

## Formulas reference list

Cramer's Rule: If  $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc \neq 0$ , then the solutions of the linear system

$$ax + by = e$$

$$cx + dy = f$$

are  $x = \frac{\begin{vmatrix} e & b \\ f & d \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}$  and  $y = \frac{\begin{vmatrix} a & e \\ c & f \end{vmatrix}}{\begin{vmatrix} a & b \\ c & d \end{vmatrix}}$ .

$$\mathcal{L}(t^n) = \frac{n!}{s^{n+1}}$$

$$\mathcal{L}(t^\alpha) = \frac{\Gamma(\alpha + 1)}{s^{\alpha+1}}, \text{ where } \Gamma(x) = \int_0^\infty e^{-t} t^{x-1} dt$$

$$\mathcal{L}(e^{at}) = \frac{1}{s - a}$$

$$\mathcal{L}(\cos(at)) = \frac{s}{s^2 + a^2}$$

$$\mathcal{L}(\sin(at)) = \frac{a}{s^2 + a^2}$$

$$\mathcal{L}(\cosh(at)) = \frac{s}{s^2 - a^2}$$

$$\mathcal{L}(\sinh(at)) = \frac{a}{s^2 - a^2}$$

$$\mathcal{L}\left(\frac{1}{2a} t \sin(at)\right) = \frac{s}{(s^2 + a^2)^2}$$

$$\mathcal{L}\left(\frac{1}{2a^3} (\sin(at) - at \cos(at))\right) = \frac{1}{(s^2 + a^2)^2}$$

$$\mathcal{L}(u_a(t)) = \frac{e^{-as}}{s}, \text{ where } u_a(t) = 0 \text{ for } t < a \text{ and } u_a(t) = 1 \text{ for } t \geq a$$

$$\mathcal{L}(f^{(n)}(t)) = s^n \mathcal{L}(f(t)) - s^{n-1} f(0) - s^{n-2} f'(0) - s^{n-3} f''(0) - \dots - s f^{(n-2)}(0) - f^{(n-1)}(0)$$

$$\mathcal{L}\left(\int_0^t f(\tau) d\tau\right) = \frac{1}{s} \mathcal{L}(f(t))$$

$$\mathcal{L}(e^{at} f(t)) = F(s - a)$$

$$\mathcal{L}(t^n f(t)) = (-1)^n \frac{d^n}{ds^n} F(s)$$

$$\mathcal{L}\left(\frac{f(t)}{t}\right) = \int_s^\infty F(\sigma) d\sigma$$

$$\mathcal{L}((f * g)(t)) = F(s) G(s), \text{ where } (f * g)(t) = \int_0^t f(\sigma) g(t - \sigma) d\sigma$$

$$\mathcal{L}(u_a(t) f(t - a)) = e^{-as} F(s)$$