Basic integration formulas

$$\int x^n \ \mathrm{d}x = \frac{x^{n+1}}{n+1} + C$$

$$\int \frac{1}{x} \ \mathrm{d}x = \ln|x| + C$$

$$\int a^x \ \mathrm{d}x = \frac{a^x}{\ln a} + C$$

$$\int \sin x \ \mathrm{d}x = -\cos x + C$$

$$\int \cos x \ \mathrm{d}x = \sin x + C$$

$$\int \sec^2 x \ \mathrm{d}x = \tan x + C$$

$$\int \sec x \tan x \ \mathrm{d}x = \sec x + C$$

$$\int \csc^2 x \ \mathrm{d}x = -\cot x + C$$

$$\int \csc x \cot x \ \mathrm{d}x = -\csc x + C$$

$$\int \tan x \ \mathrm{d}x = \ln|\sec x| + C$$

$$\int \cot x \ \mathrm{d}x = \ln|\sin x| + C$$

$$\int \sec x \ \mathrm{d}x = \ln|\sec x + \tan x| + C$$

$$\int \csc x \ \mathrm{d}x = -\ln|\csc x + \cot x| + C$$

$$\int \frac{1}{\sqrt{a^2 - x^2}} \ \mathrm{d}x = \arcsin(\frac{x}{a}) + C$$

$$\int \frac{1}{x^2 + a^2} \ \mathrm{d}x = \frac{1}{a} \arctan(\frac{x}{a}) + C$$

$$\int \frac{1}{x\sqrt{x^2 - a^2}} \ \mathrm{d}x = \frac{1}{a}\mathrm{arcsec}|\frac{x}{a}| + C$$

u-substitution:

$$\int g(f(x)) \cdot f'(x) \ \mathrm{d}x = \int g(u) \ \mathrm{d}u\Big|_{u=f(x)} + C$$

Special case: $\displaystyle\int \frac{f'(x)}{f(x)} \ \mathrm{d}x = \ln|f(x)| + C$

Integration by parts:

$$\int u \ \mathrm{d}v = uv - \int v \ \mathrm{d}u + C$$

Partial Fractions: to integrate a function like $\dfrac{ax+b}{(x+c)(x+d)}$:

Write $\dfrac{ax+b}{(x+c)(x+d)} = \dfrac{A}{(x+c)} + \dfrac{B}{(x+d)} = \dfrac{A(x+d)+B(x+c)}{(x+c)(x+d)}$,
so $ax+b = A(x+d)+B(x+c) = (A+B)x + (Ad+Bc)$, so $a = A+B$ and $b = Ad+Bc$; solve for A and B .

The approach for more general denomenator can be found in nearly any calculus textbook.