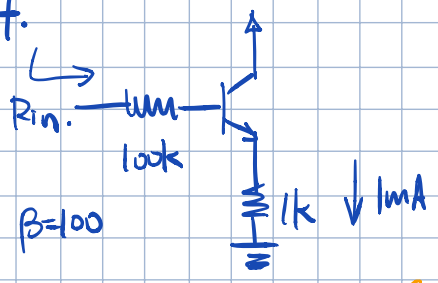
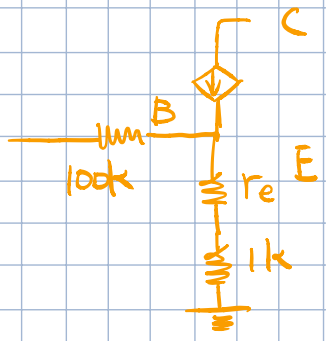
Q7.



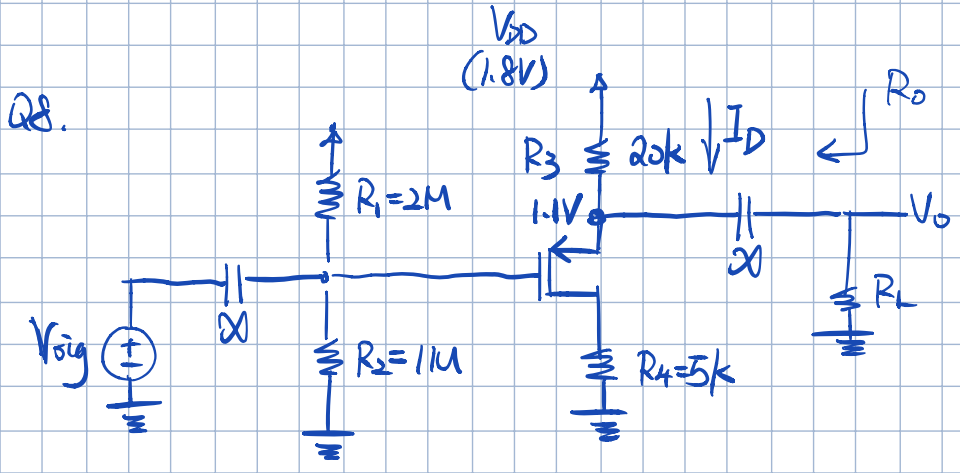
find Rin.



$$r_e = \frac{V_T}{1mA} = 25\,\Omega$$

$$R_{in} = 100k + (\beta+1)(r_e+1k) = 202.5\,k\Omega$$

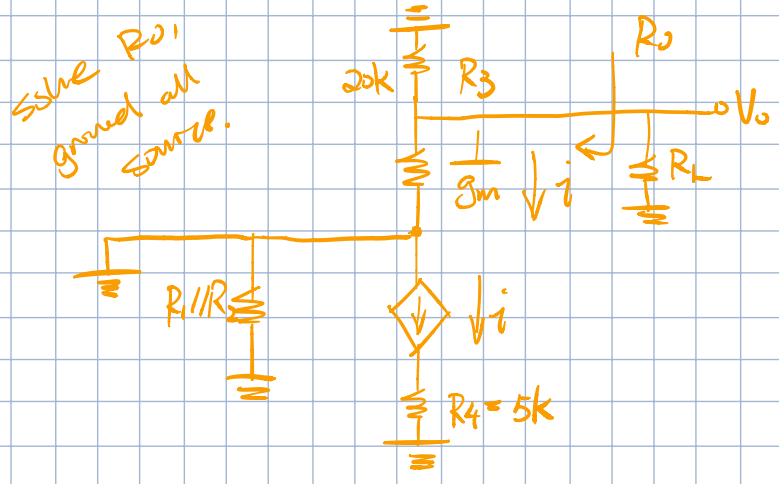
Q8.



find R_o

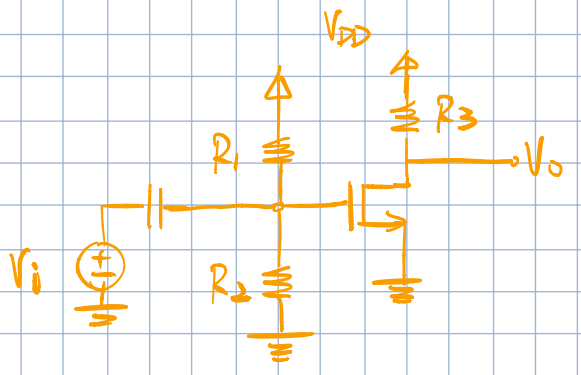
$$I_D = \frac{V_{DD} - 1.1V}{R_3} = 35\mu A$$

$$\frac{1}{g_m} = \frac{1}{\sqrt{2k_p' I_D}} = 8.45k$$



$$R_o = R_3 // \frac{1}{g_m} = 5.94\,k$$

Q9 Design an inv. amplifier w/ gain of $-10\ V/V$, using only Cap. + 3 resistors R_1, R_2, R_3 ($R_1+R_2 = 1M\Omega$ for gate biasing.) current consumption of $1mA$ ($\lambda = 0$)



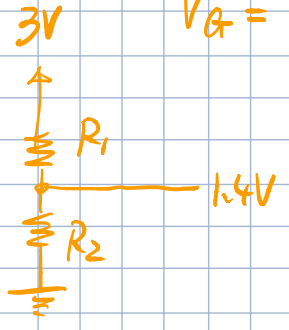
$$g_m = \sqrt{2k_n I_D} = 2mA/V$$

$$\text{gain} = -g_m R_3 = -10\ V/V$$

$$\Rightarrow R_3 = 500\Omega$$

$$V_{OV} = V_G - V_t = \frac{2I_D}{g_m} = 1V$$

$$V_G = 1.4V$$

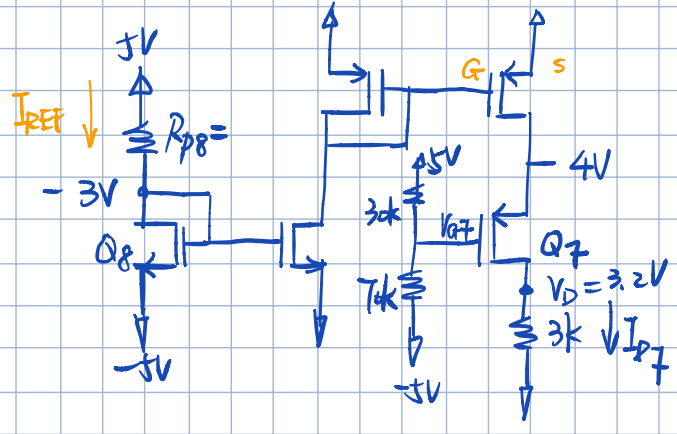


$$\frac{R_2}{R_1+R_2}\,1.8 = 1.4V$$

$$R_1 = 533k\Omega$$

$$R_2 = 467k\Omega$$

Q11

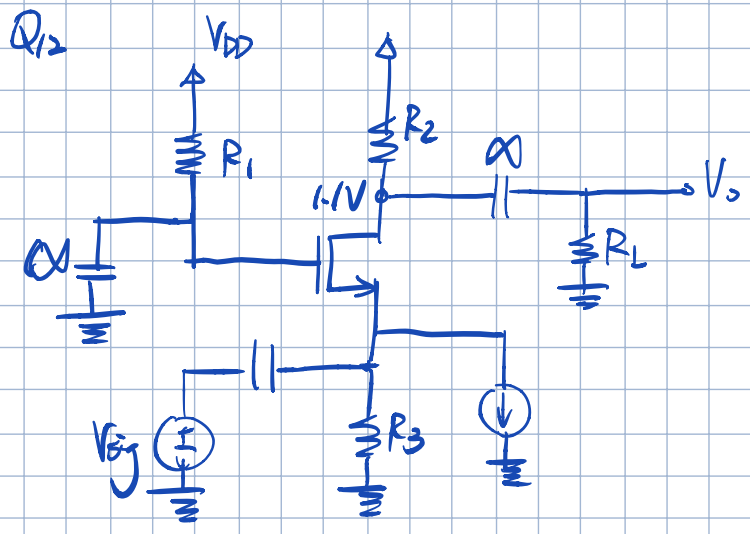


$$V_{G7} = -5 + \left(\frac{I_D}{g_{D7}+g_{D8}}\right)(5+5) = 2V$$

$$I_{D7} = \frac{V_D+5}{3k} = 2.73mA$$

$$I_{REF} = \frac{I_{D7}}{3} = 0.91\ mA$$

$$R_{P8} = (5-(-3))/I_{REF} = 8.78k\Omega$$



Relative Rin high ~~low~~

" Rout ~~high~~ low

gain inv. non-inv.