5-1

a) $x(t) = (1 - e^{-2t})\, u(t)$

$$X(S) = \frac{1}{S} - \frac{1}{S+2}$$

b) $X(S) = \dfrac{1}{S+2} - \dfrac{1}{S+10}$

c) $X(S) = \dfrac{1}{S} - \dfrac{e^{-10S}}{S}$

d) $X(S) = 1 - e^{-10S}$

5-4

a) $x(t) = e^{-10t}\, u(t)$ has both transforms.

because $\int_{-\infty}^{\infty} |x(t)|\, dt < \infty$.

b) $x(t) = e^{10t}\, u(t)$ has a La Place transform only, because $\int_{-\infty}^{\infty} x(t)\, e^{-j2\pi f t}\, dt \to \infty$.

but $\int_{0}^{\infty} x(t)\, e^{-St}\, dt$ is convergent in a certain region of S.

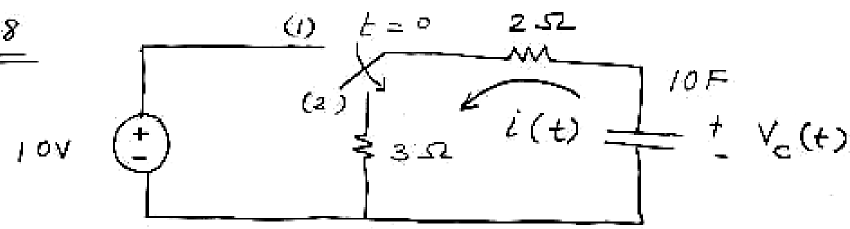
c) $x(t) = e^{-10|t|}$ has both transforms,

because $\int_{-\infty}^{\infty} |x(t)|\, dt < \infty$

d) $x(t) = r(t)$ has a La Place transform only, because $\int_{-\infty}^{\infty} r(t) e^{-j2\pi f t} dt$ diverges.

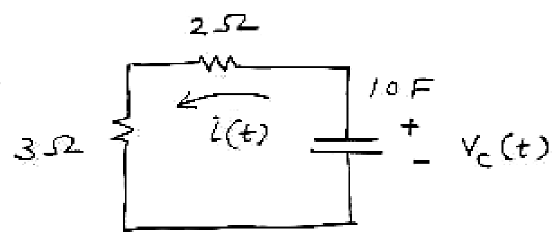
e) $x(t) = t e^{-10t} u(t)$ has both transforms, because $\int_{-\infty}^{\infty} |x(t)| \, dt < \infty$

5-8



For $t < 0 \Rightarrow i(t) = 0$, $V_c(t) = 10\,V$

For $t \geq 0 \Rightarrow$



$$-5i(t) + V_c(t) = 0$$

$$-5i(t) - \frac{1}{10}\int_0^t i(t)\, dt + v_c(0) = 0$$

$V_c(t) = -\frac{1}{C}\int_{t_0}^{t} i(t)\, dt + v_c(t_0)$ is used.

Note the negative sign in this case.

$$\therefore \quad -5\,I(s) - \frac{0.1\,I(s)}{s} - \frac{0.1}{s}\cancel{\int_0^0 i(t)\,dt} + \frac{v_c(0)}{s} = 0$$

$$\therefore \quad -5\,I(S) - \frac{0.1\,I(S)}{s} + \frac{10}{s} = 0$$

$$\therefore \quad I(S) = \frac{+10/s}{\frac{0.1}{s} + 5} = \frac{+10}{5S + 0.1} = \frac{+100}{50S + 1}$$

$$= \frac{+2}{S + 0.02}$$

$$\therefore \quad i(t) = +2\,e^{-0.02t}, \quad t > 0$$

$$\therefore \quad i(t) = \begin{cases} 0, & t < 0 \\ +2\,e^{-0.02t}, & t > 0 \end{cases}$$

Another approach. (convert to a diff. eqn.)

$$+5\left(10\,\frac{dV_c}{dt}\right) + V_c = 0$$

$$+50\left[S\,V_c(S) - V_c(0)\right] + V_c(S) = 0$$

$$+50\left[S\,V_c(S) - 10\right] + V_c(S) = 0$$

$$V_c(s) = \frac{500}{50s+1} = \frac{10}{s+0.02}$$

$$V_c(t) = 10\, e^{-0.02t} \quad , t \geq 0$$

$$i_c(t) = -10 \frac{dV_c}{dt} = 2\, e^{-0.02t} \quad , t > 0.$$

Same answer.

5-10

a) $$X(s) = \frac{s+10}{s^2+8s+20} = \frac{s+10}{s^2+8s+16+4} = \frac{(s+4)+6}{(s+4)^2+2^2}$$

$$= \frac{s+4}{(s+4)^2+2^2} + \frac{6}{2}\,\frac{2}{(s+4)^2+2^2}$$

$$x(t) = e^{-4t}\cos 2t + 3\, e^{-4t}\sin 2t$$

b) $$X(s) = \frac{s+3}{s^2+4s+5} = \frac{(s+2)+1}{(s+2)^2+1} = \frac{s+2}{(s+2)^2+1} + \frac{1}{(s+2)^2+1}$$

$$x(t) = e^{-2t}\cos t + e^{-2t}\sin t$$

c) $X(s) = \dfrac{s}{s^2+6s+18} = \dfrac{s}{(s+3)^2+3^2} = \dfrac{s+3-3}{(s+3)^2+3^2}$

$x(t) = e^{-3t}\cos 3t - e^{-3t}\sin 3t$

d) $X(s) = \dfrac{10}{s^2+10s+34} = \dfrac{10}{(s+5)^2+3^2} = \dfrac{10}{3}\,\dfrac{3}{(s+5)^2+3^2}$

$x(t) = \dfrac{10}{3}\,e^{-5t}\sin 3t$