Solving Differential Equations: Summary of Steps

I. Separation of variables

1. Rewrite y' as $\frac{dy}{dx}$ (or $\frac{dy}{dt}$ if time t is independent variable)

*numerator of the differential fraction (dy) is the **dependent variable**.

* Denominator of the differential fraction(dx) is the independent variable.

- 2. Group the dependent variables together on **left side** of equation (y & dy)
- 3. Independent variables on the **right side** of equation $(x \& dx \ or \ t \& dt)$
- 4. Start by cross-multiplying equation to rearrange all variables in the numerator.

5. Divide terms and/or variables to the other side if the variables are not yet separated.

6. Remember that dy & dx terms need to be in the **numerator location** of their respective sides, never in the denominator once variables are separated.

7. It's ok to have variable(s) *x* or *y* in the denominator after all variables are separated.

8. If parentheses are presented in the differential equation, keep them. Don't expand or distribute. The parentheses are there to help you group the terms that need to stay together.

9. Try to keep the left side of the equation with just the bare minimum terms if possible. (y, dy & any terms grouped with y in parentheses). Any coefficient constants keep (or move) to the right side of the equation.

II. Antidifferentiation (Take Integral of both sides)

1. Treat each side as a separate problem and take the appropriate indefinite integral of each side. (Power Rule, other Integral rules, or U-Substitution)

2. We only need to display a "+C" on the right side of the equation.

3. Solve for the "+C" constant

a) <u>Option 1</u>: Solve for the **C** immediately after it appears. Use the ordered pair given in the problem to solve for C. (my preference is solving for +C if y is raised to a power; example: y^2 , y^3 , $y^{3/2}$)

b) <u>Option 2</u>: Wait to solve for **C**. First, clean up the equation by solving for y (isolate y variable) on the left side of the equation (my preference is solving for y first if I see ln(y) on the left side of the equation). Finally, solve for the value of **C** using the given ordered pair.