x(t) = 3\,(e)^{2t} - 5\,(e)^{-2t} \tag{53}$$

$dsolve(eq, x(t));$

$$x(t) = e^{t}\_C2 + e^{t}\,t\,\_C1 + 3\,e^{2t} - \frac{5}{9}\,e^{-2t} \tag{54}$$

$eq := diff(x(t), t\$2) - 2\cdot diff(x(t), t) + x(t) = \exp(1)^{(2\cdot t)}$

$$\frac{d^2}{dt^2}x(t) - 2\left(\frac{d}{dt}x(t)\right) + x(t) = (e)^{2t} \tag{55}$$

$dsolve(eq, x(t));$

$$x(t) = e^{t}\_C2 + e^{t}\,t\,\_C1 + e^{2t} \tag{56}$$

$eq := diff(x(t), t\$2) + 4\cdot x(t) = \cos(2\cdot t);$

$$\frac{d^2}{dt^2}x(t) + 4\,x(t) = \cos(2\,t) \tag{57}$$

$dsolve(eq, x(t));$

$$x(t) = \sin(2\,t)\,\_C2 + \cos(2\,t)\,\_C1 + \frac{1}{8}\cos(2\,t) + \frac{1}{4}\sin(2\,t)\,t \tag{58}$$

$eq := t^2\cdot diff(x(t), t\$2) + 2\cdot t\cdot diff(x(t), t) - 2\cdot x(t) = 0;$

$$t^2\left(\frac{d^2}{dt^2}x(t)\right) + 2\,t\left(\frac{d}{dt}x(t)\right) - 2\,x(t) = 0 \tag{59}$$

$dsolve(eq, x(t));$

$$x(t) = \_C1\,t + \frac{\_C2}{t^2} \tag{60}$$

$ic1 := x(1) = 0, D(x)(1) = 0;$

$$x(1) = 0, D(x)(1) = 0 \tag{61}$$

$dsolve(\{eq, ic1\}, x(t));$

$$x(t) = 0 \tag{62}$$

$eq := diff(x(t), t\$2) + 4\cdot x(t) = \cos(2\cdot t);$

$$\frac{d^2}{dt^2}x(t) + 4\,x(t) = \cos(2\,t) \tag{63}$$

$dsolve(eq, x(t));$

$$x(t) = \sin(2\,t)\,\_C2 + \cos(2\,t)\,\_C1 + \frac{1}{8}\cos(2\,t) + \frac{1}{4}\sin(2\,t)\,t \tag{64}$$

```
eq := diff(Θ(t), t$2) + diff(Θ(t), t) + Θ(t) = 0;
```

$$\frac{d^2}{dt^2}\Theta(t) + \frac{d}{dt}\Theta(t) + \Theta(t) = 0 \tag{65}$$

```
dsolve(eq, Θ(t));
```

$$\Theta(t) = \_C1\, e^{-\frac{1}{2}t}\sin\left(\frac{1}{2}\sqrt{3}\,t\right) + \_C2\, e^{-\frac{1}{2}t}\cos\left(\frac{1}{2}\sqrt{3}\,t\right) \tag{66}$$

```
eq := diff(x(t), t$2) + 25·x(t) = 0;
```

$$\frac{d^2}{dt^2}x(t) + 25\,x(t) = 0 \tag{67}$$

```
ic1 := x(0) = 0, D(x)(0) = 1;
```

$$x(0) = 0,\ D(x)(0) = 1 \tag{68}$$

```
dsolve({eq, ic1}, x(t));;
```

$$x(t) = \frac{1}{5}\sin(5\,t) \tag{69}$$

```
plot(eq, t=-5..5);
```

```
Error, (in plot) unexpected options: [diff(diff(x(t), t), t)+25*x(t) = 0, t = -5 .. 5]
```

```
with(DEplot);
```

```
Error, invalid input: with expects its 1st argument, pname, to be of type {`module`, package}, but received DEplot
```

```
with(DEtools);
```

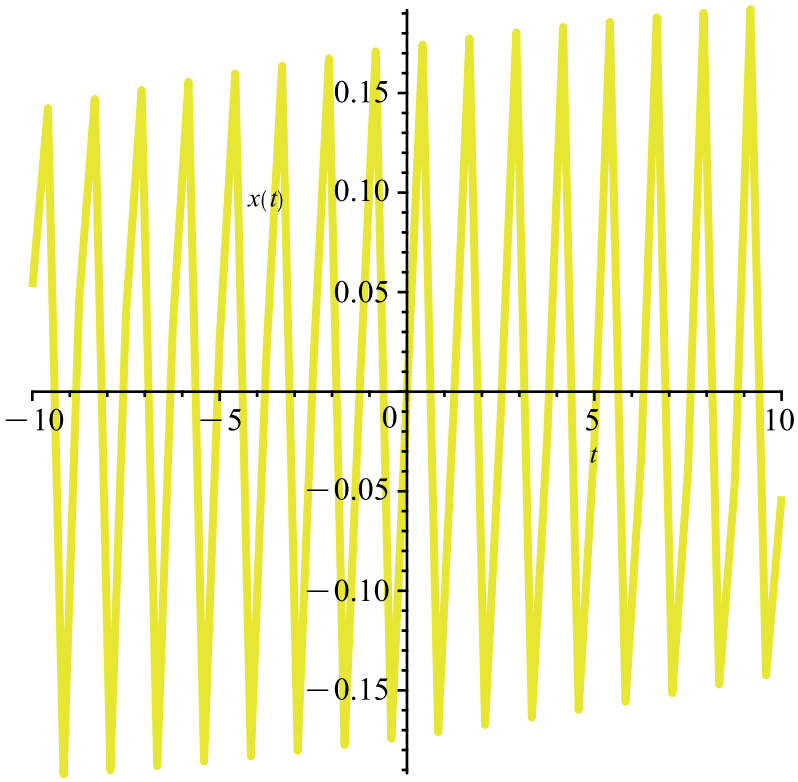
[*AreSimilar*, *Closure*, *DEnormal*, *DEplot*, *DEplot3d*, *DEplot_polygon*, *DFactor*, *DFactorLCLM*, *DFactorsols*, *Dchangevar*, *Desingularize*, *FunctionDecomposition*, *GCRD*, *Gosper*, *Heunsols*, *Homomorphisms*, *IVPsol*, *IsHyperexponential*, *LCLM*, *MeijerGsols*, *MultiplicativeDecomposition*, *ODEInvariants*, *PDEchangecoords*, *PolynomialNormalForm*, *RationalCanonicalForm*, *ReduceHyperexp*, *RiemannPsols*, *Xchange*, *Xcommutator*, *Xgauge*, *Zeilberger*, *abelsol*, *adjoint*, *autonomous*, *bernoullisol*, *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*, *expsols*, *exterior_power*, *firint*, *firtest*, *formal_sol*, *gen_exp*, *generate_ic*, *genhomosol*, *gensys*, *hamilton_eqs*, *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*, **(70)**

singularities, *solve_group*, *super_reduce*, *symgen*, *symmetric_power*, *symmetric_product*, *symtest*, *transinv*, *translate*, *untranslate*, *varparam*, *zoom*]

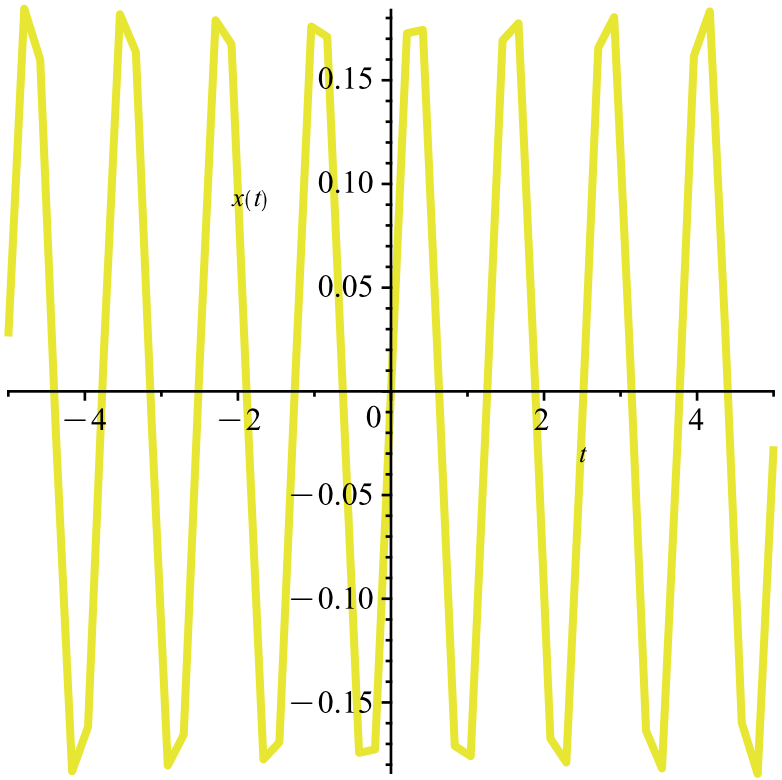
$DEplot(eq, x(t), t = -10..10);$

```
Error, (in DEtools/DEplot) cannot produce plot, non-autonomous DE(s) require initial conditions.
```

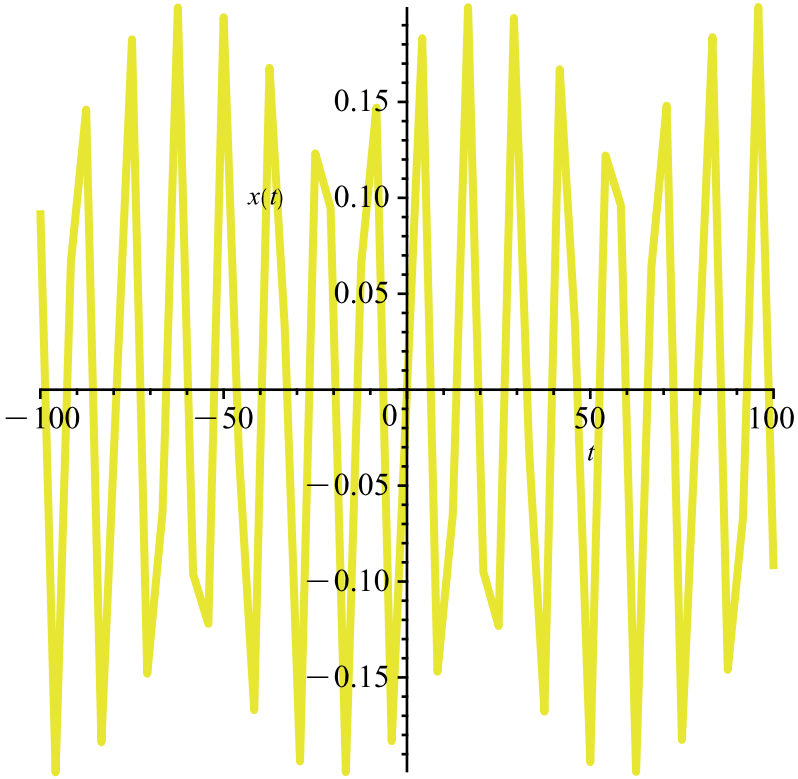
$DEplot(eq, x(t), t = -10..10, [[ic1]]);$



$DEplot(eq, x(t), t = -5..5, [[ic1]]);$



$DEplot(eq, x(t), t = -100..100, [[ic1]]);$



$eq := diff(x(t), t\$2) + 25 \cdot x(t) = 25 - 25 \cdot \sin(5\,t);$

$$\frac{d^2}{dt^2} x(t) + 25\,x(t) = 25 - 25\,\sin(5\,t) \qquad \textbf{(71)}$$

dsolve(eq, x(t))l

$$l\,x(t) = l\left(\sin(5\,t)\,\_C2 + \cos(5\,t)\,\_C1 + 1 - \frac{1}{2}\sin(5\,t) + \frac{5}{2}\cos(5\,t)\,t\right) \tag{72}$$

dsolve(eq, x(t));

$$x(t) = \sin(5\,t)\,\_C2 + \cos(5\,t)\,\_C1 + 1 - \frac{1}{2}\sin(5\,t) + \frac{5}{2}\cos(5\,t)\,t \tag{73}$$

eq := diff(x(t), t$2) + 25·x(t) = sin(5 t);

$$\frac{d^2}{dt^2}x(t) + 25\,x(t) = \sin(5\,t) \tag{74}$$

dsolve(eq, x(t));

$$x(t) = \sin(5\,t)\,\_C2 + \cos(5\,t)\,\_C1 - \frac{1}{10}\cos(5\,t)\,t \tag{75}$$

$$eq := diff(x(t), t) + \frac{1}{t^2}\cdot x(t) = 0;$$

$$\frac{d}{dt}x(t) + \frac{x(t)}{t^2} = 0 \tag{76}$$

ic1 := x(−1) = 1;

$$x(-1) = 1 \tag{77}$$

dsolve({eq, ic1}, x(t))l

$$l\,x(t) = \frac{l\,e^{\frac{1}{t}}}{e^{-1}} \tag{78}$$

dsolve({eq, ic1}, x(t));

$$x(t) = \frac{e^{\frac{1}{t}}}{e^{-1}} \tag{79}$$

dsolve(eq, x(t));

$$x(t) = \_C1\,e^{\frac{1}{t}} \tag{80}$$

$$eq := diff(x(t), t) + \frac{1}{t^2}\cdot x(t) = 1 + \frac{1}{t};$$

$$\frac{d}{dt}x(t) + \frac{x(t)}{t^2} = 1 + \frac{1}{t} \tag{81}$$

dsolve(eq, x(t));

$$x(t) = t + \_C1\,e^{\frac{1}{t}} \tag{82}$$

$$eq := diff(x(t), t\$2) - diff(x(t), t) - 20\cdot x(t) = 0;$$

$$\frac{d^2}{dt^2}x(t) - \left(\frac{d}{dt}x(t)\right) - 20\,x(t) = 0 \tag{83}$$

dsolve(eq, x(t))l

$$l\,x(t) = l\left(\_C1\ e^{5\,t} + \_C2\ e^{-4\,t}\right) \tag{84}$$

$dsolve(eq, x(t))$;

$$x(t) = \_C1\ e^{5\,t} + \_C2\ e^{-4\,t} \tag{85}$$