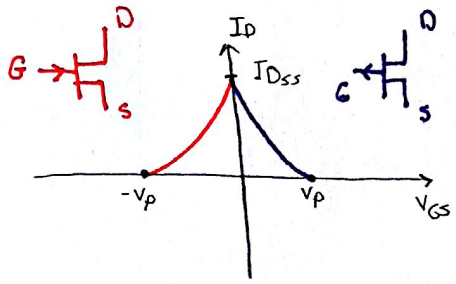
FET Transistorlar

① JFET



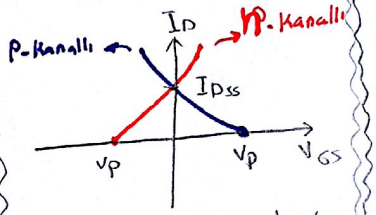
Transfer karakteristigi

"n-Kanalli, p-Kanalli"

- Burada dikkatedilmesi gereken sey "JFET"lerde (I_D, I_{DSS} ile sinirli, V_{GS}, V_P ile sinirli).

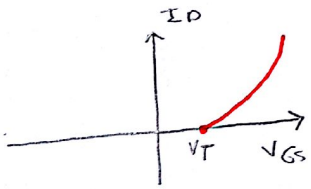
② MOSFET

ⓐ Kanal ayarlamali MOSFET



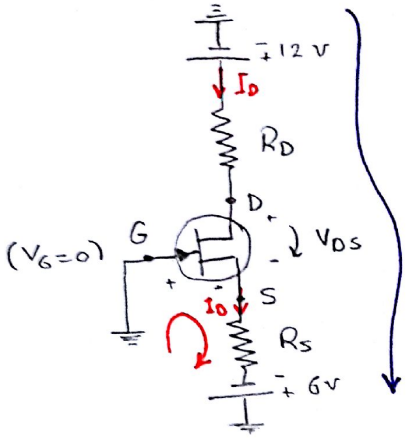
- JFET'lerden tek farki, I_{DSS}'nin asabilmesi

ⓑ Kanal olusturmali MOSFET



- Burada transistoru calistirmak için V_{GS} en azinda V_T'ye "esik gerilim" esit olmali.

(7)



$R_D = 1.5\ K\Omega$

$R_S = 1\ K\Omega$

$V_p = -4$

$I_{DSS} = 8\ mA$

$V_{GS} + I_D R_S - 6 = 0 \Rightarrow$ **$V_{GS} = 6 - 1\ K\Omega * I_D\ mA$** Doğru Denklem

$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_P}\right)^2$

$\Rightarrow$ **$I_D = 8\ mA\left(1 - \frac{V_{GS}}{-4}\right)^2$** eğri denklem

((JFET ve kanal ayarlamalı MosFET transistorlerde ikalip denklemdir))

Doğru Denklemden

V_{GS} (V)	I_D (mA)
6	0
0	6

eğri denklemden

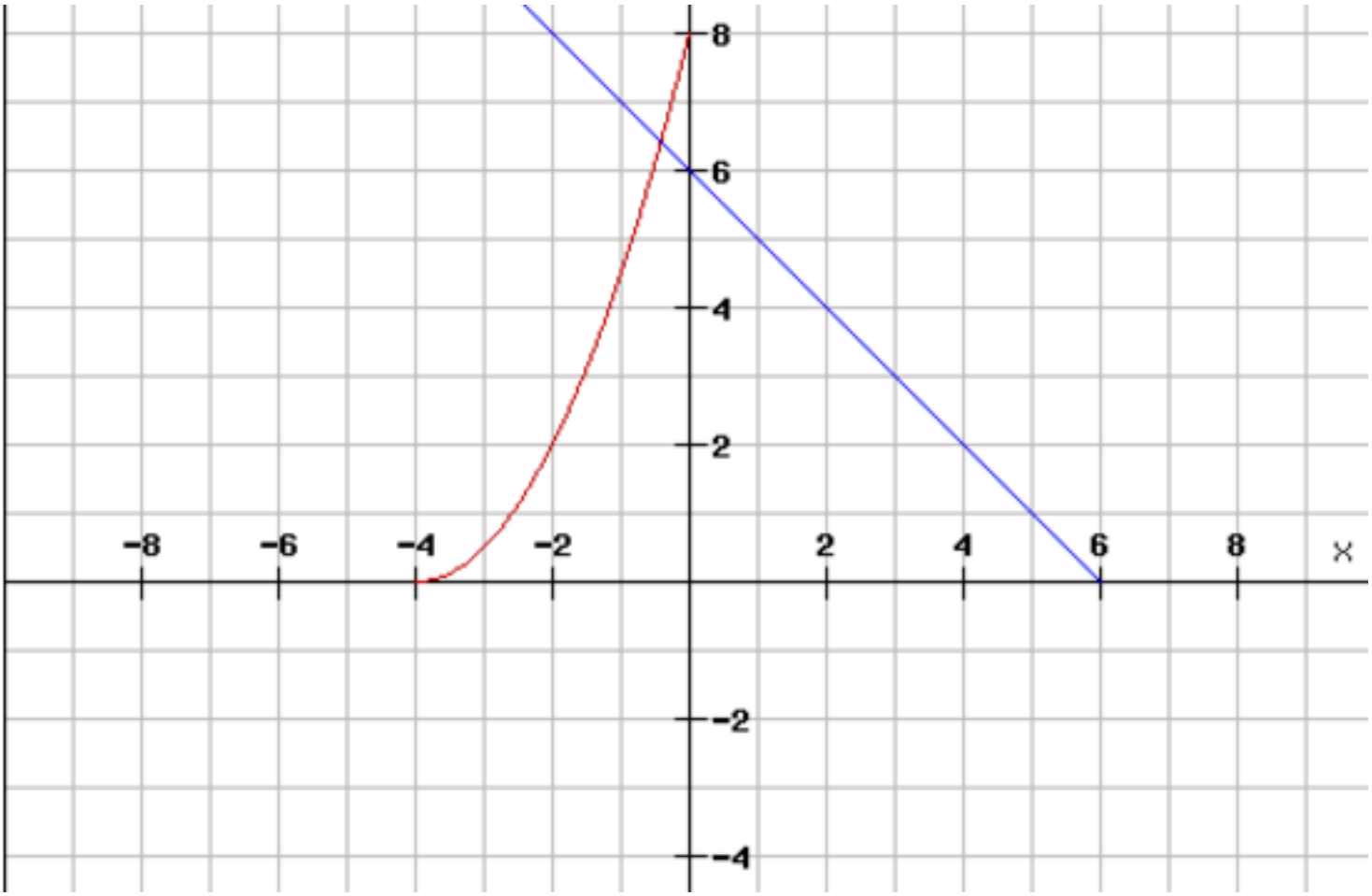
V_{GS} (V)	I_D (mA)	
0	8	[I_{DSS}]
[0.3 V_P] -1.2	4	[$I_{DSS}/2$]
[0.5 V_P] -2	2	[$I_{DSS}/4$]
[V_P] -4	0	

* Bu iki eğrinin kesişim noktaları bir sonraki sayfada bulunyor ve $\underbrace{I_{DQ}}_{6.42}$, $\underbrace{V_{GSQ}}_{-0.42}$ "Çalışma noktaları" bulunur.

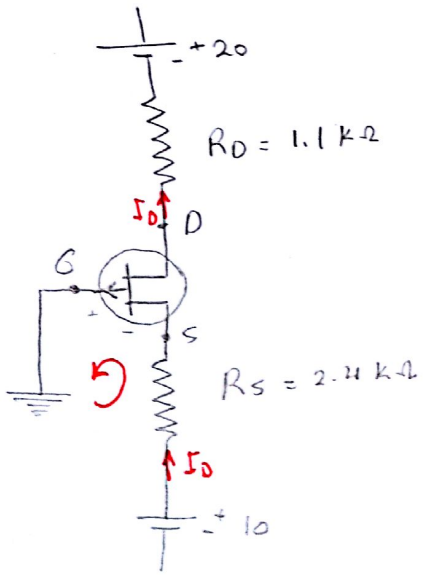
$V_S = I_D R_S - 6 = 6.42\ mA * 1\ K\Omega - 6 = 0.42$ Volt

$V_D = 12 - I_D R_D = 12 - 6.42\ mA * 1.5\ K\Omega = 2.37$ Volt

$V_{DS} = V_D - V_S = 1.95$ Volt


8
6
4
2
−2
−4
−8
−6
−4
−2
2
4
6
8
x

(8)



I_{DSS} = 20 mA

V_p = 8V

$-10 + I_D R_S - V_{GS} = 0 \Rightarrow \boxed{V_{GS} = 2.4\, I_D - 10}$ Doğru denklem

$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2$

$\Rightarrow \boxed{I_D = 20\left(1 - \frac{V_{GS}}{8}\right)^2}$ eğri denklem

Doğru denklemden

V_{GS} (V)	I_D (mA)
-10	0
0	4.12

	V_{GS} (V)	I_D (mA)	
	0	20	[I_{DSS}]
[$0.3V_p$]	2.4	10	[$I_{DSS}/2$]
[$0.5V_p$]	4	5	[$I_{DSS}/4$]
[V_p]	8	0	

eğri denklemi

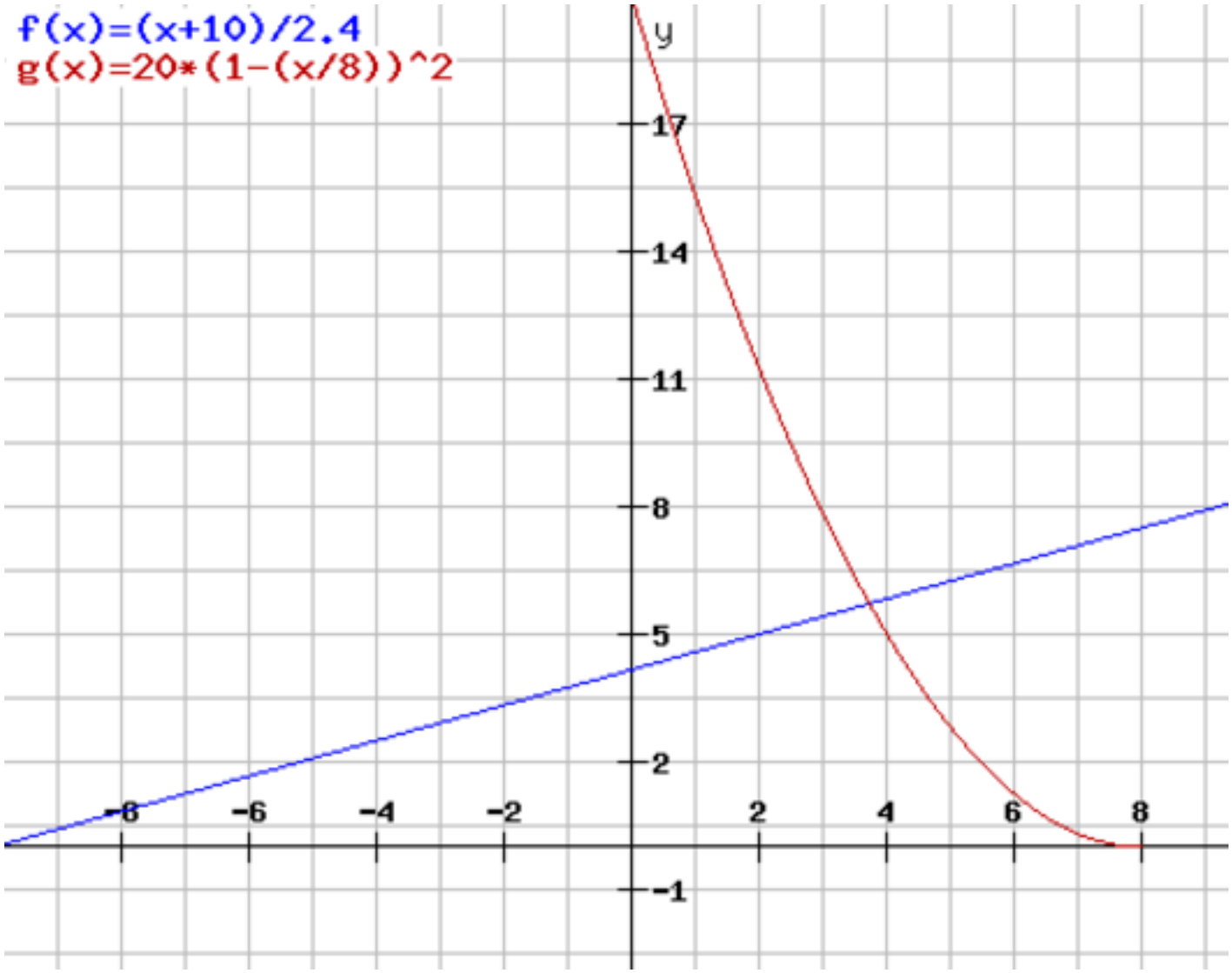
- Kesişim noktaları bulduktan sonra "bir sonraki grafta"

$V_{GS_Q} = 3.72$ V , $I_{D_Q} = 5.72$ mA

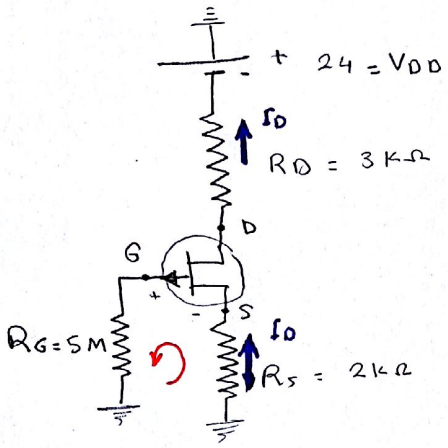
$V_S = -I_D R_S + 10 = -(5.72\text{ mA} * 2.4\text{ kΩ}) + 10 = -3.73$ Volt

$V_D = I_D R_D - 20 = 5.72\text{ mA} * 1.1\text{ kΩ} - 20 = -13.7$ Volt

$V_{DS} = V_D - V_S = -13.7 + 3.73 = -9.98$ Volt


f(x)=(x+10)/2.4
g(x)=20*(1-(x/8))^2
y
17
14
11
8
5
2
-1
-8
-6
-4
-2
2
4
6
8

(9)



$V_p = 6\ V$

$I_{DSS} = 8\ mA$

$I_D R_S - V_{GS} = 0 \Rightarrow V_{GS} = I_D R_S$

$\Rightarrow$ $V_{GS} = 2\ I_D$ Doğru denklemi

$$I_D = I_{DSS}\left(1 - \frac{V_{GS}}{V_p}\right)^2$$

$$\Rightarrow I_D = 8\left(1 - \frac{V_{GS}}{6}\right)^2$$ eğri denklemi

Doğru Denkleminden

V_{GS} (V)	I_D (mA)
0	0
6	3

Eğri denkleminden

V_{GS} (V)	I_D (mA)	
0	8	$[I_{DSS}]$
$[0.3V_p]$	1.8	$[I_{DSS}/2]$
$[0.5V_p]$	3	2 $[I_{DSS}/4]$
$[V_p]$	6	0

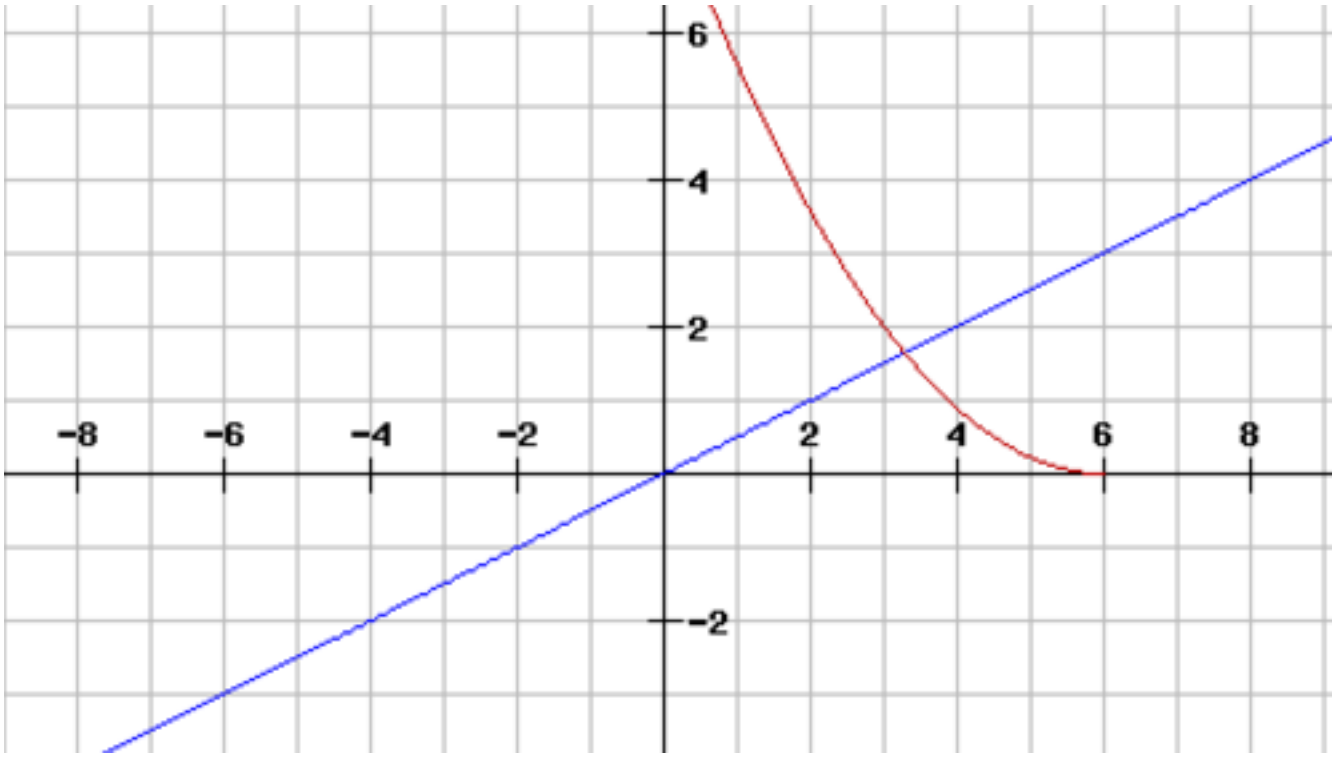
- kesişim noktaları bulduktan sonra "bir sonraki graftan"

$V_{GS_Q} = 3.28\ V$, $I_{D_Q} = 1.64\ mA$

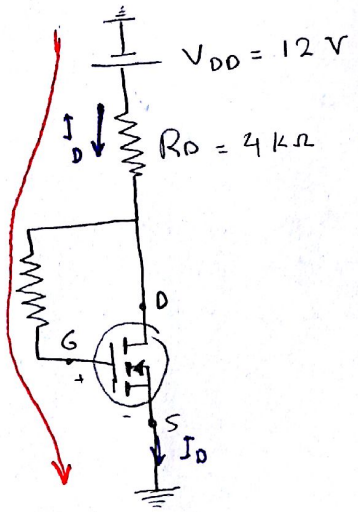
$V_S = -I_D R_S = -1.64 * 2 = -3.28$

$V_D = I_D R_D - 24 = 1.64 * 3 - 24 = -19.1$ Volt

$V_{DS} = V_D - V_S = -19.1 + 3.28 = -15.8$ Volt


6
4
2
-2
-8
-6
-4
-2
2
4
6
8

(10)



$K = 0.5\ mA/V^2$

$V_T = 4\ V$

$I_G = 0 \Rightarrow V_G = V_D$ her zaman

$$-V_{DD} + I_D R_D + \underbrace{I_G R_G}_{0} + V_{GS} = 0$$

$$\Rightarrow V_{GS} = V_{DD} - I_D R_D$$

$$\Rightarrow V_{GS} = 12 - 4 I_D$$ Doğru denklemi

$$I_D = K(V_{GS} - V_T)^2$$

$$I_D = 0.5(V_{GS} - 4)^2$$ eğri denklemi

doğru denklemden

V_{GS} (V)	I_D (mA)
12	0
0	3

eğri denklemden

V_{GS} (V)	I_D (mA)
4	0
6	2
8	8
10	18

"bu tip transistorlarda V_{GS}'e istenen değerler koyup I_D bulunur Fakat $V_{GS} \geq V_T$ olmalı

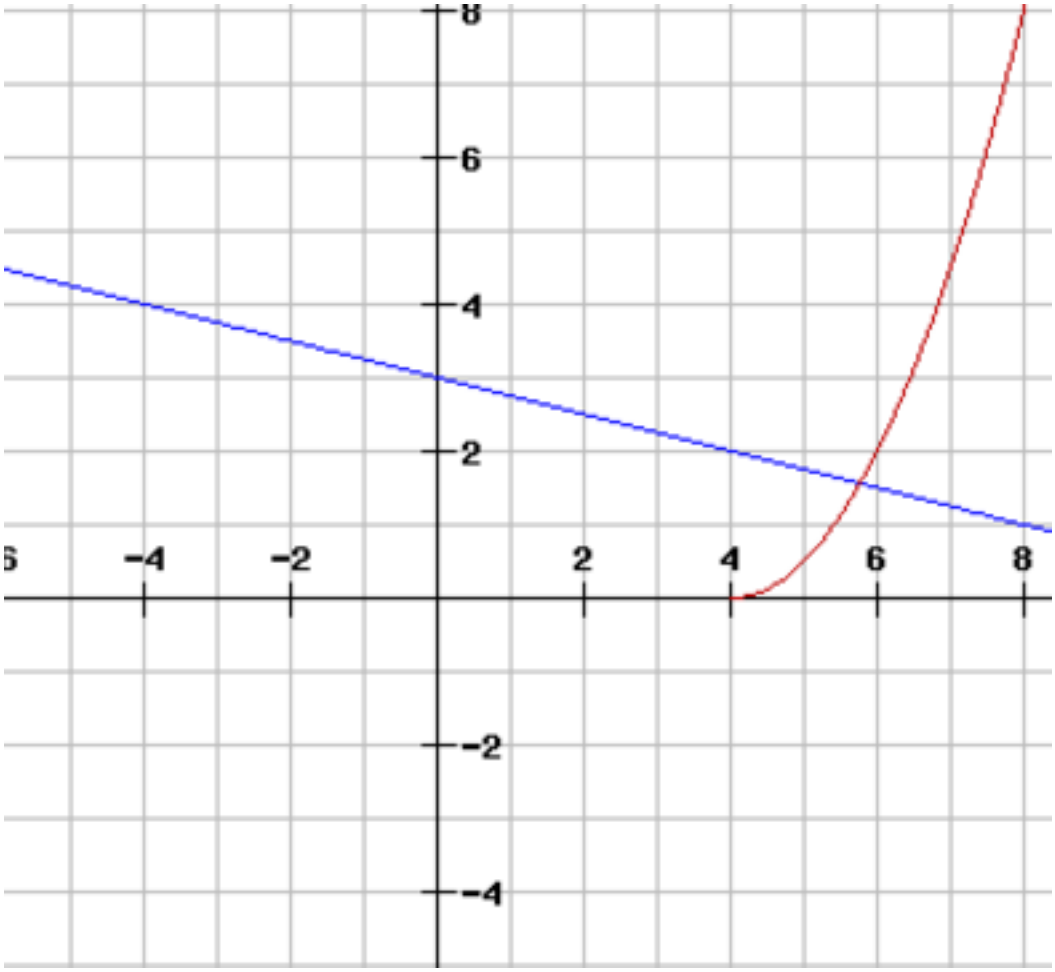
kesişim noktaları alındığında:

$V_{GS_Q} = 5.76\ V$, $I_{DQ} = 1.56\ mA$

$V_S = 0$ (toprağa bağlı)

$V_D = V_{GS_Q} = 12 - 4 I_D = 12 - 4\ k\Omega * 1.56 = 5.76\ V$

$\Rightarrow V_{DS} = V_D - V_S = V_D - 0 = 5.76\ V$


8
6
4
2
−4
−2
2
4
6
8
−2
−4