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$20\log(100) = 40$

(a) $w_{p2} = 2\text{MHz}$

$20\cdot\log\frac{2M}{1M} = 20\cdot 0.301$

$= 6.02$

$40 - 6.02 = 33.98$

$33.98 - 40\log\frac{xM}{2M} = 0$

$x = 14.1426$

14.143 MHz #

(b) $w_{p2} = 3\text{ MHz}$

$20\cdot\log\frac{3M}{1M} = 9.5424$

$40 - 9.5424 = 30.4576$

$30.4576 - 40\log\frac{xM}{3M} = 0$

$x = 17.3205$

Unity-gain freq. $= 17.3205\text{ MHz}$

Phase reaches -180° at $10\cdot w_{p2} = 30\text{MHz}$

$-\arctan\left(\frac{17.3205M}{1M}\right) - \arctan\left(\frac{17.3205M}{3M}\right) = -166.8692^\circ$

$-166.8692^\circ + 180^\circ = 13.1308$

$\doteq 13.131^\circ$ #

8.2

(a) $r_{o2} = \frac{1}{0.1\cdot 0.25m} = 40k$ $r_{o3} = \frac{1}{0.2\cdot 0.25m} = 20k$

$R_x = (r_{o1} + r_{o2}) \parallel r_{o3}$

$= 16k$

$\frac{1}{w_{px}} = R_x C_x = 13.3333n$

$w_{px} = 62.5\text{ M rad/s}$ #

$g_{m4} = \sqrt{2\cdot 0.13428m\cdot 100\cdot 0.5m} = 3.6644m$

$R_Y = \frac{1}{g_{m4}} \parallel r_{o4} = 269.221\,\Omega$

$\frac{1}{w_{pY}} = R_Y C_Y = 269.221p$

$w_{pY} = 3.7144\text{ G rad/s}$ #

$$g_{m2} = \sqrt{2 \cdot 0.13928m \cdot 100 \cdot 0.25m} = 2.59114\,m$$

(b) $$\text{DC gain} = \frac{g_{m2}}{2}\left(2r_{o2} \| r_{o3}\right)\frac{r_{o4}}{\frac{1}{g_{m4}} + r_{o4}}$$

$$= 20.449$$

$$= 26.2113\ dB$$

$$26.2113\ dB - 20\log\left(\frac{x}{62.5\,M}\right) = 0$$

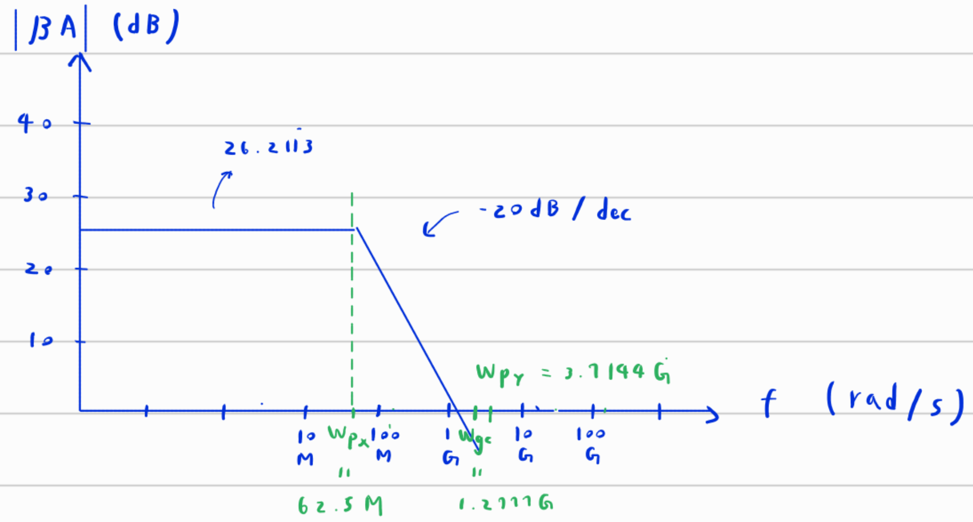
$$x = 1.2777\,G\ rad/s$$

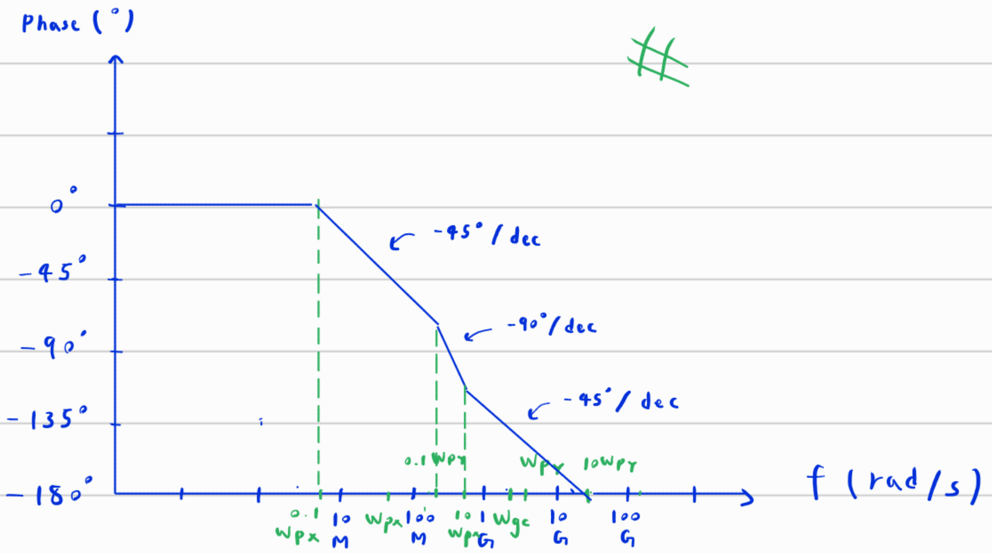
$$-\arctan\left(\frac{1.2777\,G}{62.5\,M}\right) - \arctan\left(\frac{1.2777\,G}{3.7144\,G}\right) = -106.182^\circ$$

$$-106.182 + 180 = 73.818^\circ$$

\#

(c)





\#

(d) $x + 180° = 60°$

$x = -120°$

$$-\arctan\left(\frac{1.2777G}{62.5M}\right) - \arctan\left(\frac{1.2777G}{w_{pr}'}\right) = -120°$$

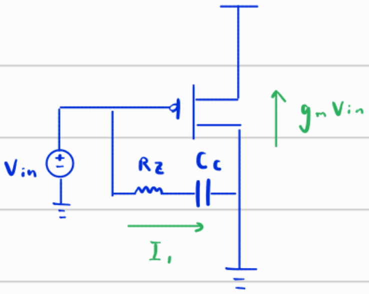
$w_{pr}' = 1.98257$ rad/s

$$\frac{1}{w_{pr}'} = 504.3963p$$

$237.9590p \div R_r = 1.874pF$ #

8.3

(a) To determine the zero, ground Vout



$$I_1 = \frac{V_{in}}{R_z + \frac{1}{sC_c}} = g_m V_{in}$$

$$\frac{1}{R_z + \frac{1}{sC_c}} = g_{m_q}$$

$$1 = g_{m_q} R_z + g_{m_q} \frac{1}{sC_c}$$

$$sC_c = g_{m_q} R_z sC_c + g_{m_q}$$

$$s(C_c - g_{m_q} R_z C_c) = g_{m_q}$$

$$s\, C_c(1 - g_{m_q} R_z) = g_{m_q}$$

$$s = \frac{g_{m_q}}{C_c(1 - g_{m_q} R_z)}$$

$$w_z = \frac{1}{C_c\left(\frac{1}{g_{m_q}} - R_z\right)}$$ #

(b) This leads to a positive zero in the right half plane. The zero contributes negative phase shift, moving w_{pc} closer to the origin. The zero also slows down the drop of the magnitude, moving w_{gc} further away from the origin. Both changes are undesirable because we want $w_{gc} < w_{pc}$ #

to keep the circuit stable.

(c) If $\dfrac{1}{C_c\left(\frac{1}{g_{m9}} - R_z\right)} = \dfrac{-g_{m9}}{C_L}$, then the pole and zero cancel out

$$-g_{m9} C_c \left(\frac{1}{g_{m9}} - R_z \right) = C_L$$

$$C_c(-1 + g_{m9} R_z) = C_L$$

$$-C_c + C_c g_{m9} R_z = C_L$$

$$R_z = \frac{C_L + C_c}{g_{m9} C_c} \quad \#$$