[86.03/66.25] Dispositivos Semiconductores

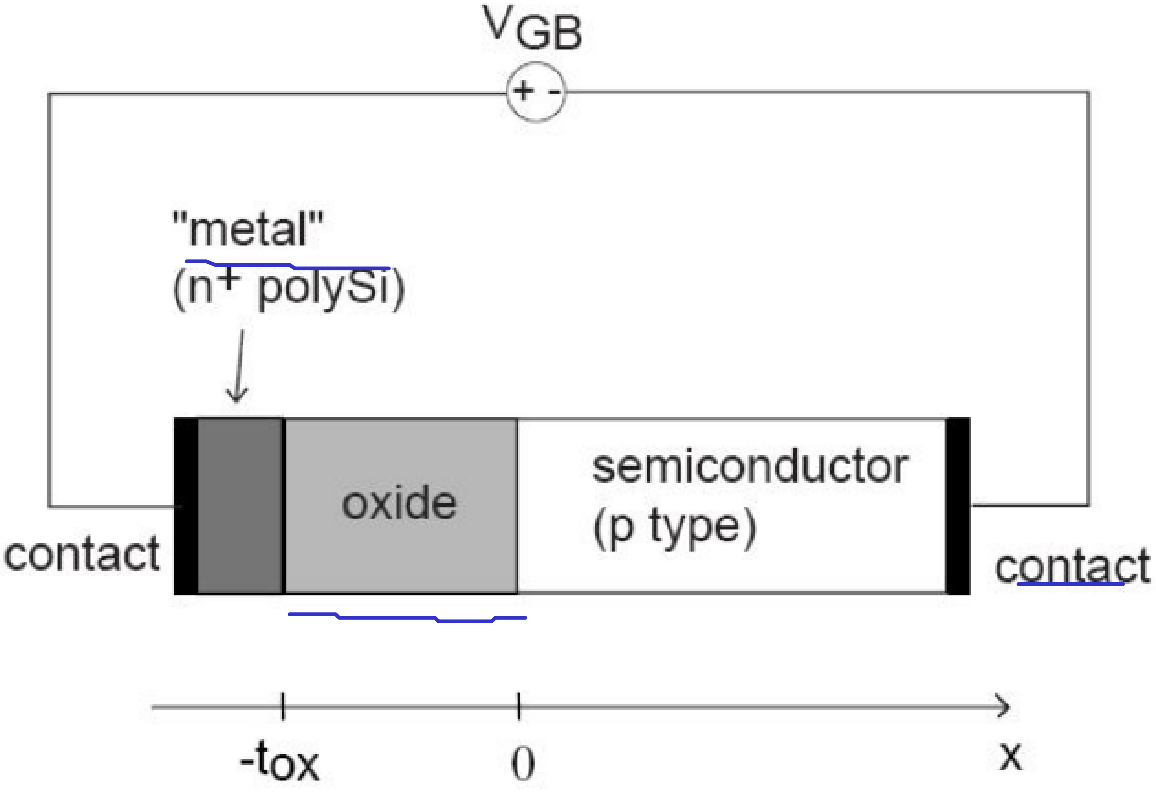
1er Cuatrimestre de 2020

Juntura MOS

Se tiene una juntura MOS construida con poly N+ y substrato P de la cual se conocen los siguientes datos:

- $t_{ox} = 150\ \text{Å}$
- $N_A = 3 \cdot 10^{15}\ cm^{-3}$
- $V_{FB} = -0.876\ V$
- $V_T = 0.884\ V$

Hallar ϕ_B, C'_{OX}, x_d, Q'_{SCR}, ΔV_{BULK} y ΔV_{OX} cuando $V_{GB} = 0.2\ V$.



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- $t_{ox} = 150\ \text{Å}$
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- $v_{th} = 25.9\ mV$

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$$1\ \text{Å} = 10^{-10}\ m$$

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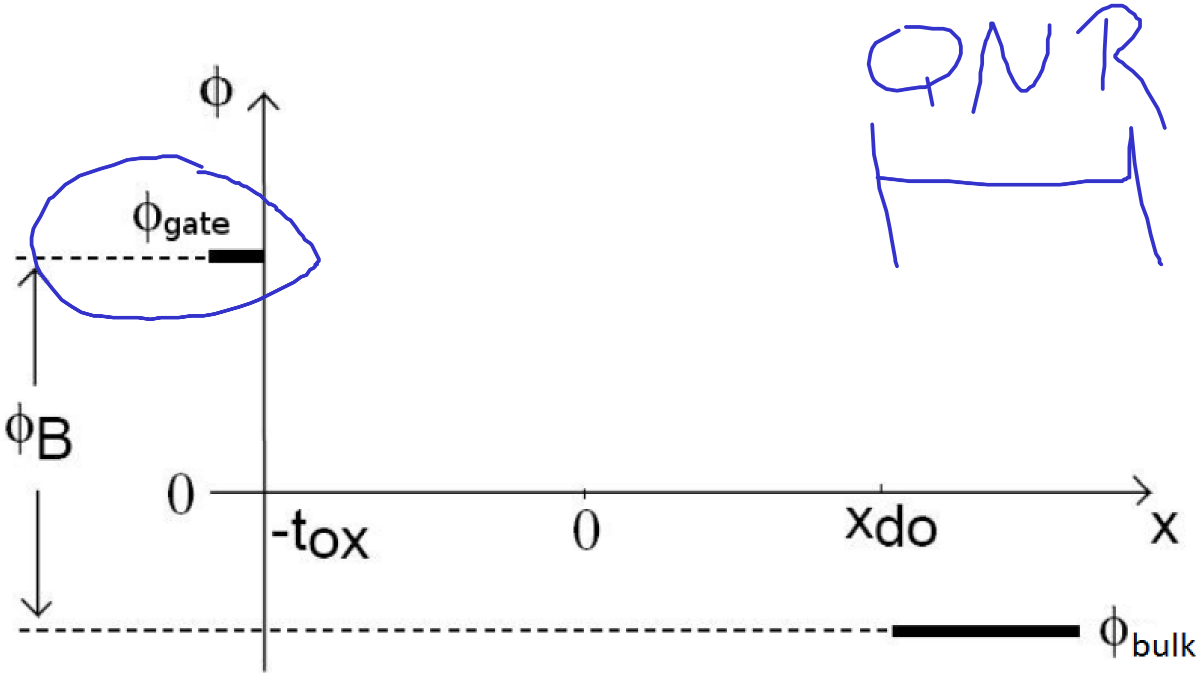

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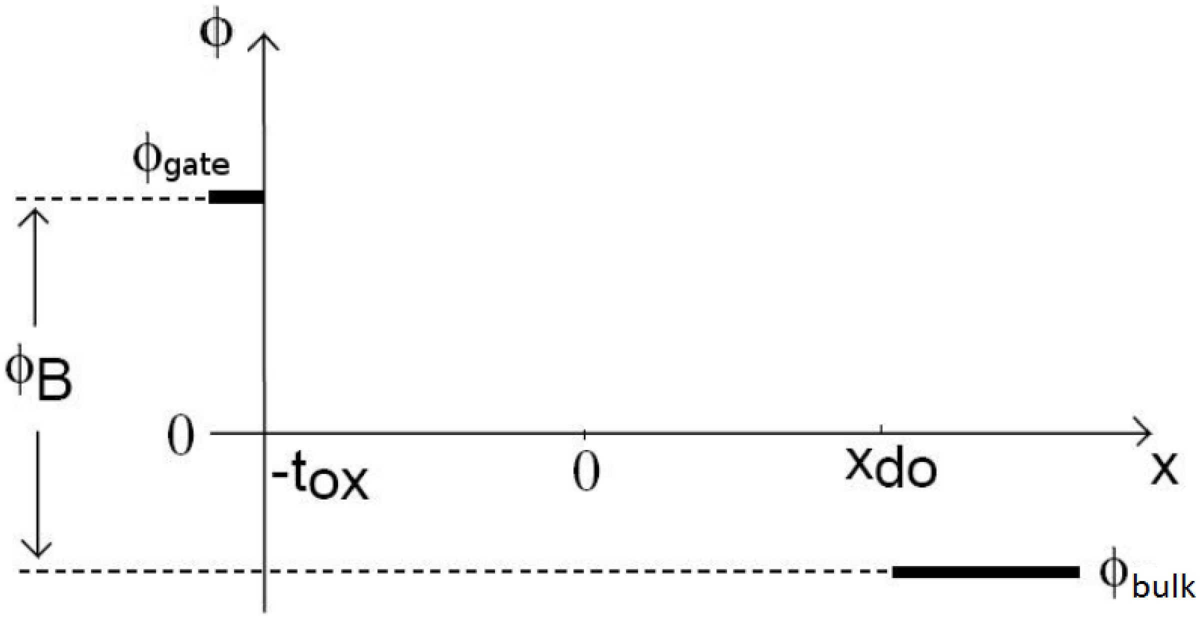
Gate : PolySi N^+ → $\boxed{\phi_{gate} = 550\ mV}$

Bulk : Tipo P → $\phi_{bulk} = -v_{th} \ln\left(\frac{N_A}{n_i}\right) = -326\ mV$



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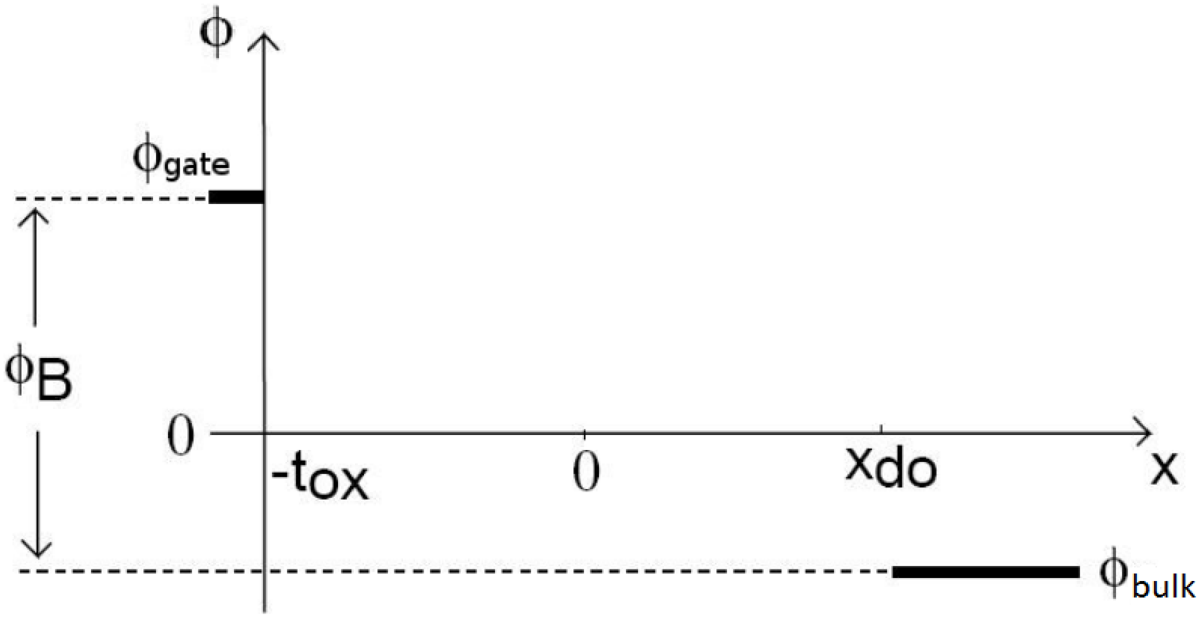

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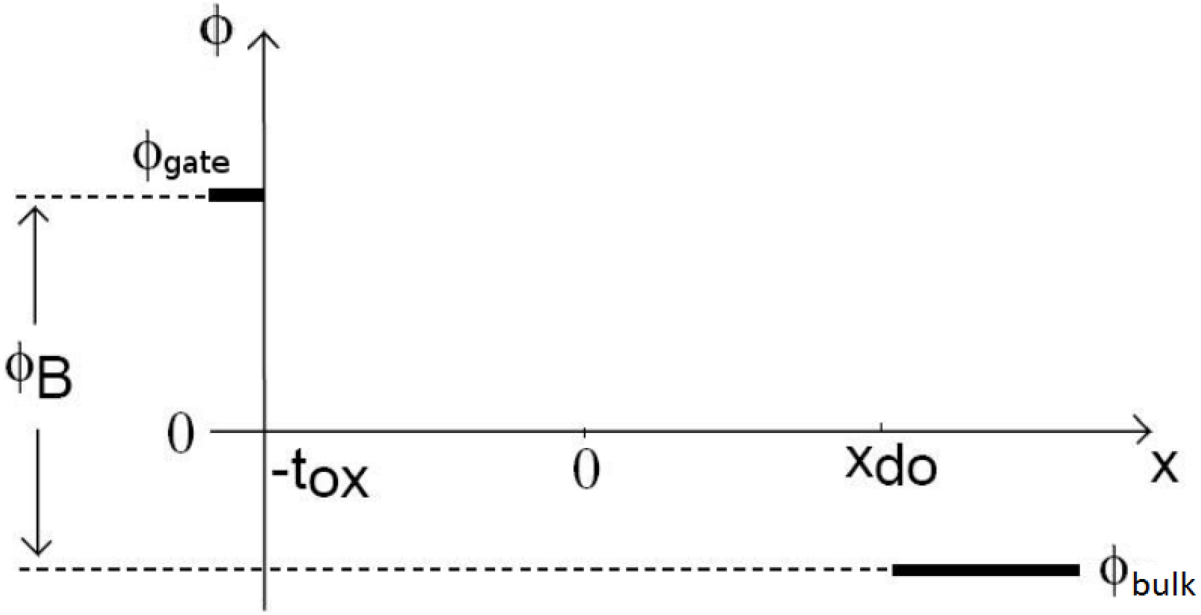
$$\boxed{(V_{FB} = -876\ mV = -\phi_B\ )}$$



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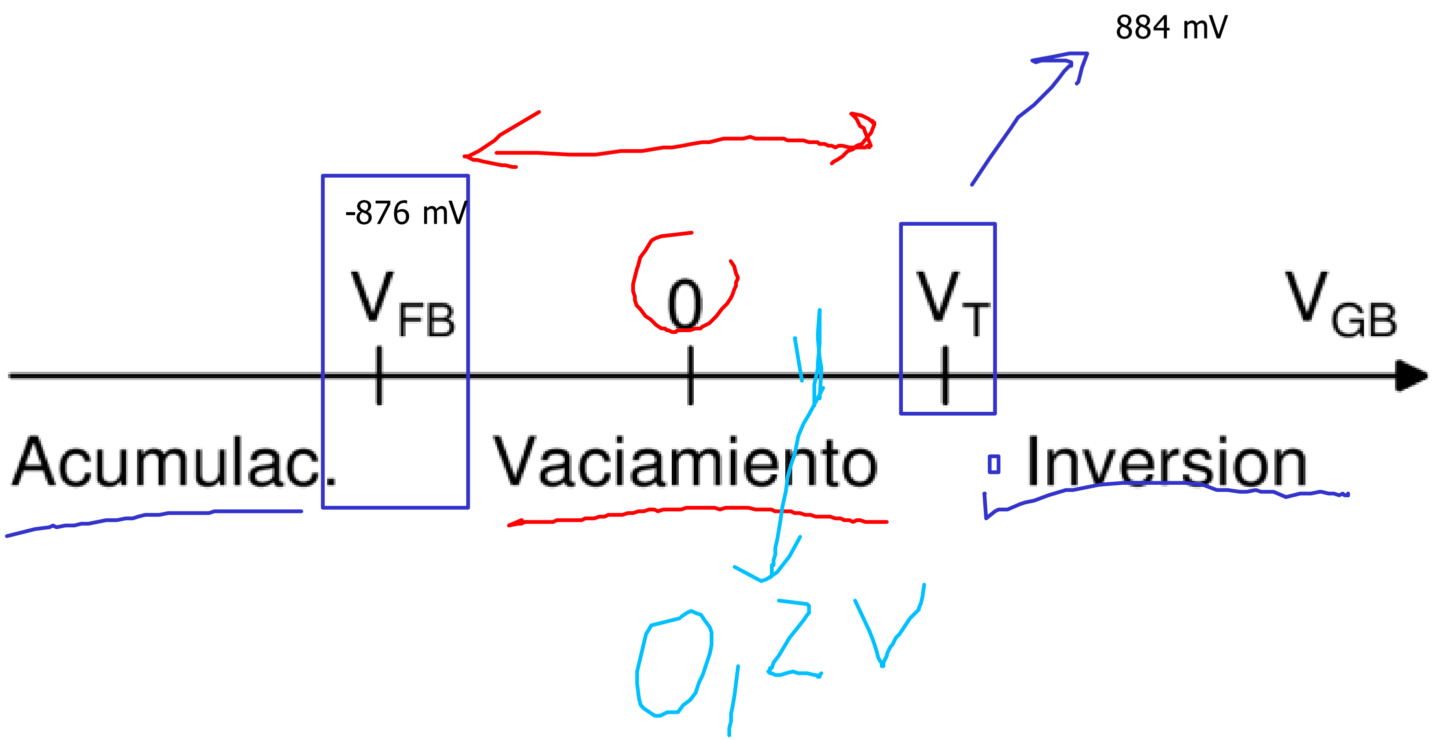
¿En que régimen estamos?

$V_{GB} = 0,2V$



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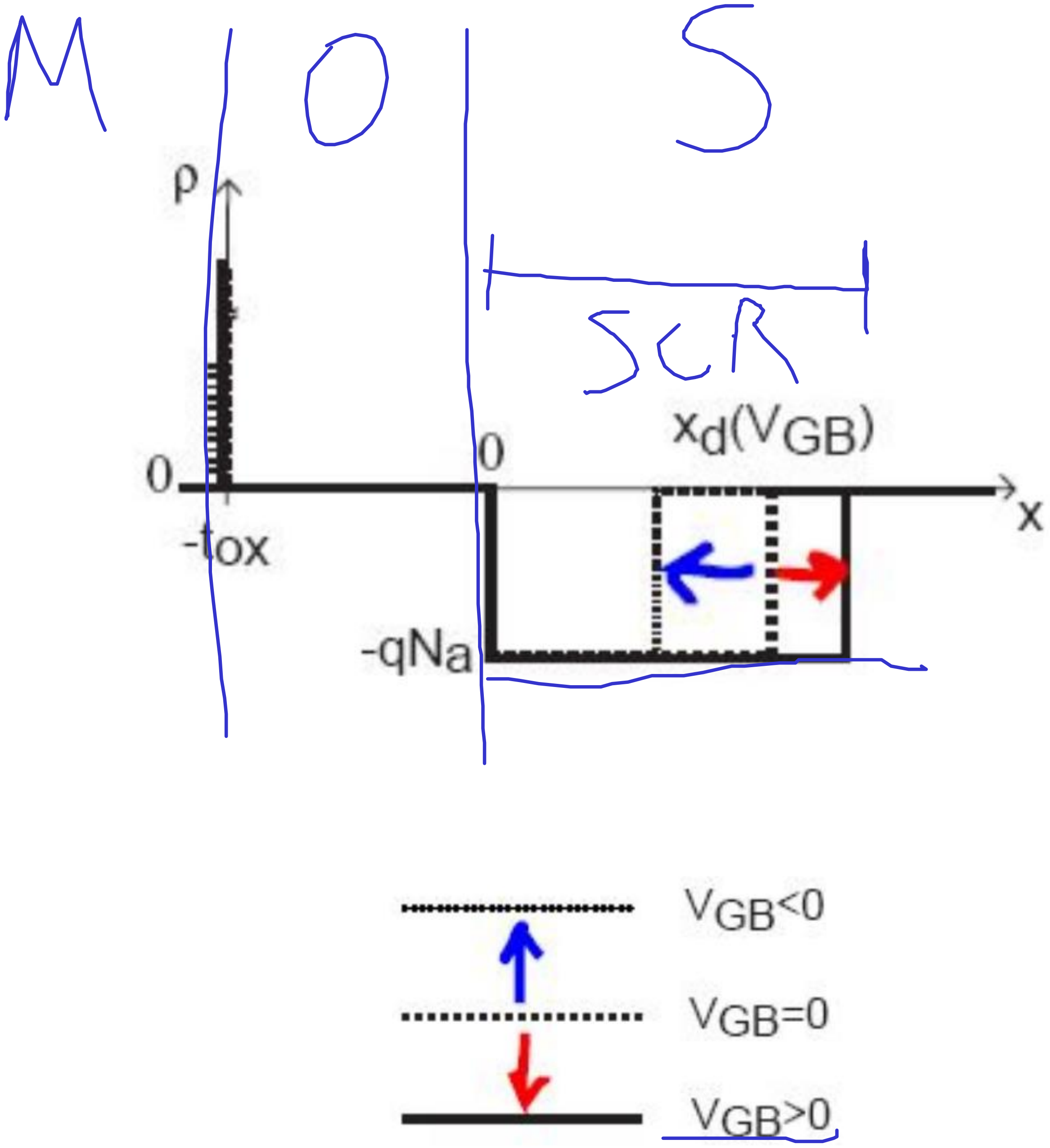
$$x_d = \frac{\varepsilon_{si}}{\underline{C'_{OX}}}\left[\sqrt{1+\frac{4\left(\underline{\phi}_B + \underline{V}_{GB}\right)}{\underline{\gamma^2}}}-1\right]$$



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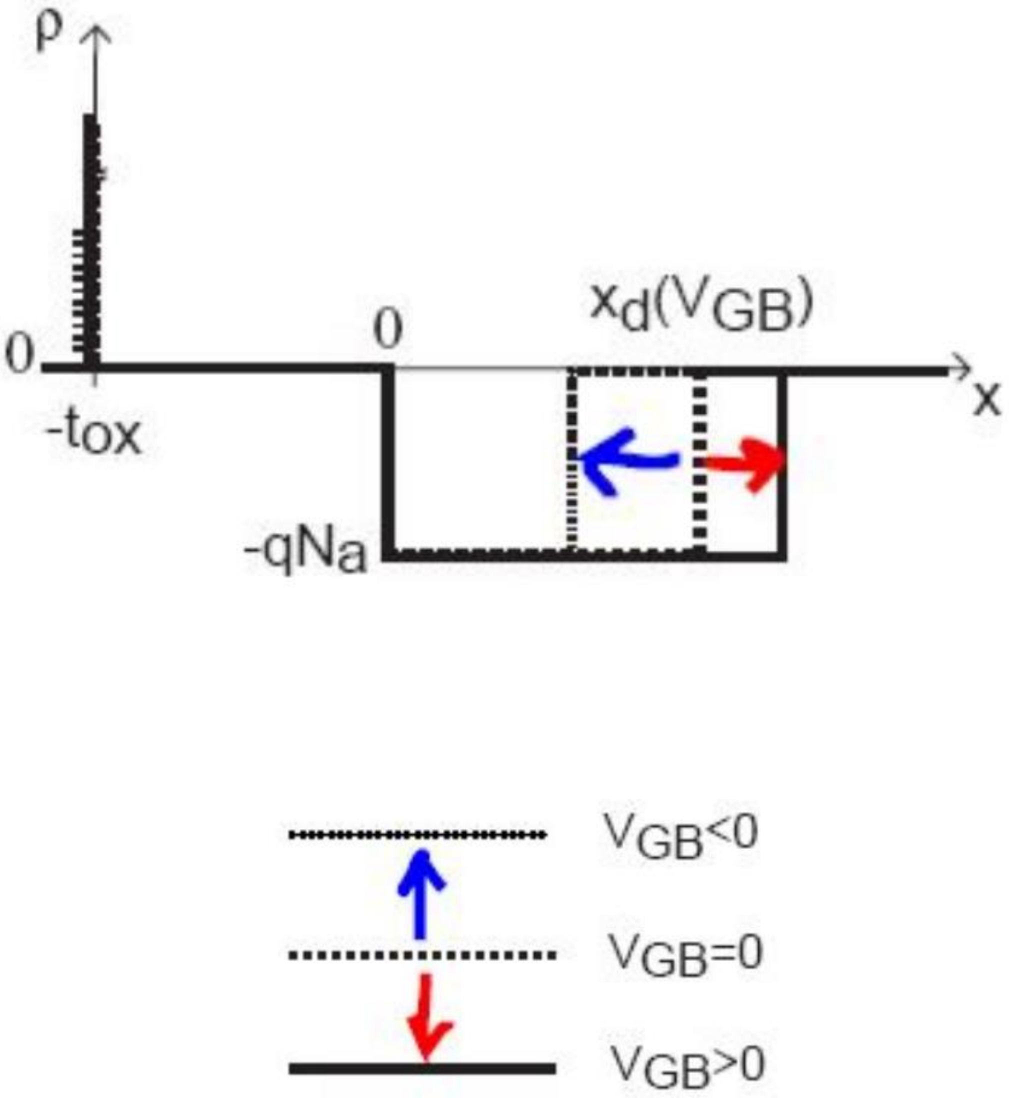
$$\gamma = \frac{1}{\underline{C'_{OX}}}\sqrt{2\,\underline{\varepsilon_{si}}\;q\;\underline{N_A}} \rightarrow [\gamma] = \sqrt{V}$$



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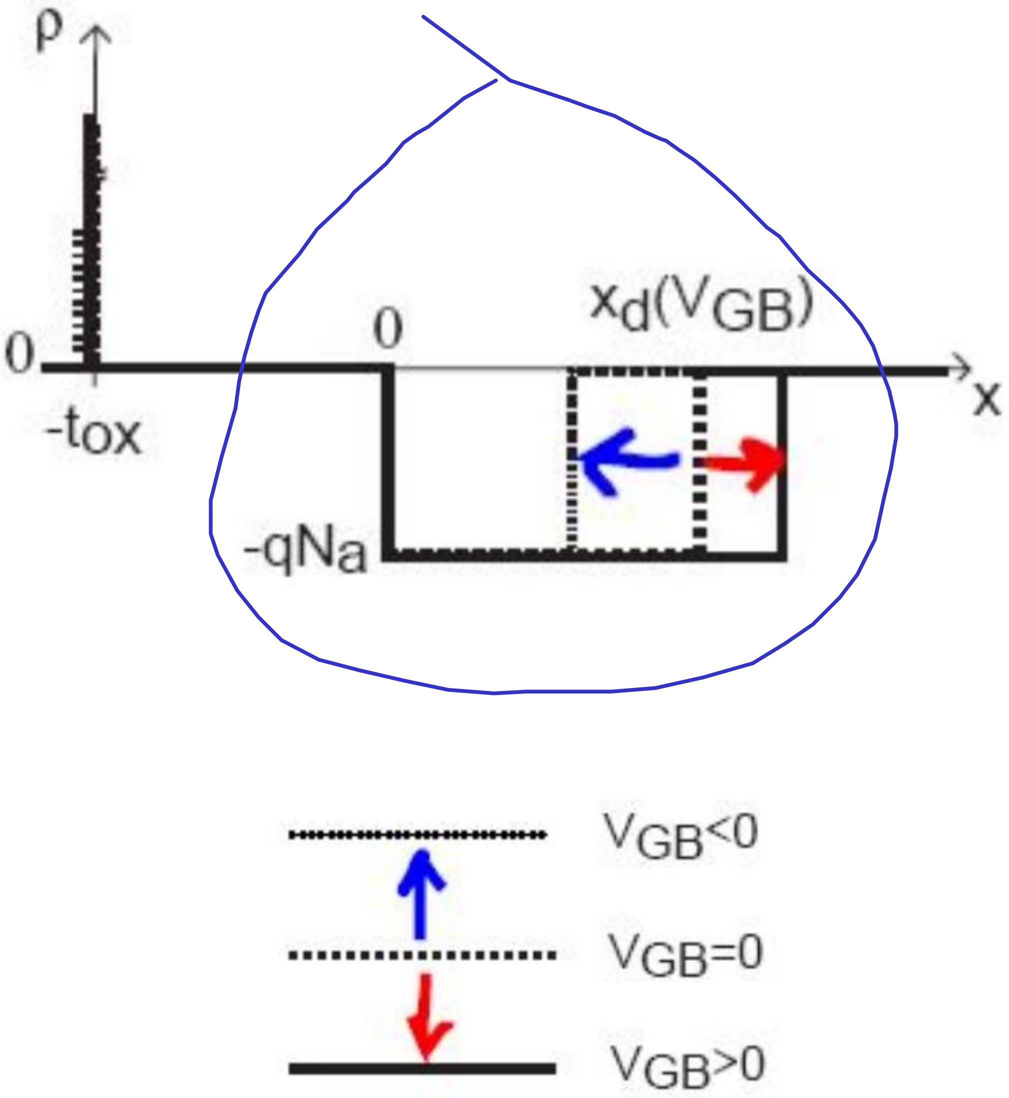
$$\boxed{\gamma = 1.37\ V^{1/2}} \rightarrow \boxed{x_d = 366\ nm}$$



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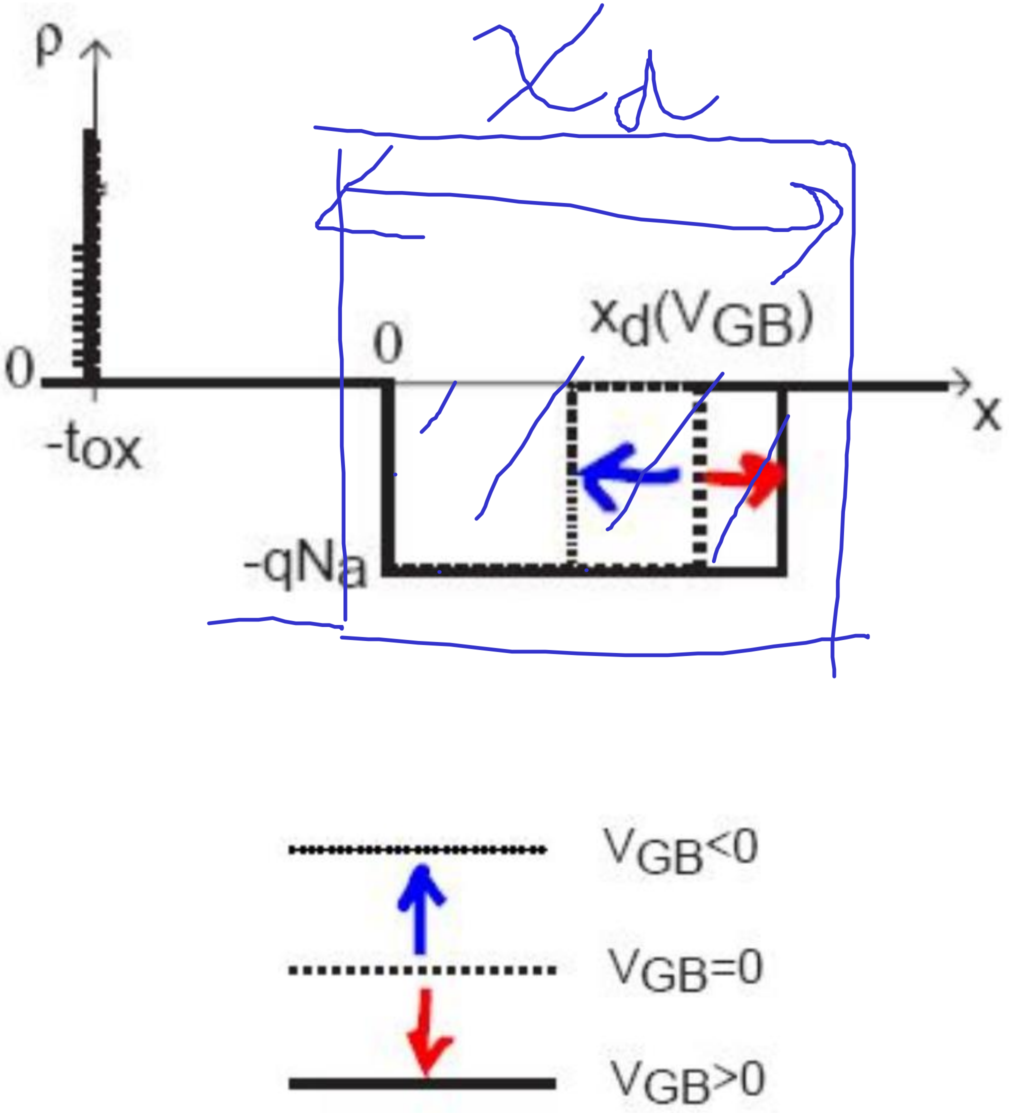
$$Q'_{SCR}(V_{GB}) = \underline{-q\,N_A\,x_d(V_{GB})}$$



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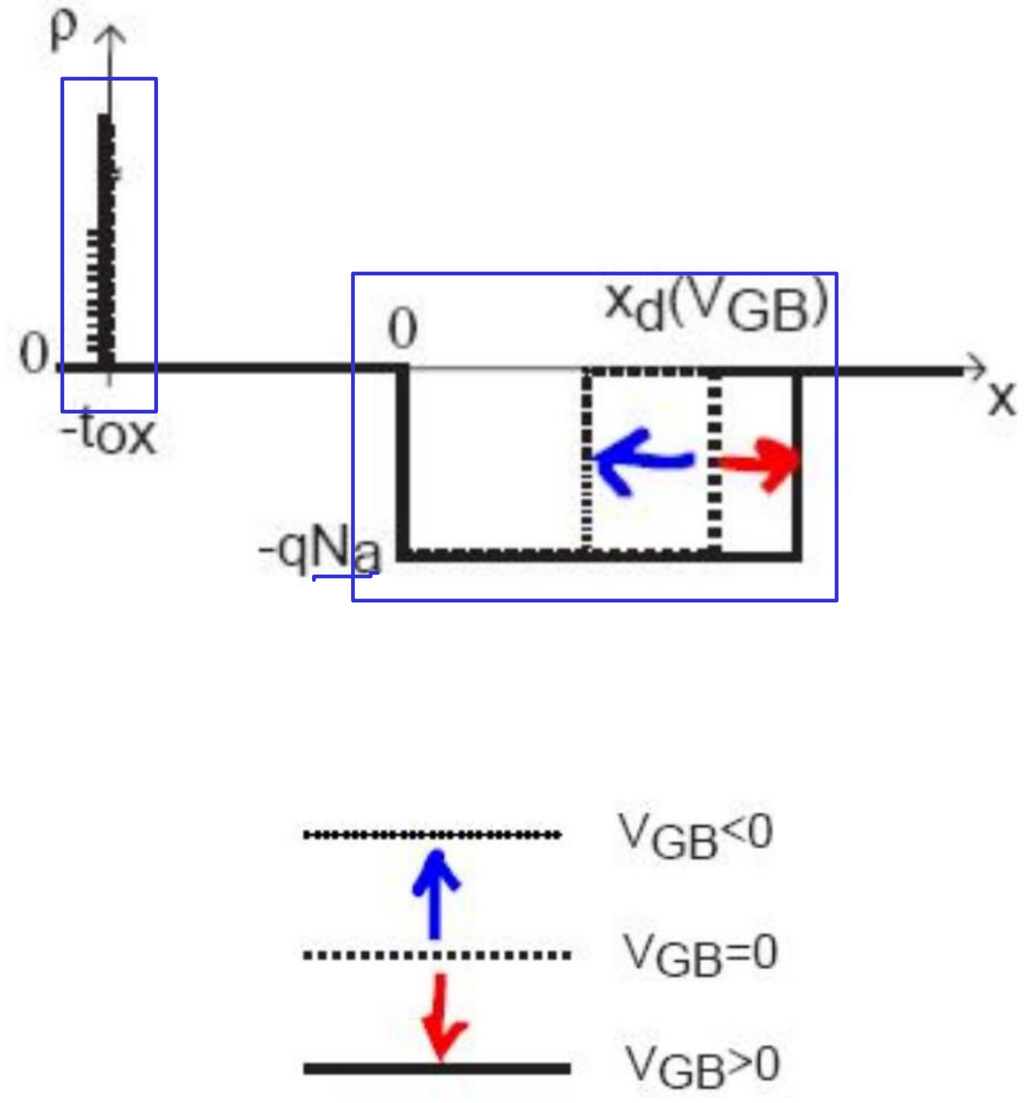

$$Q'_{SCR}(V_{GB}) = -q\ N_A\ x_d(V_{GB})$$

$$\hookrightarrow Q'_{SCR} = -1.76\,\frac{C}{cm^2}$$

$$(|Q'_{\underline{M-Ox}}| = |Q'_{SCR}|)$$

Los potenciales cuando aplicamos tensión a la juntura…

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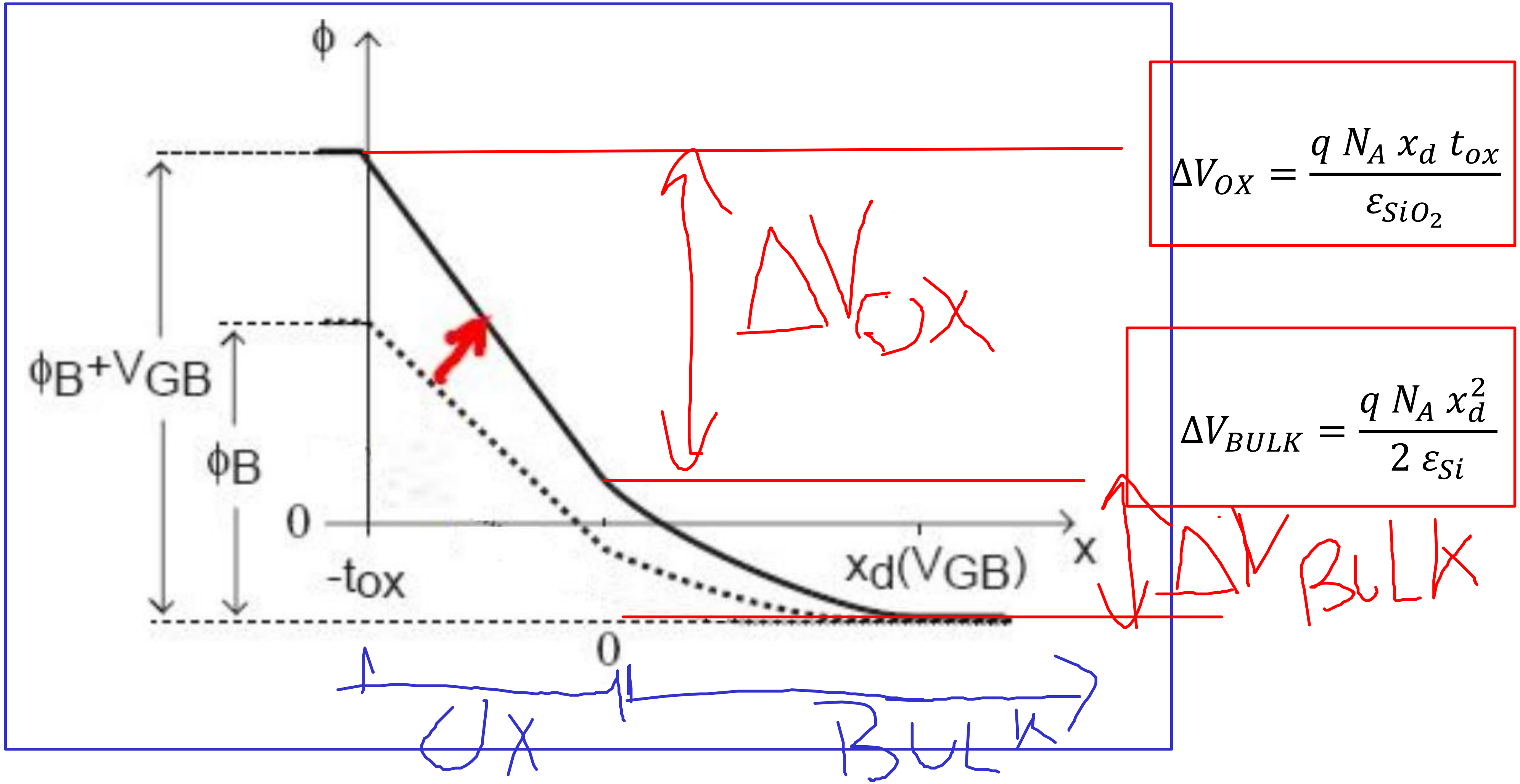

$$\Delta V_{OX} = \frac{q\,N_A\,x_d\,t_{ox}}{\varepsilon_{SiO_2}}$$

$$\Delta V_{BULK} = \frac{q\,N_A\,x_d^2}{2\,\varepsilon_{Si}}$$

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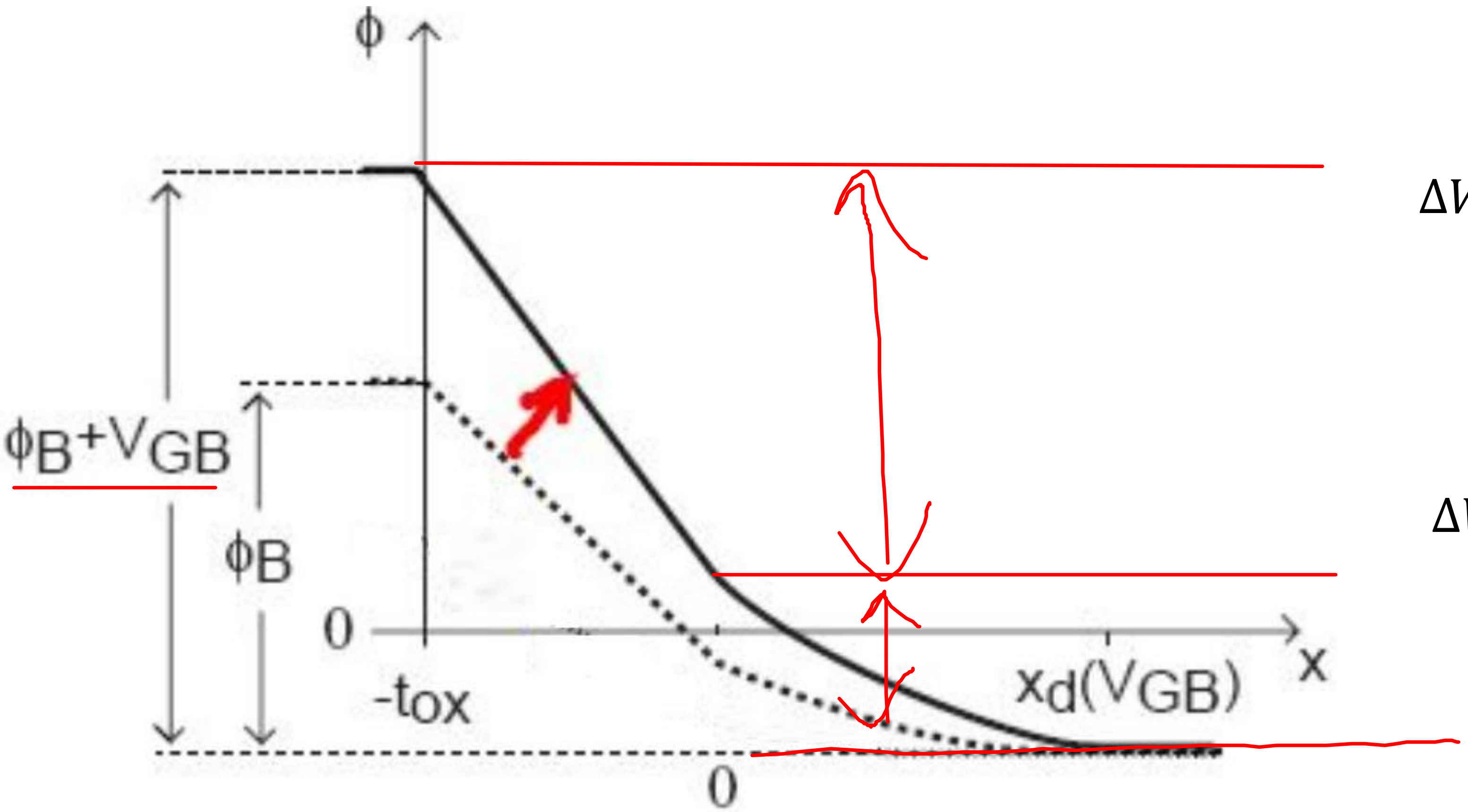

$$\Delta V_{OX} = \frac{q\, N_A\, x_d\, t_{ox}}{\varepsilon_{SiO_2}} = \underline{765\; mV}$$

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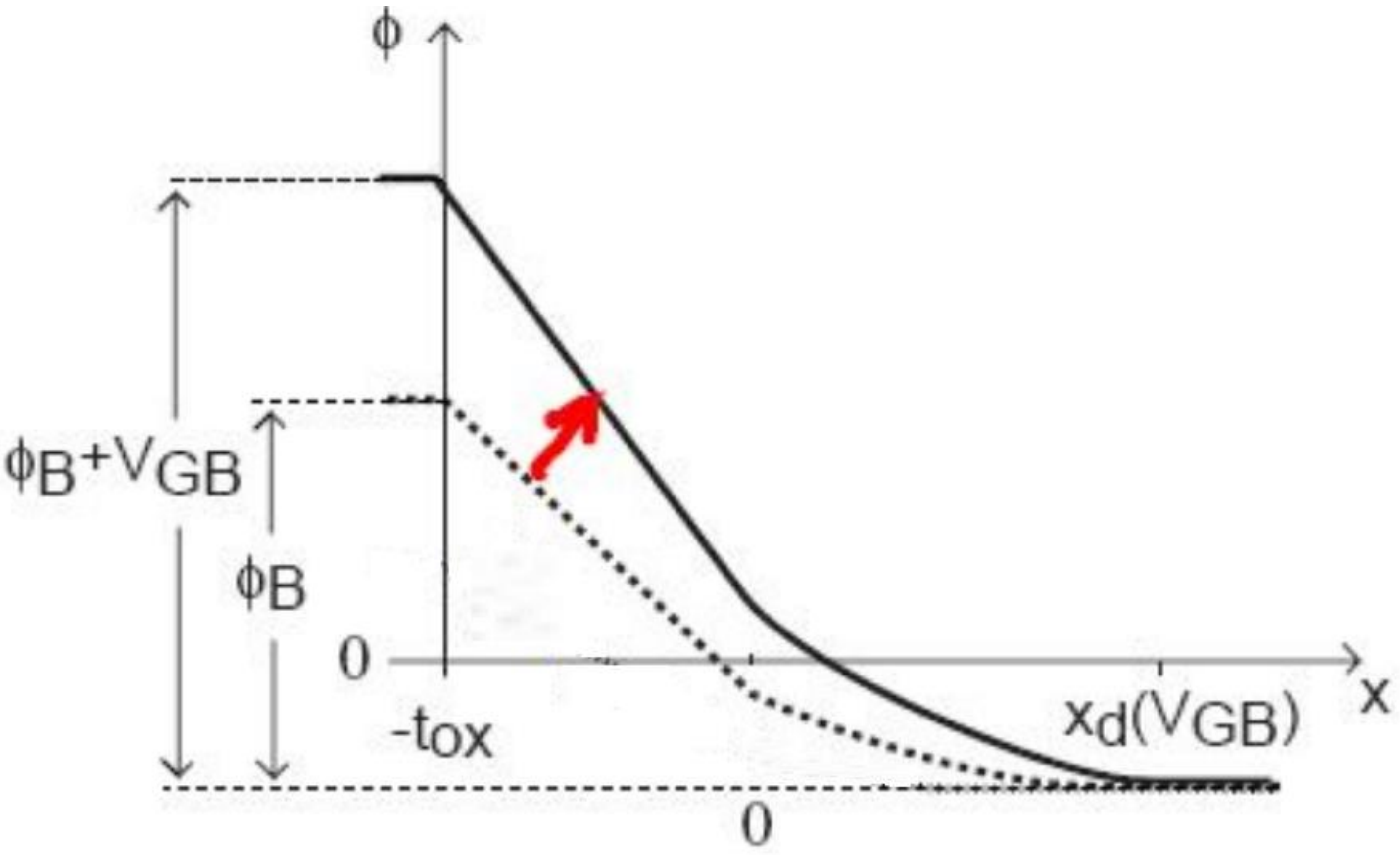

$$\Delta V_{OX} = \frac{q\ N_A\ x_d\ t_{ox}}{\varepsilon_{SiO_2}} = \ 765\ mV$$

$$\Delta V_{BULK} = \frac{q\ N_A\ x_d^2}{2\ \varepsilon_{Si}} = 311\ mV$$

Notemos que: $V_{GB} + \phi_B = \Delta V_{OX} + \Delta V_{BULK} = \underline{1076\ mV}$