Useful Formulas

1. Power Rule: $\int u^n \, du = \frac{u^{n+1}}{n+1} + C$ for $n \neq -1$
2. $\int \frac{du}{u} = \ln|u| + C$
3. $\int \cos u \, du = \sin u + C$
4. $\int \sin u \, du = -\cos u + C$
5. $\int \tan u \, du = -\ln|\cos u| + C$
6. $\int \sec u \, du = \ln|\sec u + \tan u| + C$
7. $\int \sec^2 u \, du = \tan u + C$
8. $\int \sec u \tan u \, du = \sec u + C$
9. $\int e^u \, du = e^u + C$
10. $\int e^{ax} \, dx = \frac{1}{a} e^{ax} + C$
11. $\int b^u \, du = \frac{1}{\ln b} b^u + C$ where $b > 0$ and $b \neq 1$
12. $\int \frac{du}{1+u^2} = \arctan u + C$
13. $\int \frac{du}{\sqrt{1-u^2}} = \arcsin u + C$
14. Sum Rule: $\int (f(x) + g(x)) \, dx = \int f(x) \, dx + \int g(x) \, dx$
15. Constant Multiple Rule: $\int cf(x) \, dx = c \int f(x) \, dx$ where c is any real constant
16. How to use Integration by u Substitution
17. How to use Integration by Parts: $\int u \, dv = uv - \int v \, du$
18. How to use Integration by Partial Fractions to evaluate integrals like $\int \frac{p(x)}{q(x)} \, dx$ where $p(x)$ and $q(x)$ are polynomials

Recognize the Type

1. First check to see if it is separable.
2. Next check to see if it is linear by looking at what is being done to the dependent variable and its derivatives.
3. If it is not linear, but looks close, try Bernoulli form.
4. Next, try checking for exactness.
5. If x and y are only to the first power with the same coefficients, try substitution.
6. If none of these work, try checking if it is separable again.

Separable Linear Equations

1. Check that the dependent variable (the one having its derivative taken) is only to the first power.
2. Check that the dependent variable is not in a function (trig, exponential, log).
3. Check that equation can be reorganized so that each variable is on opposite sides by itself.
4. Integrate both sides and solve for dependent variable (don't forget C).

Non-separable Linear Equations

1. Reorganize into general form:

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2. Find the integrating factor:

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3. Use integrating factor in solved formula:

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Bernoulli Equations

1. Reorganize equation into general form:

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2. Substitute v:

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3. Solve resulting linear equation:

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4. Solve for v and resubstitute.

Exact Equations

1. Reorganize into general form:

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2. Test for exactness with partial derivatives:

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3. Find f(x,y) for both M and N with partial integration:

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4. Find the general solution, including any terms that are missing from either integration:

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Substitution Equations

1. Reorganize into general form:

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2. Let z equal:

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3. Find dz/dx:

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4. Substitute and solve resulting separable equation for dy/dx.