

A Checklist for How to Determine which Integration Technique to Use

1. Is it one of the basic integrals?

$$\int a \, dx = ax + C$$

$$\int x^n \, dx = \left(\frac{1}{n+1}\right)x^{n+1} + C, \quad n \neq -1$$

$$\int \frac{1}{x} \, dx = \ln|x| + C$$

$$\int \frac{1}{a^2 + x^2} \, dx = \frac{1}{a} \arctan\left(\frac{x}{a}\right) + C$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} \, dx = \frac{1}{a} \arcsin\left(\frac{x}{a}\right) + C$$

$$\int e^x \, dx = e^x + C$$

$$\int a^x \, dx = \frac{a^x}{\ln(a)} + C$$

$$\int \sin(x) \, dx = -\cos(x) + C$$

$$\int \cos(x) \, dx = \sin(x) + C$$

$$\int \sec^2(x) \, dx = \tan(x) + C$$

$$\int \sec(x) \tan(x) \, dx = \sec(x) + C$$

$$\int \csc^2(x) \, dx = -\cot(x) + C$$

$$\int \csc(x) \cot(x) \, dx = -\csc(x) + C$$

2. Can it be simplified?

a. Multiplication? Ex: $x^2 \left(2x - \frac{1}{x} + \sqrt{x}\right) = 2x^3 - x + x^{5/2}$

b. Fraction? Ex: $\frac{3y - y^4}{y^2} = 3y^{-1} - y^2$

c. Power? Ex: $(x - 3)^2 = x^2 - 6x + 9$

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3. Can you use U Substitution?
 - a. Is there a composition? (ie: $f(g(x))$)
 - b. Is the du there?

4. Is it a Product?
 - a. Can you use integration by parts? $\int f(x)g'(x) dx = f(x)g(x) - \int f'(x)g(x) dx$
 - b. If possible, pick $f(x)$ to be the polynomial.

5. Is it a Fraction?
 - a. Is the degree of the top of the fraction larger than the degree of the bottom? If so, do long division to simplify the fraction.
 - b. Is it in an $\ln()$ form? Look for $\frac{g'(x)}{g(x)}$.
 - c. Is it in an $\arctan()$ form? Look for $\frac{g'(x)}{a^2+g^2(x)}$.
 - d. Can you factor the denominator? Use partial fractions.
 - e. Last option: complete the square on the denominator and use $\arctan()$

6. Is it an Improper Integral?
 - a. Is there an $\pm\infty$ for one or more of the bounds of integration?
 - b. Is the function undefined for any x where $a \leq x \leq b$?