Separable	$f(x) = g(y)\dfrac{dy}{dx}$	Separate $\dfrac{dy}{dx}$ and then integrate
Linear	$y' + a(x)y = b(x)$	Multiply by $e^{A(x)}$ where $A(x) = \int a(x)dx$
Exact	$M(x,y) + N(x,y)\cdot y' = 0$	Test: $\dfrac{\partial M}{\partial y} = \dfrac{\partial N}{\partial x}$ Find f where $\dfrac{\partial f}{\partial x} = M$ and $\dfrac{\partial f}{\partial y} = N$ Solution: $f(x,y) = c$
Constant coefficient	$a_2y'' + a_1y' + a_0y = 0$	Two real roots r_1, r_2 use e^{r_1x} and e^{r_2x} If double real root r use e^{rx} and xe^{rx} If complex roots $r = \alpha \pm \beta i$ use $e^{\alpha x}\cos(\beta x)$ and $e^{\alpha x}\sin(\beta x)$
Variation of parameters	$y'' + a_1(x)y' + a_0(x)y = b(x)$ y_1 and y_2 sols. to homogeneous eqn.	$y_p = v_1y_1 + v_2y_2$ $v_1 = \int \dfrac{-y_2\cdot b(x)}{W(y_1,y_2)}dx$ $\quad v_2 = \int \dfrac{y_1\cdot b(x)}{W(y_1,y_2)}dx$
Reduction of Order	$y'' + a_1(x)y' + a_0(x)y = 0$ on the interval I	y_1 is a solution that isn't zero on I $y_2 = y_1 \cdot \int \dfrac{e^{-\int a_1(x)dx}}{y_1^2}dx$
Euler's method	$y' = f(x,y)$ $y(x_0) = y_0$	$x_n = x_{n-1} + h$ $y_n = y_{n-1} + h\cdot f(x_{n-1}, y_{n-1})$

$b(x)$	y_p guess for undetermined coefficients
constant	A
$5x - 3$	$Ax + B$
$10x^2 - x + 1$	$Ax^2 + Bx + C$
$\sin(6x)$	$A\cos(6x) + B\sin(6x)$
$\cos(6x)$	$A\cos(6x) + B\sin(6x)$
e^{3x}	Ae^{3x}
$(2x+1)e^{3x}$	$(Ax + B)e^{3x}$
x^2e^{3x}	$(Ax^2 + Bx + C)e^{3x}$
$e^{3x}\sin(4x)$	$Ae^{3x}\cos(4x) + Be^{3x}\sin(4x)$
$e^{3x}\cos(4x)$	$Ae^{3x}\cos(4x) + Be^{3x}\sin(4x)$

Taylor series: $f(x_0) + f'(x_0)(x - x_0) + \dfrac{f''(x_0)}{2!}(x - x_0)^2 + \dfrac{f^{(3)}(x_0)}{3!}(x - x_0)^3 + \dfrac{f^{(4)}(x_0)}{4!}(x - x_0)^4 + \dots$

$\int u\,dv = uv - \int v\,du$ $\quad \int \sin(x)dx = -\cos(x)$ $\quad \int \cos(x)dx = \sin(x)$ $\quad W(y_1, y_2) = \begin{vmatrix} y_1 & y_2 \\ y_1' & y_2' \end{vmatrix} = y_1y_2' - y_2y_1'$