Math 3195
Linear Algebra and Differential Equations
Cheat Sheet

Name	Form of Equation	Solution Method
	$\frac{dy}{dx} = f(x)$	$y(x) = \int f(x)dx + C$
Separable	$\frac{dy}{dx} = \frac{g(x)}{f(y)}$	$\int f(y)dy = \int g(x)dx + C$
First-Order Linear	$\frac{dy}{dx} + P(x)y = Q(x)$	Set $\rho(x) = e^{\int P(x)dx}$ So $\rho(x)\frac{dy}{dx} + \rho(x)P(x)y = \rho(x)Q(x)$. Then $\rho(x)y(x) = \int \rho(x)Q(x)dx + C$.
	Substitutions	
	$\frac{dy}{dx} = F(ax + by + c)$	Let $v = ax + by + c$, solve for y, find $\frac{dy}{dx}$ in terms of $\frac{dv}{dx}$ and rewrite the equation in terms of $\frac{dv}{dx}$.
Homogeneous	$\frac{dy}{dx} = F(\frac{y}{x})$	Let $v = \frac{y}{x}$ so $y = vx$ and $\frac{dy}{dx} = v + x\frac{dv}{dx}$. Rewrite equation in terms of $\frac{dv}{dx}$.
Bernoulli	$\frac{dy}{dx} + P(x)y = Q(x)y^n$	If $n = 0$ or $n = 1$, this is linear, otherwise Let $v = y^{1-n}$, Apply the substitution to get a linear form.