Notes for the khan academy course: https://www.khanacademy.org/math/differential-equations/laplace-transform

$$L\{f(t)\} = F(s)$$

or

$$L\{f(t)\} = \int_0^\infty e^{-st} f(t)\, dt$$

General Rule

This rule uses the integration by parts rule, or:

$$u'v = uv - \int uv'$$

$$L\{f'(t)\} = sL\{f(t)\} - f(0)$$

which also gives:

$$L\{f\} = \frac{1}{s}\{L\{f'\} + f_0\}$$

and for the second order derivative:

$$L\{f''(t)\} = s^2 L\{f(t)\} - sf(0) - f'(0)$$

This is useful, as it the Laplace transform turns derivatives into multiplications

Important Entries:

$$L\{1\} = \frac{1}{s}$$

$$L\{t\} = \frac{1}{s^2}$$

$$L\{t^2\} = \frac{1}{s}\left\{\frac{2}{s^2}\right\} = \frac{2}{s^3}$$

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

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

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

Given

$$L\{f(t)\} = F(s)$$

Then

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

Example:

$$L\{e^{3t}\cos(at)\} = \frac{(s-3)}{(s-3)^2+2^2}$$

$$L\{\mu_\pi(t) f(t-c)\} = e^{-cs} L\{f(t)\}$$