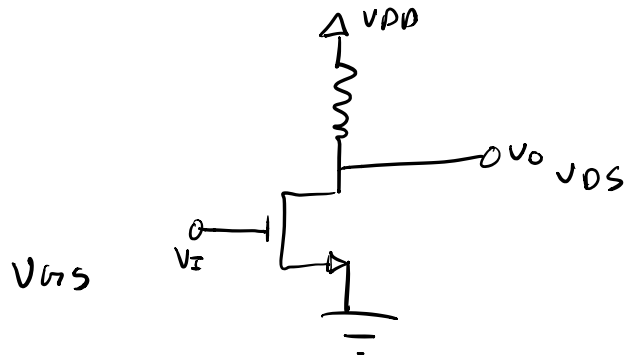


Nolan Anderson

1.) $k'n = .4$ $\frac{w}{L} = 3 = 1.2$

$V_t = 1V$



A: $V_t = V_I = 1V$
 $V_0 = V_{DD} = 4V$

B: $V_0 = V_I - V_t$
 $V_I = V_{gs} = V_t + \frac{\sqrt{1 + 2CR_0k'n\frac{w}{L}V_{DD}} - 1}{R_0k'n\frac{w}{L}}$
 $= 1 + \frac{\sqrt{1 + 2(3.3)(1.2)(4)} - 1}{(3.3)(1.2)}$

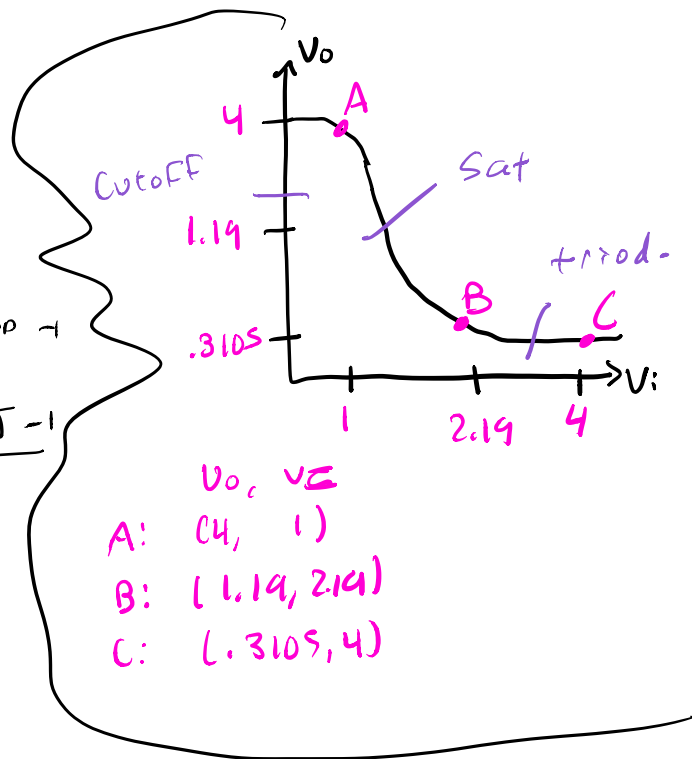
$V_I = 2.19V$

$V_0 = V_{DS} = V_I - V_t$
 $V_0 = 1.19V$

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

$V_0 = \frac{4}{1 + 3.3 \cdot 1.2 (4 - 1)} \quad (0.3105, 4)$
 $V_0 = 0.3105V$

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
Yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}	Septillion
Zetta	Z	1,000,000,000,000,000,000,000,000	10^{21}	Sextillion
Exa	E	1,000,000,000,000,000,000,000,000	10^{18}	Quintillion
Peta	P	1,000,000,000,000,000,000,000,000	10^{15}	Quadrillion
Tera	T	1,000,000,000,000,000,000,000,000	10^{12}	Trillion
Giga	G	1,000,000,000,000,000,000,000,000	10^9	Billion
Mega	M	1,000,000,000,000,000,000,000,000	10^6	Million
kilo	k	1,000	10^3	Thousand
hecto	h	100	10^2	Hundred
deca	da	10	10^1	Ten
base	b	1	10^0	One
deci	d	1/10	10^{-1}	Tenth
centi	c	1/100	10^{-2}	Hundredth
milli	m	1/1,000	10^{-3}	Thousandth
micro	μ	1/1,000,000	10^{-6}	Millionth
nano	n	1/1,000,000,000	10^{-9}	Billionth
pico	p	1/1,000,000,000,000	10^{-12}	Trillionth
femto	f	1/1,000,000,000,000,000	10^{-15}	Quadrillionth
atto	a	1/1,000,000,000,000,000,000	10^{-18}	Quintillionth
zepto	z	1/1,000,000,000,000,000,000,000	10^{-21}	Sextillionth
yocto	y	1/1,000,000,000,000,000,000,000,000	10^{-24}	Septillionth



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

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

$$V_{OQ} = 4 - (0.384)(3.3)$$

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

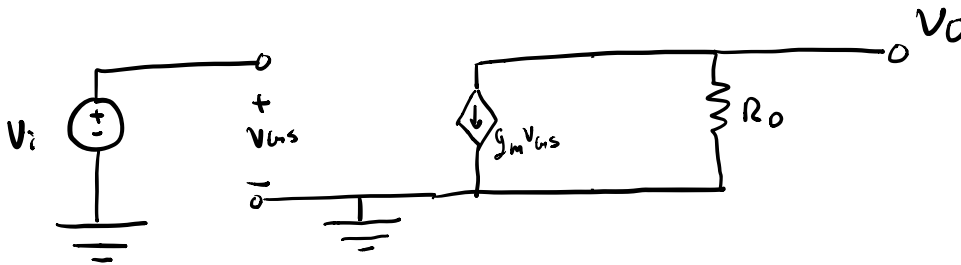
$$0.384 = \frac{1}{2} (1.2) (x - 1)^2$$

$$\sqrt{\frac{0.384}{0.6}} + 1 = \boxed{V_{ZQ} = 1.8 \text{ V}}$$

C.) $A_{VO} = -(0.2)(1.8 - 1)(3.3)$ $g_m = (-1.2)(1.8 - 1)$

$$\boxed{A_{VO} = -3.168 \text{ V}}$$

$$\boxed{g_m = -1.96 \text{ mA/V}}$$



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

$$R_O = 2.8 \text{ k}\Omega$$

$$R_L = 3.7 \text{ k}\Omega$$

$$R_{sig} = 340 \Omega$$

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

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

$$g_m = 15.75 \text{ mA/V}$$

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

$$R_{in} = 63.49 \text{ V}$$

$$R_D = R_O = 2.8 \text{ k}\Omega$$

$$R_O \parallel R_{in}$$

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
Yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}	Septillion
Zetta	Z	1,000,000,000,000,000,000,000,000	10^{21}	Sextillion
Exa	E	1,000,000,000,000,000,000,000,000	10^{18}	Quintillion
Peta	P	1,000,000,000,000,000,000,000,000	10^{15}	Quadrillion
Tera	T	1,000,000,000,000,000,000,000,000	10^{12}	Trillion
Giga	G	1,000,000,000,000,000,000,000,000	10^9	Billion
Mega	M	1,000,000,000,000,000,000,000,000	10^6	Million
kilo	k	1,000,000,000,000,000,000,000,000	10^3	Thousand
hecto	h	100,000,000,000,000,000,000,000	10^2	Hundred
deca	da	10,000,000,000,000,000,000,000	10^1	Ten
base	b	1,000,000,000,000,000,000,000,000	10^0	One
deci	d	0.1,000,000,000,000,000,000,000	10^{-1}	Tenth
centi	c	0.01,000,000,000,000,000,000,000	10^{-2}	Hundredth
milli	m	0.001,000,000,000,000,000,000,000	10^{-3}	Thousandth
micro	μ	0.000,000,000,000,000,000,000,000	10^{-6}	Millionth
nano	n	0.000,000,000,000,000,000,000,000	10^{-9}	Billionth
pico	p	0.000,000,000,000,000,000,000,000	10^{-12}	Trillionth
femto	f	0.000,000,000,000,000,000,000,000	10^{-15}	Quadrillionth
atto	a	0.000,000,000,000,000,000,000,000	10^{-18}	Quintillionth
zepto	z	0.000,000,000,000,000,000,000,000	10^{-21}	Sextillionth
yocto	y	0.000,000,000,000,000,000,000,000	10^{-24}	Septillionth

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

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

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

$$g_m =$$

Where is V_{GSQ} ???

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
Yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}	Septillion
Zetta	Z	1,000,000,000,000,000,000,000,000	10^{21}	Sextillion
Exa	E	1,000,000,000,000,000,000,000,000	10^{18}	Quintillion
Peta	P	1,000,000,000,000,000,000,000,000	10^{15}	Quadrillion
Tera	T	1,000,000,000,000,000,000,000,000	10^{12}	Trillion
Giga	G	1,000,000,000,000,000,000,000,000	10^9	Billion
Mega	M	1,000,000,000,000,000,000,000,000	10^6	Million
kilo	k	1,000	10^3	Thousand
hecto	h	100	10^2	Hundred
deca	da	10	10^1	Ten
base	b	1	10^0	One
deci	d	1/10	10^{-1}	Tenth
centi	c	1/100	10^{-2}	Hundredth
milli	m	1/1,000	10^{-3}	Thousandth
micro	μ	1/1,000,000	10^{-6}	Millionth
nano	n	1/1,000,000,000	10^{-9}	Billionth
pico	p	1/1,000,000,000,000	10^{-12}	Trillionth
femto	f	1/1,000,000,000,000,000	10^{-15}	Quadrillionth
atto	a	1/1,000,000,000,000,000,000	10^{-18}	Quintillionth
zepto	z	1/1,000,000,000,000,000,000,000	10^{-21}	Sextillionth
yocto	y	1/1,000,000,000,000,000,000,000,000	10^{-24}	Septillionth

a)



b) $g_m = (1.5)(V_{GSQ} - 1.1) = ?$

Assuming $V_{GSQ} = 1.5$, not shown.

$$g_m = (1.5)(1.4) \quad g_m = 0.6$$

$$c) A_v = \frac{R_o \parallel R_L}{R_{sig} + 1/g_m} = \frac{.3116}{300 + 1/g_m} = \frac{.286}{300 + 1/g_m} \approx .00095$$

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

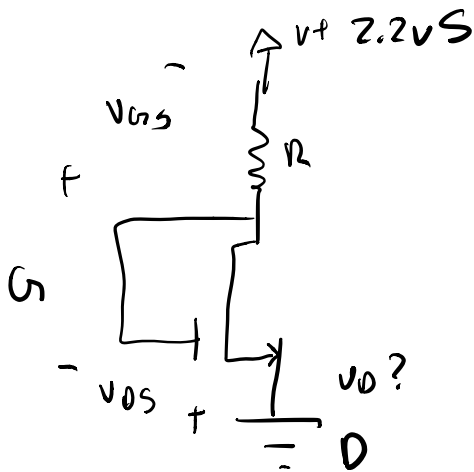
Assuming

$$V_{GSQ} = 1.5V$$

$$4.) \quad k' n \frac{w}{L} = 5 \text{ mA/V}^2$$

$$I_D = 41 \text{ mA}$$

$$V_T = 2.2 \text{ V}$$



$$V_{GS} = 0.7 \text{ V}$$

$$4 = \frac{1}{2} (5) (V_{GS} - 0.7)^2$$

$$\sqrt{4/2.5} + 0.7 = V_{GS}$$

$$V_{GS} = 2.3 \text{ V}$$

$$V_{GS} =$$

$$V_{GS} =$$

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

$$R = 0.55 \text{ k}\Omega$$

$$V_D = V_{GS} = 0.1 \text{ V}$$

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

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
Yotta	Y	1,000,000,000,000,000,000,000,000	10 ²⁴	Septillion
Zetta	Z	1,000,000,000,000,000,000,000,000	10 ²¹	Sextillion
Exa	E	1,000,000,000,000,000,000,000,000	10 ¹⁸	Quintillion
Peta	P	1,000,000,000,000,000,000,000,000	10 ¹⁵	Quadrillion
Tera	T	1,000,000,000,000,000,000,000,000	10 ¹²	Trillion
Giga	G	1,000,000,000,000,000,000,000,000	10 ⁹	Billion
Mega	M	1,000,000,000,000,000,000,000,000	10 ⁶	Million
kilo	k	1,000,000,000,000,000,000,000,000	10 ³	Thousand
hecto	h	100,000,000,000,000,000,000,000	10 ²	Hundred
deca	da	10,000,000,000,000,000,000,000	10 ¹	Ten
base	b	1,000,000,000,000,000,000,000,000	10 ⁰	One
deci	d	1/10,000,000,000,000,000,000,000	10 ⁻¹	Tenth
centi	c	1/100,000,000,000,000,000,000,000	10 ⁻²	Hundredth
milli	m	1/1,000,000,000,000,000,000,000,000	10 ⁻³	Thousandth
micro	μ	1/1,000,000,000,000,000,000,000,000	10 ⁻⁶	Millionth
nano	n	1/1,000,000,000,000,000,000,000,000	10 ⁻⁹	Billionth
pico	p	1/1,000,000,000,000,000,000,000,000	10 ⁻¹²	Trillionth
femto	f	1/1,000,000,000,000,000,000,000,000	10 ⁻¹⁵	Quadrillionth
atto	a	1/1,000,000,000,000,000,000,000,000	10 ⁻¹⁸	Quintillionth
zepto	z	1/1,000,000,000,000,000,000,000,000	10 ⁻²¹	Sextillionth
yocto	y	1/1,000,000,000,000,000,000,000,000	10 ⁻²⁴	Septillionth

$$5.) i_B = 0.0009 \text{ mA}$$

$$i_E = 1.1 \text{ mA}$$

$$V_B = 0.7 \text{ V}$$

$$I_B = .0009$$

$$I_E = 1.1$$

$$1.1 = I_C + .009$$

$$I_C = 1.099$$

$$\alpha = \frac{I_C}{I_E} = \frac{1.099}{1.1} = .999$$

$$\beta = \frac{I_C}{I_B} = \frac{1.099}{.009}$$

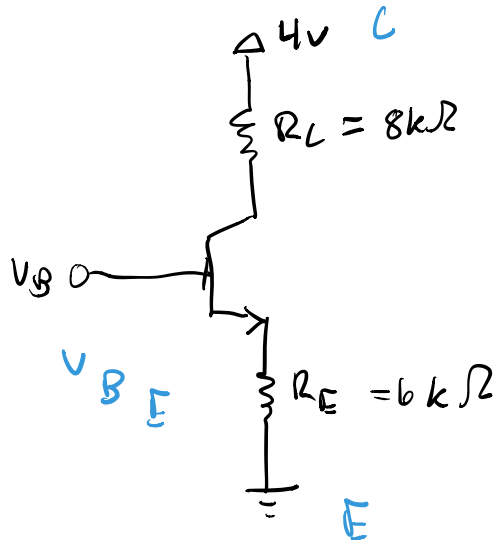
$$\beta = 122.1$$

$$I_S = ?$$

6.) $\beta = 80$

$V_{BE} = 0.7$

$V_t = 4V$ $R_C = 8k\Omega$ $R_E = 6k\Omega$



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

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

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

$$i_B = i_E - i_C = .183 - .181 = .002mA = 2.263\mu A$$

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

Metric Prefix	Symbol	Multiplier (Traditional Notation)	Exponential	Description
Yotta	Y	1,000,000,000,000,000,000,000,000	10^{24}	Septillion
Zetta	Z	1,000,000,000,000,000,000,000,000	10^{21}	Sextillion
Exa	E	1,000,000,000,000,000,000,000,000	10^{18}	Quintillion
Peta	P	1,000,000,000,000,000,000,000,000	10^{15}	Quadrillion
Tera	T	1,000,000,000,000,000,000,000,000	10^{12}	Trillion
Giga	G	1,000,000,000,000,000,000,000,000	10^9	Billion
Mega	M	1,000,000,000,000,000,000,000,000	10^6	Million
kilo	k	1,000	10^3	Thousand
hecto	h	100	10^2	Hundred
deca	da	10	10^1	Ten
base	b	1	10^0	One
deci	d	1/10	10^{-1}	Tenth
centi	c	1/100	10^{-2}	Hundredth
milli	m	1/1,000	10^{-3}	Thousandth
micro	μ	1/1,000,000	10^{-6}	Millionth
nano	n	1/1,000,000,000	10^{-9}	Billionth
pico	p	1/1,000,000,000,000	10^{-12}	Trillionth
femto	f	1/1,000,000,000,000,000	10^{-15}	Quadrillionth
atto	a	1/1,000,000,000,000,000,000	10^{-18}	Quintillionth
zepto	z	1/1,000,000,000,000,000,000,000	10^{-21}	Sextillionth
ycto	y	1/1,000,000,000,000,000,000,000,000	10^{-24}	Septillionth