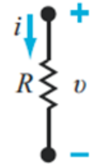
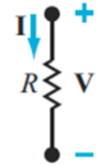
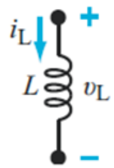
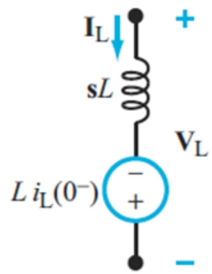
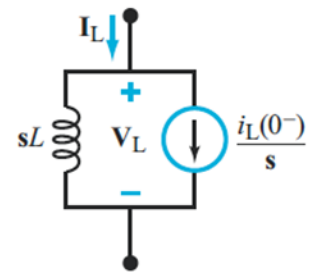
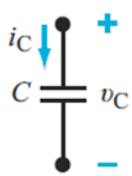
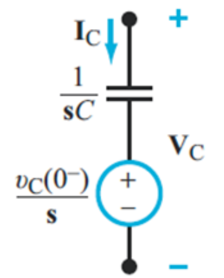
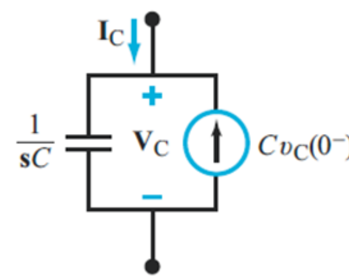
Table 3-2: Examples of Laplace transform pairs. Note that $x(t) = 0$ for $t < 0^-$ and $T \geq 0$.

	Laplace Transform Pairs		
	$x(t)$		$\mathbf{X}(\mathrm{s}) = \mathcal{L}[x(t)]$
1	$\delta(t)$	$\Leftrightarrow$	1
1a	$\delta(t-T)$	$\Leftrightarrow$	$e^{-T\mathrm{s}}$
2	$u(t)$	$\Leftrightarrow$	$\dfrac{1}{\mathrm{s}}$
2a	$u(t-T)$	$\Leftrightarrow$	$\dfrac{e^{-T\mathrm{s}}}{\mathrm{s}}$
3	$e^{-at}\,u(t)$	$\Leftrightarrow$	$\dfrac{1}{\mathrm{s}+a}$
3a	$e^{-a(t-T)}\,u(t-T)$	$\Leftrightarrow$	$\dfrac{e^{-T\mathrm{s}}}{\mathrm{s}+a}$
4	$t\,u(t)$	$\Leftrightarrow$	$\dfrac{1}{\mathrm{s}^2}$
4a	$(t-T)\,u(t-T)$	$\Leftrightarrow$	$\dfrac{e^{-T\mathrm{s}}}{\mathrm{s}^2}$
5	$t^2\,u(t)$	$\Leftrightarrow$	$\dfrac{2}{\mathrm{s}^3}$
6	$te^{-at}\,u(t)$	$\Leftrightarrow$	$\dfrac{1}{(\mathrm{s}+a)^2}$
7	$t^2e^{-at}\,u(t)$	$\Leftrightarrow$	$\dfrac{2}{(\mathrm{s}+a)^3}$
8	$t^{n-1}e^{-at}\,u(t)$	$\Leftrightarrow$	$\dfrac{(n-1)!}{(\mathrm{s}+a)^n}$
9	$\sin(\omega_0 t)\,u(t)$	$\Leftrightarrow$	$\dfrac{\omega_0}{\mathrm{s}^2+\omega_0^2}$
10	$\sin(\omega_0 t+\theta)\,u(t)$	$\Leftrightarrow$	$\dfrac{\mathrm{s}\sin\theta+\omega_0\cos\theta}{\mathrm{s}^2+\omega_0^2}$
11	$\cos(\omega_0 t)\,u(t)$	$\Leftrightarrow$	$\dfrac{\mathrm{s}}{\mathrm{s}^2+\omega_0^2}$
12	$\cos(\omega_0 t+\theta)\,u(t)$	$\Leftrightarrow$	$\dfrac{\mathrm{s}\cos\theta-\omega_0\sin\theta}{\mathrm{s}^2+\omega_0^2}$
13	$e^{-at}\sin(\omega_0 t)\,u(t)$	$\Leftrightarrow$	$\dfrac{\omega_0}{(\mathrm{s}+a)^2+\omega_0^2}$
14	$e^{-at}\cos(\omega_0 t)\,u(t)$	$\Leftrightarrow$	$\dfrac{\mathrm{s}+a}{(\mathrm{s}+a)^2+\omega_0^2}$
15	$2e^{-at}\cos(bt-\theta)\,u(t)$	$\Leftrightarrow$	$\dfrac{e^{j\theta}}{\mathrm{s}+a+jb}+\dfrac{e^{-j\theta}}{\mathrm{s}+a-jb}$
15a	$e^{-at}\cos(bt-\theta)\,u(t)$	$\Leftrightarrow$	$\dfrac{(\mathrm{s}+a)\cos\theta+b\sin\theta}{(\mathrm{s}+a)^2+b^2}$
16	$\dfrac{2t^{n-1}}{(n-1)!}e^{-at}\cos(bt-\theta)\,u(t)$	$\Leftrightarrow$	$\dfrac{e^{j\theta}}{(\mathrm{s}+a+jb)^n}+\dfrac{e^{-j\theta}}{(\mathrm{s}+a-jb)^n}$

Table 3-1: Properties of the Laplace transform for causal functions; i.e., $x(t) = 0$ for $t < 0^-$.

Property	$x(t)$		$\mathbf{X}(\mathrm{s}) = \mathcal{L}[x(t)]$
1. Multiplication by constant	$K\,x(t)$	$\Leftrightarrow$	$K\,\mathbf{X}(\mathrm{s})$
2. Linearity	$K_1\,x_1(t)+K_2\,x_2(t)$	$\Leftrightarrow$	$K_1\,\mathbf{X}_1(\mathrm{s})+K_2\,\mathbf{X}_2(\mathrm{s})$
3. Time scaling	$x(at),\quad a>0$	$\Leftrightarrow$	$\dfrac{1}{a}\mathbf{X}\left(\dfrac{\mathrm{s}}{a}\right)$
4. Time shift	$x(t-T)\,u(t-T),\,T\geq 0$	$\Leftrightarrow$	$e^{-T\mathrm{s}}\,\mathbf{X}(\mathrm{s})$
5. Frequency shift	$e^{-at}\,x(t)$	$\Leftrightarrow$	$\mathbf{X}(\mathrm{s}+\mathrm{a})$
6. Time 1st derivative	$x'=\dfrac{dx}{dt}$	$\Leftrightarrow$	$\mathrm{s}\,\mathbf{X}(\mathrm{s})-x(0^-)$
7. Time 2nd derivative	$x''=\dfrac{d^2x}{dt^2}$	$\Leftrightarrow$	$\mathrm{s}^2\mathbf{X}(\mathrm{s})-\mathrm{s}x(0^-)-x'(0^-)$
8. Time integral	$\displaystyle\int_{0^-}^{t}x(t')\,dt'$	$\Leftrightarrow$	$\dfrac{1}{\mathrm{s}}\mathbf{X}(\mathrm{s})$
9. Frequency derivative	$t\,x(t)$	$\Leftrightarrow$	$-\dfrac{d}{d\mathrm{s}}\mathbf{X}(\mathrm{s})=-\mathbf{X}'(\mathrm{s})$
10. Frequency integral	$\dfrac{x(t)}{t}$	$\Leftrightarrow$	$\displaystyle\int_{\mathrm{s}}^{\infty}\mathbf{X}(\mathrm{s}')\,d\mathrm{s}'$
11. Initial value	$x(0^+)$	$=$	$\lim\limits_{\mathrm{s}\to\infty}\mathrm{s}\,\mathbf{X}(\mathrm{s})$
12. Final value	$\lim\limits_{t\to\infty}x(t)=x(\infty)$	$=$	$\lim\limits_{\mathrm{s}\to 0}\mathrm{s}\,\mathbf{X}(\mathrm{s})$
13. Convolution	$x_1(t)*x_2(t)$	$\Leftrightarrow$	$\mathbf{X}_1(\mathrm{s})\,\mathbf{X}_2(\mathrm{s})$

Table 4-1: Circuit models for R, L, and C in the s-domain.

Time-Domain	s-Domain		
Resistor  $\upsilon = Ri$	 $\mathbf{V} = R\mathbf{I}$		
Inductor  $\upsilon_L = L\,\dfrac{di_L}{dt}$ $i_L = \dfrac{1}{L}\displaystyle\int_{0^-}^{t} \upsilon_L\,dt' + i_L(0^-)$	 $\mathbf{V}_L = \mathbf{s}L\mathbf{I}_L - L\,i_L(0^-)$	OR	 $\mathbf{I}_L = \dfrac{\mathbf{V}_L}{\mathbf{s}L} + \dfrac{i_L(0^-)}{\mathbf{s}}$
Capacitor  $i_C = C\,\dfrac{d\upsilon_C}{dt}$ $\upsilon_C = \dfrac{1}{C}\displaystyle\int_{0^-}^{t} i_C\,dt' + \upsilon_C(0^-)$	 $\mathbf{V}_C = \dfrac{\mathbf{I}_C}{\mathbf{s}C} + \dfrac{\upsilon_C(0^-)}{\mathbf{s}}$	OR	 $\mathbf{I}_C = \mathbf{s}C\mathbf{V}_C - C\,\upsilon_C(0^-)$