

November 28

SWBAT:
Solve Separable
Differential Equations



Solve the
initial value
problem

$$y' - 3y = 6$$
$$y(0) = 5$$

$$y' - 3y = 6$$

$$y' = 6 + 3y$$

$$\frac{dy}{dx} = 6 + 3y$$

$$dy = (6 + 3y)dx$$

$$\frac{dy}{6+3y} = dx$$

$$\int \frac{dy}{6+3y} = \int dx$$

$$u = 6 + 3y$$

$$du = 3 dy$$

$$\frac{du}{3} = dy$$

$$\int \frac{1}{u} \cdot \frac{du}{3} = \int dx$$

$$\frac{1}{3} \ln|u| = x + C$$

$$\frac{1}{3} \ln|6+3y| = x + C$$

$$\frac{1}{3} \ln|6+3y| = x + C$$

$$y(0) = 5$$

$$\frac{1}{3} \ln|6+3(5)| = 0 + C$$

$$\frac{1}{3} \ln|21| = C$$

$$\frac{1}{3} \ln|6+3y| = x + \frac{1}{3} \ln(21)$$

$$\ln|6+3y| = 3x + \ln 21$$

e

$$|6+3y| = e^{3x + \ln 21} = e^{3x} e^{\ln 21}$$

$$6+3y = 21e^{3x}$$

$$3y = 21e^{3x} - 6$$

$$y = 7e^{3x} - 2$$

Differential Equation	Solution	Differential Equation	Solution
$\frac{dy}{dx} = 27y$ if $y(0) = 23$	$y = 23e^{27x}$	$\frac{dy}{dx} = 14y$ if $y(0) = 6$	$y = 6e^{14x}$
$\frac{dy}{dx} = 18y$ if $y(0) = 15$	$y = 15e^{18x}$	$\frac{dy}{dx} = 6y$ if $y(0) = 11$	$y = 11e^{6x}$
$\frac{dy}{dx} = 16y$ if $y(0) = 30$	$y = 30e^{16x}$	$\frac{dy}{dx} = 9y$ if $y(0) = 5$	$y = 5e^{9x}$
$\frac{dy}{dx} = 11y$ if $y(0) = 21$	$y = 21e^{11x}$	$\frac{dy}{dx} = 12y$ if $y(0) = 4$	$y = 4e^{12x}$
$\frac{dy}{dx} = 19y$ if $y(0) = 2$	$y = 2e^{19x}$	$\frac{dy}{dx} = 7y$ if $y(0) = 10$	$y = 10e^{7x}$
$\frac{dy}{dx} = 4y$ if $y(0) = 9$	$y = 9e^{4x}$	$\frac{dy}{dx} = 5y$ if $y(0) = 7$	$y = 7e^{5x}$

exponential
change

$$\text{if } \frac{dy}{dt} = Ky$$

with $y = y_0$ when $t = 0$

$$\text{Then } y = y_0 e^{kt}$$

$$\frac{dy}{dt} = 4y$$

$y = -18$ when $t = 0$

$$y = -18e^{4t}$$

$$\frac{dy}{dx} = 3y$$

$y = 6, x = 2$

$$y = Ce^{3x}$$
$$6 = Ce^{3(2)}$$

$$\frac{6}{e^6} = \frac{Ce^6}{e^6} \rightarrow C = \frac{6}{e^6}$$
$$y = \frac{6}{e^6} e^{3x}$$