

# Linear First Order Template

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Goal: Find an analytic solution to a linear first order DE:  $y' + p(x)y = g(x)$

Example:  $y' - 2y = 3, y(0) = 1$ .

Clear variables

$y = .$

$x = .$

Specify the coefficients  $p(x)$  and  $g(x)$ :

$p = -2$

$-2$

$g = 3$

$3$

Set the initial Conditions:

$x_0 = 0$

$y_0 = 1$

$0$

$1$

Determine the integrating factor  $\mu$ :

$\mu = \text{Exp}[\text{Integrate}[p, x]]$

$e^{-2x}$

$\text{gensln} = 1 / \mu (\text{Integrate}[\mu * g, x] + C)$

$e^{2x} \left( C - \frac{3 e^{-2x}}{2} \right)$

$\text{IC} = \text{Solve} [y == \text{gensln}, C] /. \{y \rightarrow y_0, x \rightarrow x_0\}$

$\left\{ \left\{ C \rightarrow \frac{5}{2} \right\} \right\}$

$\text{sln} = \text{gensln} /. \text{IC} \{ \{1\} \}$

$\left\{ e^{2x} \left( \frac{5}{2} - \frac{3 e^{-2x}}{2} \right) \right\}$

$\text{Simplify}[\text{sln}]$

$\left\{ \frac{1}{2} (-3 + 5 e^{2x}) \right\}$