

$$1) \quad k'_n = 400 \text{ nA/V}^2 \quad V_{t_n} = 0.5 \text{ V} \quad \lambda = 0 \quad \frac{W}{L} = 10$$

$$V_{DS} = 4 \text{ V} \quad V_{GS} = 4.4 \text{ V}$$

$$4.4 > 0.5 \rightarrow \text{saturation}$$

Saturation Region

$$V_{DS} > V_{GS} - V_{t_n} \rightarrow \text{edge of saturation}$$

$$V_{DS} \geq V_{GS} - V_{t_n} \quad V_{DS} = V_{GS} - V_{t_n}$$

$$i_D = \frac{1}{2} k'_n \frac{W}{L} (V_{GS} - V_{t_n})^2$$

$$I_D = \frac{1}{2} (400) (10) (3.9)^2 = 30.42$$

$$30420 \text{ nA}$$

$$= 30420 \text{ E-6}$$

$$= 0.3042$$

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

$$2) \quad k'_p = 50 \text{ nA/V}^2 \quad V_{t_p} = -1.5 \text{ V} \quad \lambda = 0 \quad \frac{W}{L} = 10$$

$$V_{SD} = 1.5 \text{ V} \quad V_{SG} = 3.1 \text{ V}$$

$$i_D = k'_p \frac{W}{L} (V_{SG} - |V_{t_p}|) V_{SD}$$

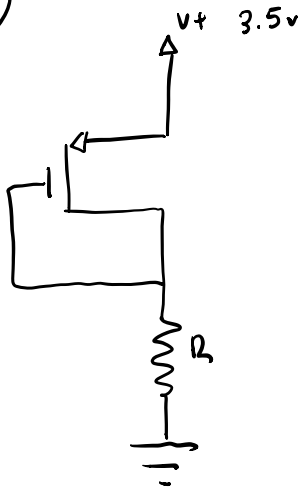
$$I_D = (50) (10) (3.1 - 1.5) (1.5)$$

$$V_{SG} > |V_{t_p}|$$

\hookrightarrow Triode

$$I_D = 1200 \text{ E-6} \quad 1.2 \text{ mA}$$

③



$$V_{t1} = -1.1 \text{ V}$$

$$k'_p = 500 \mu\text{A/V}^2$$

$$\frac{W}{L} = 10$$

$$I_D =$$

$$V_D = 1.9 \text{ V} = V_{GS} \quad V_{SD} = 3.5 - 1.9$$

$$V_t = 3.5$$

$$V_{SG} = 1.6 \text{ V}$$

$$V_{SG} > |V_t|$$

$$1.6 > 1.1$$

$$I_D = k'_p \frac{W}{L} (V_{SG} - |V_{tP}|) V_{SD}$$

$$I_D =$$

$$r_d = \frac{1}{k'_p \frac{W}{L} (V_{SG} - |V_{tP}|)}$$

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$$I_D = (500)(10)(0.5)(1.9)$$

$$I_D = 4.75 \text{ mA}$$

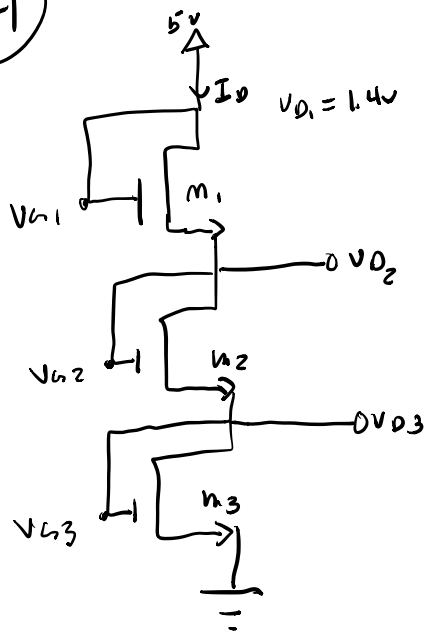
$$r_d = \frac{1}{k'_p \frac{W}{L} (V_{SG} - |V_{tP}|)}$$

$$R_D = \frac{1}{(500)(10)(0.5)}$$

$$10,000 \Omega$$

$$10 \text{ k}\Omega$$

4



$$V_{GS2} =$$

$$V_t = 1V$$

$$\mu_n C_{ox} = 80 \mu A/V^2$$

$$\lambda = 0$$

$$L = 1 \mu m$$

$$I_{D1} = \frac{1}{2} \mu_n C_{ox} \left(\frac{W_1}{L_1} \right) (V_{GS1} - V_t)^2$$

$$.15 = \frac{1}{2} (80) \left(\frac{W_1}{1} \right) (1.4 - 1)^2$$

$$.30 = 12.8 W_1$$

$$W_2$$

$$.15 = \frac{1}{2} (80) (W_2) (1.75 - 1)^2$$

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