BJT
(Bipolar Junction Transistor)

Elektronika
(TKE 4012)

Eka Maulana

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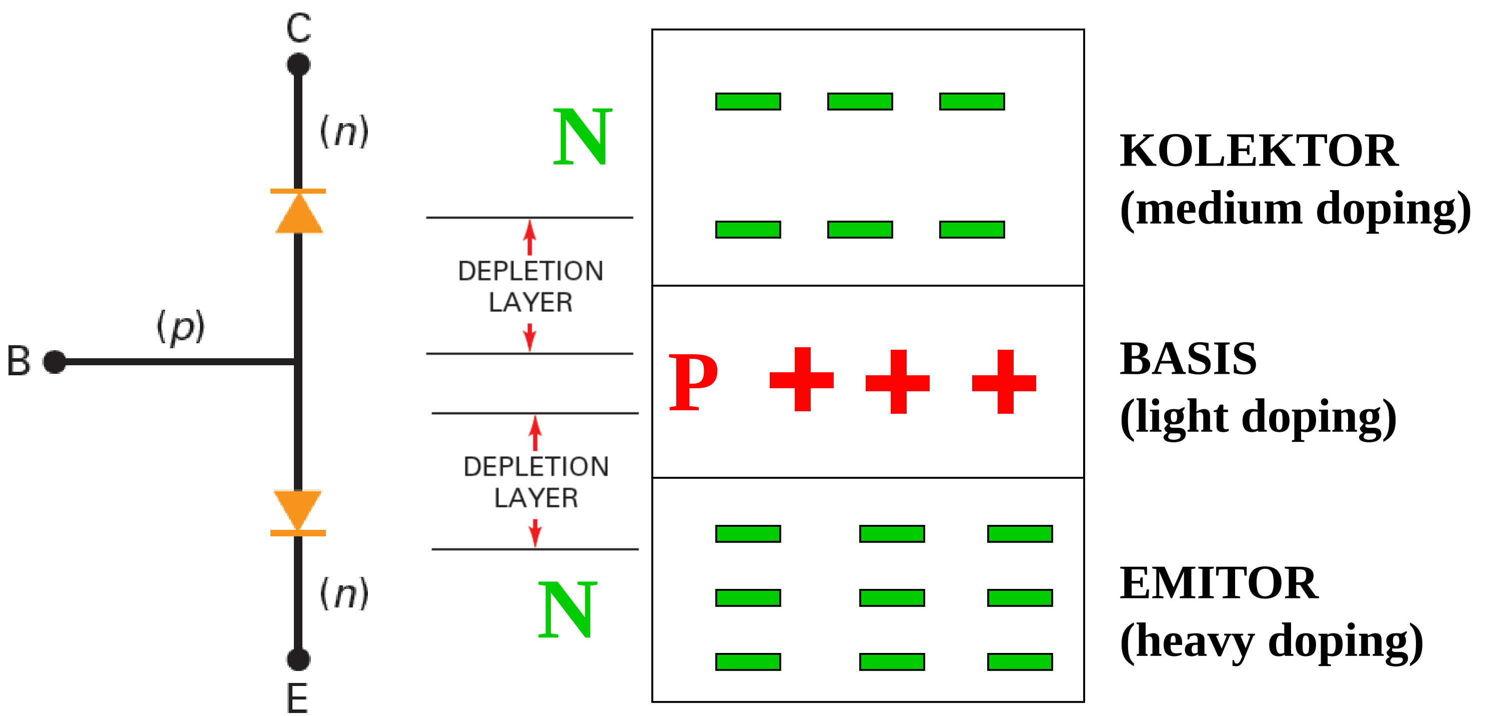
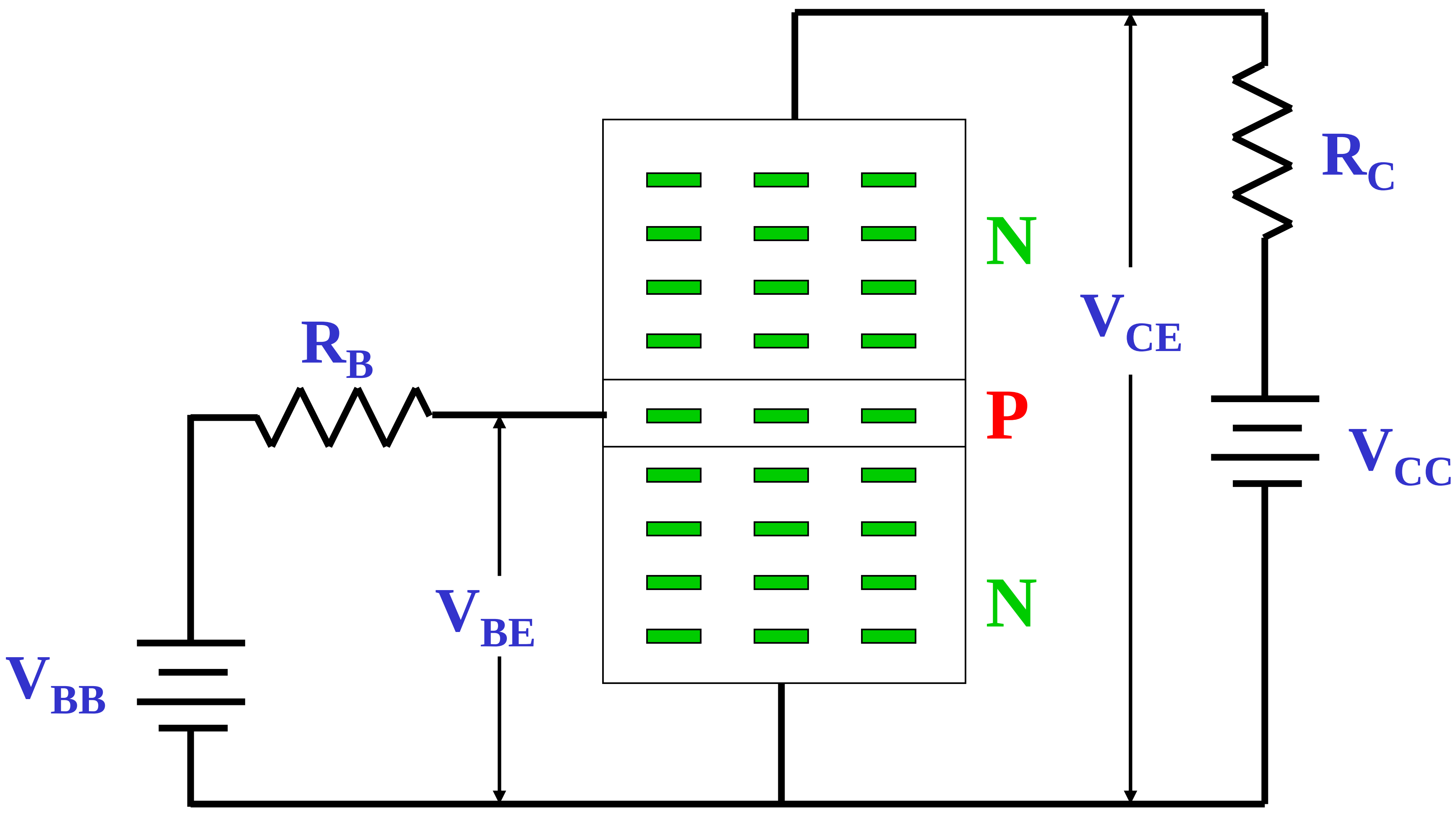
Pokok Bahasan

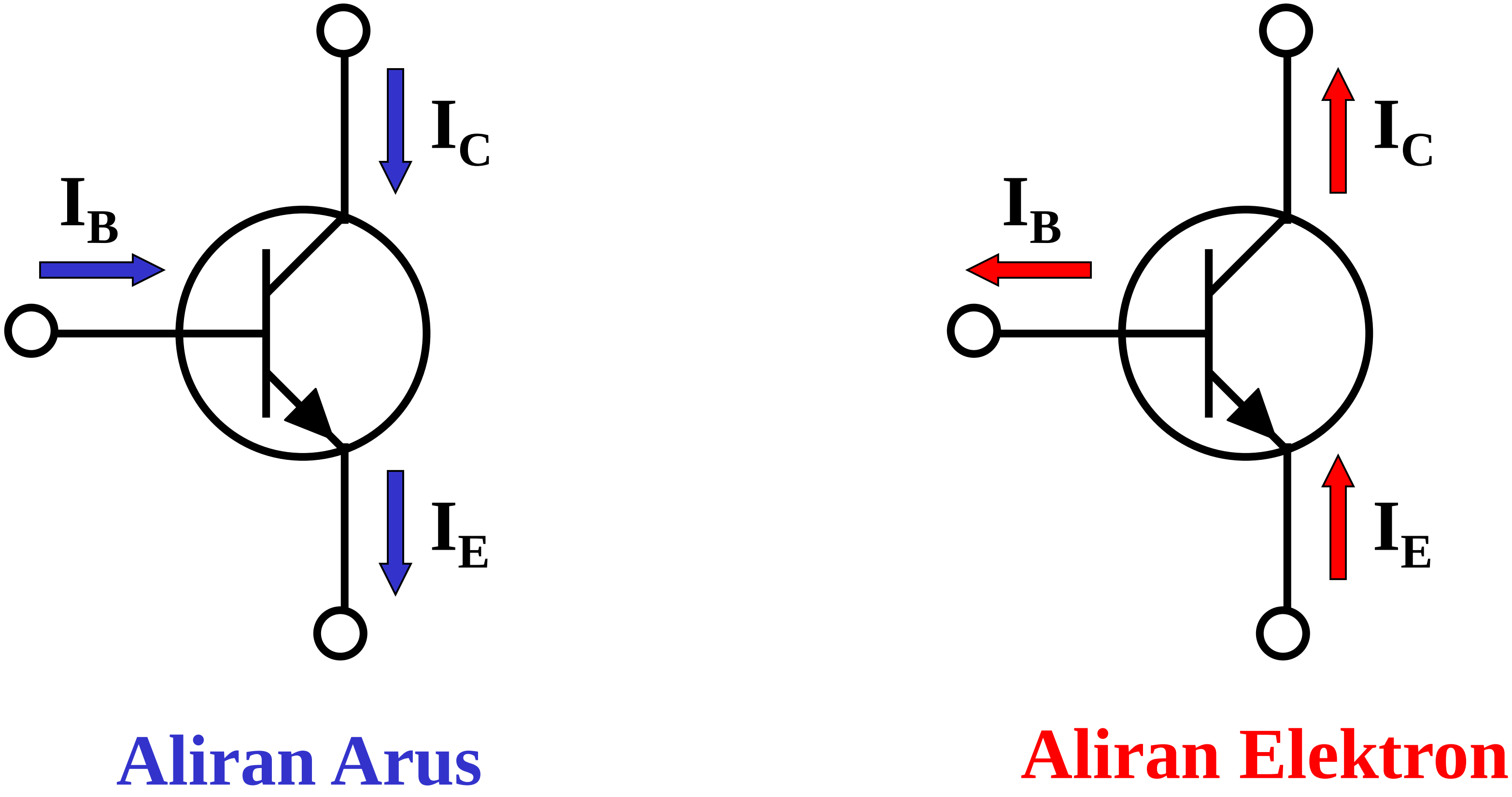
- Dasar Transistor
- Arus transistor
- Koneksi rangkaian
- Kurva transistor
- Pendekatan transistor
- Datasheet
- Load Line
- Titik Kerja

BJT terdiri dari 3 bagian (dopping)



Saat transistor NPN dibias maju, electron emiter menyebar ke basis dan kolektor





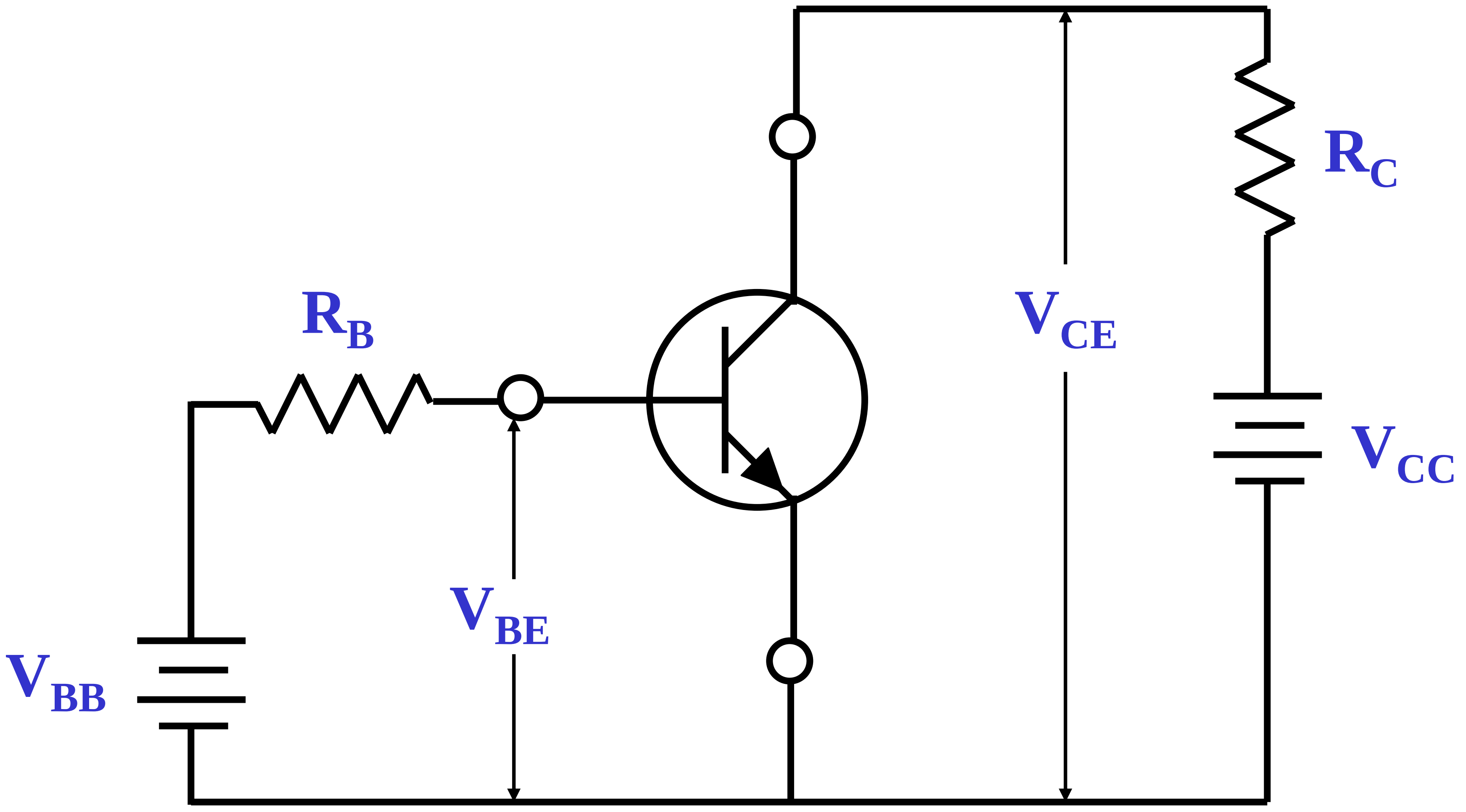
$I_E = I_C + I_B$ $\quad$ $I_C \cong I_E$ $\quad$ $I_B << I_C$

$$\alpha_{dc} = \frac{I_C}{I_E} \qquad \beta_{dc} = \frac{I_C}{I_B}$$

BJT (Bipolar Junction Transistor)

Common Emitor memiliki dua loop:

Loop Basis dan Loop Kolektor

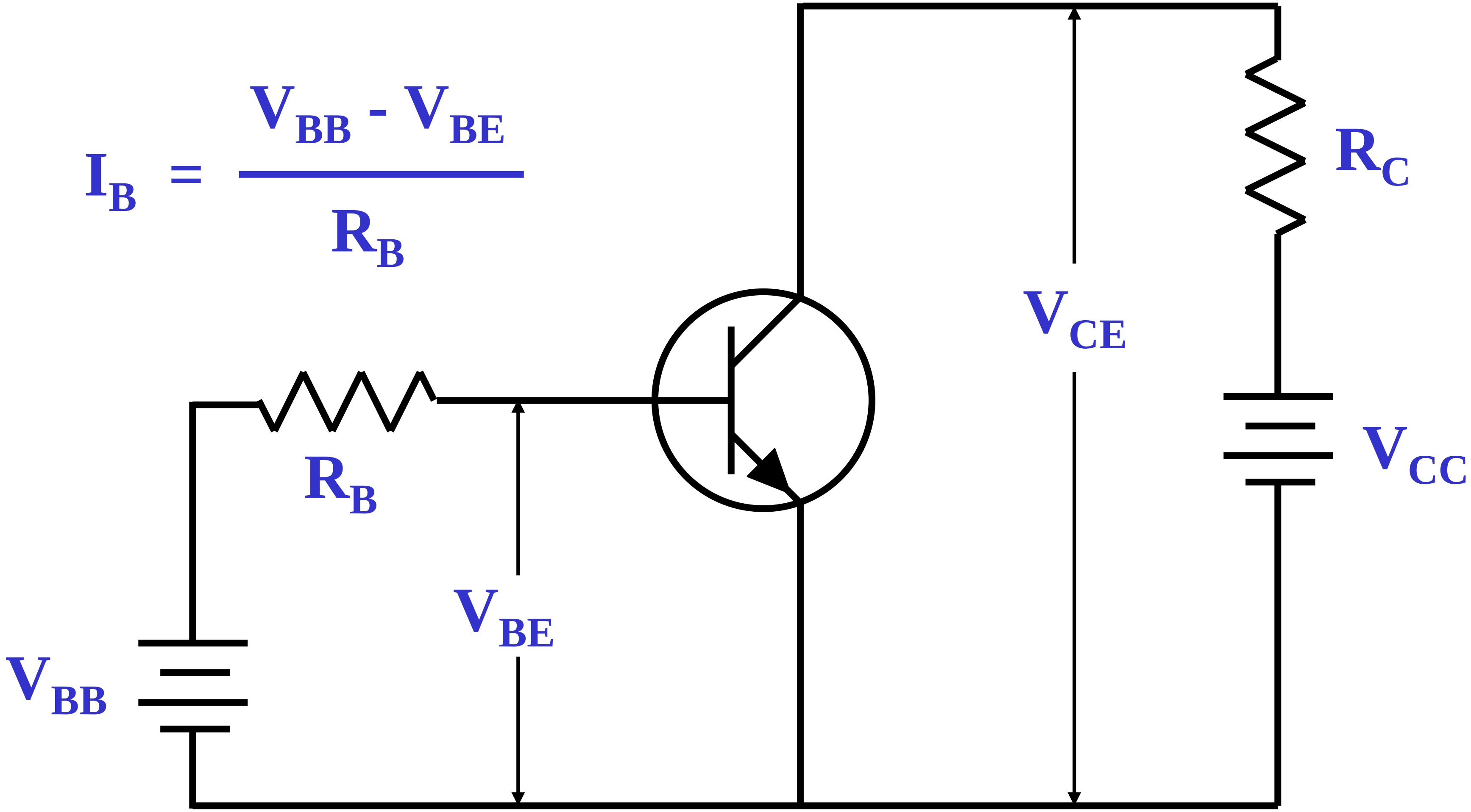


Notasi Subscript

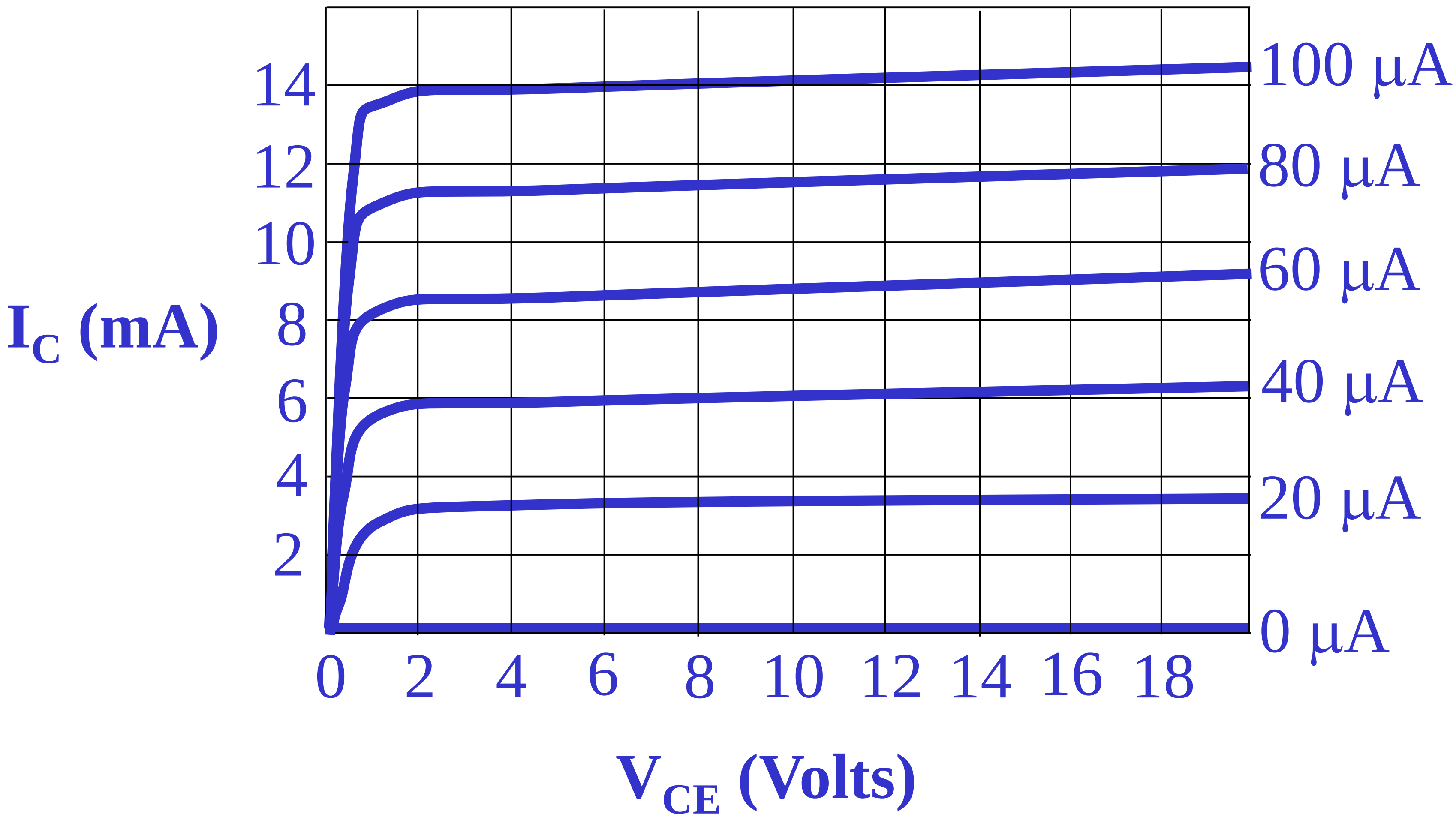
- **Ketika notasi subscript sama, maka menyatakan sumber tegangan (V_{CC}).**
- **Ketika notasi subscript sama, menyatakan tegangan dua titik (V_{CE}).**
- **Notasi single digunakan untuk menyatakan tegangan node dengan ground sebagai referensi (V_C).**

Rangkaian pada BASIS biasanya dianalisis dengan pendekatan yang sama seperti digunakan pada dioda.

$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$



Grafik I_C versus V_{CE}



(nilai I_B baru merepresentasikan kurva baru)

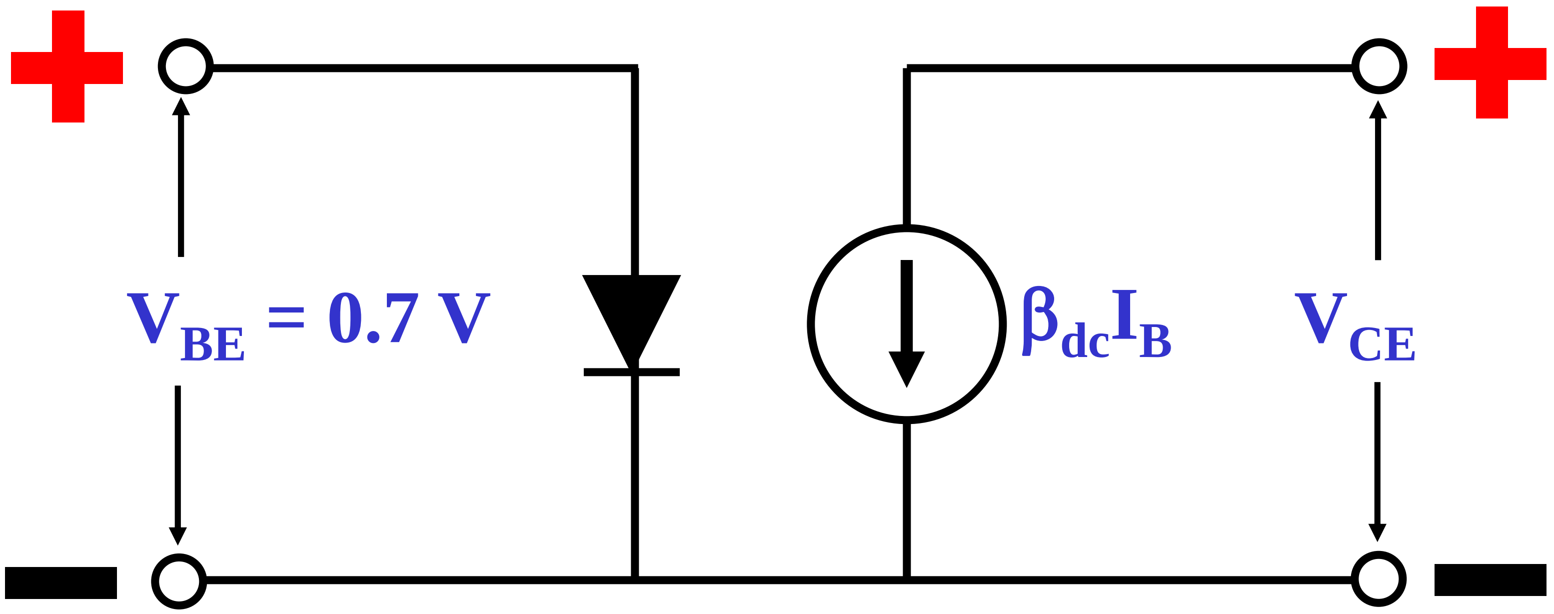
Daerah Kerja Transistor

- **Cutoff -** digunakan untuk aplikasi switching
- **Active -** digunakan untuk **penguatan linear**
- **Saturation -** digunakan untuk aplikasi switching
- **Breakdown - dapat merusak transistor**

Pendekatan Rangkaian Transistor

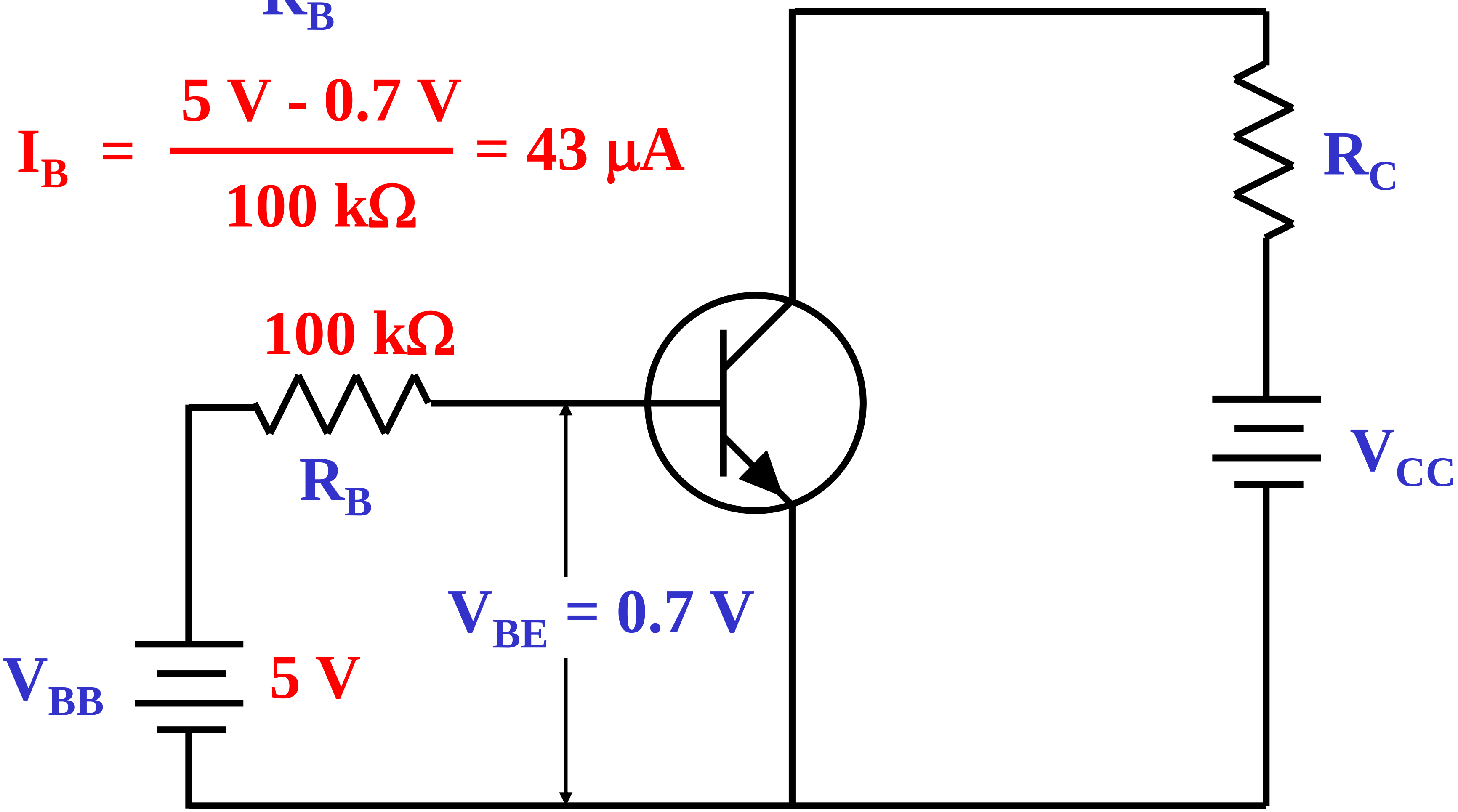
- **First: dioda ideal pada basis-emitor dan menggunakan βI_B untuk menentukan I_C.**
- **Second: menggunakan V_{BE} dan βI_B untuk menentukan I_C.**
- **Third (and higher): menggunakan perhitungan resistansi bulk dan pengaruh lain.** Biasanya diselesaikan dengan simulasi komputer.

Pendekatan Kedua:



$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$

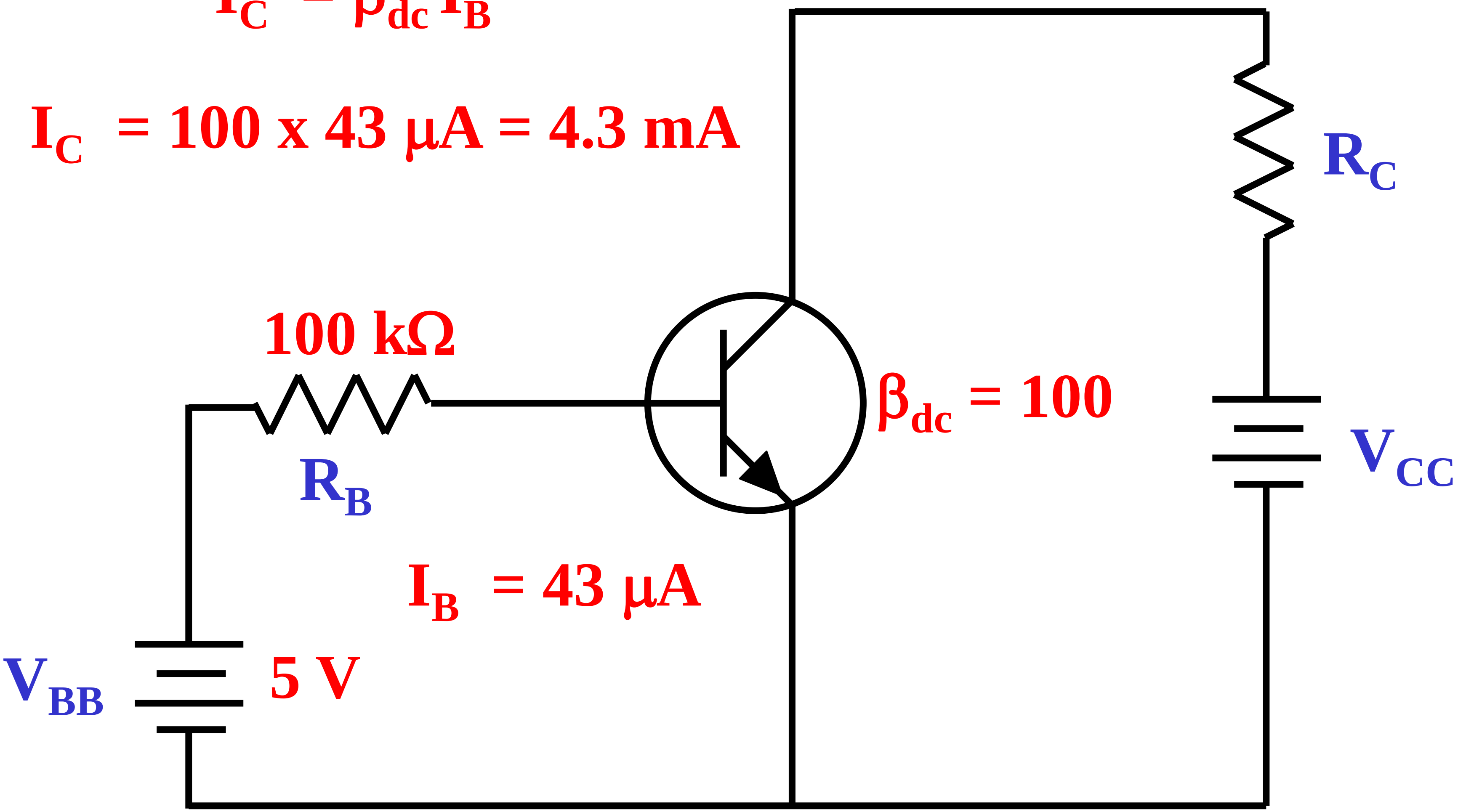
$$I_B = \frac{5\text{ V} - 0.7\text{ V}}{100\text{ k}\Omega} = 43\ \mu\text{A}$$



BJT (Bipolar Junction Transistor)

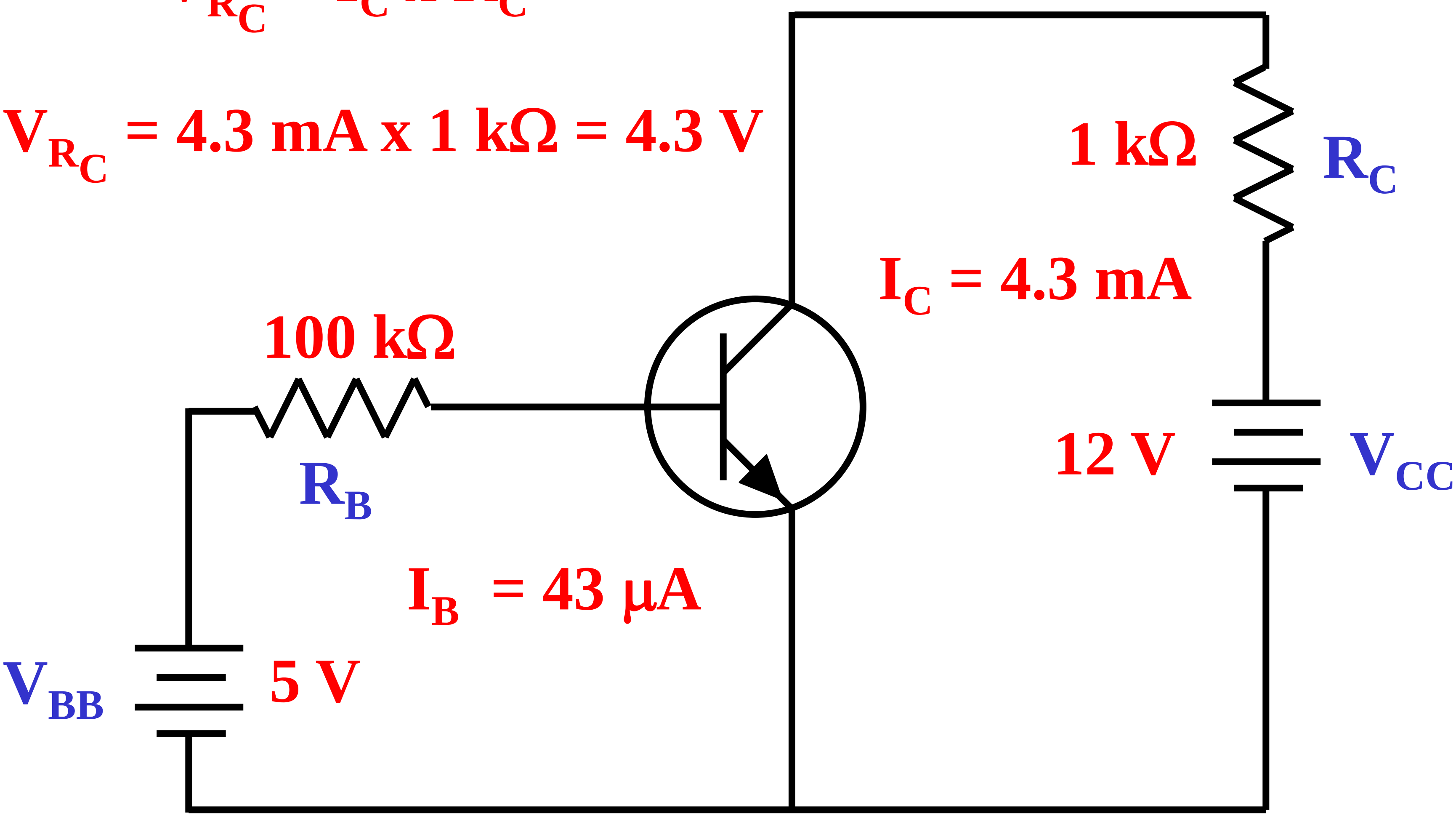
$$I_C = \beta_{dc} I_B$$

$$I_C = 100 \times 43\ \mu A = 4.3\ mA$$



$$V_{R_C} = I_C \times R_C$$

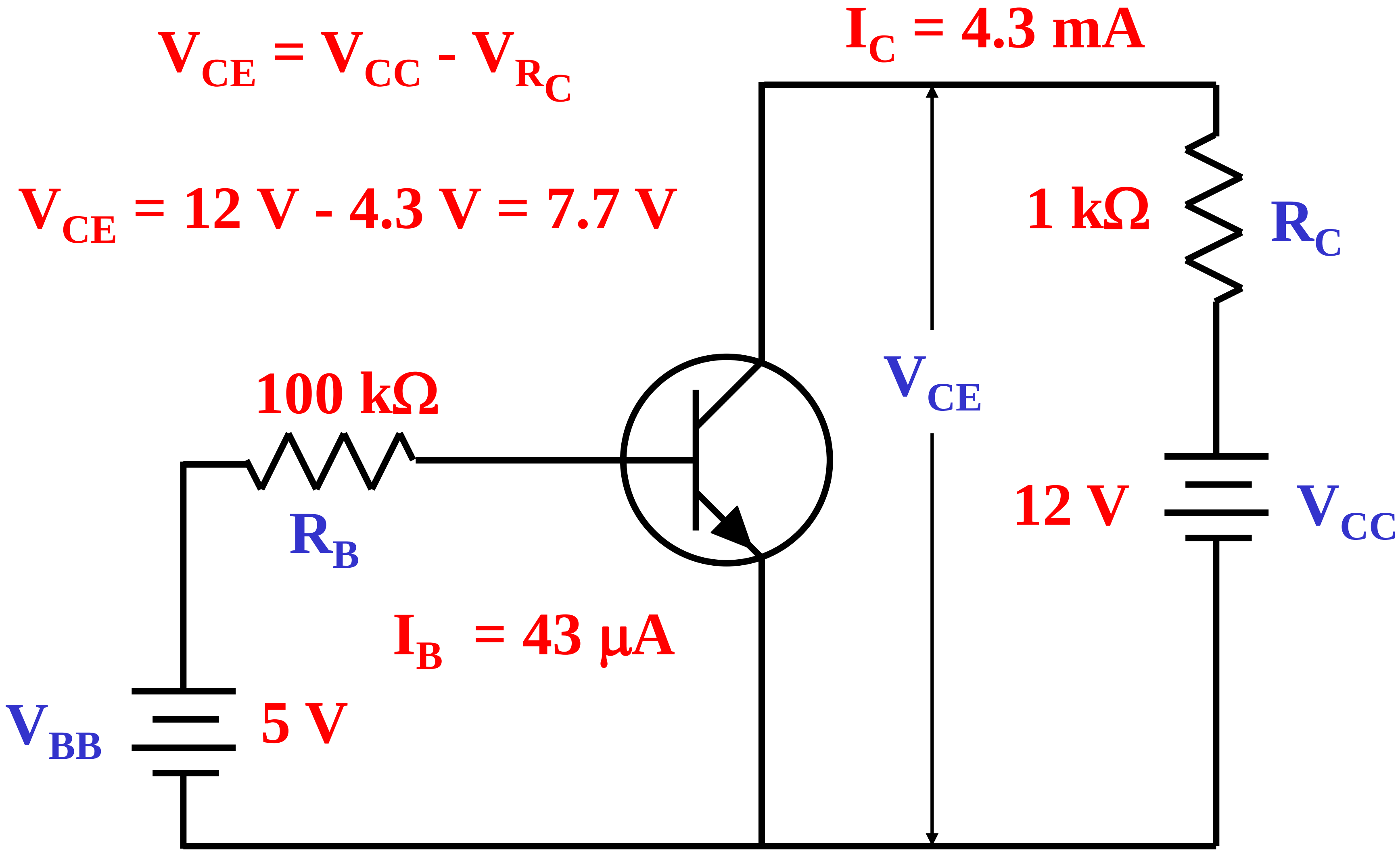
$$V_{R_C} = 4.3\ \text{mA} \times 1\ \text{k}\Omega = 4.3\ \text{V}$$



BJT (Bipolar Junction Transistor)

$$V_{CE} = V_{CC} - V_{R_C}$$

$$V_{CE} = 12\text{ V} - 4.3\text{ V} = 7.7\text{ V}$$



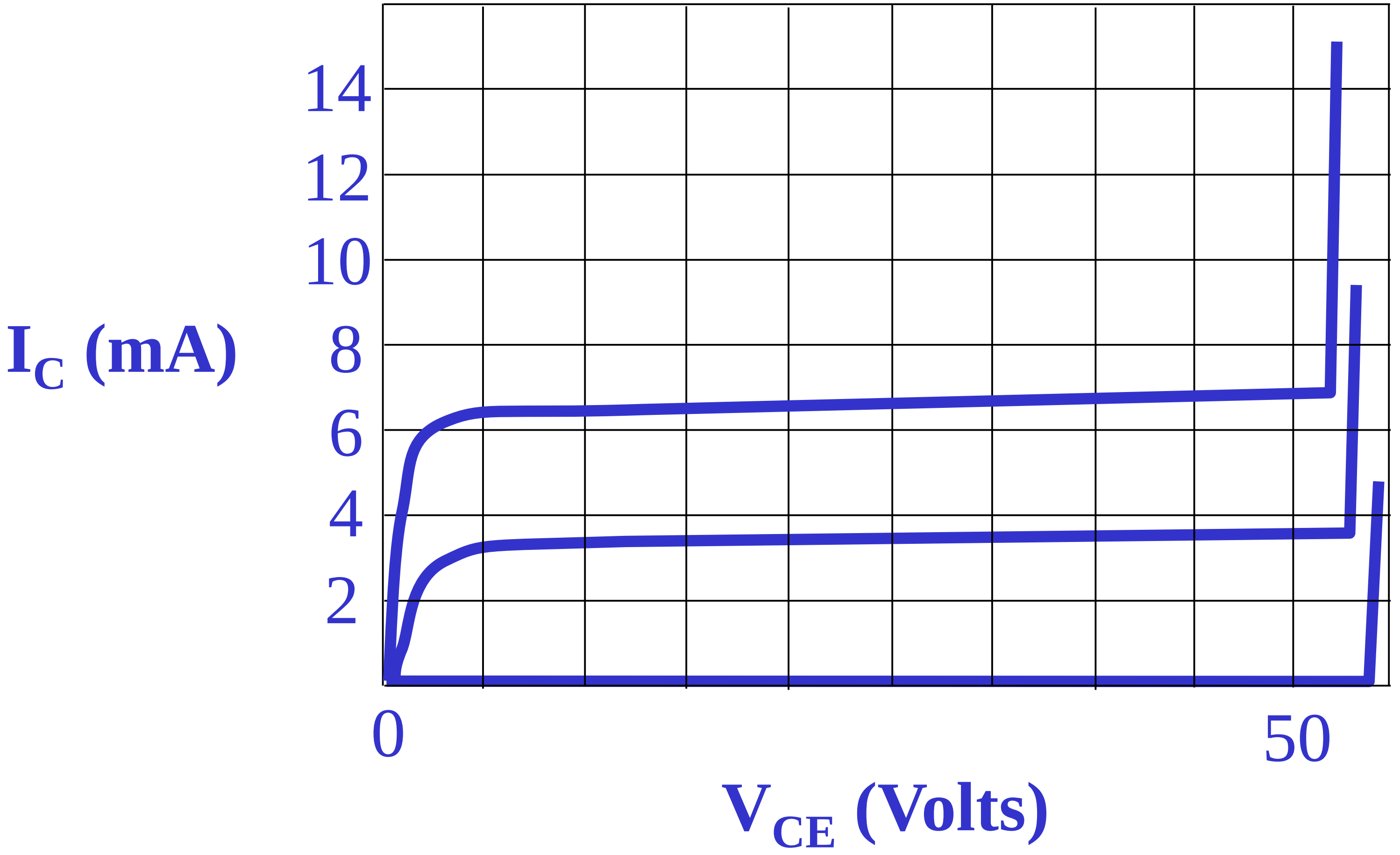
BJT (Bipolar Junction Transistor)

Typical Breakdown Ratings

- V_{CBO} = 60 V
- V_{CEO} = 40 V
- V_{EBO} = 6 V

- Note: these are reverse breakdown ratings

Grafik breakdown Colector



Typical Maximum Ratings

- I_C = 200 mA dc
- P_D = 250 mW (for $T_A = 60\ ^oC$)
- P_D = 350 mW (for $T_A = 25\ ^oC$)
- P_D = 1 W (for $T_C = 60\ ^oC$)

Pembiasan BJT
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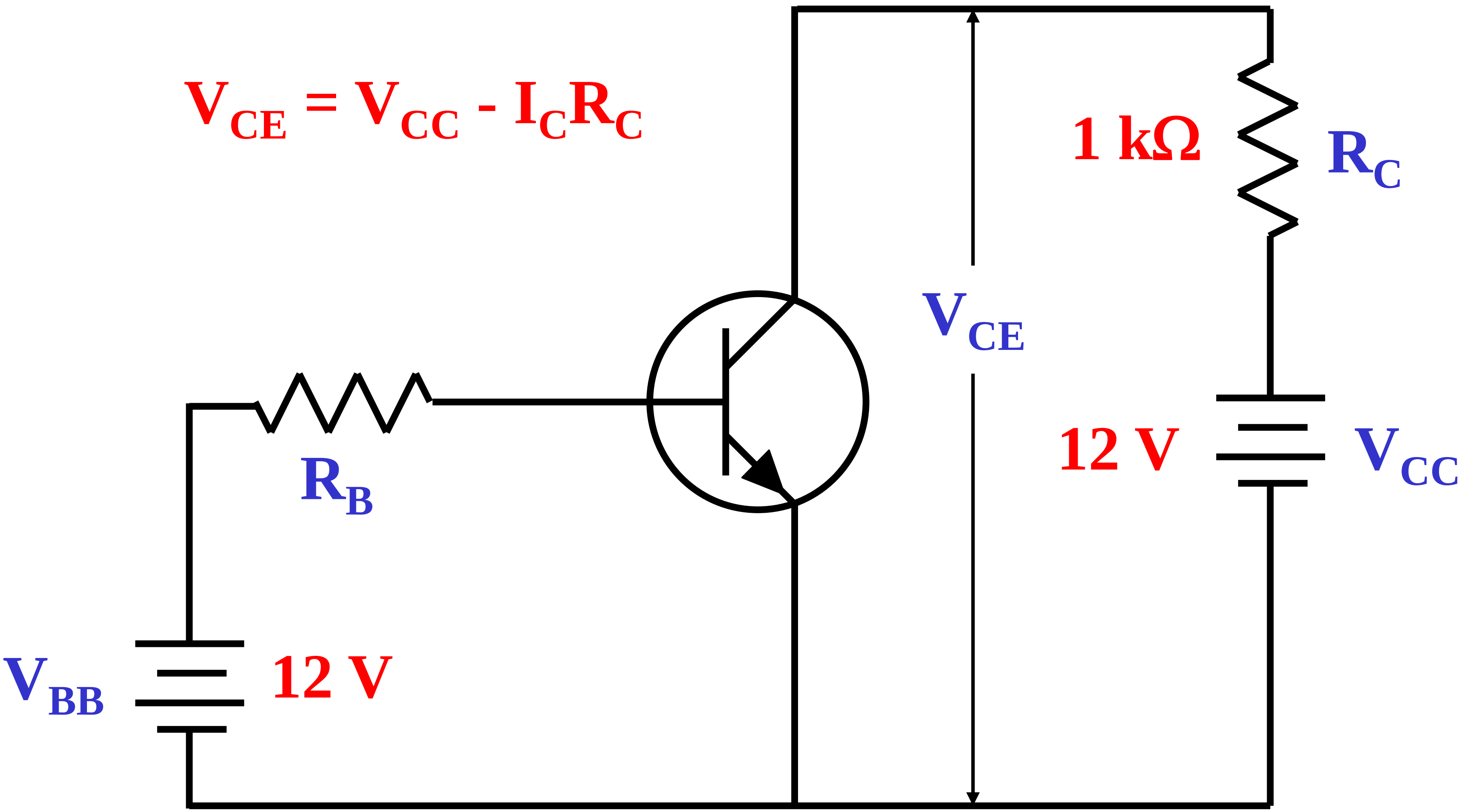
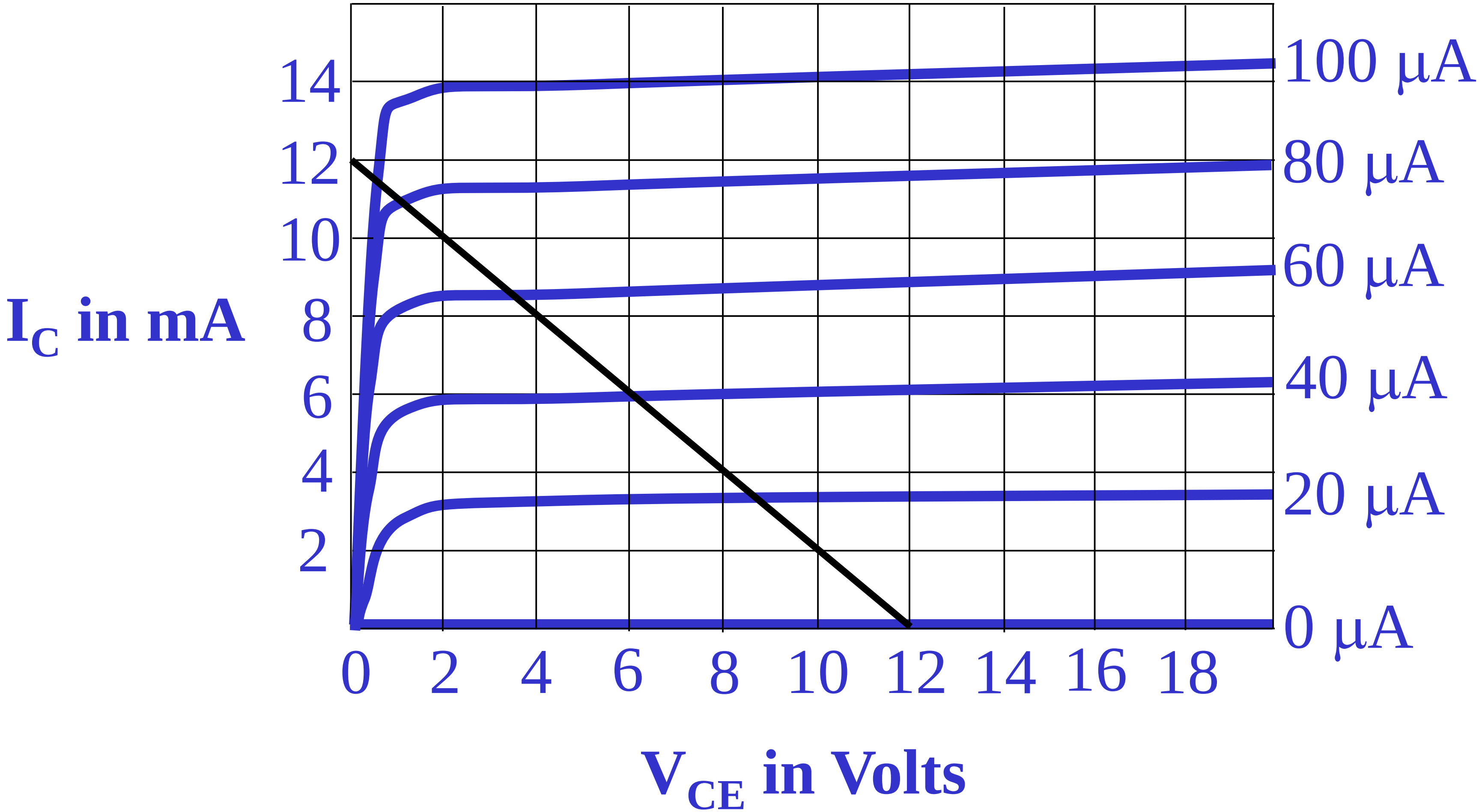
$$V_{CE} = V_{CC} - I_C R_C$$

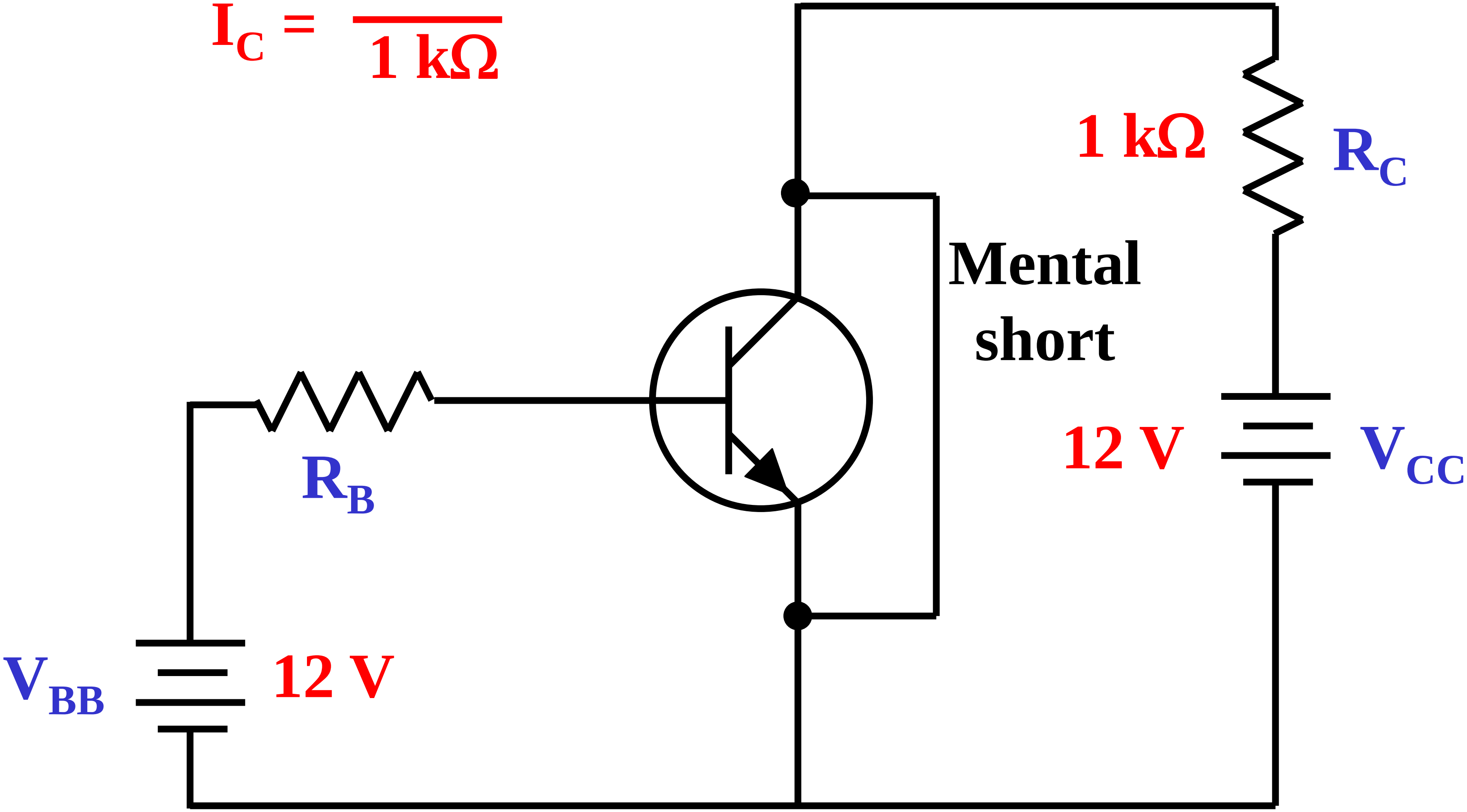


$$I_C = \frac{V_{CC} - V_{CE}}{R_C}$$

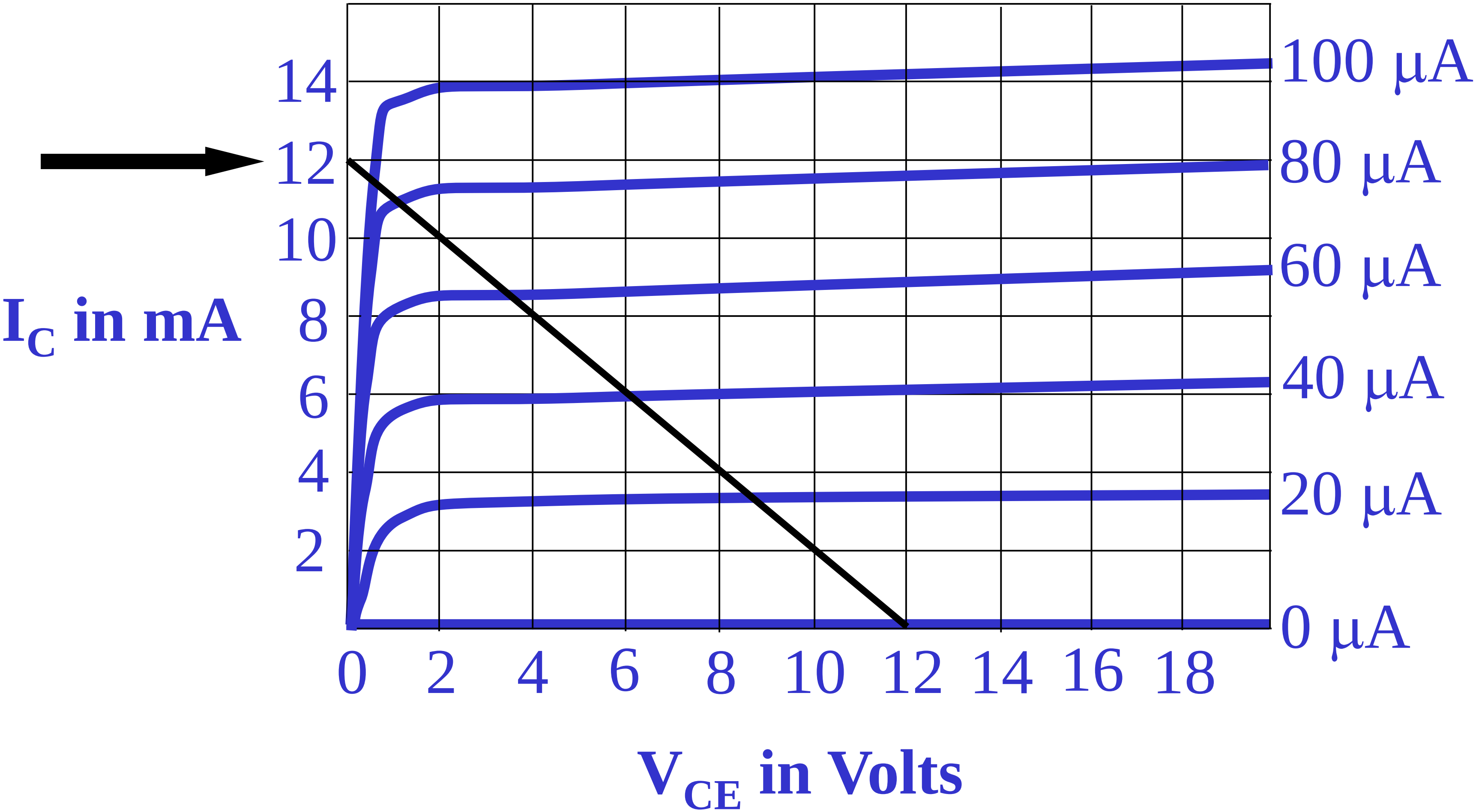
Persaman ini menghasilkan load line.

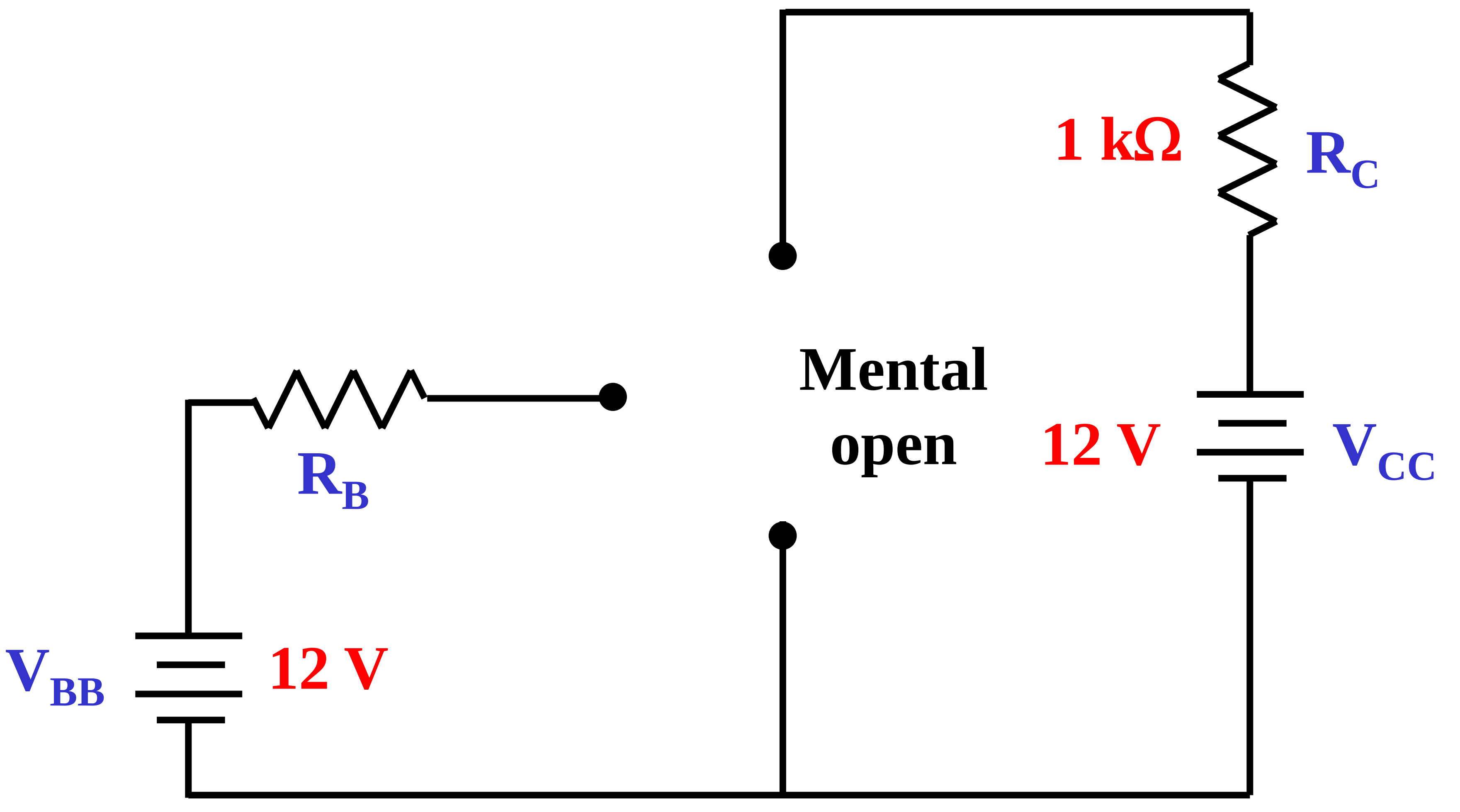


$$I_C = \frac{12\ \text{V}}{1\ \text{k}\Omega}$$

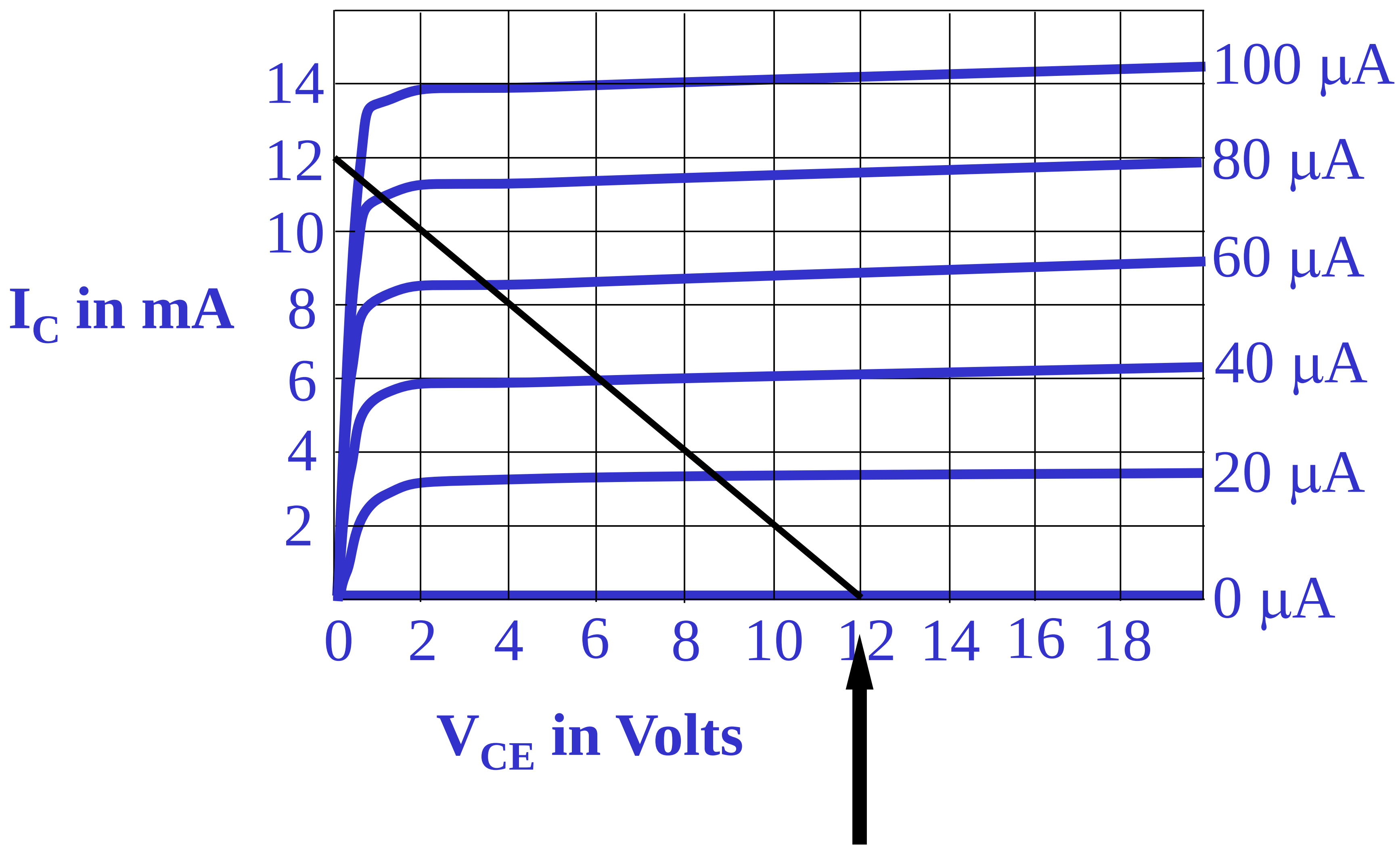


$$I_C = \frac{12\ \text{V}}{1\ \text{k}\Omega} = 12\ \text{mA}$$ ← **Arus satutasi**

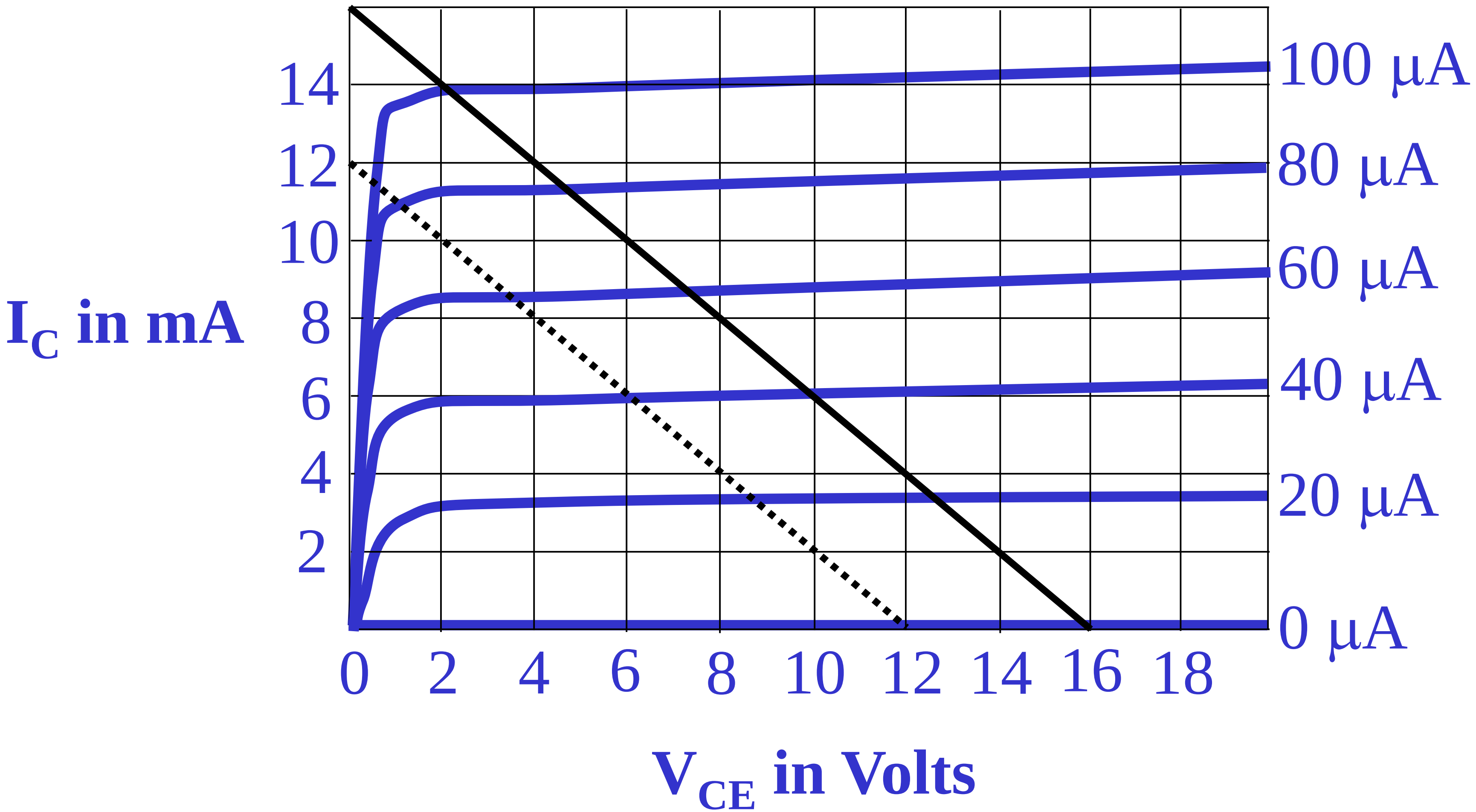



1 kΩ
RC
Mental
open
12 V
VCC
RB
VBB
12 V

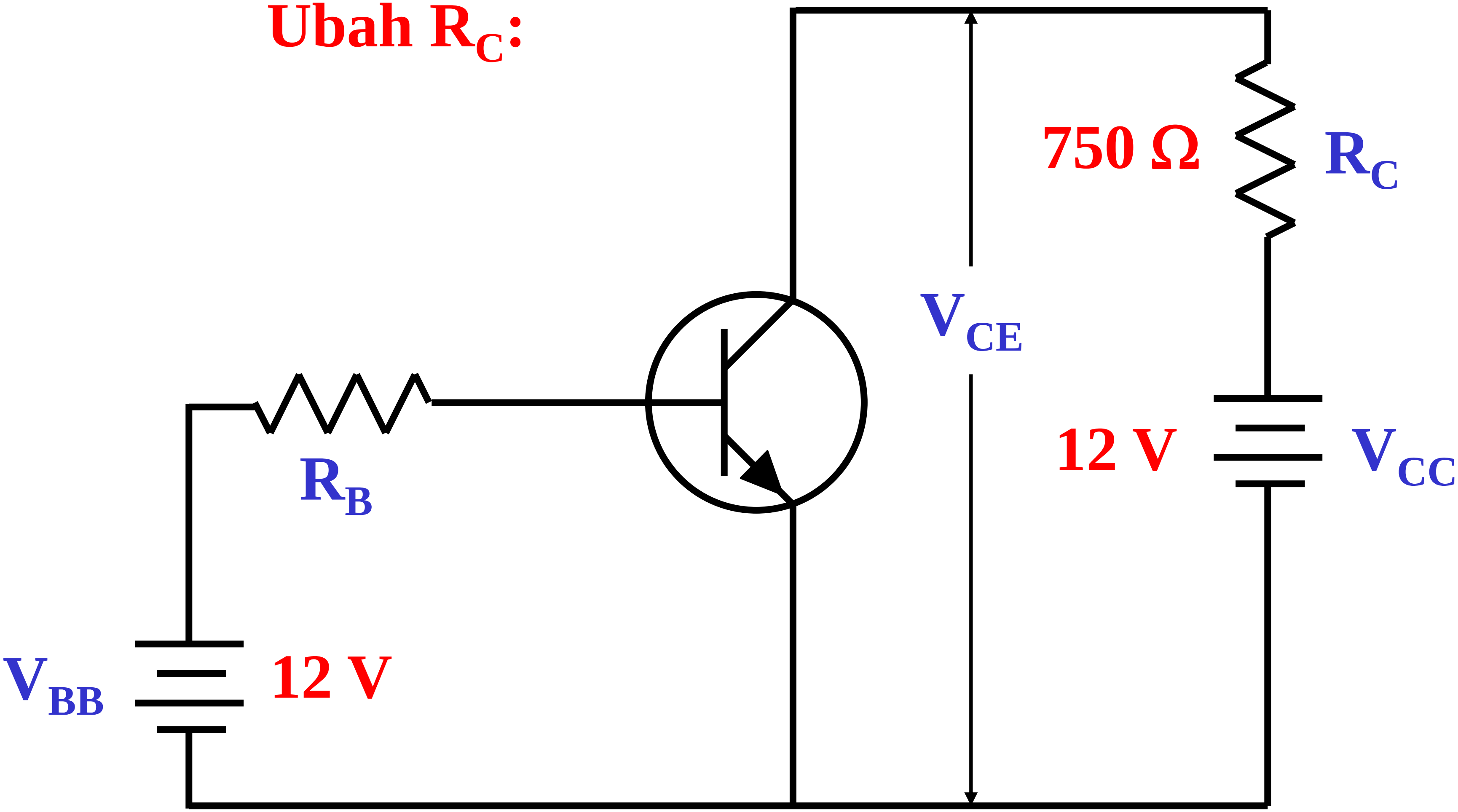
$$V_{CE(cutoff)} = V_{CC}$$



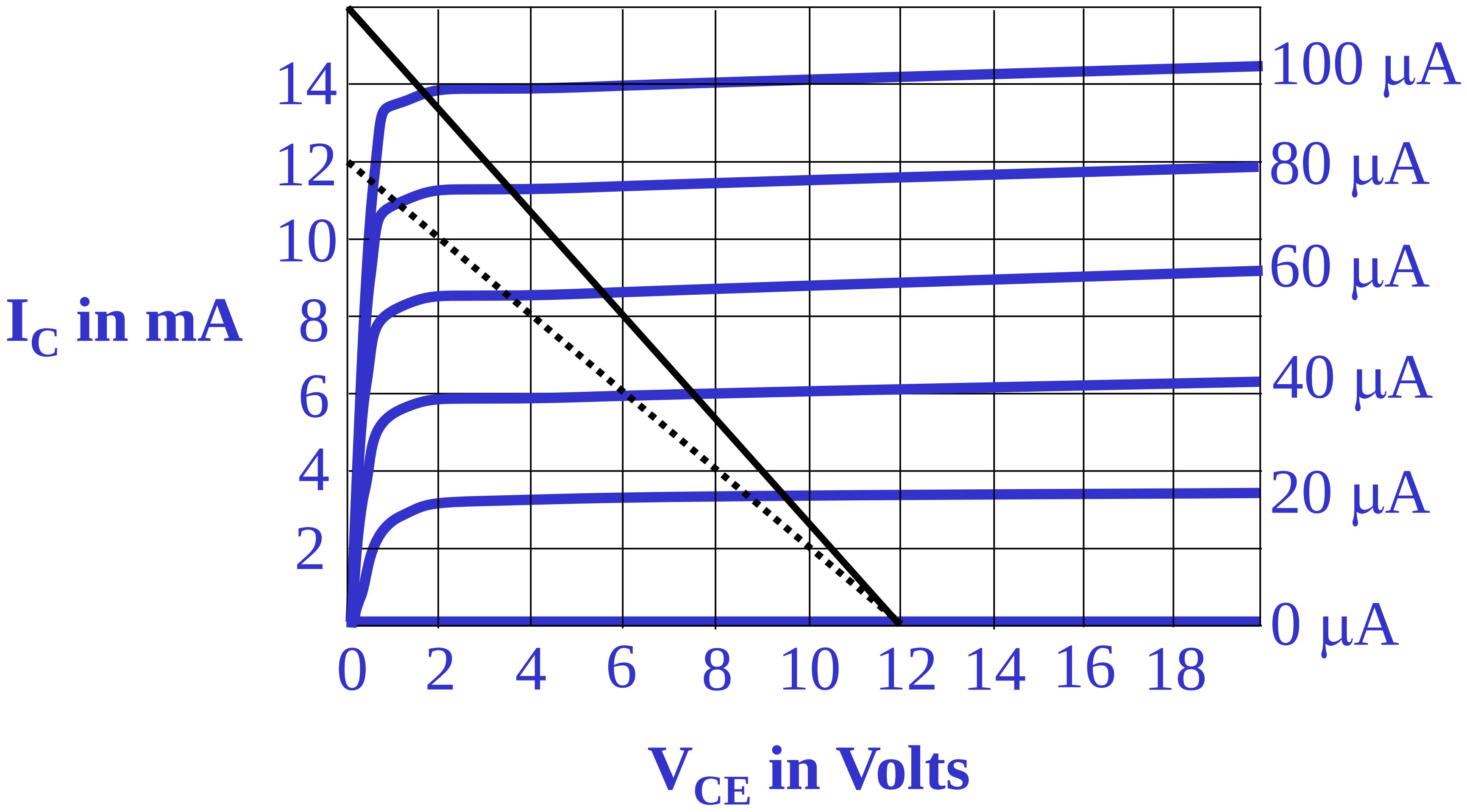
load line baru dengan kemiringan yang sama



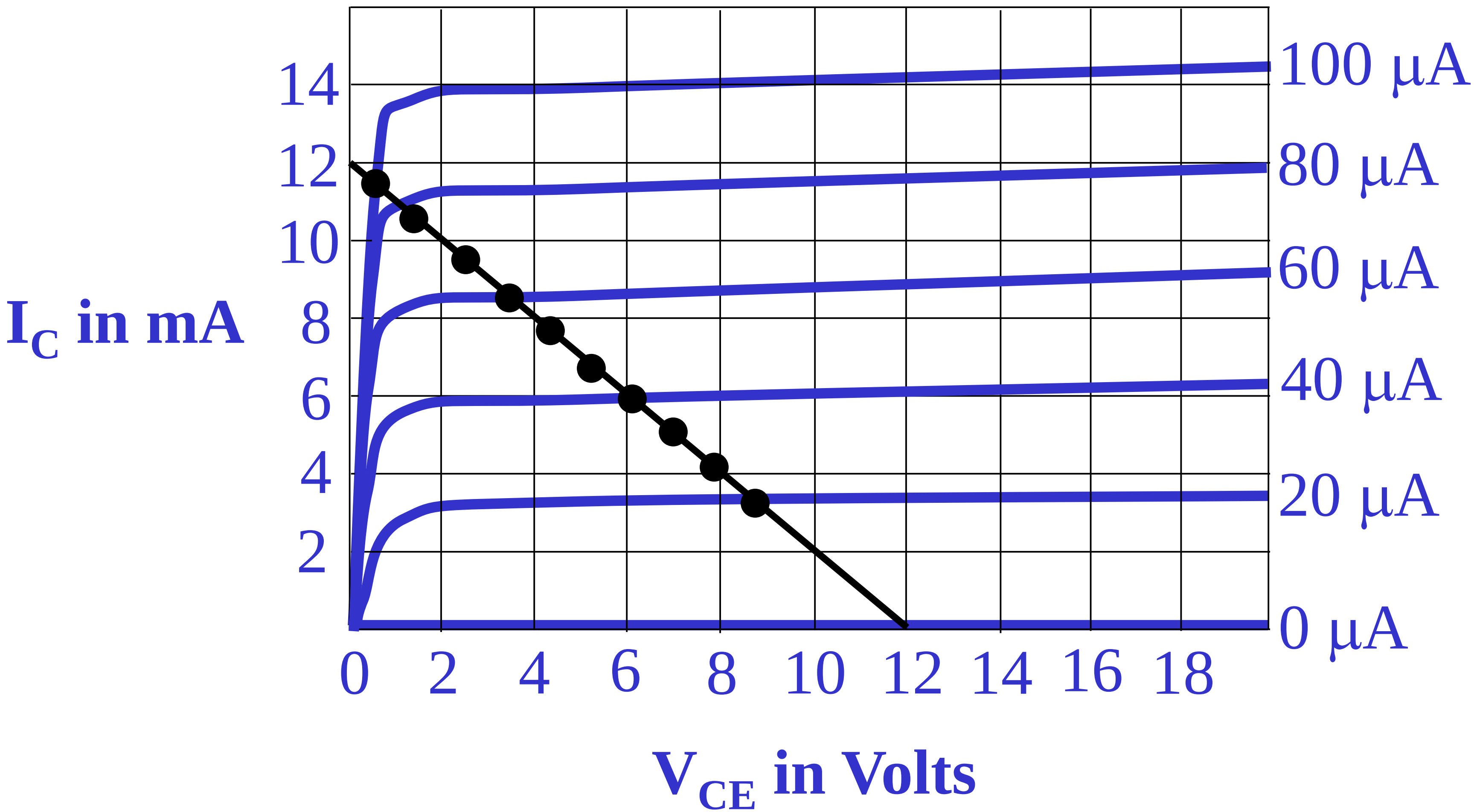
Ubah R_C:



Smaller R_C menghasilkan steeper slope



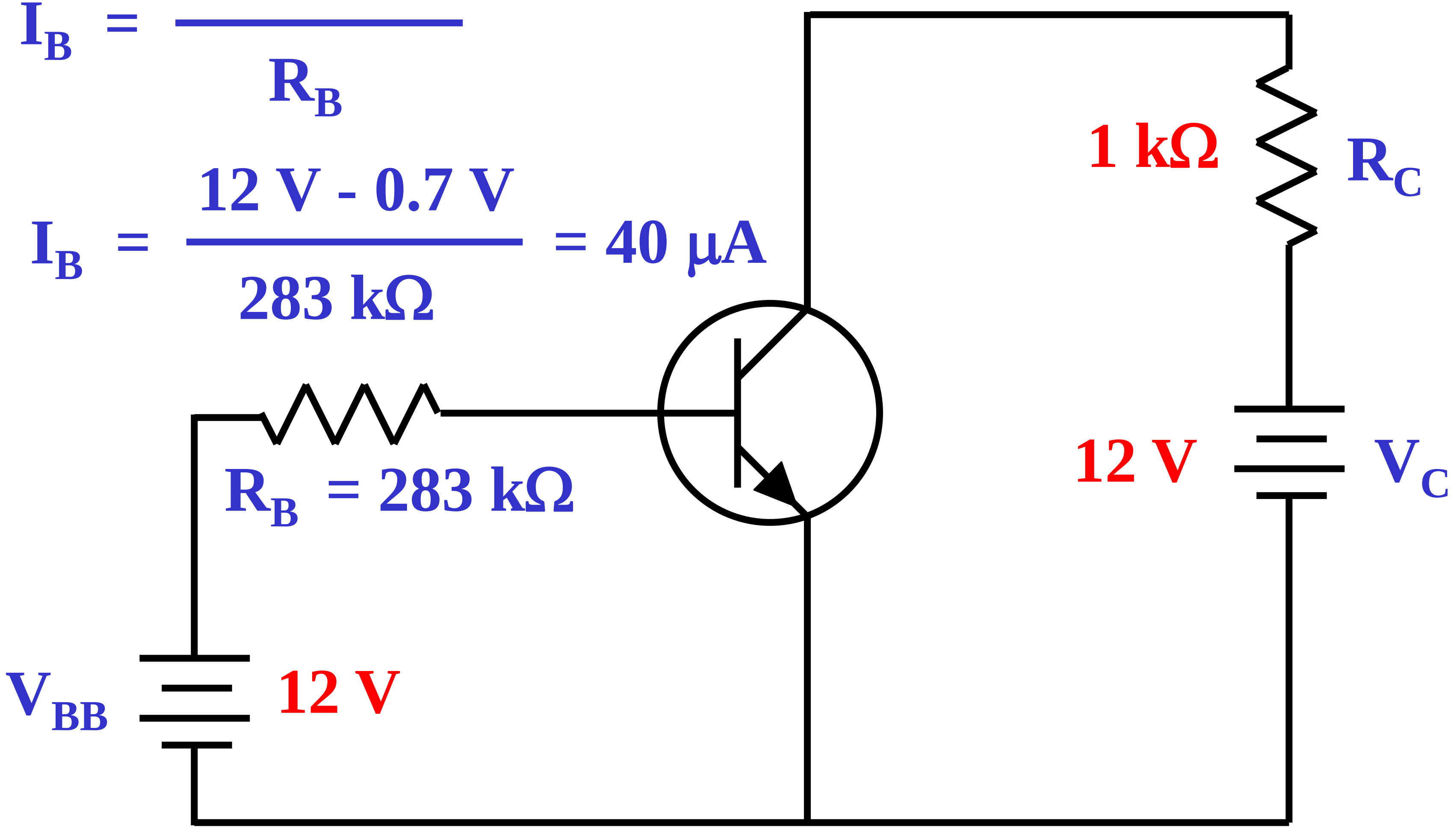
Rangkain dapat dioperasikan pada setiap titik pada load line



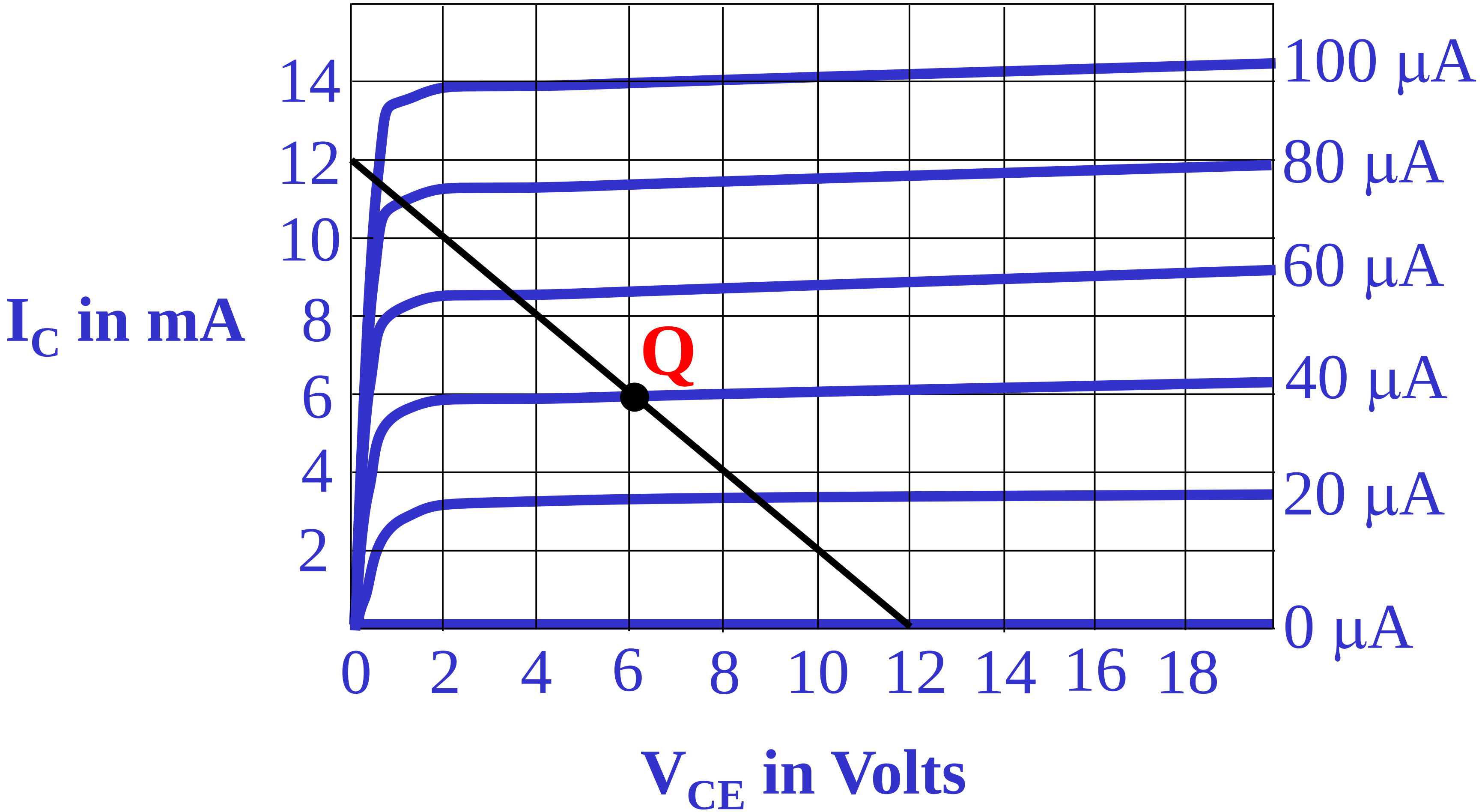
The operating point is determined by the base current.

$$I_B = \frac{V_{BB} - V_{BE}}{R_B}$$

$$I_B = \frac{12\text{ V} - 0.7\text{ V}}{283\text{ k}\Omega} = 40\ \mu\text{A}$$

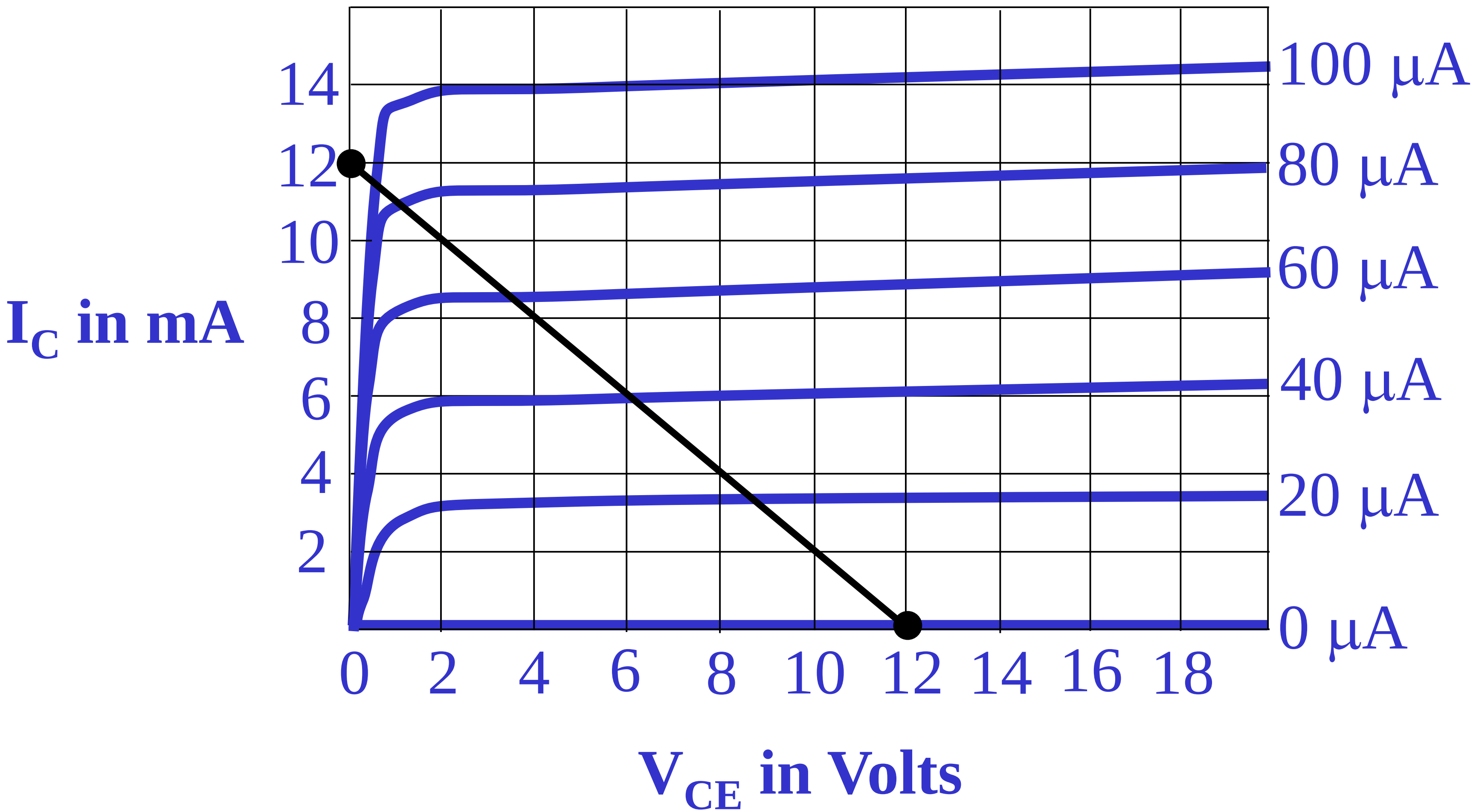


The operating point is called the quiescent point.



This Q point is in the linear region.

Saturation and cutoff are non-linear operating points.



These Q points are used in switching applications.

Recognizing saturation

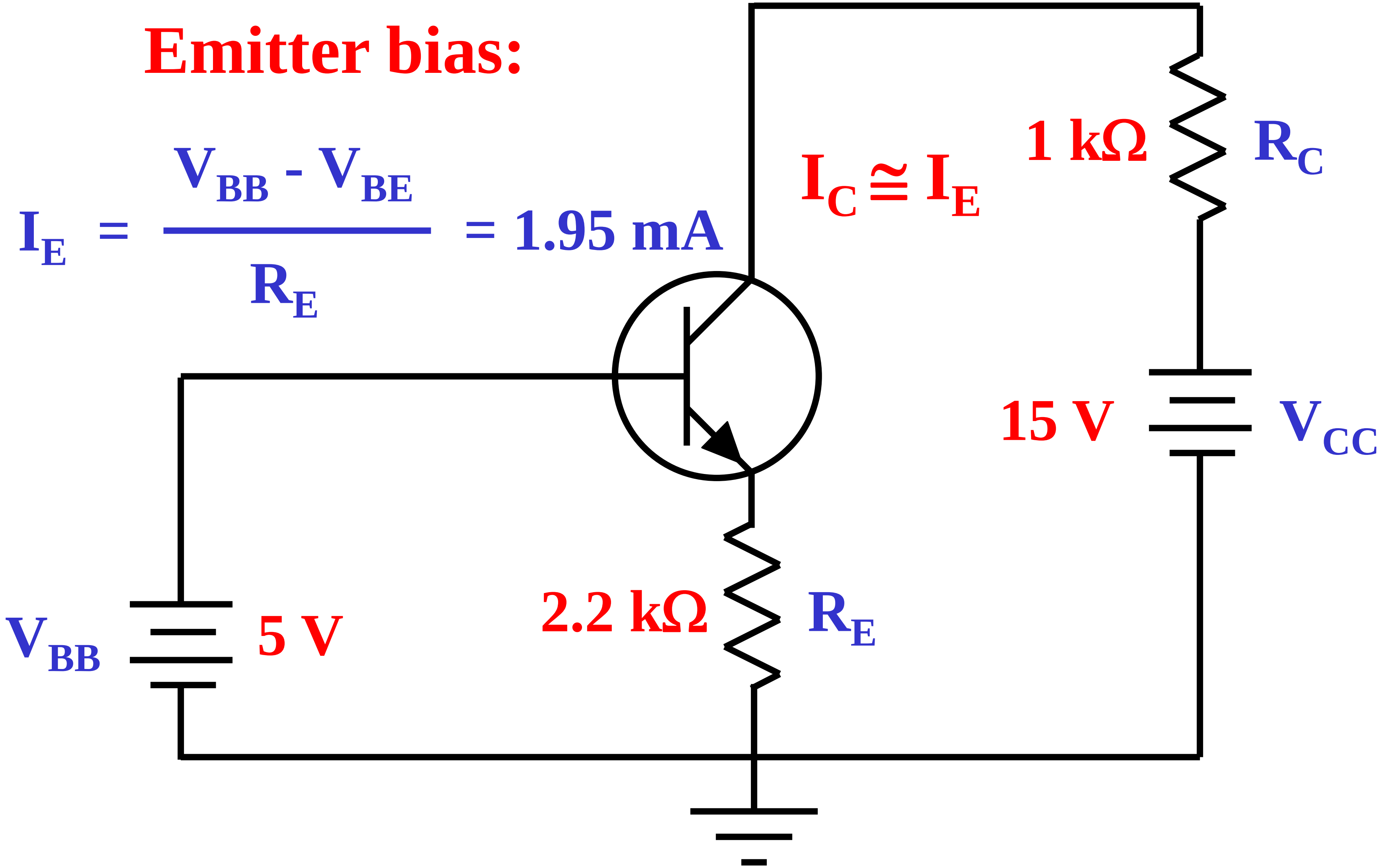
- Assume linear operation.
- Perform calculations for currents and voltages.
- An impossible result means the assumption is false.
- An impossible result indicates saturation.

Base bias

- **The base current is established by V_{BB} and R_B.**
- **The collector current is β times larger in linear circuits.**
- **The transistor current gain will have a large effect on the operating point.**
- **Transistor current gain is unpredictable.**

Emitter bias:

$$I_E = \frac{V_{BB} - V_{BE}}{R_E} = 1.95 \text{ mA}$$



$$V_C = 15 \text{ V} - (1.95 \text{ mA})(1 \text{ k}\Omega) = 13.1 \text{ V}$$

$$V_{CE} = 13.1 \text{ V} - 4.3 \text{ V} = 8.8 \text{ V}$$