Nolan Anderson

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
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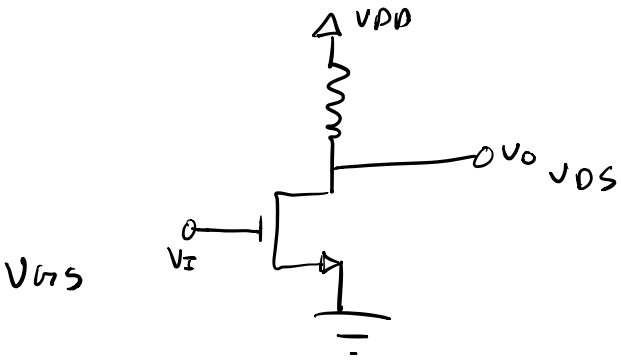
1.) $k'_n = .4 \quad \frac{W}{L} = 3 = 1.2$

$V_t = 1V$



A: $V_t = V_I = 1V$

$V_o = V_{DD} = 4V$

B: $V_o = V_I - V_t$

$$V_I = V_{GS} = V_t + \frac{\sqrt{1 + 2(R_D k'_n \frac{W}{L} V_{DD}} - 1}{R_D k'_n \frac{W}{L}}$$

$$= 1 + \frac{\sqrt{1 + 2(3.3)(1.2)(4)} - 1}{(3.3)(1.2)}$$

$V_I = 2.19V$

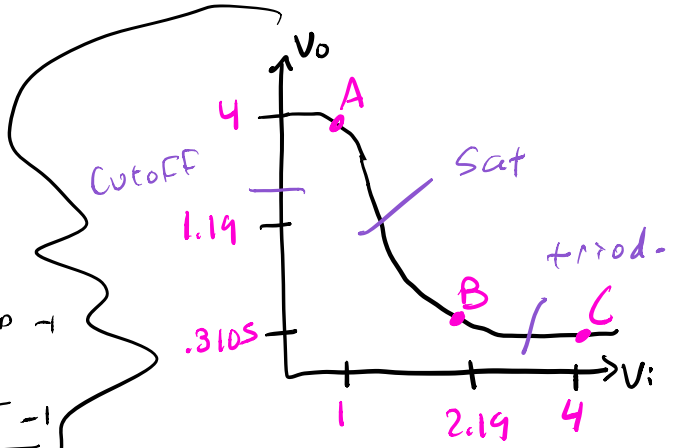
$V_o = V_{DS} = V_I - V_t$

$V_o = 1.19V$

C: $V_{GS} = V_I = V_{DD} = 4V$

$$V_o = \frac{4}{1 + 3.3 \cdot 1.2 (4 - 1)} \qquad (.3105, 4)$$

$V_o = .3105\ V$



V_o, V_I

A: (4, 1)

B: (1.19, 2.19)

C: (.3105, 4)

B.) $I_{DQ} = 0.384mA$ $V_{ZQ} = ?$ $V_{OQ} = ?$

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$V_{OQ} = V_{DD} - I_{DQ}(R_D)$

$V_{OQ} = 4 - (.384)(3.3)$

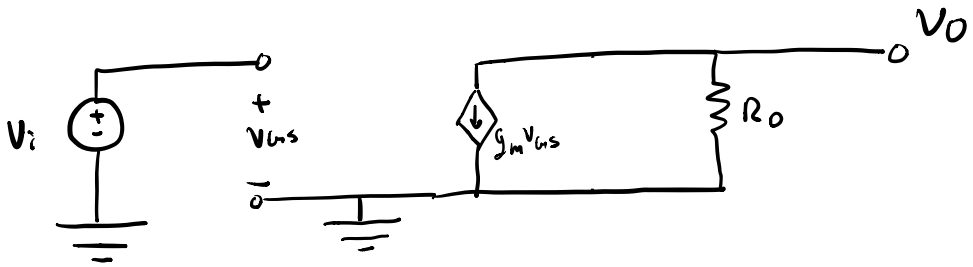
$\boxed{V_{OQ} = 2.733\,V}$

$.384 = \frac{1}{2}(1.2)(x-1)^2$

$\sqrt{\frac{.384}{.6}} + 1 = \boxed{V_{ZQ} = 1.8V}$

C.) $A_{VO} = -(1.2)(1.8-1)(3.3)$ $g_m = (-1.2)(1.8-1)$

$\boxed{A_{VO} = -3.168V}$ $\boxed{g_m = -.96\,mA/V}$



2) $\frac{W}{L} k'_n = 7.5$ $V_t = 0.6$

$R_D = 2.8k\Omega$

$R_L = 3.7k\Omega$

$R_{sig} = 340\Omega$

$g_m = (7.5)(2.7-0.6)$

$g_m = 15.75mA/V$

$R_{in} = \frac{1}{15.75E-3}$

$R_{in} = 63.49V$

$G_v = \frac{(1594\Omega)}{340 + 63.49} = 3.95\,V/V$

$R_O = R_D = 2.8k\Omega$

$R_D \| R_L$

3.) $R_{sig} = 300\Omega$ @ gate

$R_D = 0.3k\Omega$ $\quad R_L = 6k\Omega$

$k'_n \cdot \frac{W}{L} = 1.5$ $\quad V_t = 1.1V$

$g_m =$

Where is V_{GSQ}???

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a)

b) $g_m = (1.5)(V_{GSQ} - 1.1) = ?$ Assuming $V_{GSQ} = 1.5$, not shown.

$g_m = (1.5)(.4)$ $\quad g_m = 0.6$

c) $G_V = \dfrac{R_D \| R_L}{R_{sig} + 1/g_m} = .3116 = \dfrac{.286}{300 + 1/g_m} \approx .0009s$

d) V_{GSQ}??? not shown, but it asks for g_m which uses V_{GSQ}?

Assuming $V_{GSQ} = 1.5V$

4.) $k'_n \frac{W}{L} = 5\ mA/V^2$

$I_D = 4.1\ mA$

$V_t = 2.2V$

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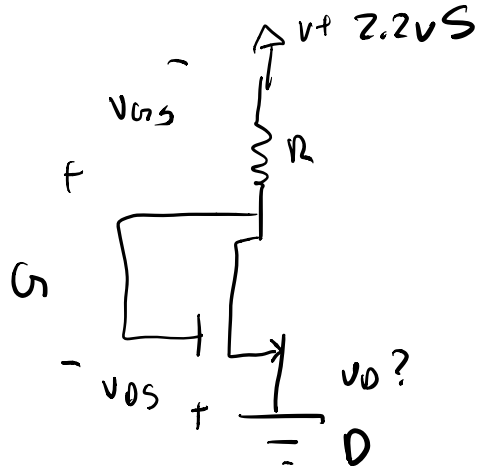

$V_{GS} = 0.7V$

$4 = \frac{1}{2}(5)(V_{GS} - .7)^2$

$\sqrt{4/2.5} + .7 = V_{GS}$

$V_{GS} = 2.3V$

$V_G =$

$V_G =$

$R = \frac{V_D}{I_D} \quad \frac{2.2}{4mA}$

$R = 0.55\ k\Omega$

$V_D = V_G = 0.1V$

$V_D = V_S - V_{GS} \qquad V_D = 2.3 - 2.2$

5.) $i_B = 0.0009mA$

$i_E = 1.1mA$

$V_B = 0.7V$

$I_B = .0009$

$I_E = 1.1$

$1.1 = I_C + .009$

$I_C = 1.099$

$\alpha = \frac{I_C}{I_E} = \frac{1.091}{1.1} = .992$

$\beta = \frac{I_C}{I_B} = \frac{1.09}{.009}$

$\beta = 121.1$

$I_S = ?$

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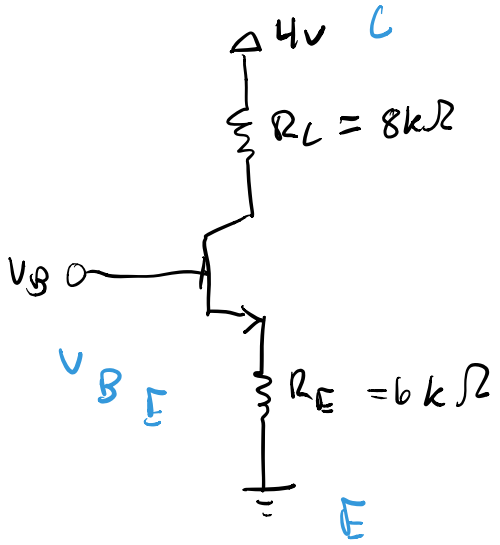
6.) $\beta = 80$

$V_{BE} = 0.7$

$V_+ = 4v \quad R_C = 8k\Omega \quad R_E = 6k\Omega$



$V_E = 1.8 - .7 = 1.1v$

$V_E = 1.1v$

$i_E = \frac{1.1}{6k\Omega} = .183mA$

$\alpha = \frac{80}{81} = 0.988$

$i_C = \alpha i_E = (.988)(.183) = .181mA$

$i_B = i_E - i_C = .183 - .181 = .002mA$

$= 2.263\mu A$

$V_C = I_C R_C = .181 \times 8 = 1.45v$