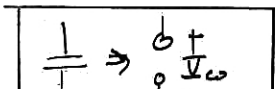
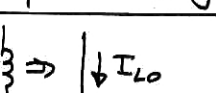
Solving First-Order Circuits | EE223

First, ask: is it a first order circuit? It needs (1C or 1L) and at least 1R, usually more, and something that causes a change - a switch or a $u(t)$ or $u(-t)$ source. Then:

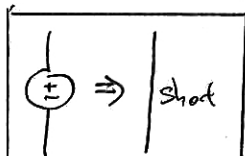
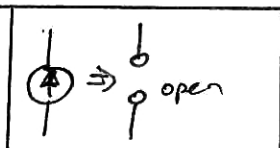
① Draw $t<0$ to find V_{C0} or I_{L0} NO MATTER WHAT YOU ARE ASKED TO FIND!!

In this DC steady state region

		Switches ⇒ opens or shorts	$u(t)$ ⇒ evaluate ex: $2u(t)+3 \Rightarrow 3$

★ ② Draw $t \geq 0$ to find R_{Th} seen by C or L, then find τ

To find R_{Th}

		Switches ⇒ opens or shorts	$u(t)$ ⇒ evaluate ex $2u(t)+3 \Rightarrow 5$

③ Draw $t=\infty$ to find $V_{C\infty}$ or $I_{L\infty}$ NO MATTER WHAT YOU ARE ASKED TO FIND!!

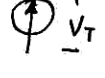
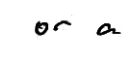
Same substitutions as in ① DC steady state except the example $2u(t)+3$ would evaluate to 5

④ $$v_C(t) = \begin{cases} V_{C0} \\ V_{C\infty} + (V_{C0} - V_{C\infty})\, e^{-t/\tau} \end{cases} \begin{matrix} , t<0 \\ , t \geq 0 \end{matrix} \qquad \tau = RC$$

$$i_L(t) = \begin{cases} I_{L0} \\ I_{L\infty} + (I_{L0} - I_{L\infty})\, e^{-t/\tau} \end{cases} \begin{matrix} , t<0 \\ , t \geq 0 \end{matrix} \qquad \tau = L/R$$

⑤ Find whatever asked to find. Ex: $\begin{cases} i_C(t) = C\, v_C'(t) \\ v_L(t) = L\, i_L'(t) \end{cases}$

also can use Ohm's Law, KVL, KCL

★ If there is an opamp, follow step ② but also replace the C or L with a  or a  and find the resulting V_T or I_T for the test current or voltage source respectively. Then $R_{Th} = \frac{V_T}{1A}$ for the test current or $R_{Th} = \frac{1V}{I_T}$ for the test voltage.

—COL Squire