1. $G_1(V_{in} - V) + sC_2(V_o - V) = (G_4 + sC_3)V$

$(G_1 + sC_2 + G_4 + sC_3)V = G_1 V_{in} + sC_2 V_o$

$V = \frac{G_1 V_{in} + sC_2 V_o}{(\quad)}$

$G_5 V_o = -sC_3 V$

$(\quad) G_5 V_o = -sC_3 G_1 V_{in} - s^2 C_2 C_3 V_o$

$V_o = -sC_3 G_1 V_{in} / [s^2 C_2 C_3 + G_5(G_1 + G_4 + s(C_2 + C_3)]$

$= \frac{-sG_1 C_3 V_{in}}{s^2 C_2 C_3 + sG_5(C_2 + C_3) + (G_1 + G_4)G_5}$

a. $\omega_p^2 = \frac{G_1 + G_4}{C_2 C_3} G_5$

$\omega_p / Q_p = G_5(1/C_2 + 1/C_3)$

$Q_p = \frac{\sqrt{G_5(G_1 + G_4)}\sqrt{C_2 C_3}}{\sqrt{C_2 C_3}\sqrt{G_5}(C_2 + C_3)}$

$y = 1/Q_p = \sqrt{\frac{G_5}{G_1 + G_4}}\left[\sqrt{\frac{C_2}{C_3}} + \sqrt{\frac{C_3}{C_2}}\right] = K(x + 1/x)$

K $\quad x \quad 1/x$

b. $\frac{\partial y}{\partial x} = 1 - 1/x^2 \rightarrow x_{opt} = \pm 1$, $C_2 = C_3$

c. $Q_{p\,max} = \frac{1}{2}\sqrt{\frac{G_1 + G_4}{G_5}}$

2. $(V_{in} - V_b)sC_1 - G_{m1}V_{out} = 0$

$$sC_1V_b = sC_1V_{in} - G_{m1}V_{out}$$

$$V_b = V_{in} - \frac{G_{m1}}{sC_1}V_{out}$$

$$V_{out} = \frac{1}{sC_2}\left[G_{m2}V_b - G_{m3}V_{out}\right]$$

$$\left[1 + \frac{G_{m3}}{sC_2}\right]V_{out} = \frac{G_{m2}}{sC_2}\left[V_{in} - \frac{G_{m1}}{sC_1}V_{out}\right]$$

$$\left[\frac{G_{m1}G_{m2}}{s^2C_1C_2} + \frac{G_{m3}}{sC_2} + 1\right]V_{out} = \frac{G_{m2}}{sC_2}V_{in}$$

a. $$H(s) = \frac{(G_{m2}/C_2)s}{s^2 + (G_{m3}/C_2)s + (G_{m1}G_{m2}/C_1C_2)}$$

b. $$Q_p^2 = \frac{C_2}{C_1}\frac{G_{m1}G_{m2}}{G_{m3}^2} \qquad \omega_p^2$$

c. Midband gain $|H(j\omega_p)| = G_{m2}/G_{m3}$

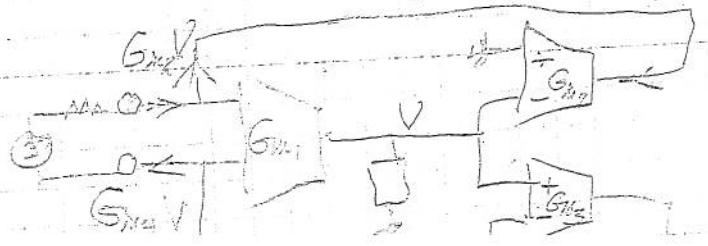
3. $V = G_{m1}V_{in}Z_L$

$$I = G_{m2}V = G_{m2}G_{m1}V_{in}Z_L$$

a. $$Z_{in} = \frac{V_{in}}{I} = \frac{1}{G_{m1}G_{m2}Z_L}$$

b. Floating inductor.

c. Ideally, impossible



Gaussian surface forces $G_{m2}V = G_{m3}V$. So, circuit stops working.