Laplace Transform Pairs (Table 2.2.1)

	$X(s)$	$x(t),\ t \geq 0$
1.	1	$\delta(t)$, unit impulse
2.	$\frac{1}{s}$	$u_s(t)$, unit step
3.	$\frac{c}{s}$	constant, c
4.	$\frac{e^{-sD}}{s}$	$u_s(t-D)$, shifted unit step
5.	$\frac{n!}{s^{n+1}}$	t^n
6.	$\frac{1}{s+a}$	e^{-at}
7.	$\frac{1}{(s+a)^n}$	$\frac{1}{(n-1)!}t^{n-1}e^{-at}$
8.	$\frac{b}{s^2+b^2}$	$\sin bt$
9.	$\frac{s}{s^2+b^2}$	$\cos bt$
10.	$\frac{b}{(s+a)^2+b^2}$	$e^{-at}\sin bt$
11.	$\frac{s+a}{(s+a)^2+b^2}$	$e^{-at}\cos bt$
12.	$\frac{a}{s(s+a)}$	$1-e^{-at}$
13.	$\frac{1}{(s+a)(s+b)}$	$\frac{1}{b-a}(e^{-at}-e^{-bt})$
14.	$\frac{s+p}{(s+a)(s+b)}$	$\frac{1}{b-a}[(p-a)e^{-at}-(p-b)e^{-bt}]$
15.	$\frac{1}{(s+a)(s+b)(s+c)}$	$\frac{e^{-at}}{(b-a)(c-a)}+\frac{e^{-bt}}{(c-b)(a-b)}+\frac{e^{-ct}}{(a-c)(b-c)}$
16.	$\frac{s+p}{(s+a)(s+b)(s+c)}$	$\frac{(p-a)e^{-at}}{(b-a)(c-a)}+\frac{(p-b)e^{-bt}}{(c-b)(a-b)}+\frac{(p-c)e^{-ct}}{(a-c)(b-c)}$
17.	$\frac{b}{s^2-b^2}$	$\sinh bt$
18.	$\frac{s}{s^2+b^2}$	$\cosh bt$
19.	$\frac{a^2}{s^2(s+a)}$	$at-1+e^{-at}$
20.	$\frac{a^2}{s(s+a)^2}$	$1-(at+1)e^{-at}$
21.	$\frac{\omega_n^2}{s^2+2\zeta\omega_n s+\omega_n^2}$	$\frac{\omega_n}{\sqrt{1-\zeta^2}}e^{-\zeta\omega_n t}\sin \omega_n\sqrt{1-\zeta^2}t$
22.	$\frac{s}{s^2+2\zeta\omega_n s+\omega_n^2}$	$-\frac{1}{\sqrt{1-\zeta^2}}e^{-\zeta\omega_n t}\sin\left(\omega_n\sqrt{1-\zeta^2}t-\phi\right),\ \phi=\tan^{-1}\frac{\sqrt{1-\zeta^2}}{\zeta}$
23.	$\frac{\omega_n^2}{s\left(s^2+2\zeta\omega_n s+\omega_n^2\right)}$	$1-\frac{1}{\sqrt{1-\zeta^2}}e^{-\zeta\omega_n t}\sin\left(\omega_n\sqrt{1-\zeta^2}t+\phi\right)$
24.	$\frac{1}{s[(s+a)^2+b^2]}$	$\frac{1}{a^2+b^2}\left[1-\left(\frac{a}{b}\sin bt+\cos bt\right)e^{-at}\right],\ \phi=\tan^{-1}\frac{\sqrt{1-\zeta^2}}{\zeta}$
25.	$\frac{b^2}{s(s^2+b^2)}$	$1-\cos bt$
26.	$\frac{b^3}{s^2(s^2+b^2)}$	$bt-\sin bt$
27.	$\frac{2b^3}{(s^2+b^2)^2}$	$\sin bt-bt\cos bt$
28.	$\frac{2bs}{(s^2+b^2)^2}$	$t\sin bt$
29.	$\frac{s^2-b^2}{(s^2+b^2)^2}$	$t\cos bt$
30.	$\frac{s}{\left(s^2+b_1^2\right)\left(s^2+b_2^2\right)}$	$\frac{1}{b_2^2-b_1^2}(\cos b_1t-\cos b_2t),\quad \left(b_1^2\neq b_2^2\right)$
31.	$\frac{s^2}{(s^2+b^2)^2}$	$\frac{1}{2b}(\sin bt+bt\cos bt)$

Properties of the Laplace Transform (Table 2.2.2)

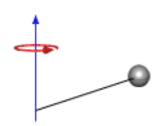
$x(t)$	$X(s) = \int_0^\infty f(t)e^{-st}\,dt$
1. $af(t) + bg(t)$	$aF(s) + bG(s)$
2. $\dfrac{dx}{dt}$	$sX(s) - x(0)$
3. $\dfrac{d^2x}{dt^2}$	$s^2X(s) - sx(0) - \dot{x}(0)$
4. $\dfrac{d^nx}{dt^n}$	$s^nX(s) - \sum_{k=1}^{n} s^{n-k} g_{k-1}$ $g_{k-1} = \left.\dfrac{d^{k-1}x}{dt^{k-1}}\right\|_{t=0}$
5. $\int_0^t x(t)\,dt$	$\dfrac{X(s)}{s} + \dfrac{g(0)}{s}$ $g(0) = \left.\int x(t)\,dt\right\|_{t=0}$
6. $x(t) = \begin{cases} 0 & t < D \\ g(t-D) & t \geq D \end{cases}$ $= u_s(t-D)g(t-D)$	$X(s) = e^{-sD}G(s)$
7. $e^{-at}x(t)$	$X(s+a)$
8. $tx(t)$	$-\dfrac{dX(s)}{ds}$
9. $x(\infty) = \lim_{s\to 0} sX(s)$	
10. $x(0+) = \lim_{s\to\infty} sX(s)$	

For Entries 2, 3, 4, and 5, if $x \neq 0$ for $t < 0$, then replace the initial conditions at $t = 0$ with the pre-initial condtions at $0-$.

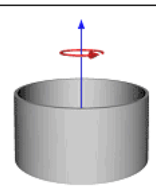
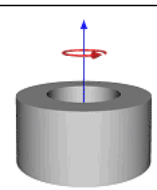
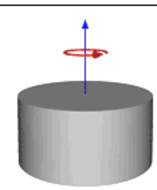
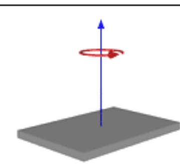
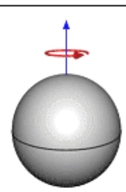
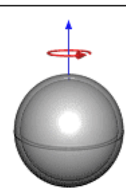
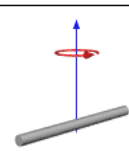
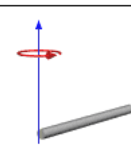
Mass Moments of Inertia Table

Mass Moment of Inertia

Also called Moment of Inertia, Angular Mass



Point mass M
at radius R
$I = M R^2$

			
thin hoop or ring of radius R & mass M:	thick ring of inner radius R1, outer radius R2, and mass M:	solid cylinder or disc of radius R and mass M:	flat plate with sides of length A and B and mass M:
$M r^2$	$M (r_1^2 + r_2^2) / 2$	$M r^2 / 2$	$M (A^2 + B^2) / 12$
			
solid sphere of radius R and mass M:	thin-walled hollow sphere of radius R & mass M:	slender rod of length L and mass M, spinning around center:	slender rod of length L and mass M, spinning around end:
$(2/5) M r^2$	$(2/3) M r^2$	$M L^2 / 12$	$M L^2 / 3$