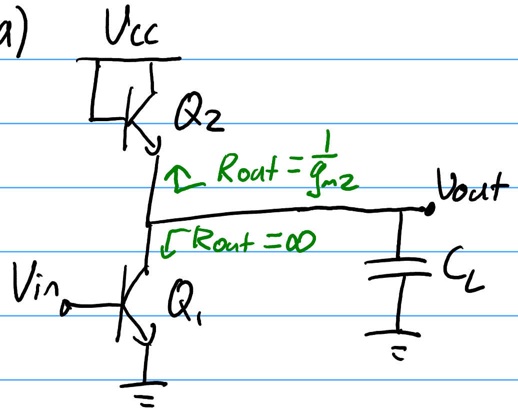
11.3 (a)

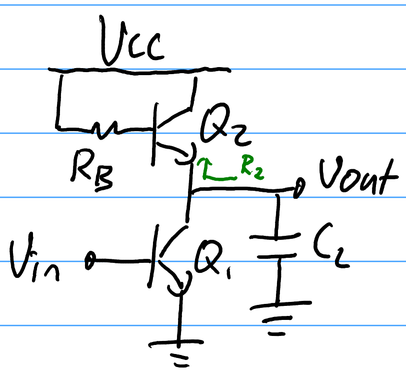


Looking into Q_2 emitter, $R_{out} = \frac{1}{g_{m2}}$

Looking into Q_1 collector, $R_{out} = \infty$ because $V_A = \infty$.

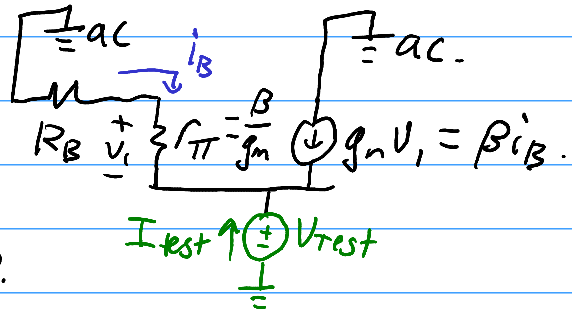
$\therefore$ Only one pole, the $-3\,dB$ point is $f = \frac{1}{\frac{1}{g_{m2}} C_L} = \frac{g_{m2}}{C_L}$

(b)



Need to find the impedance seen looking into Q_2's emitter.

Consider small signal model.



By KCL, $i_B + I_{Test} + \beta i_B = 0$

$\therefore (1+\beta) i_B + I_{Test} = 0.$

By Ohm's law, $i_B = \frac{0 - V_{Test}}{R_B + r_\pi}$

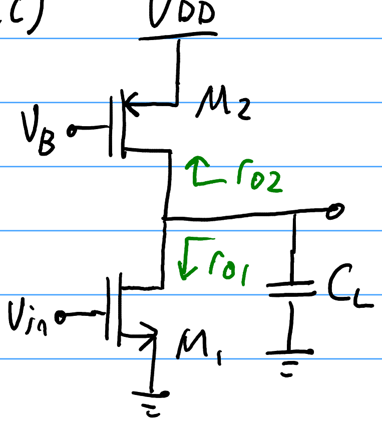
$\therefore (1+\beta)\left(\frac{-V_{Test}}{R_B + r_\pi}\right) + I_{Test} = 0.$

$(1+\beta) V_{Test} = (R_B + r_\pi) I_{Test} = \left(R_B + \frac{\beta}{g_m}\right) I_{Test}$

$\frac{V_{Test}}{I_{Test}} = \frac{R_B + \frac{\beta}{g_m}}{1+\beta} \approx \frac{R_B + \frac{\beta}{g_m}}{\beta} = \frac{1}{g_m} + \frac{R_B}{\beta}.$

$\therefore -3dB$ point is $\frac{1}{2\pi C_L \left(\frac{1}{g_m} + \frac{R_B}{\beta}\right)}$

(c)



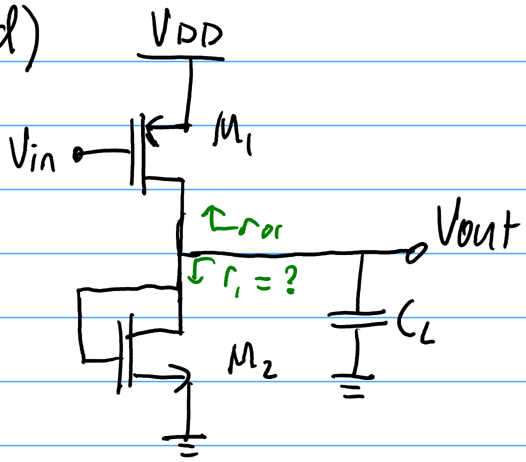
Notice M_2 is PMOS

∴ we are looking into the drain of both devices.

∴ Resistances are the r_o of each transistor.

∴ −3 dB point is $\frac{1}{2\pi (r_{o1} \| r_{o2}) C_L}$.

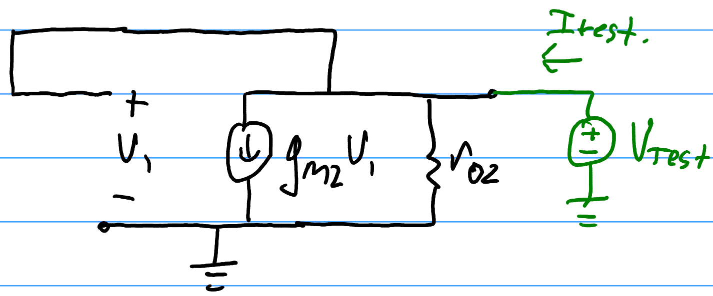
(d)



- See r_{o1} looking into M_1
- Looking into M_2, notice that $V_{out} = V_{GS}$

∴ Current is controlled.

Need to check small signal model.



$V_1 = V_{Test}$

By KCL: $I_{Test} = g_m V_{Test} + \frac{V_{Test}}{r_{o1}} = \left(g_m + \frac{1}{r_{o1}}\right) V_{Test}$

$\frac{V_{Test}}{I_{Test}} = \frac{1}{g_m + \frac{1}{r_{o1}}} = \frac{1}{g_m} \| r_{o1}$.

∴ −3dB point is $\frac{1}{2\pi C_L \left(\frac{1}{g_{m2}} \| r_{o1} \| r_{o2}\right)}$