MAT 239 (Differential Equations), Prof. Swift
Worksheet 3

1. Write down the general solution to $y' = x + 1$. $y = \frac{x^2}{2} + x + C$

2. Solve the Initial Value Problem (IVP) $y' = x + 1, \quad y(0) = -2$.

$y(0) = 0 + 0 + C \overset{\text{set}}{=} -2$
$\therefore C = -2$
$y = \frac{x^2}{2} + x - 2$

3. Write down the general solution to $\frac{dy}{dx} = -y$. $y = Ce^{-x}$

4. Solve the IVP $\frac{dy}{dx} = -y, \quad y(0) = 2$.

$y(0) = Ce^{-0} \overset{\text{set}}{=} C = 2$
$y = 2e^{-x}$

5. Write down the general solution to $\frac{dy}{dt} = 2y$. $y = Ce^{2x}$

6. Solve the IVP $\frac{dy}{dt} = 2y, \quad y(0) = -1$.

$y(0) = Ce^{0} = C \overset{\text{set}}{=} -1$
$C = -1$
$y = -e^{2x}$

For each of these IVPs, write down the solution by inspection.

6. $\frac{dy}{dx} = 3y, \quad y(0) = 1.$ $y = e^{3x}$

7. $\frac{dy}{dt} = -4y, \quad y(0) = 2.$ $y = 2e^{-4t}$ (Note t is the independent variable)

8. $\frac{dy}{dx} = 6y, \quad y(0) = 0.$ $y = 0$ $(y = 0e^{6x})$

9. $\frac{dy}{dt} = y, \quad y(0) = 1.$ $y = e^{t}$

oops! That should be x.

10. $\frac{dy}{dx} = -\frac{1}{2}y, \quad y(0) = 2.$ $y = 2e^{-\frac{1}{2}t}$ or $y = 2e^{-\frac{t}{2}}$ or $y = 2\exp\left(\frac{-t}{2}\right)$

$\exp(x) = e^{x}$, and exp is useful for messy exponents.