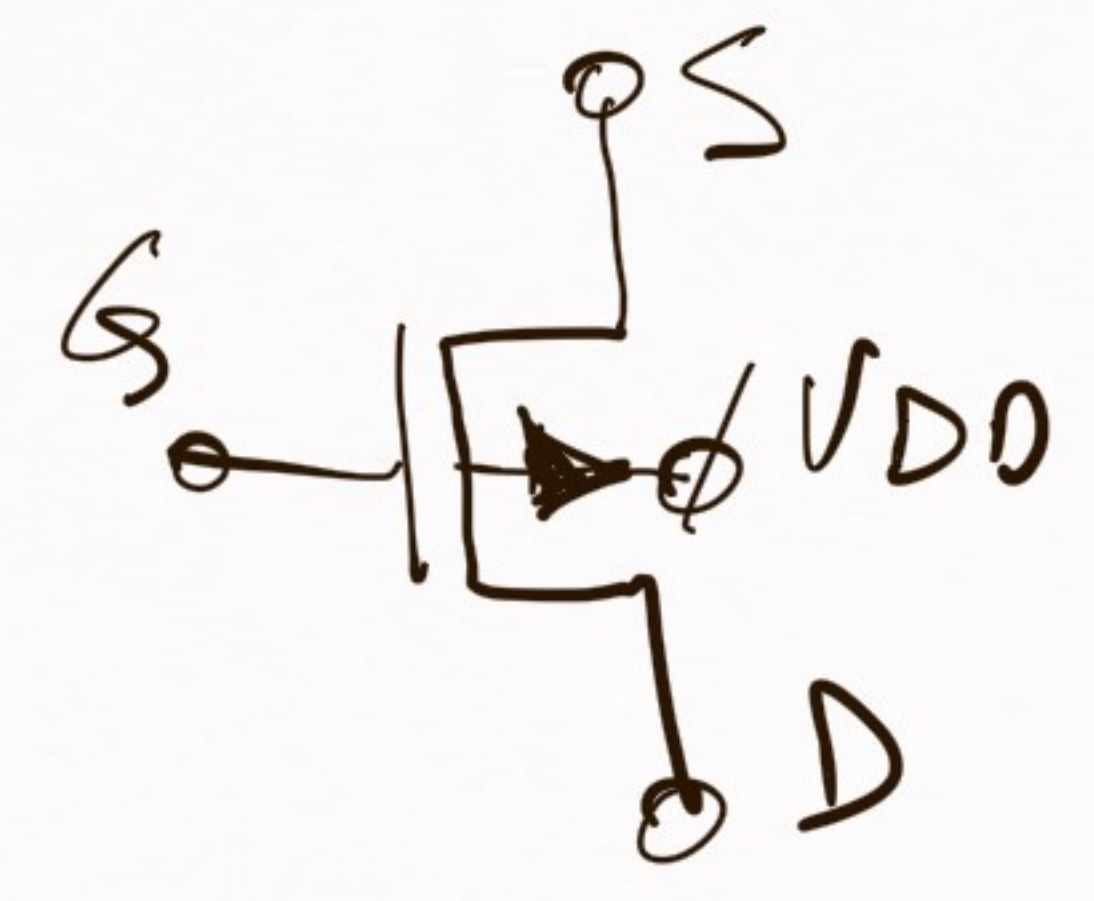


Modelo de pequeña señal del transistor PMOS

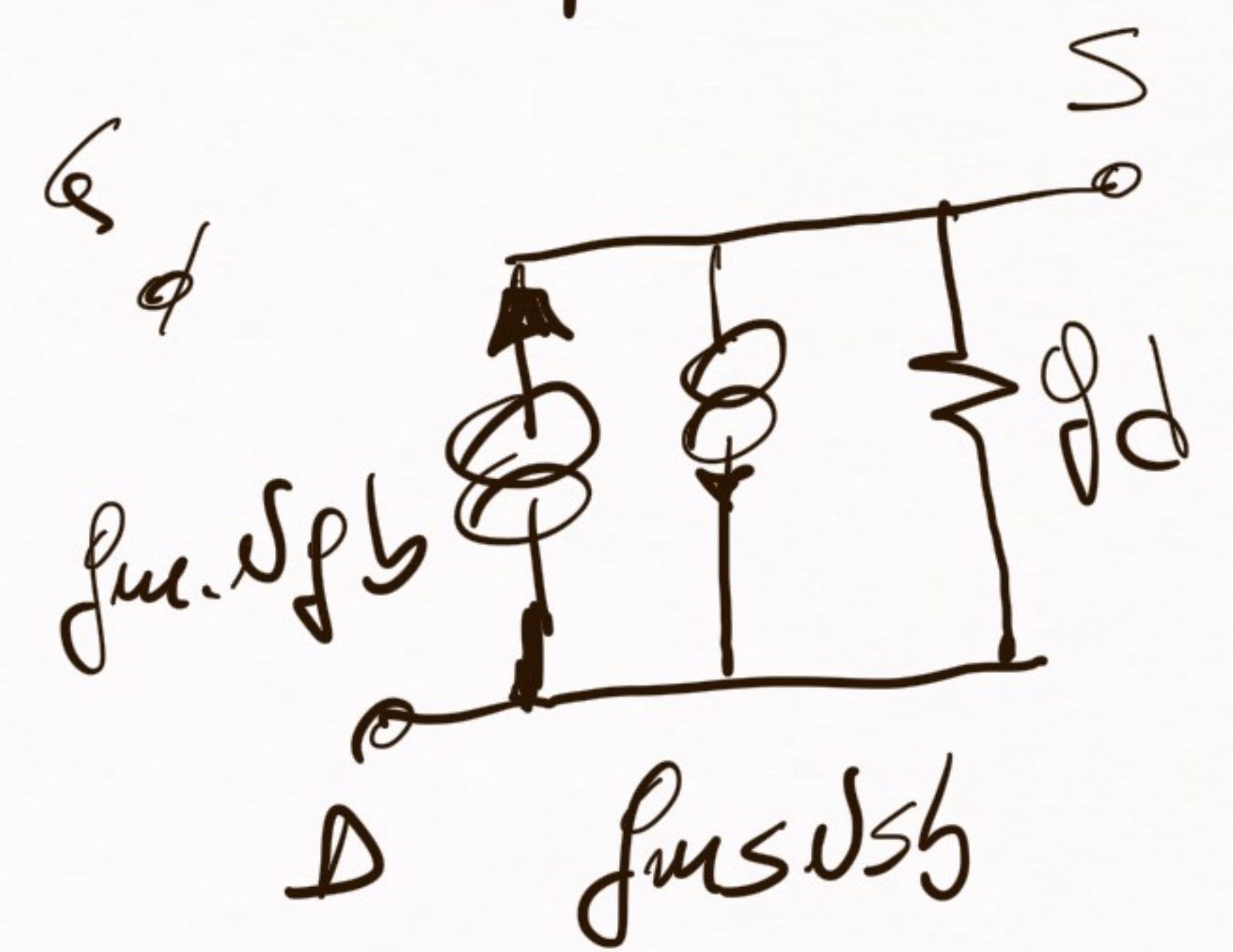
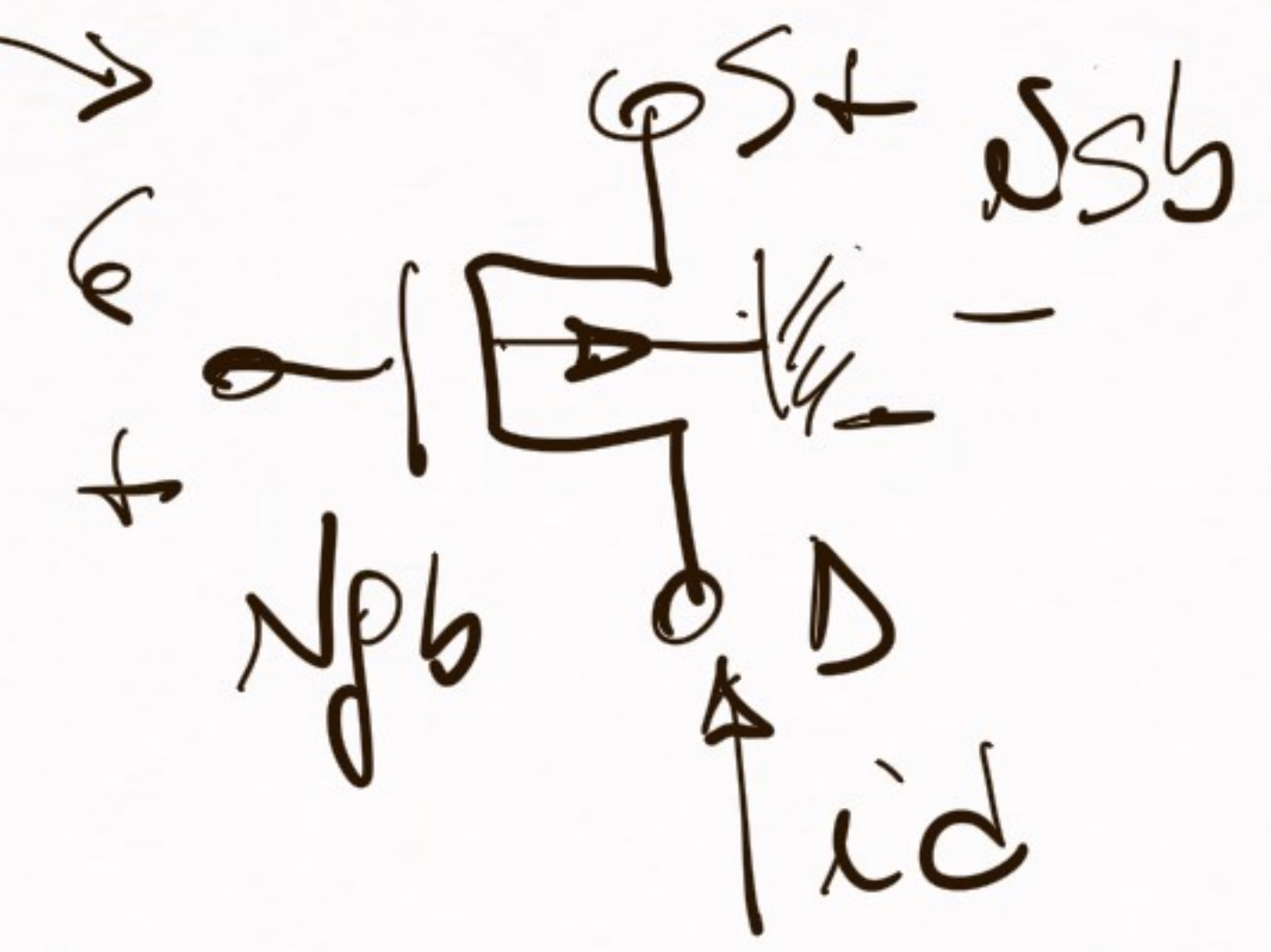
3/6/20

Es idéntico al del nMOS (con los mismos variables)

Modelo de
peq. señal



análisis AC

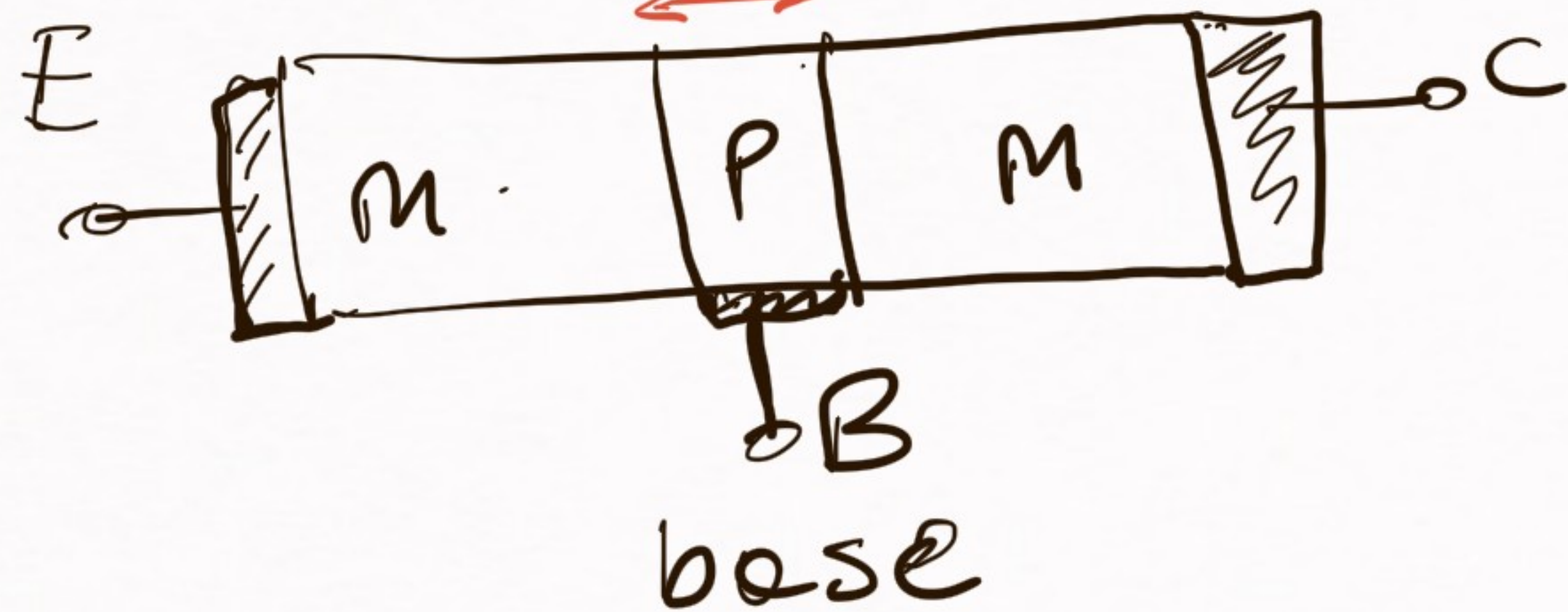


TRANSISTOR BIPOLAR

"Bipolar Junction Transistor"

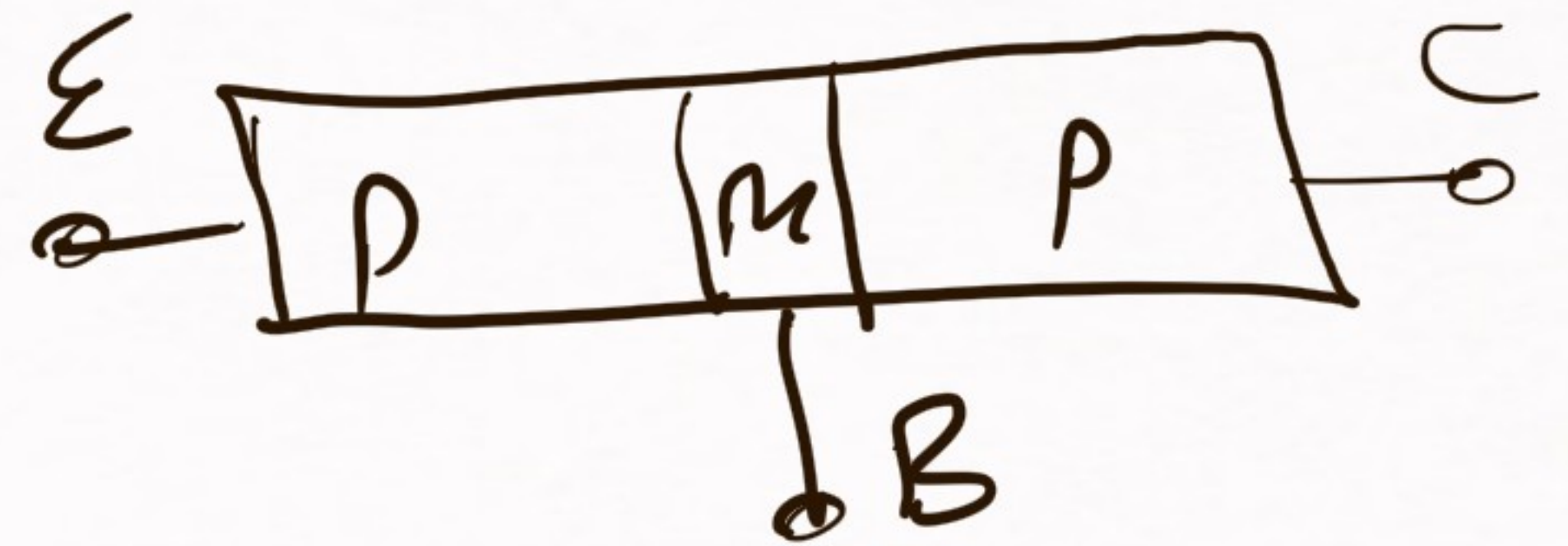
BJT

→ 2 tipos:
→ emisor



MPM } PMP

colector

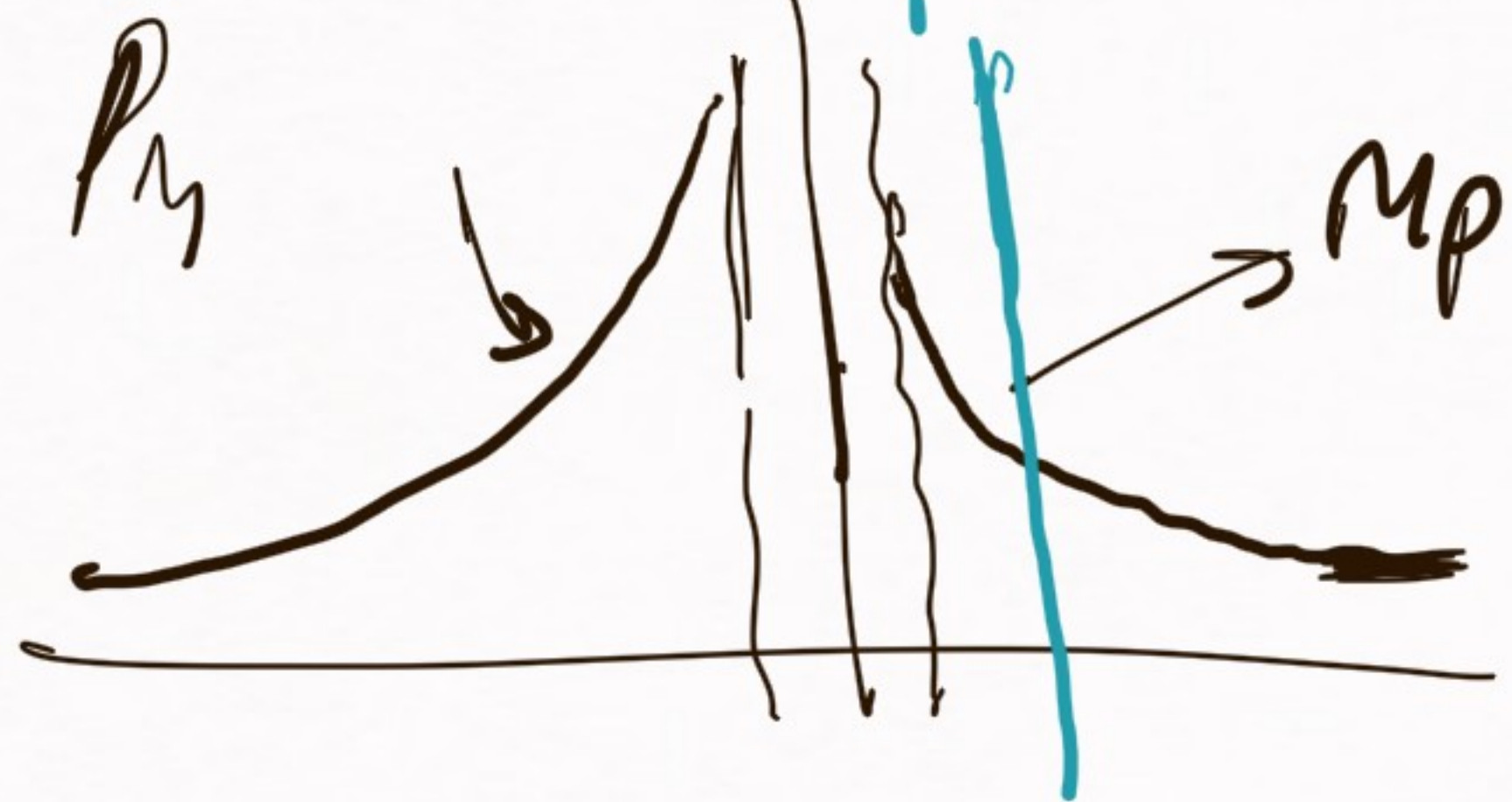
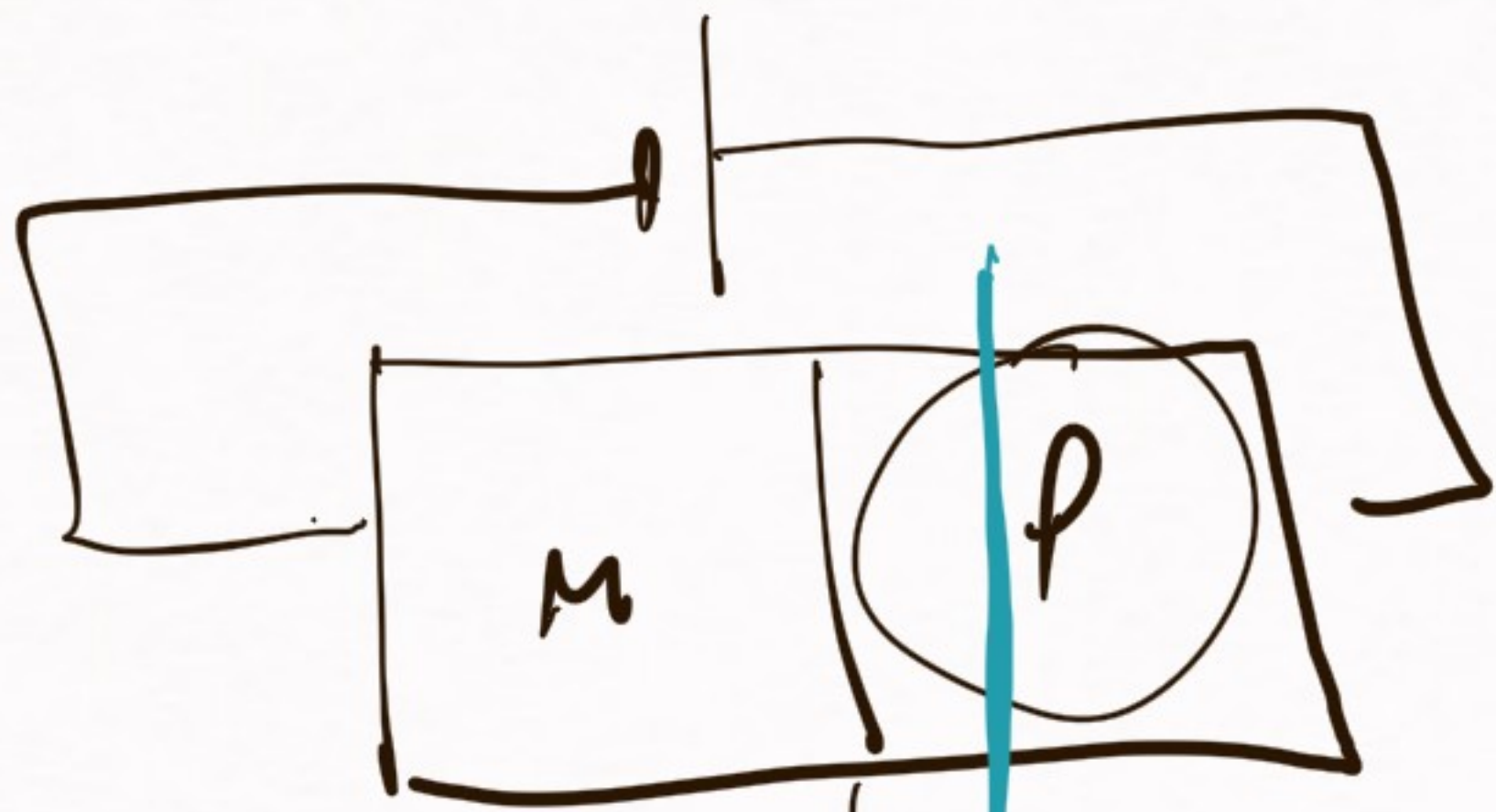
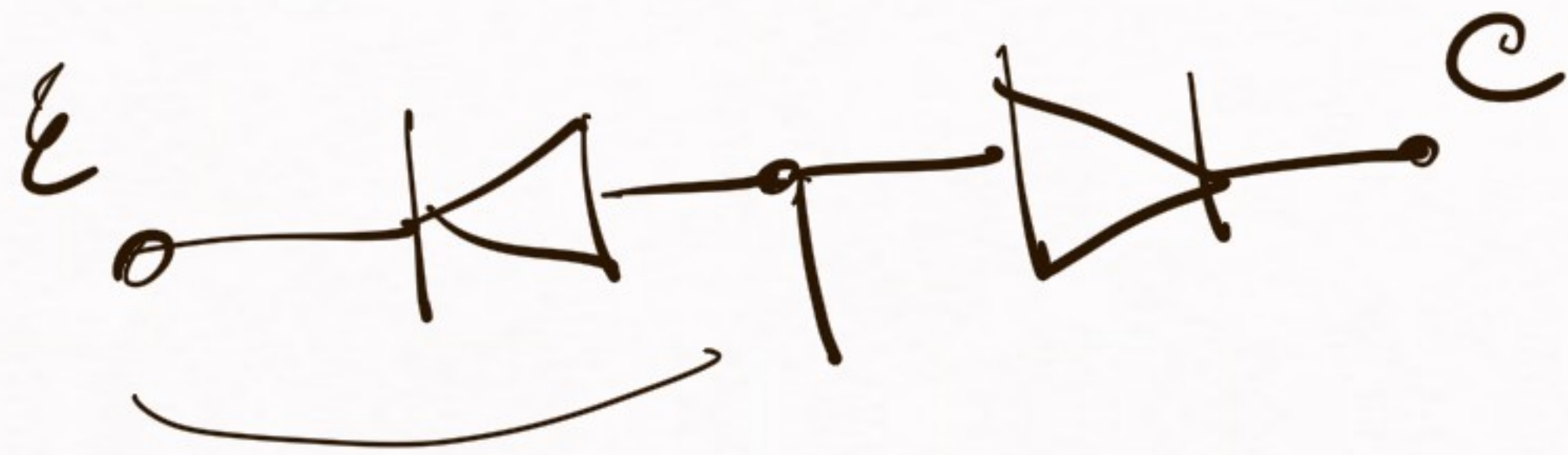
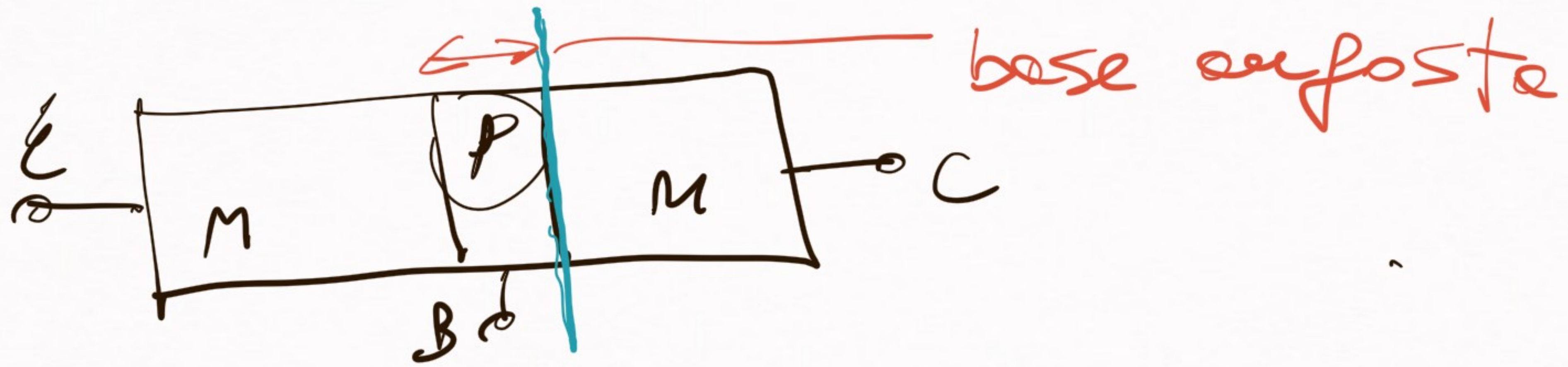


Base es "oposito"
polo dopado

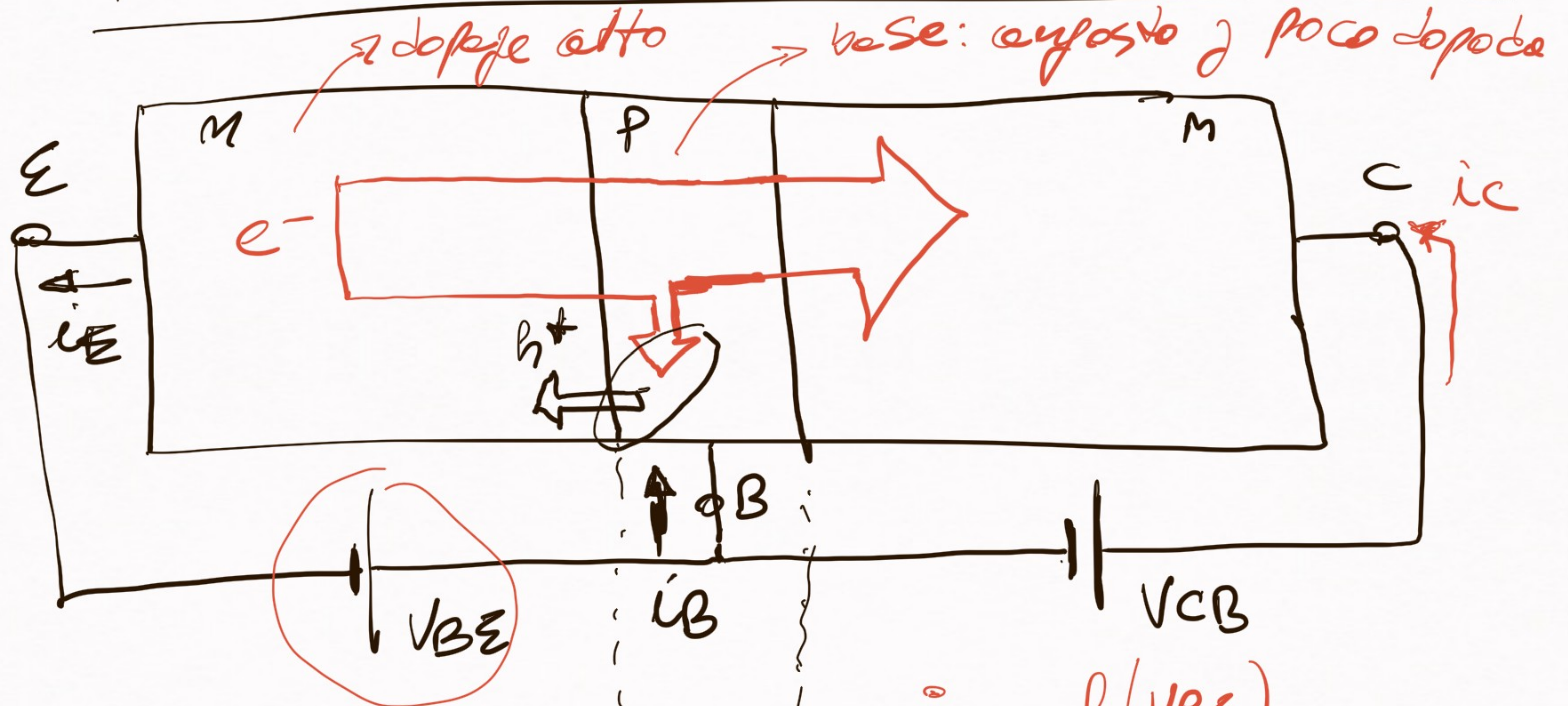
$E \neq C$ (dopaje es distinto)
el dispositivo no es simétrico

Modos de operación del BJT

Zona o modo	Juntura B-E	Juntura B-C	Función
Corte Activa	Inverso Directo	Inverso Inverso	Llave abierta Fuente de corriente (amplificador)
Saturación	Directo	Directo	→ Llave cerrada
Activa inversa	Inverso	Directo	Casi no se usa. No amplificador



Operación BIT MPM en zona activa



$$i_E = i_C + i_B$$

$i_C = f(V_{BE})$
 e indep. de V_{CB} !
 ⇒ fuerza de corriente

ÉCS y modelo del BJT MPM
en zona activa.

$$i_C = I_S \cdot e^{V_{BE}/V_T}$$

$$i_B = i_C / \beta$$

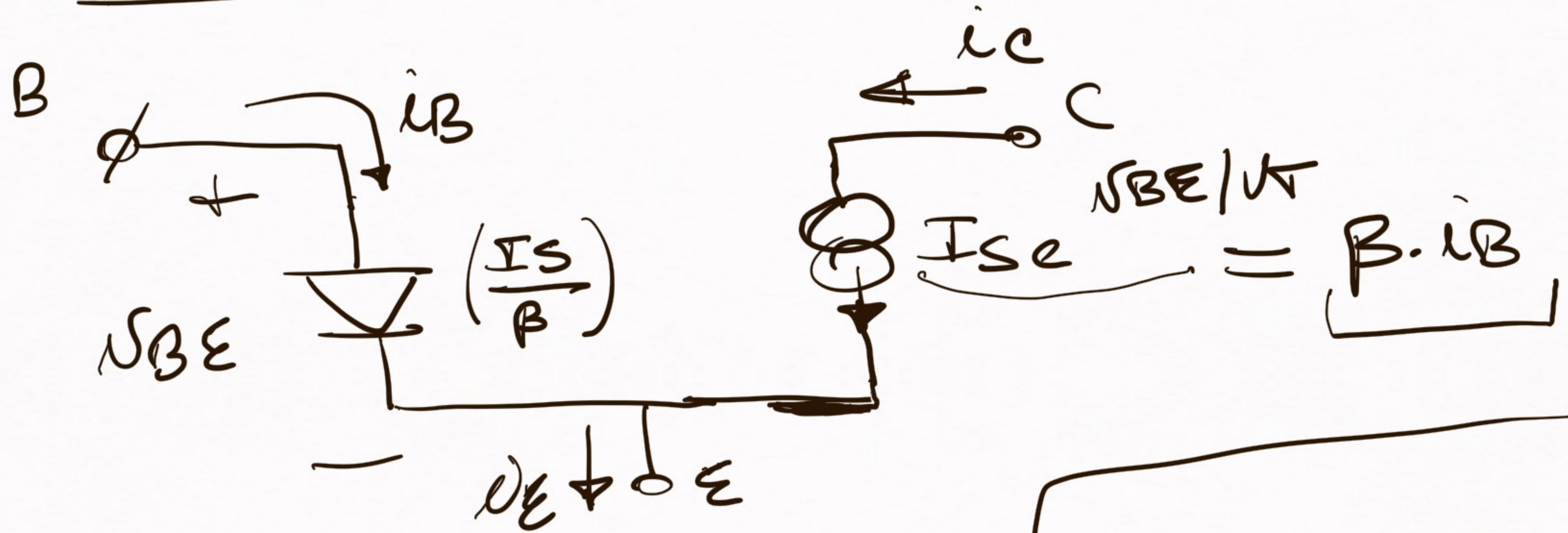
$$i_E = i_C + i_B$$

$$V_T = \frac{kT}{q}$$

β : ganancia de corriente en emisor
común

β : $\left\{ \begin{array}{ll} 100 \dots 200 \dots & \text{BJT de señal} \\ 20 \dots 50 \dots & \text{BJT de potencia} \end{array} \right.$

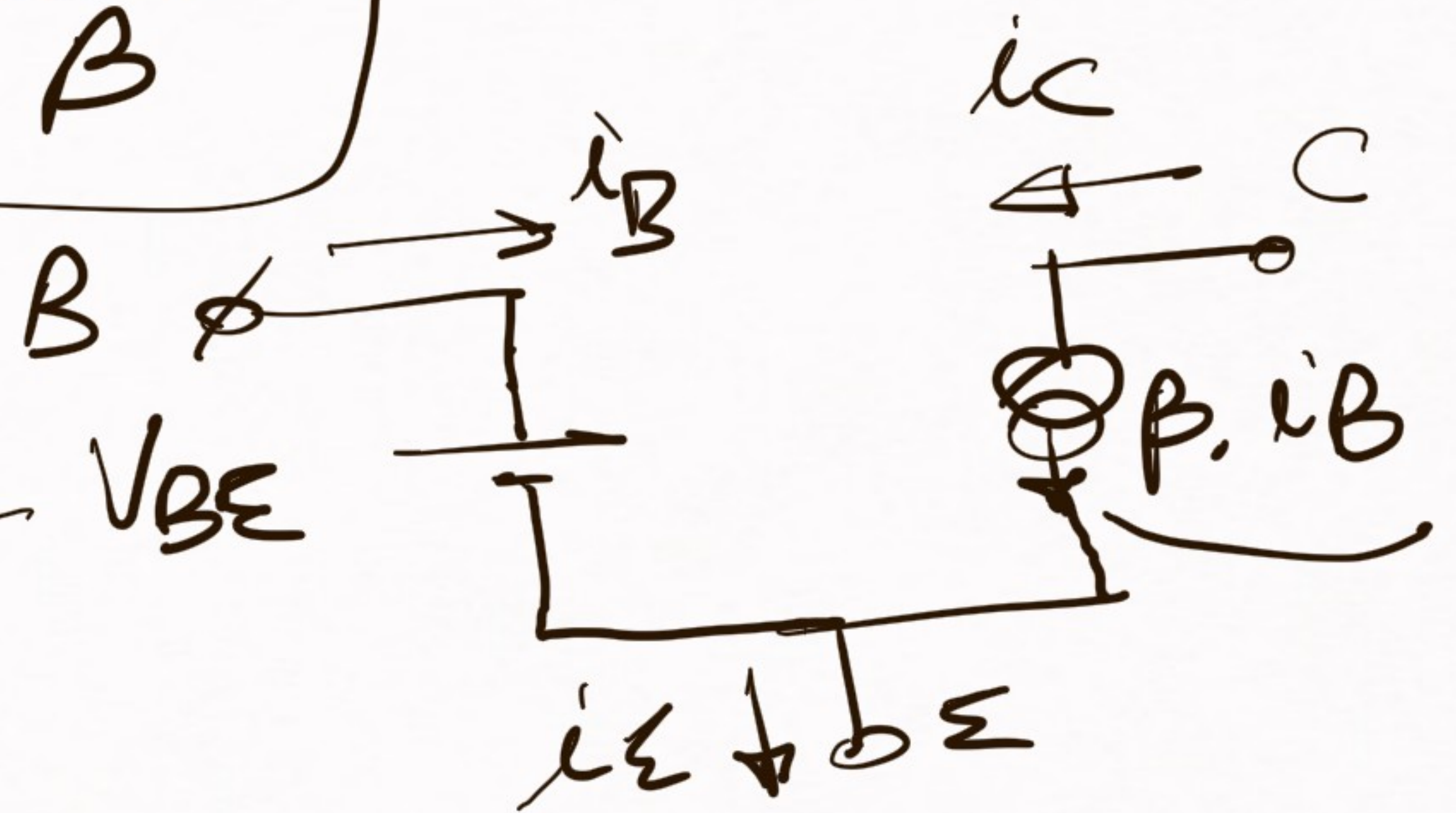
Modelo: MPM en zona activa



$$i_B = \frac{I_s}{\beta} \cdot e^{V_{BE}/V_T} = \frac{i_C}{\beta}$$

Modelo simplificado:

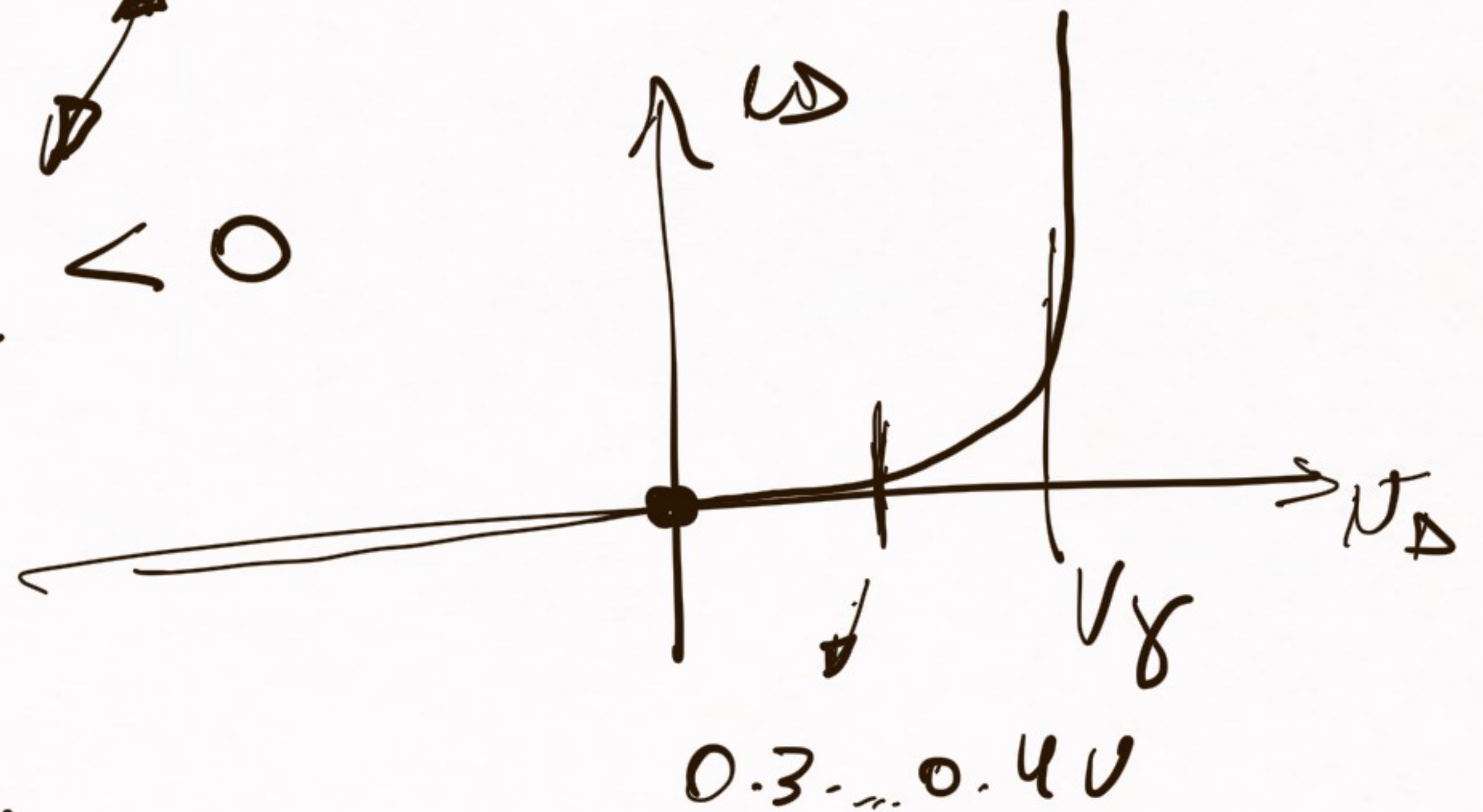
0.6V... 0.7V $\leftarrow V_{BE}$



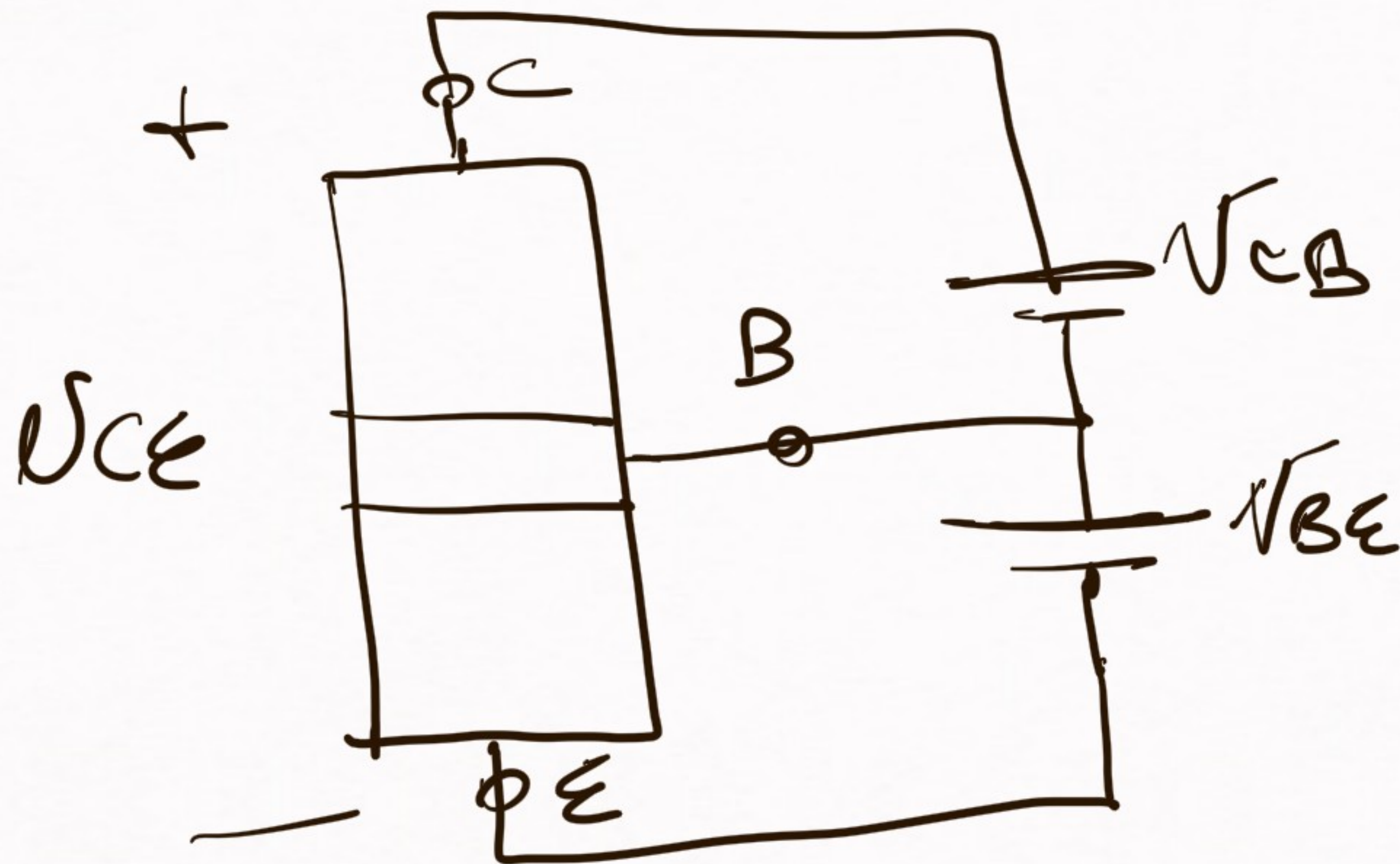
Limites de la zona activa

Z. Activa \equiv B-E directo
B-C inverso

$$V_{BC} < 0$$



En realidad podría ser $V_{BE} < 0.3 \dots 0.4V$.



$$V_{CE} = V_{CB} + V_{BE} = \underbrace{V_{BE}}_{\approx 0.7V} - \underbrace{V_{BC}}_{\approx 0.3V - 0.4V}$$

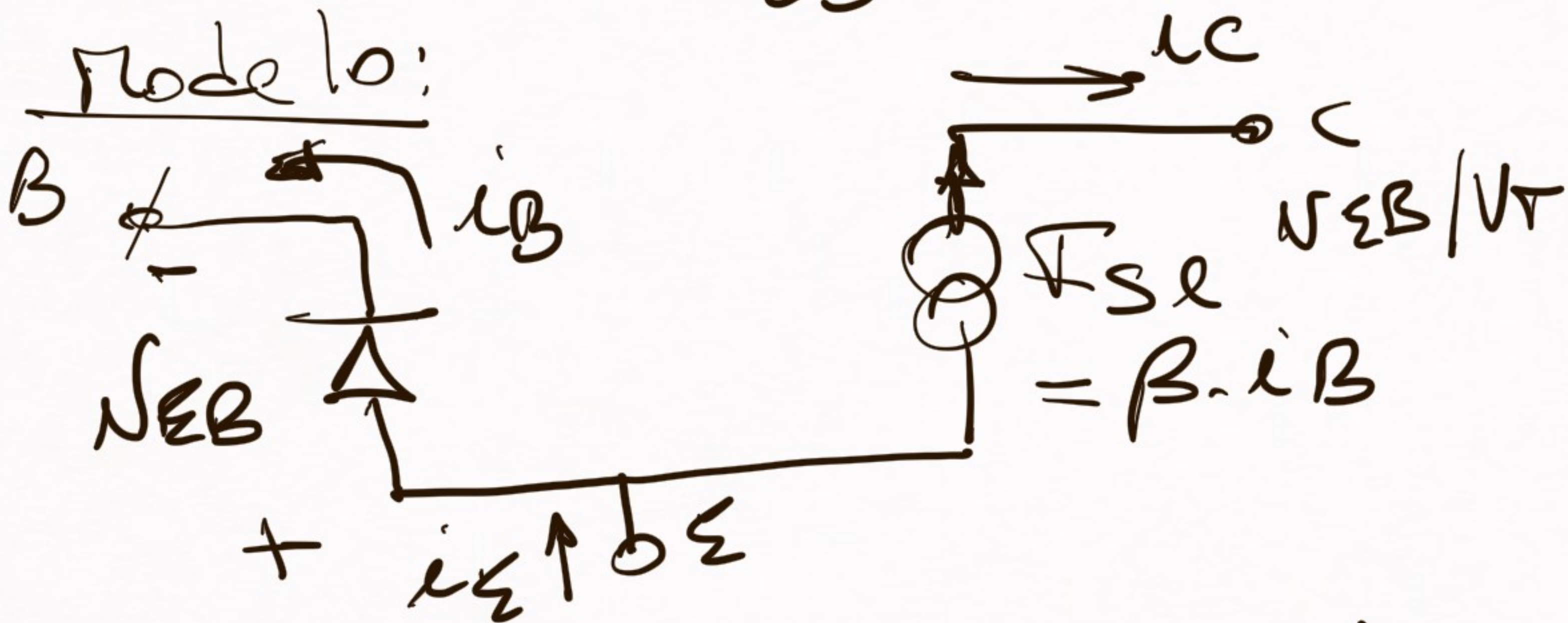
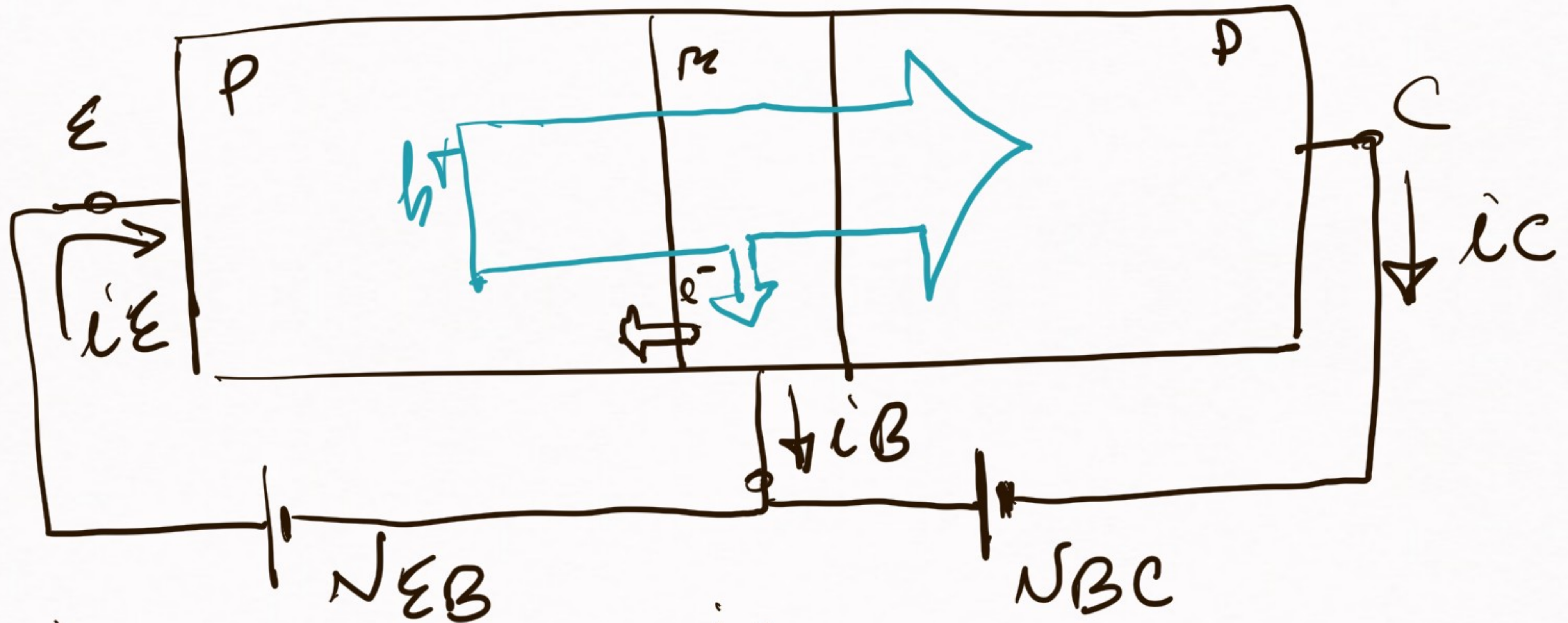
En z. Activo: \rightarrow

\rightarrow límite de zona Activo:

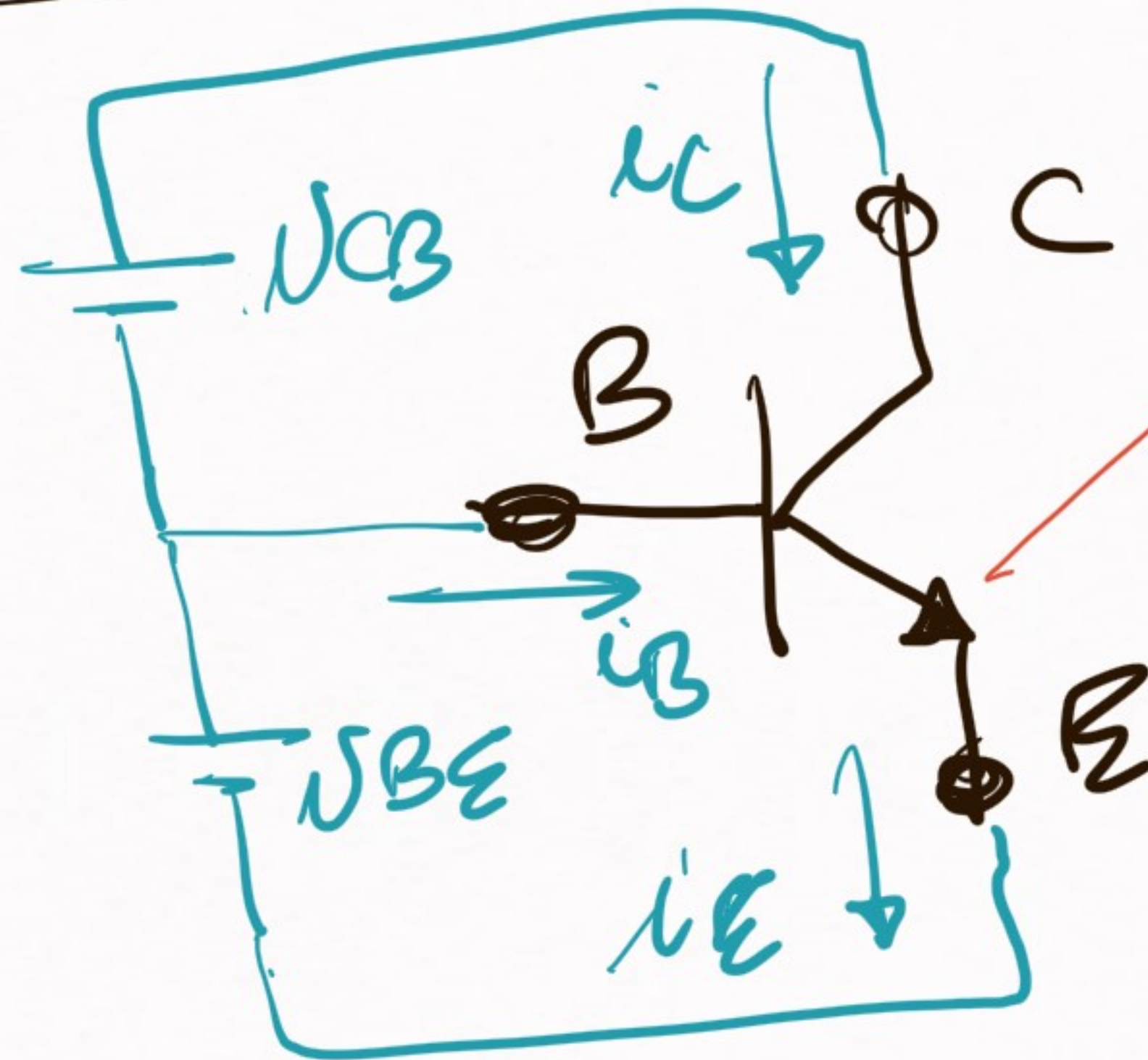
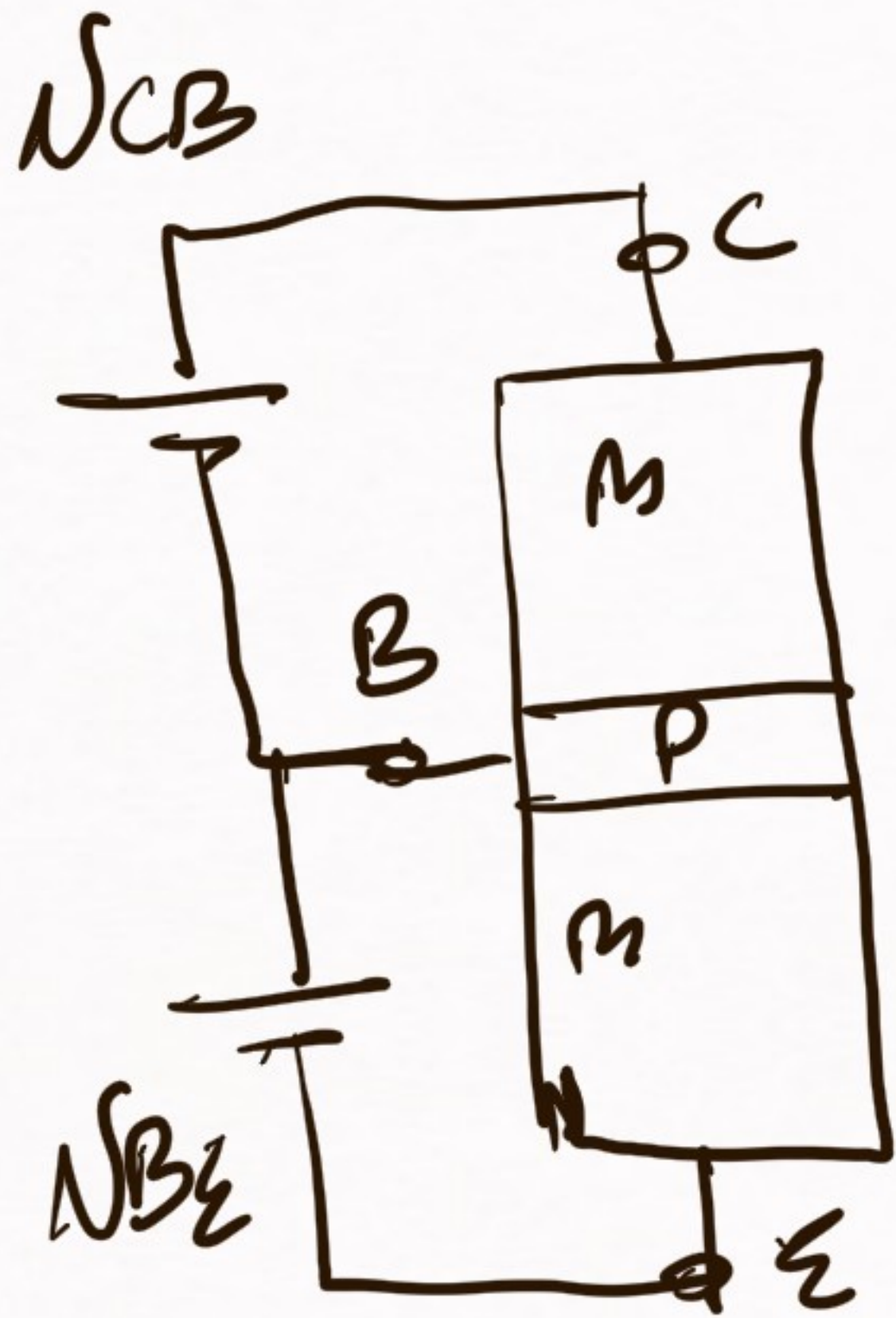
$$\left[\begin{array}{l} V_{CE} > V_{CESAT} \approx 0.3V - 0.2V \\ i_C > 0 \end{array} \right] \rightarrow \left. \begin{array}{l} \text{No saturación} \\ \text{No corte} \end{array} \right\}$$

Transistor pmf.

cu 7. Active

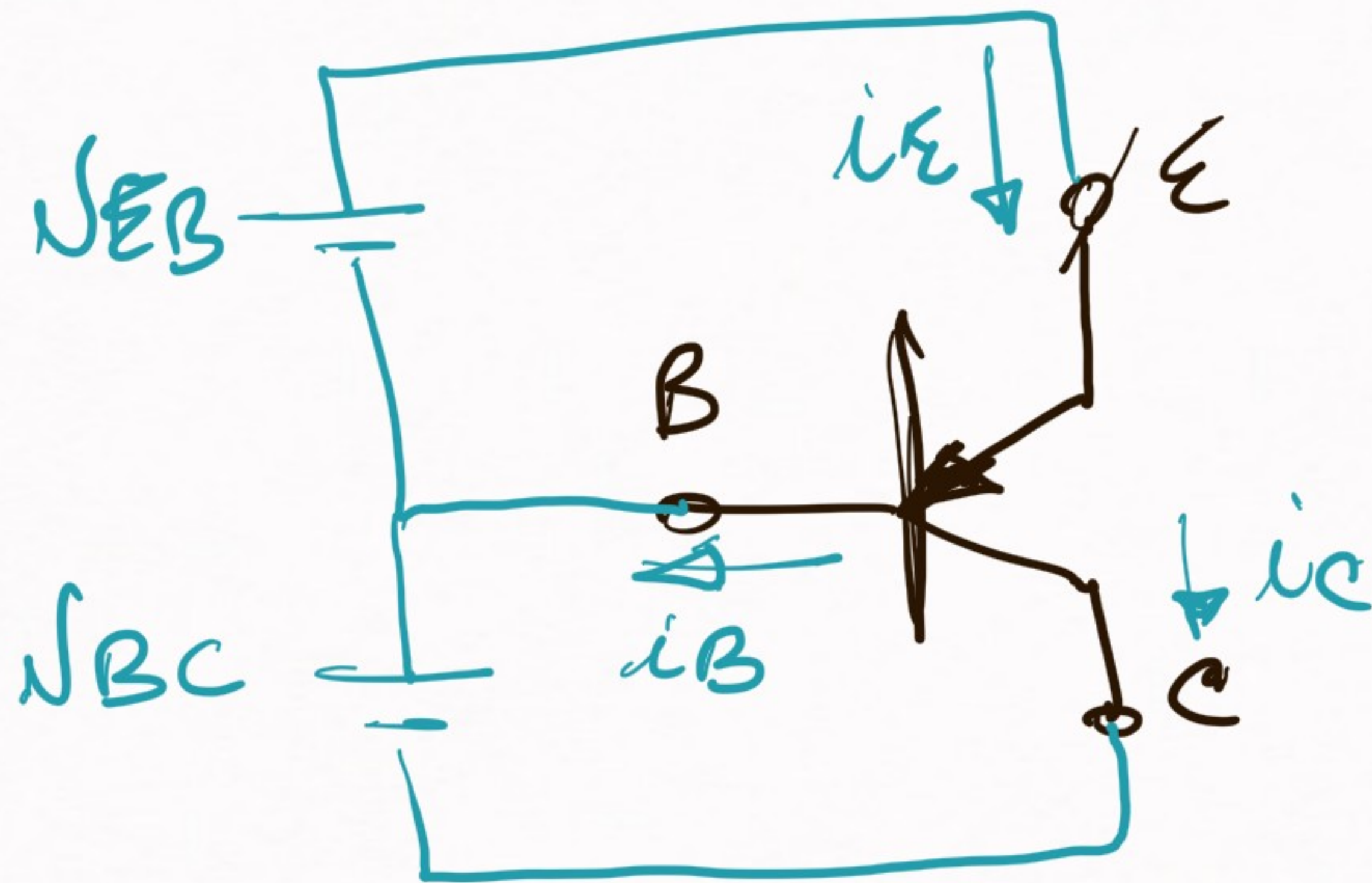


Simbolos de Circuito



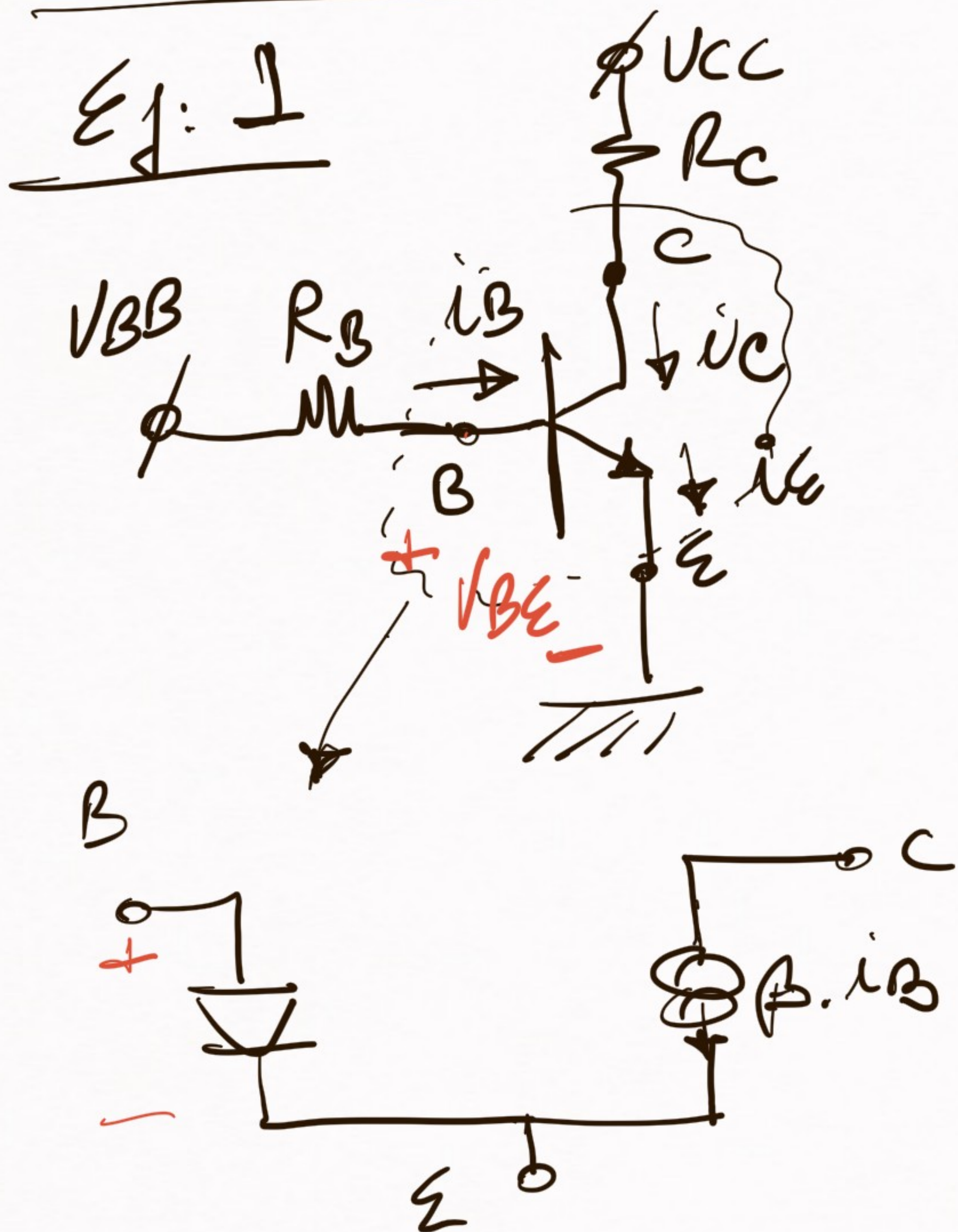
MPM

opunto en el sentido directo de la juntura B-E



MPM

Ej. análisis circ. en DC con transistor npn en zona activa



$i_C?$, $i_B?$ ⊕. Z. Activa

$$V_{BB} - R_B \cdot i_B = V_{BE}$$

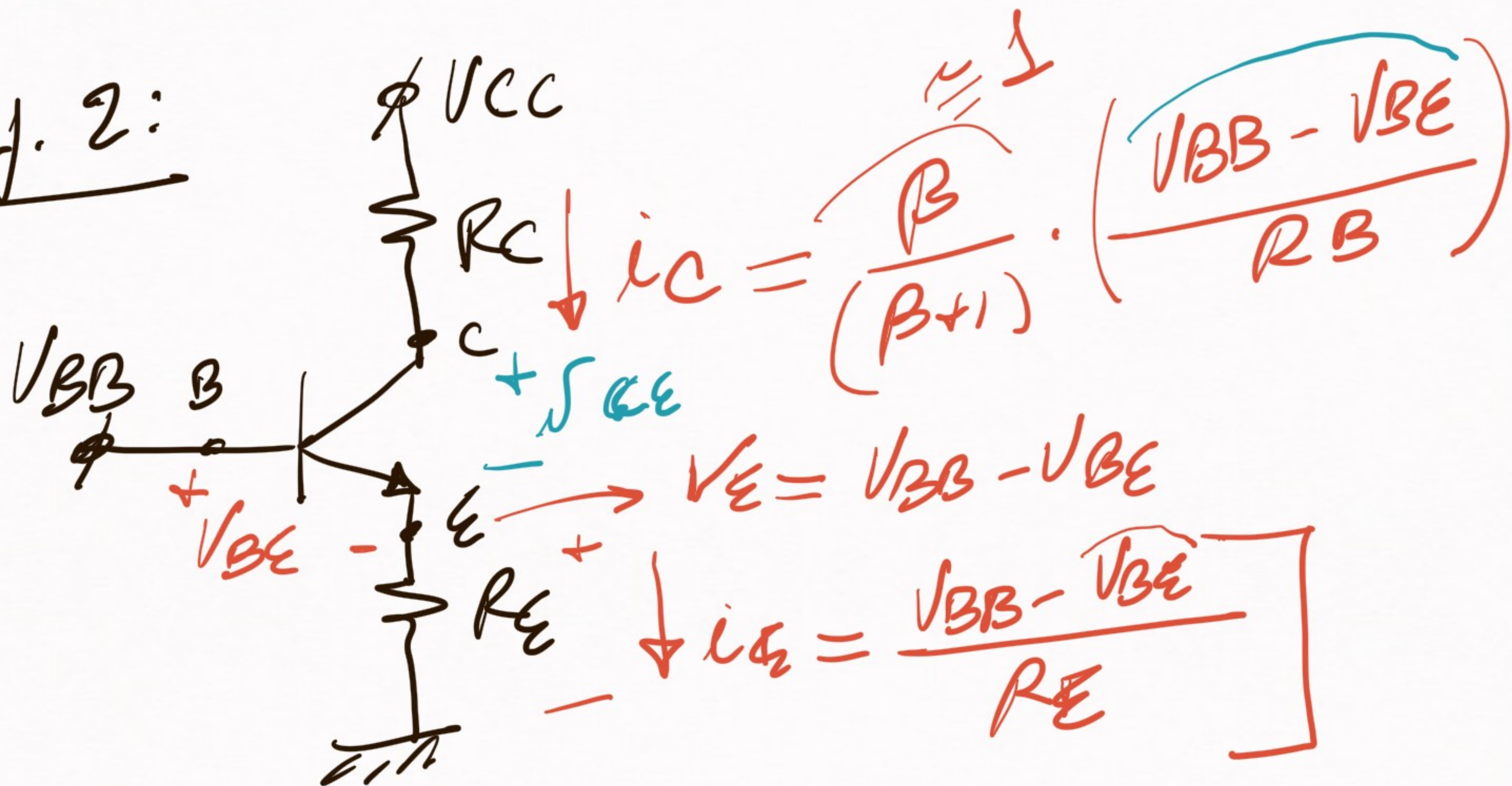
$$\Rightarrow i_B = \frac{V_{BB} - V_{BE}}{R_B}$$

$$\Rightarrow i_C = \beta \cdot i_B$$

$$i_E = (\beta + 1) i_B$$

$\Rightarrow i_C$ depende de β .

Ej. 2:



$$i_E = i_C + i_B = i_C \left(1 + \frac{1}{\beta} \right) = i_C \left(\frac{\beta + 1}{\beta} \right)$$

$$\Rightarrow i_C = \frac{\beta i_E}{\beta + 1}$$

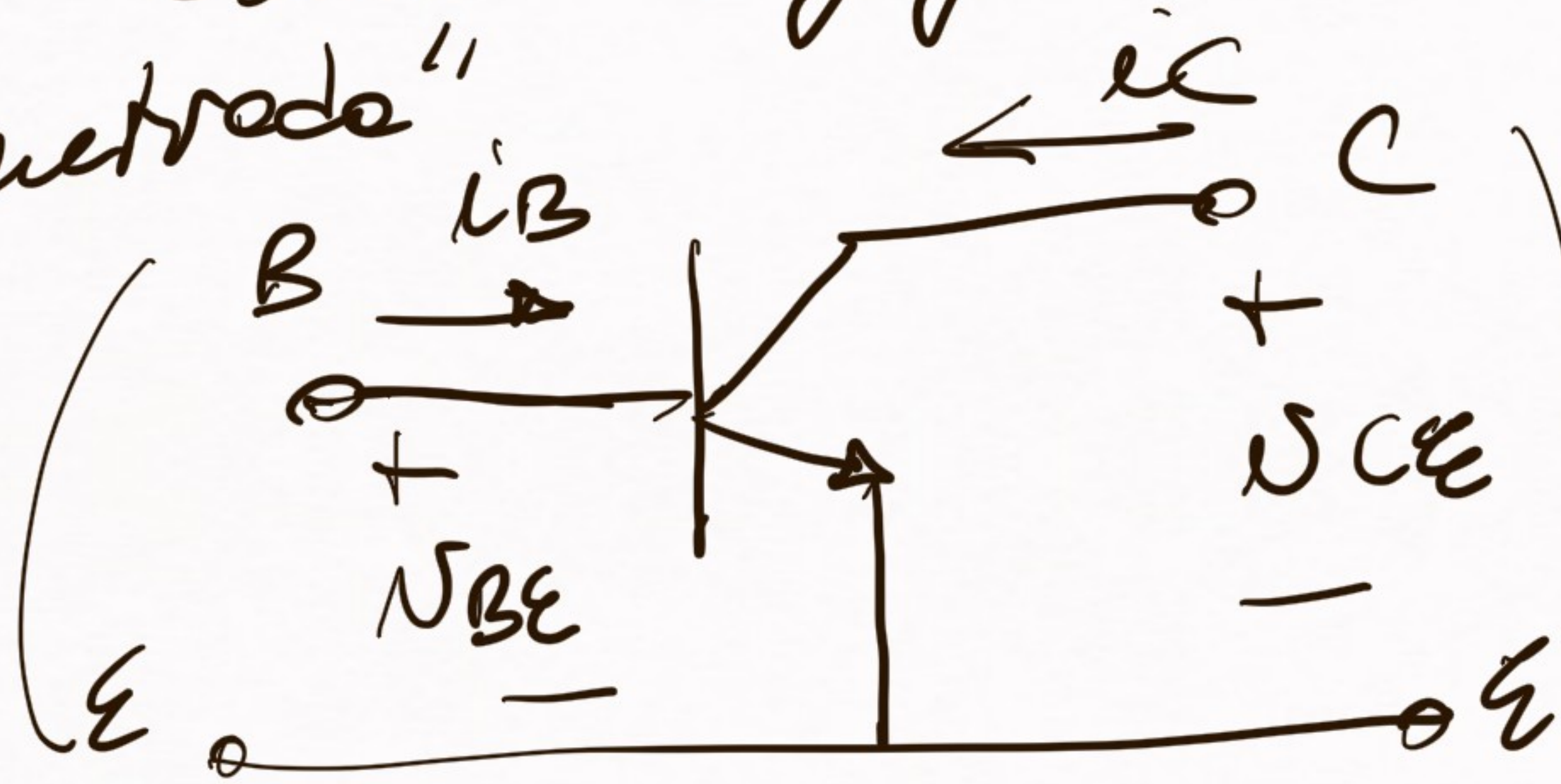
Verif. 3. Activa:

$[V_{CE} > V_{CESAT}]$

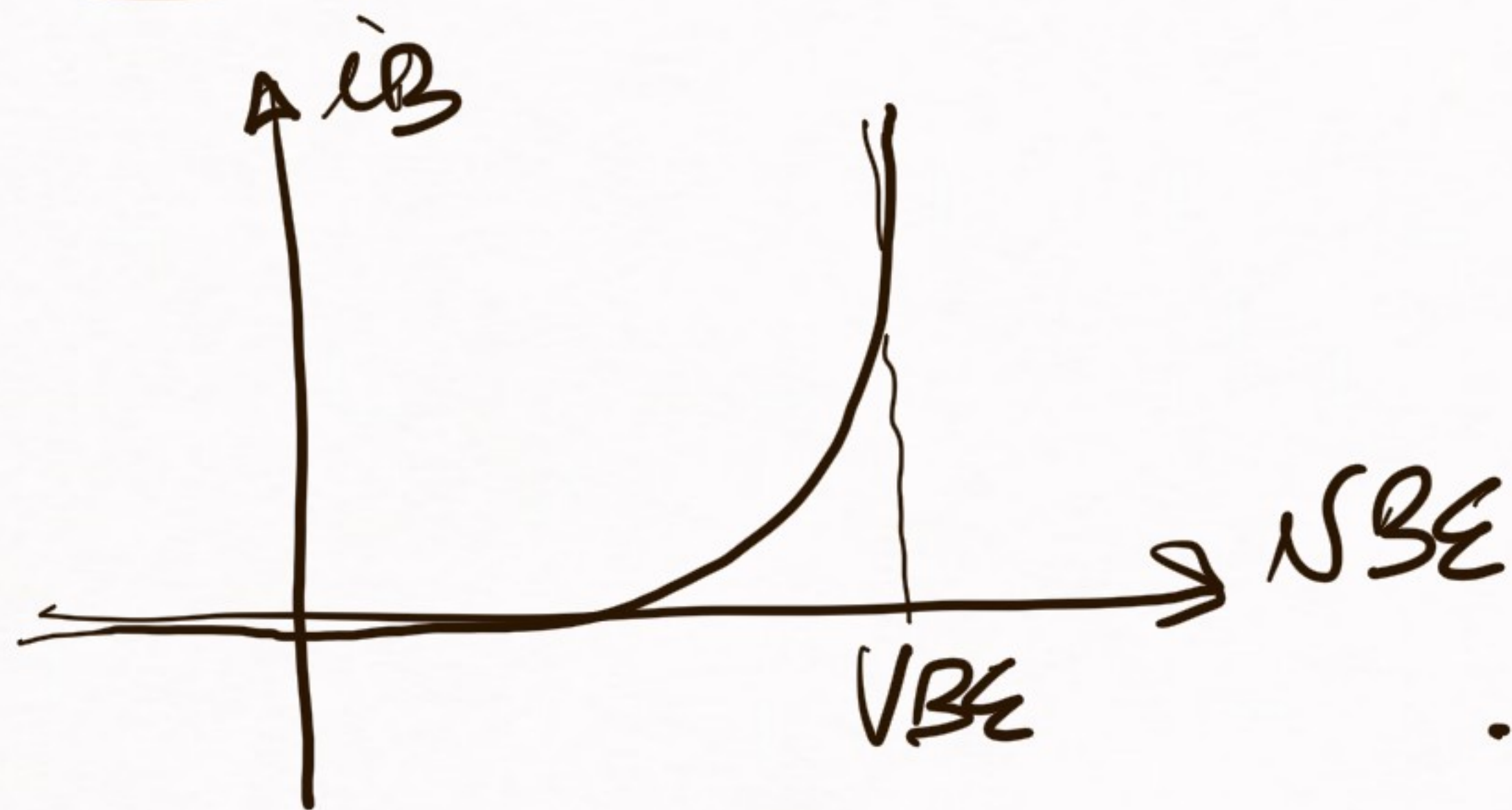
$[i_C > 0]$

Características graficas $i-v$.

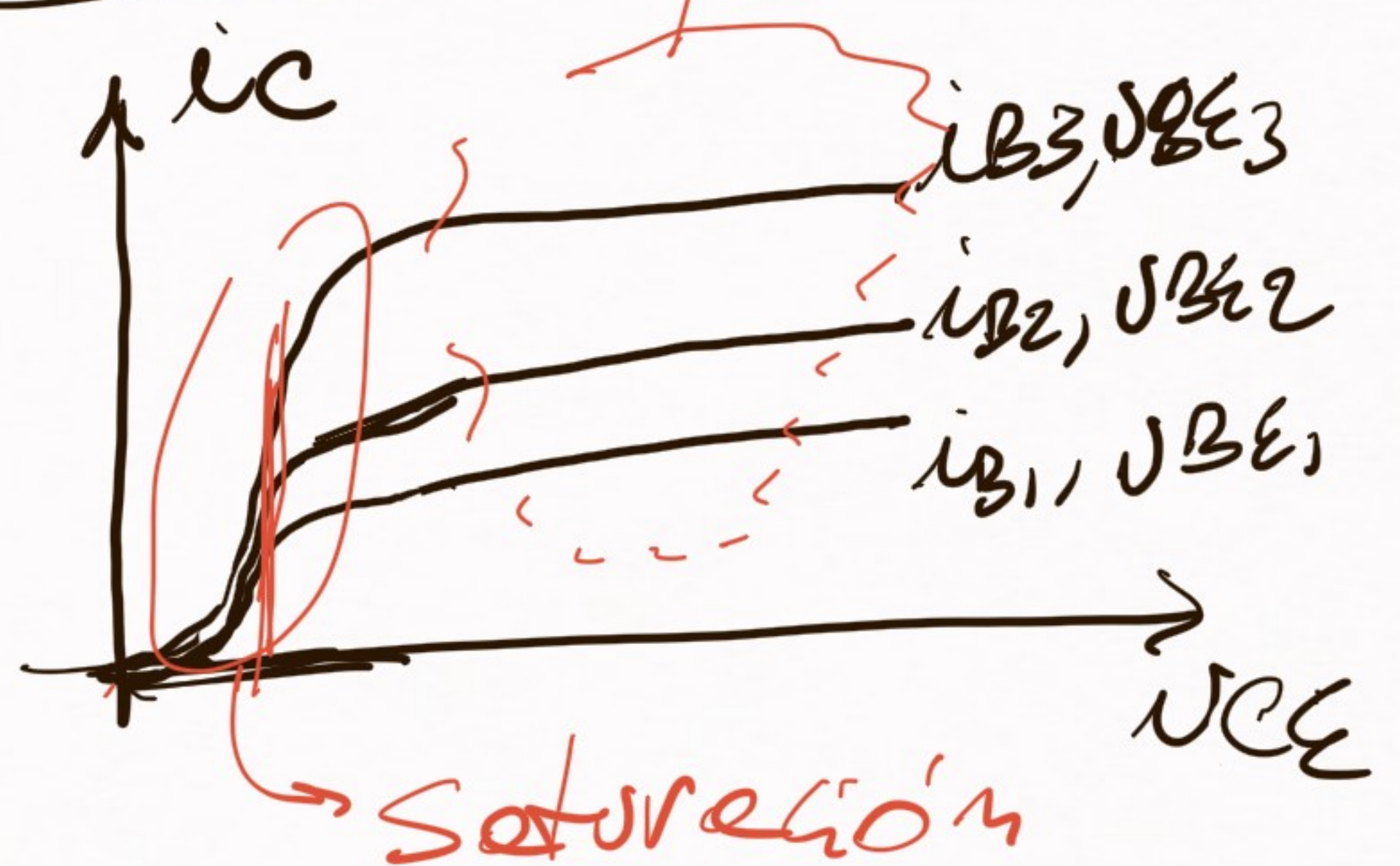
Caso "entrada" Confif. emisor común "salida"



Caract. de entrada:

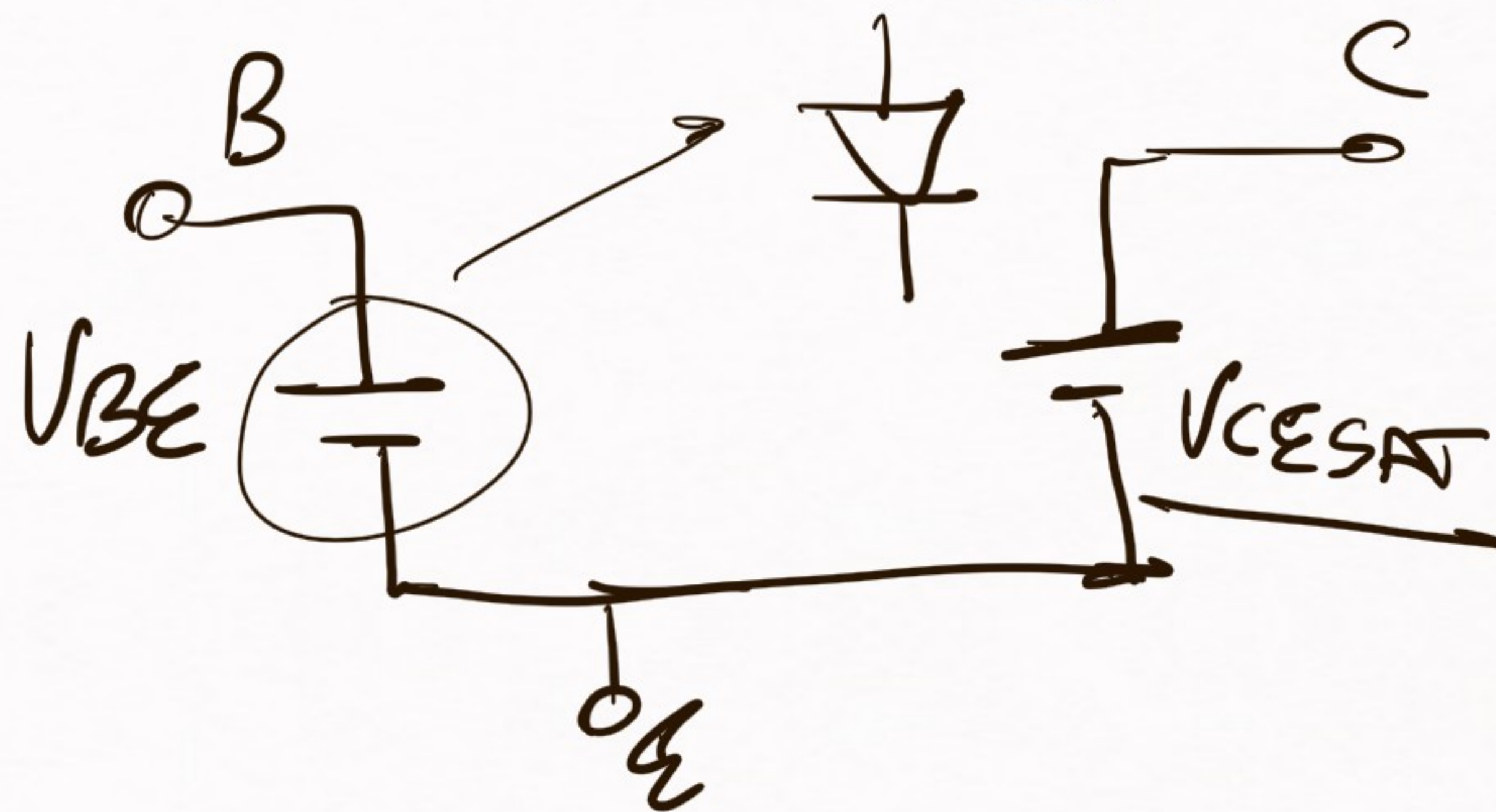
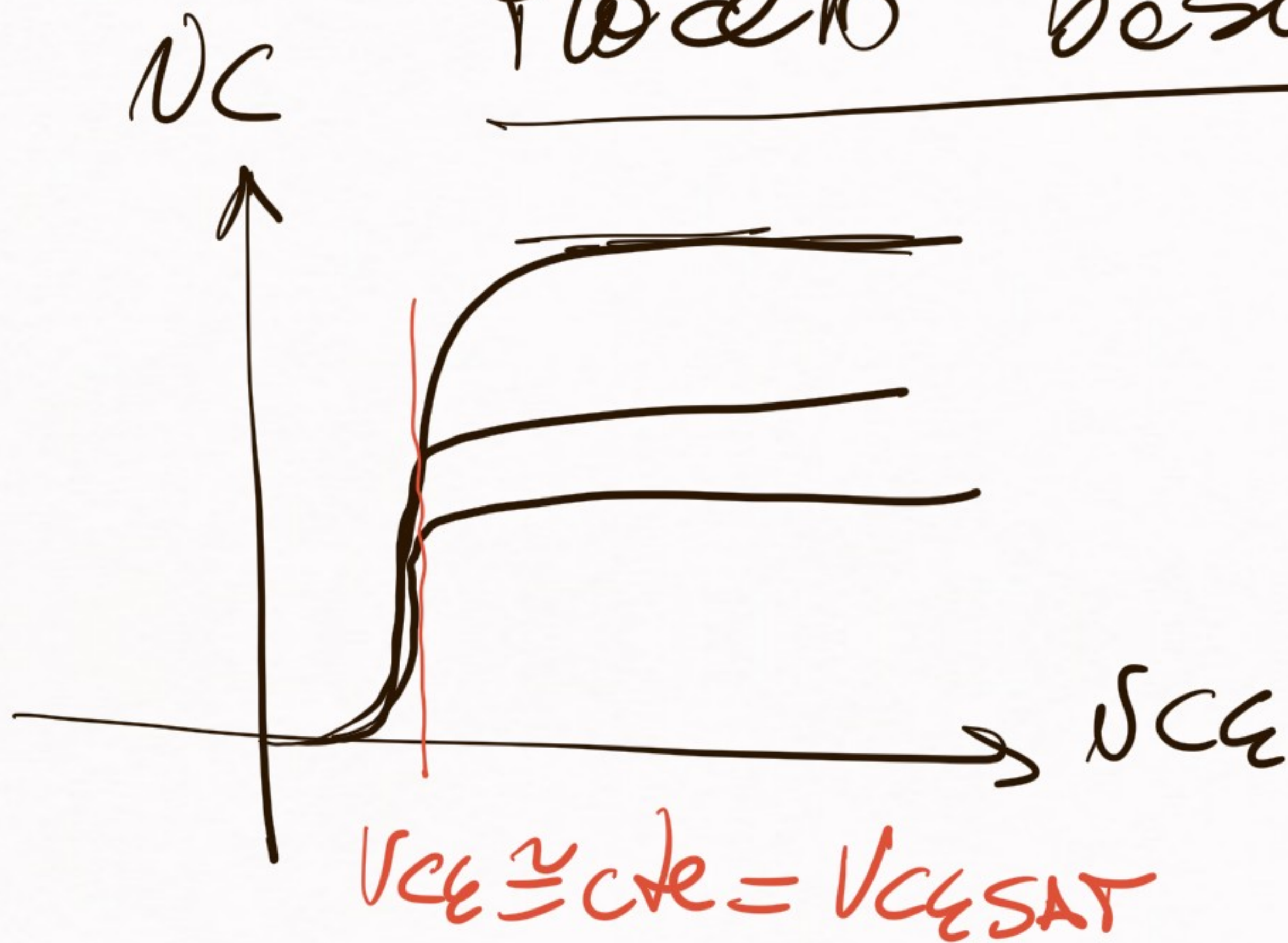


Caract. de salida:



Activa

Modelo básico en saturación:



Condiciones:

$$i_C > 0 \text{ (no corte)}$$

$$i_C < \beta \cdot i_B \text{ (no z. activa)}$$

Comparison BIT vs MOS

	BIT	MOS
Variable de control	V_{BE}, I_B	$V_{GS}, (V_{GS})$
Fracción de corriente	$I_B \neq 0$	$I_G \approx 0$ (a low freq)
Level ON	$I_C = f(V_{BE})$ exponencial	$I_D = f(V_{GS})$ (f(V _{GS})) cuadrática
Tensión de control	$V_{CE} \approx cte$ $= V_{CESAT}$ $V_{BE} \approx cte$	<u>Row</u> $V_{GS}, (V_{GS})$ variables