

Table of Laplace Transforms

	$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$	$f(t) = \mathcal{L}^{-1}\{F(s)\}$	$F(s) = \mathcal{L}\{f(t)\}$	
1.	1	$\frac{1}{s}$	2.	e^{at}	$\frac{1}{s-a}$
3.	$t^n, n=1,2,3,\dots$	$\frac{n!}{s^{n+1}}$	4.	$t^p, p > -1$	$\frac{\Gamma(p+1)}{s^{p+1}}$
5.	\sqrt{t}	$\frac{\sqrt{\pi}}{2s^{\frac{3}{2}}}$	6.	$t^{n-\frac{1}{2}}, n=1,2,3,\dots$	$\frac{1 \cdot 3 \cdot 5 \cdots (2n-1)\sqrt{\pi}}{2^n s^{n+\frac{1}{2}}}$
7.	$\sin(at)$	$\frac{a}{s^2+a^2}$	8.	$\cos(at)$	$\frac{s}{s^2+a^2}$
9.	$t \sin(at)$	$\frac{2as}{(s^2+a^2)^2}$	10.	$t \cos(at)$	$\frac{s^2-a^2}{(s^2+a^2)^2}$
11.	$\sin(at) - at \cos(at)$	$\frac{2a^3}{(s^2+a^2)^2}$	12.	$\sin(at) + at \cos(at)$	$\frac{2as^2}{(s^2+a^2)^2}$
13.	$\cos(at) - at \sin(at)$	$\frac{s(s^2-a^2)}{(s^2+a^2)^2}$	14.	$\cos(at) + at \sin(at)$	$\frac{s(s^2+3a^2)}{(s^2+a^2)^2}$
15.	$\sin(at+b)$	$\frac{s \sin(b) + a \cos(b)}{s^2+a^2}$	16.	$\cos(at+b)$	$\frac{s \cos(b) - a \sin(b)}{s^2+a^2}$
17.	$\sinh(at)$	$\frac{a}{s^2-a^2}$	18.	$\cosh(at)$	$\frac{s}{s^2-a^2}$
19.	$e^{at} \sin(bt)$	$\frac{b}{(s-a)^2+b^2}$	20.	$e^{at} \cos(bt)$	$\frac{s-a}{(s-a)^2+b^2}$
21.	$e^{at} \sinh(bt)$	$\frac{b}{(s-a)^2-b^2}$	22.	$e^{at} \cosh(bt)$	$\frac{s-a}{(s-a)^2-b^2}$
23.	$t^n e^{at}, n=1,2,3,\dots$	$\frac{n!}{(s-a)^{n+1}}$	24.	$f(ct)$	$\frac{1}{c} F\left(\frac{s}{c}\right)$
25.	$u_c(t) = u(t-c)$ Heaviside Function	$\frac{e^{-cs}}{s}$	26.	$\delta(t-c)$ Dirac Delta Function	e^{-cs}
27.	$u_c(t) f(t-c)$	$e^{-cs} F(s)$	28.	$u_c(t) g(t)$	$e^{-cs} \mathcal{L}\{g(t+c)\}$
29.	$e^{ct} f(t)$	$F(s-c)$	30.	$t^n f(t), n=1,2,3,\dots$	$(-1)^n F^{(n)}(s)$
31.	$\frac{1}{t} f(t)$	$\int_s^\infty F(u) du$	32.	$\int_0^t f(v) dv$	$\frac{F(s)}{s}$
33.	$\int_0^t f(t-\tau) g(\tau) d\tau$	$F(s)G(s)$	34.	$f(t+T) = f(t)$	$\frac{\int_0^T e^{-st} f(t) dt}{1-e^{-sT}}$
35.	$f'(t)$	$sF(s) - f(0)$	36.	$f''(t)$	$s^2 F(s) - sf'(0) - f''(0)$
37.	$f^{(n)}(t)$	$s^n F(s) - s^{n-1} f(0) - s^{n-2} f'(0) \cdots - sf^{(n-2)}(0) - f^{(n-1)}(0)$			

Table Notes

1. This list is not a complete listing of Laplace transforms and only contains some of the more commonly used Laplace transforms and formulas.
2. Recall the definition of hyperbolic functions.

$$\cosh(t) = \frac{e^t + e^{-t}}{2} \qquad \sinh(t) = \frac{e^t - e^{-t}}{2}$$

3. Be careful when using “normal” trig function vs. hyperbolic functions. The only difference in the formulas is the “+ a²” for the “normal” trig functions becomes a “- a²” for the hyperbolic functions!
4. Formula #4 uses the Gamma function which is defined as

$$\Gamma(t) = \int_0^{\infty} e^{-x} x^{t-1} dx$$

and n is a positive integer then,

$$\Gamma(n+1) = n!$$

The Gamma function is an extension of the normal factorial function. Here are a couple of quick facts for the Gamma function

$$\Gamma(p+1) = p\Gamma(p)$$

$$p(p+1)(p+2)\cdots(p+n-1) = \frac{\Gamma(p+n)}{\Gamma(p)}$$

$$\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$$