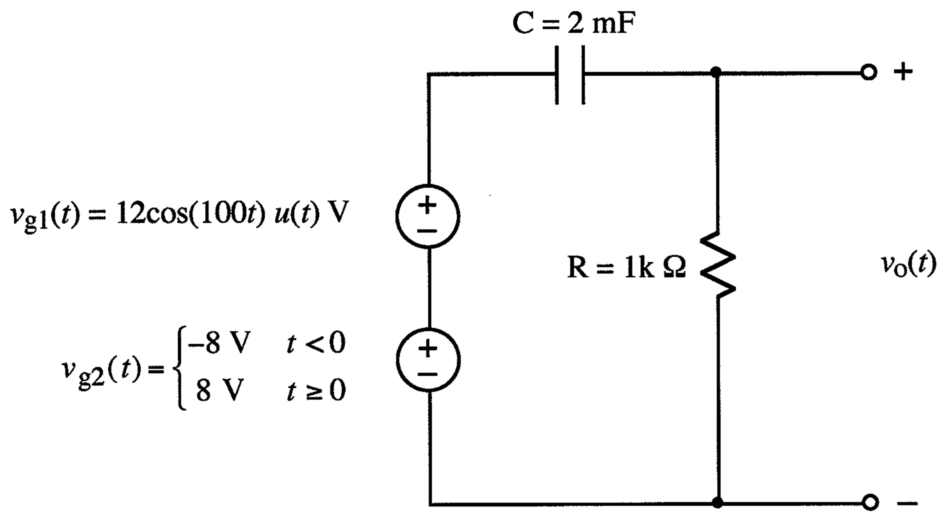
Ex:



a) Write the Laplace transform, $V_{g2}(s)$, of $v_{g2}(t)$.

b) Draw the s-domain equivalent circuit, including sources $V_{g1}(s)$ and $V_{g2}(s)$, components, initial conditions for C, and terminals for $V_o(s)$.

c) Write an expression for $V_o(s)$.

d) Apply the final value theorem to find $\lim_{t\to\infty} v_o(t)$.

sol'n: a) We only consider $v_{g2}(t)$ for $t>0$.

$$V_{g2}(t) = \mathcal{L}\{8\}\,V = \mathcal{L}\{8u(t)\}\,V = \frac{8}{s}\,V$$

b) $$\mathcal{L}\{v_{g1}(t)\} = \mathcal{L}\{12\cos(100t)u(t)\,V\}$$

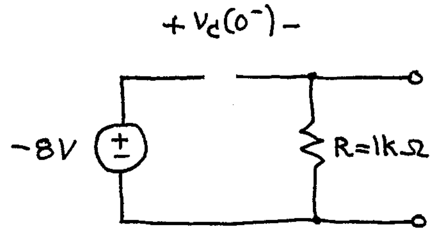
$$= 12\frac{s}{s^2+100^2}\,V$$

Initial conditions on C:

At $t=0^-$, C acts like open circuit.

$$v_{g1}(t<0) = 0\,V$$

$$v_{g2}(t<0) = -8\,V$$

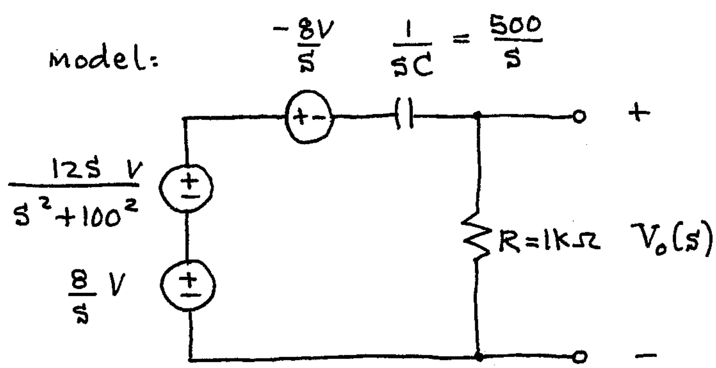


Since no current flows, there is no V-drop across R.

$$\therefore \quad v_c(0^-) = -8\,V$$

Using a series V source for initial conditions on the C is convenient.

Model:



c) We get $V_o(s)$ from a V-divider formula:

$$V_o(s) = \left(\frac{8}{s}V + \frac{12s\ V}{s^2+100^2} - -\frac{8}{s}V\right)\frac{R}{R+\frac{1}{sC}}$$

$$V_o(s) = \left(\frac{16}{s}V + \frac{12s}{s^2+100^2}\right)\frac{s}{s+\frac{1}{RC}}$$

d) We may apply the final value theorem only if the poles of $V_o(s)$, with exception of a pole at the origin (of first order), lie in the left half-plane.

Thus, <u>we may not apply the theorem</u>, since $\frac{12s}{s^2+100^2}$ gives us poles at $s = \pm j100$ r/s.

This makes sense since $v_{g1}(t)$ is a sinusoid that ~~nevers~~ decays. We could solve for $v_o(t \to \infty)$ by considering a phasor solution. We would find that $v_o(t)$ is a sinusoid of frequency 100 r/s that never decays. Thus, there is no unique value for $v_o(t \to \infty)$.