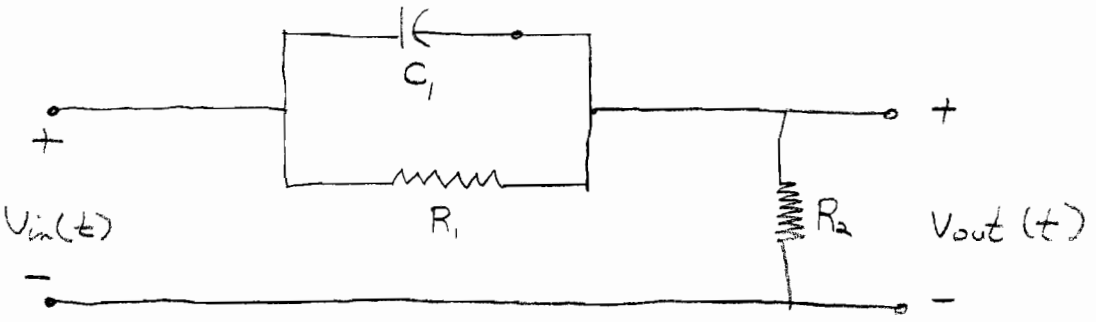
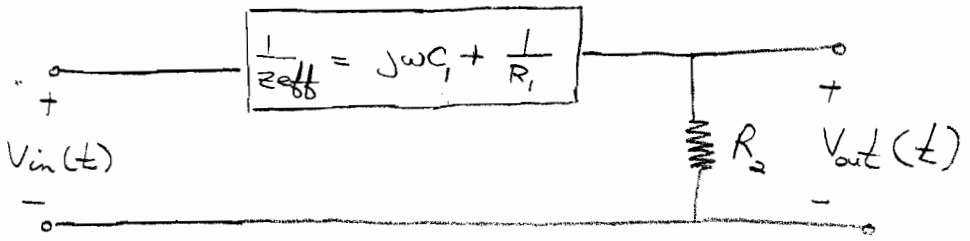
ECE-314, Fall 2008

Pole - Zero Combination:





$$\frac{V_{out}(j\omega)}{V_{in}(j\omega)} = \frac{R_2}{R_2 + \frac{R_1}{1 + j\omega R_1 C_1}} = H(j\omega)$$

$$H(j\omega) = \frac{R_2 + j\omega R_1 R_2 C_1}{R_1 + R_2 + j\omega R_1 R_2 C_1}$$

$$H(j\omega) = \frac{j\omega + \frac{1}{R_1 C_1}}{j\omega + \frac{1}{R_2 C_1} + \frac{1}{R_1 C_1}}$$

$$a = \frac{1}{R_1 C_1} \qquad b > a$$

$$b = \frac{1}{R_2 C_1} + \frac{1}{R_1 C_1}$$

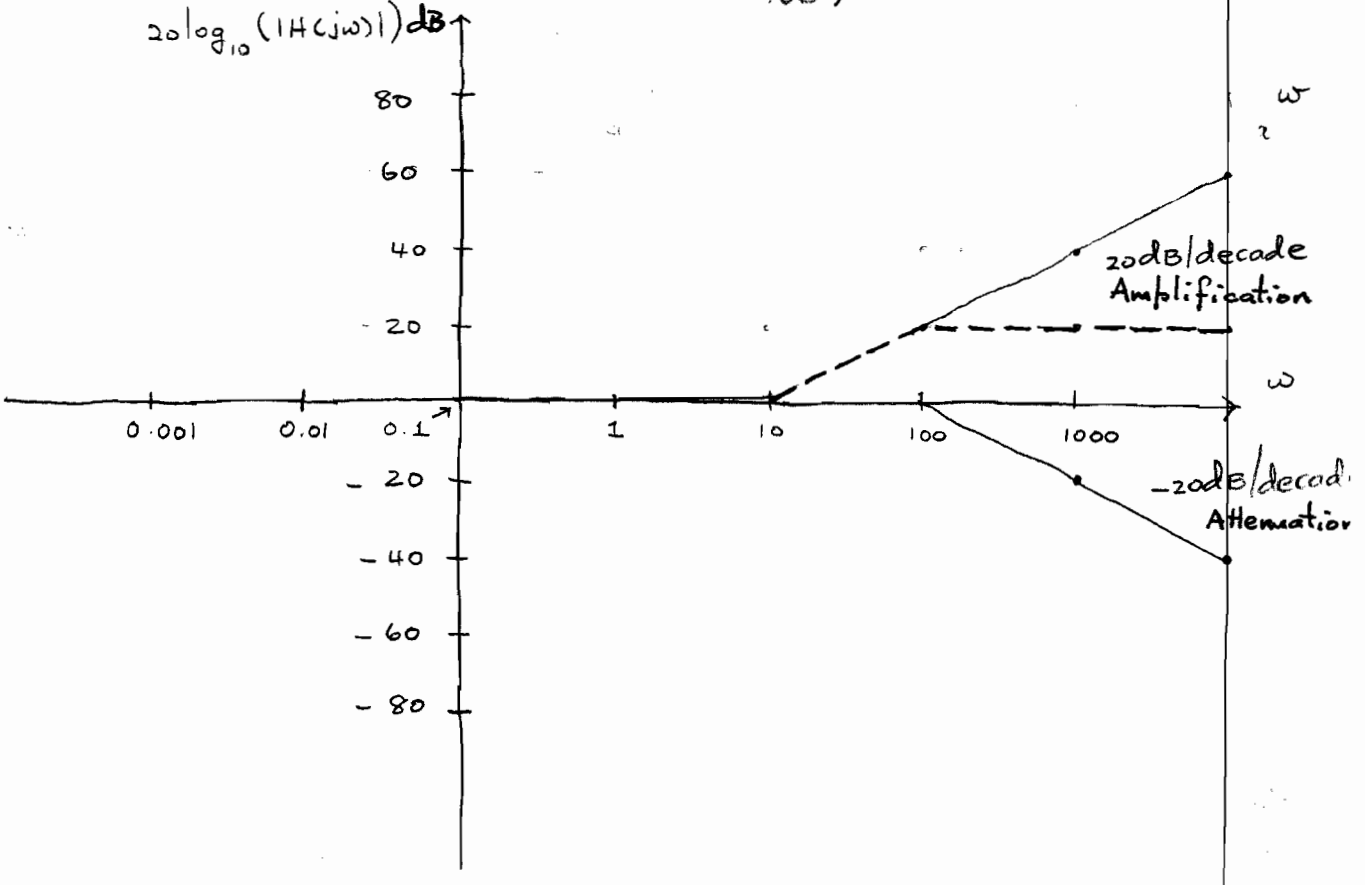
$$H(j\omega) = \frac{j\omega + a}{j\omega + b} = \frac{k\left(1 + \frac{j\omega}{a}\right)}{\left(1 + \frac{j\omega}{b}\right)}$$

$$|H(j\omega)| = k\frac{\sqrt{\omega^2 + a^2}}{\sqrt{\omega^2 + b^2}} \quad ; \quad k = \frac{a}{b} < 1$$

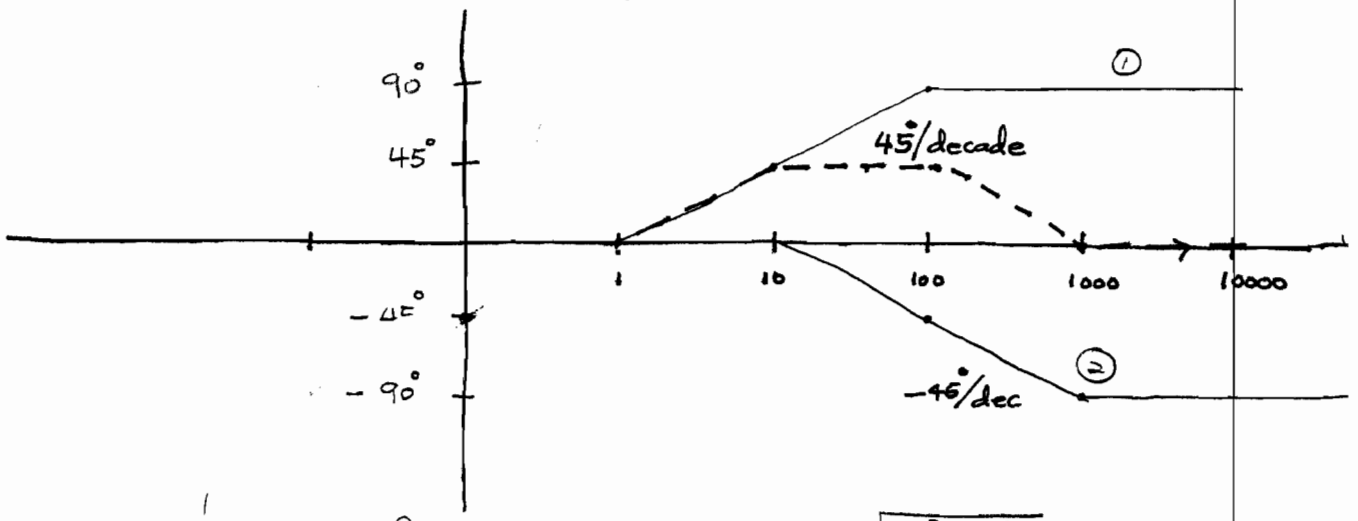
$$20\log_{10}\{|H(j\omega)|\} = 10\log_{10}(\omega^2 + a^2) - 10\log(\omega^2 + b^2) + 20\log_{10}(k)$$

$$\theta(\omega) = \tan^{-1}\left(\frac{\omega}{a}\right) - \tan^{-1}\left(\frac{\omega}{b}\right)$$

$$H(j\omega) = \frac{1 + \left(\frac{j\omega}{10}\right)}{1 + \left(\frac{j\omega}{100}\right)}$$

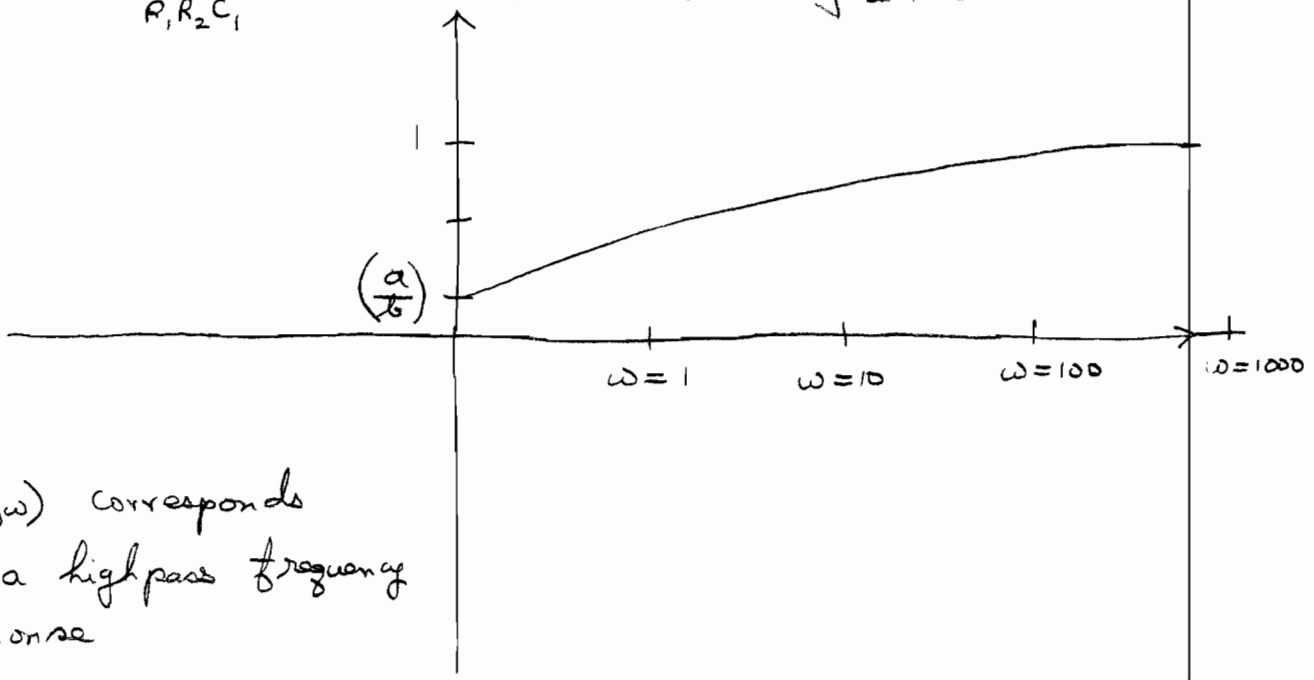


$\Theta(\omega)$ in degrees

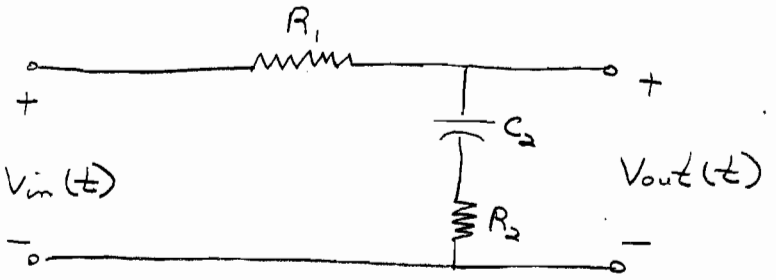


$$\frac{a}{b} = \frac{\frac{1}{R_1 C_1}}{\frac{R_1 + R_2}{R_1 R_2 C_1}} = \frac{R_2}{R_1 + R_2}$$

$$|H(j\omega)| = \frac{\sqrt{\omega^2 + a^2}}{\sqrt{\omega^2 + b^2}}$$



$H(j\omega)$ corresponds to a highpass frequency response

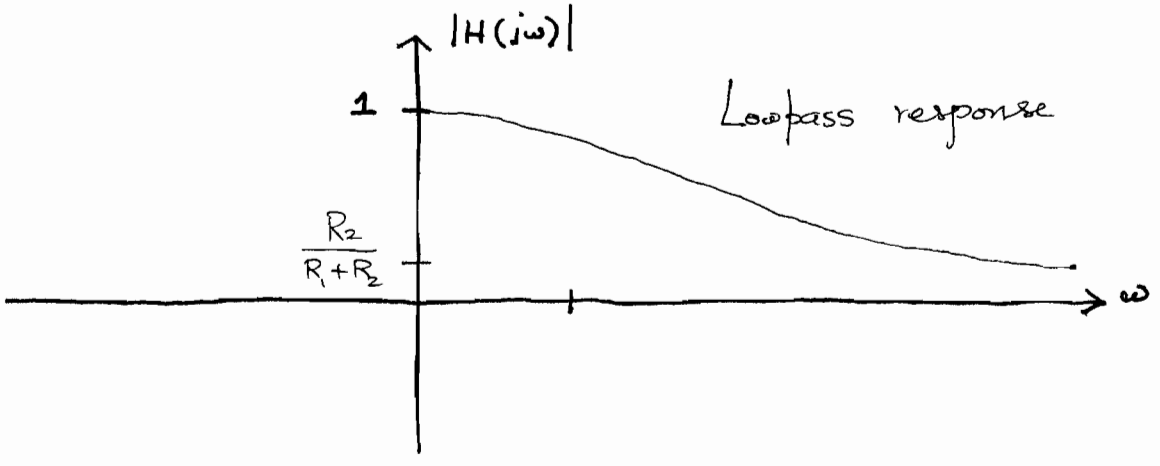


$$\frac{V_{out}(j\omega)}{V_{in}(j\omega)} = H(j\omega) = \frac{\frac{1}{j\omega C_2} + R_2}{R_1 + R_2 + \frac{1}{j\omega C_2}}$$

$$H(j\omega) = \frac{1 + j\omega R_2 C_2}{(R_1 + R_2) j\omega C_2 + 1}$$

$$H(j\omega) = \frac{j\omega + \frac{1}{R_2 C_2}}{\frac{1}{R_2 C_2} + j\omega \left(\frac{R_1 + R_2}{R_2}\right)} \qquad a > b$$

$$H(j\omega) = \left(\frac{R_2}{R_1 + R_2}\right) \frac{j\omega + \frac{1}{R_2 C_2}}{j\omega + \frac{1}{(R_1 + R_2) C_2}} = K \frac{j\omega + a}{j\omega + b}$$



$$H(j\omega) = \frac{1 + \frac{j\omega}{100}}{1 + \frac{j\omega}{10}}$$