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? DSolve
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DSolve[*eqn*, *y*, *x*] solves a differential equation for the function *y*, with independent variable *x*.
DSolve[{*eqn*$_1$, *eqn*$_2$, …}, {*y*$_1$, *y*$_2$, …}, *x*] solves a list of differential equations.
DSolve[*eqn*, *y*, {*x*$_1$, *x*$_2$, …}] solves a partial differential equation. ≫

```
(*Solve the differential eq d^2x/dt^2=-kx*)
deq = x''[t] + k * x[t] == 0;
sol = DSolve[deq, x[t], t]
```

$$\left\{\left\{x[t] \to C[1]\,\text{Cos}\left[\sqrt{k}\ t\right] + C[2]\,\text{Sin}\left[\sqrt{k}\ t\right]\right\}\right\}$$

```
xt = x[t] /. sol[[1]]
```

$$C[1]\,\text{Cos}\left[\sqrt{k}\ t\right] + C[2]\,\text{Sin}\left[\sqrt{k}\ t\right]$$

```
vt = D[xt, t]
```

$$\sqrt{k}\ C[2]\,\text{Cos}\left[\sqrt{k}\ t\right] - \sqrt{k}\ C[1]\,\text{Sin}\left[\sqrt{k}\ t\right]$$

```
xt = xt /. k → 1
vt = vt /. k → 1
```

$$C[1]\,\text{Cos}[t] + C[2]\,\text{Sin}[t]$$

$$C[2]\,\text{Cos}[t] - C[1]\,\text{Sin}[t]$$

```
eq1 = (xt /. t → 0) == 5
eq2 = (vt /. t → 0) == 1
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$$C[1] == 5$$

$$C[2] == 1$$

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constant = Solve[{eq1, eq2}, {C[1], C[2]}]
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$$\{\{C[1] \to 5, C[2] \to 1\}\}$$

```
xt = xt /. constant[[1]]
vt = vt /. constant[[1]]
```

$$5\,\text{Cos}[t] + \text{Sin}[t]$$

$$\text{Cos}[t] - 5\,\text{Sin}[t]$$

```
Plot[{xt, vt}, {t, 0, 10}]
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