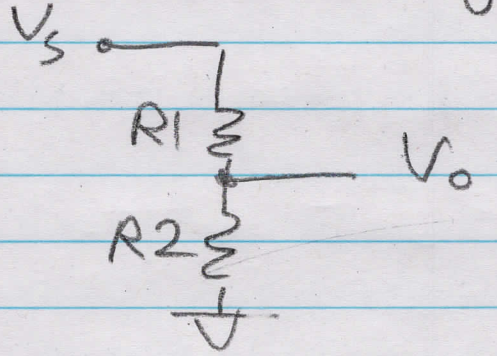
R DIVIDER

- Circuit and eqns



$$K = \frac{V_o}{V_s} = \frac{R_2}{R_1 + R_2}$$

$$R_{TOT} = R_1 + R_2$$

- sub $R_1 = R_{TOT} - R_2$ into K

$$K = \frac{R_2}{R_{TOT} - R_2 + R_2} = \frac{R_2}{R_{TOT}}$$

$$\boxed{R_2 = R_{TOT} \cdot K}$$

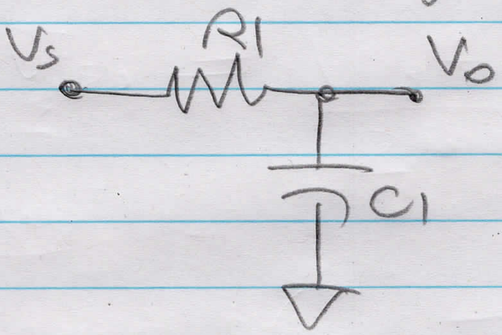
- sub $R_2 = R_{TOT} - R_1$ into eqn above

$$R_2 = R_{TOT} \cdot K$$
$$R_{TOT} - R_1 = R_{TOT} \cdot K$$
$$-R_1 = R_{TOT} \cdot K - R_{TOT}$$

$$\boxed{R_1 = R_{TOT}(1 - K)}$$

LP FILTER

- Circuit and Eqn



$$H(s) = \frac{1}{1 + \frac{s}{\omega_0}}$$

$$\omega_0 = 2\pi f_c$$

- Magnitude of $H(s)$, Sub $s = 2\pi f j$

$$|H(f)| = \left| \frac{1}{1 + \frac{2\pi f j}{2\pi f_c}} \right|$$

$$= \frac{1}{\sqrt{1 + (f/f_c)^2}}$$

- What is magnitude approx at $f >> f_c$?

$$|H(f)| = \frac{1}{\sqrt{(f/f_c)^2}} = \frac{f_c}{f}$$

- Cuttoff freq ($-H(f_c) = -3db$)

$$\tau = R1 \cdot C1$$

$$f_c = \frac{1}{2\pi\tau}$$

$$= \frac{1}{2\pi R1 \cdot C1}$$

LP FILTER

- Step Response V_s is a step input.

$$V_o = V_s\left(1 - e^{-\frac{t}{\tau}}\right)$$

- Ratio of Vo to Vs

$$\frac{V_o}{V_s} = \left(1 - e^{-t/\tau}\right)$$

- % Error to final value vs. t

$$Err = \frac{V_s - V_o}{V_s} = \frac{x\%}{100\%}$$

$$= 1 - \frac{V_o}{V_s} = 1 - \left(1 - e^{-t/\tau}\right)$$

$$= e^{-t/\tau}$$

- Solve for time to % error

$$\ln(Err) = -\frac{t}{\tau} \cdot \ln(e)$$

$$t = -\frac{\ln(Err)}{\ln(e)} \cdot \tau$$