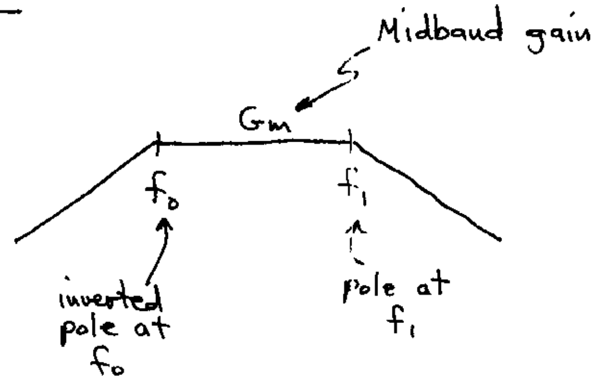
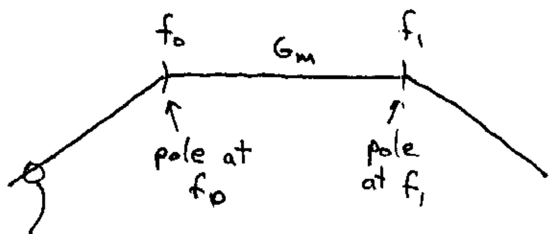
Problem 8.1

a)



$$G(s) = \frac{G_m}{\left(1+\frac{s}{\omega_1}\right)\left(1+\frac{\omega_0}{s}\right)}$$ with $\omega_0 = 2\pi f_0$, $\omega_1 = 2\pi f_1$

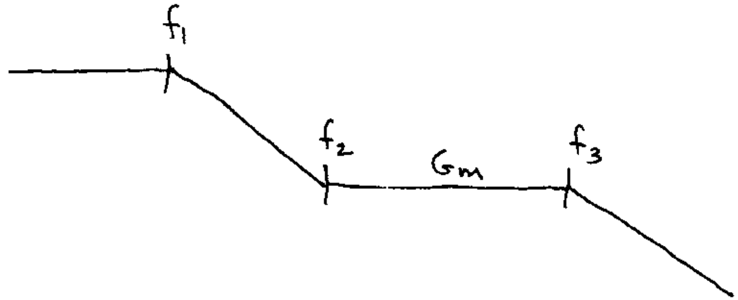
Alternate form, using zero at origin:



equation of low-frequency asymptote: $G_m \frac{s}{\omega_0}$
(asymptote has magnitude G_m at $\omega = \omega_0$)

so $$G(s) = \frac{G_m\left(\frac{s}{\omega_0}\right)}{\left(1+\frac{s}{\omega_0}\right)\left(1+\frac{s}{\omega_1}\right)}$$

b)



The midband gain G_m is specified.

We can express $G(s)$ directly in terms of G_m by using pole and zero forms whose asymptotes over the range $f_2 < f < f_3$ are zero dB.

$\Rightarrow$ for $f \le f_2$, use inverted poles and zeroes

for $f \ge f_3$, use standard (not inverted) poles & zeroes.

$$G(s) = G_m \frac{\left(1 + \frac{\omega_2}{s}\right)}{\left(1 + \frac{\omega_1}{s}\right)\left(1 + \frac{s}{\omega_3}\right)}$$

Alternate form: in terms of dc gain G_0

$$G(s) = G_0 \frac{\left(1 + \frac{s}{\omega_2}\right)}{\left(1 + \frac{s}{\omega_1}\right)\left(1 + \frac{s}{\omega_3}\right)}$$

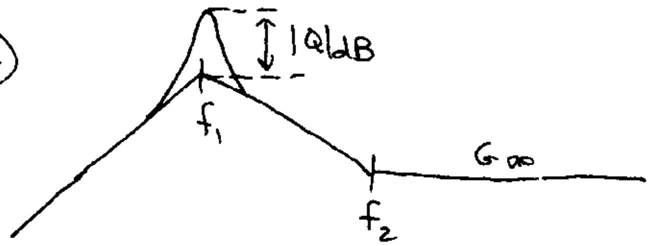
But what is G_0?

write expression for midband asymptote $f_2 < f < f_3$ and equate to G_m:

$$G_0 \frac{\left(\cancel{1} + \frac{s}{\omega_2}\right)}{\left(\cancel{1} + \frac{s}{\omega_1}\right)\left(1 + \cancel{\frac{s}{\omega_3}}\right)} = G_m = G_0 \frac{\left(\frac{s}{\omega_2}\right)}{\left(\frac{s}{\omega_1}\right)(1)} = G_0 \frac{\omega_1}{\omega_2}$$

$$\Rightarrow G_0 = G_m \frac{\omega_2}{\omega_1}$$

c)



$$G(s) = G_\infty \frac{\left(1+\frac{\omega_2}{s}\right)}{\left(1+\frac{\omega_1}{Q s} + \left(\frac{\omega_1}{s}\right)^2\right)}$$

Alternate form:

$$G(s) = \frac{G_\infty \frac{\omega_2}{\omega_1}\left(\frac{s}{\omega_1}\right)\left(1+\frac{s}{\omega_2}\right)}{\left(1+\frac{s}{Q\omega_1} + \left(\frac{s}{\omega_1}\right)^2\right)}$$