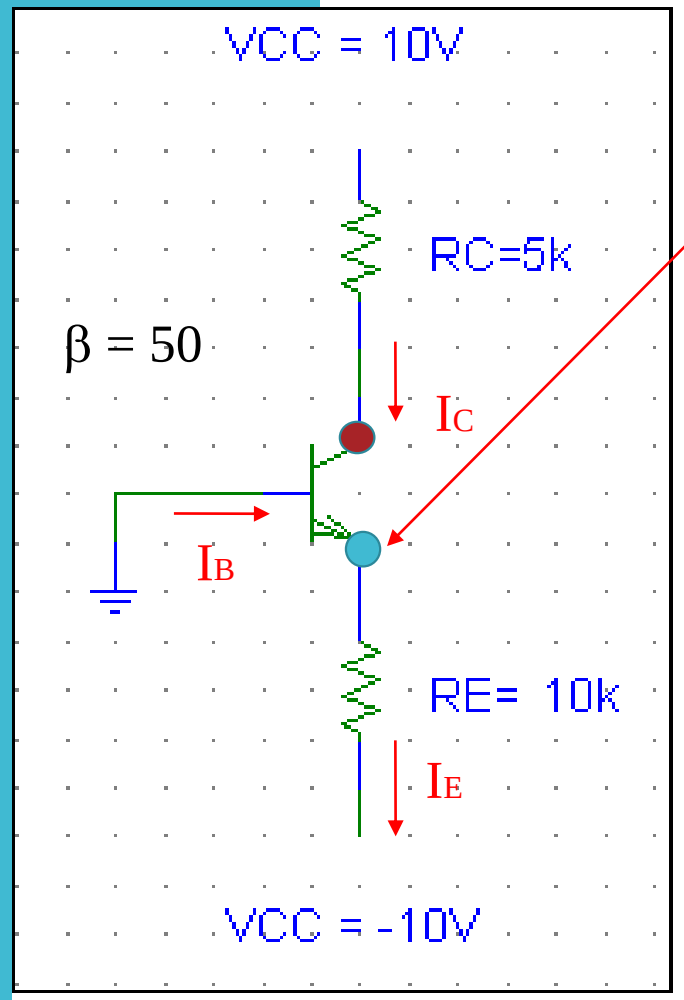
Διπολικά Transistor

18/1/2021

Άσκηση 1



$V_E = 0 - 0.7 = -0.7V$

$I_E = (V_E - (-10))/R_E = (-0.7 + 10)/10K = 0.93mA$

$I_C \approx I_E = 0.93mA$

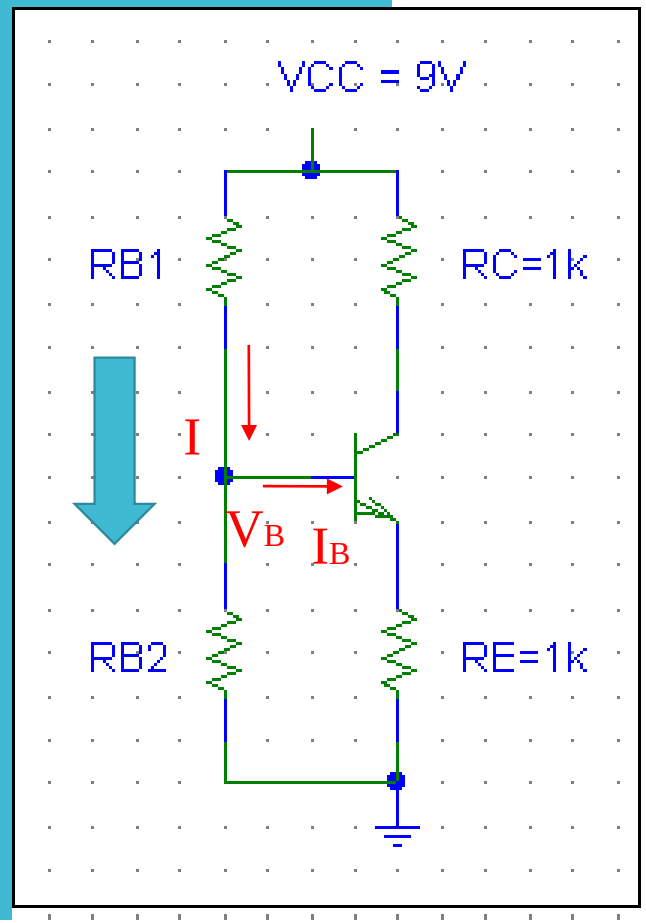
$I_C = \beta I_B + (\beta+1) I_{CBO}$ και συνεπώς (ο = open)

$I_B = I_C/\beta = (0.93/50)\ mA = 18.6\mu A$

$V_C = 10 - I_C R_C = 10 - 0.93(5) = 5.35V$ (κόκκινο σημείο)

$V_{CE} = 5.35 - -0.7 = 6.05V$

Άσκηση 2



•Έστω V_B = 3V και I = 0.2mA. Να υπολογίσετε τις αντιστάσεις του διαιρέτη τάσης

(a) R_{B1} και R_{B2} αποτελούν διαιρέτη ρεύματος

Υποθέτουμε ότι I >> I_B $I = V_{CC}/(R_{B1} + R_{B2})$

$0.2(mA) = 9 /(R_{B1} + R_{B2})$

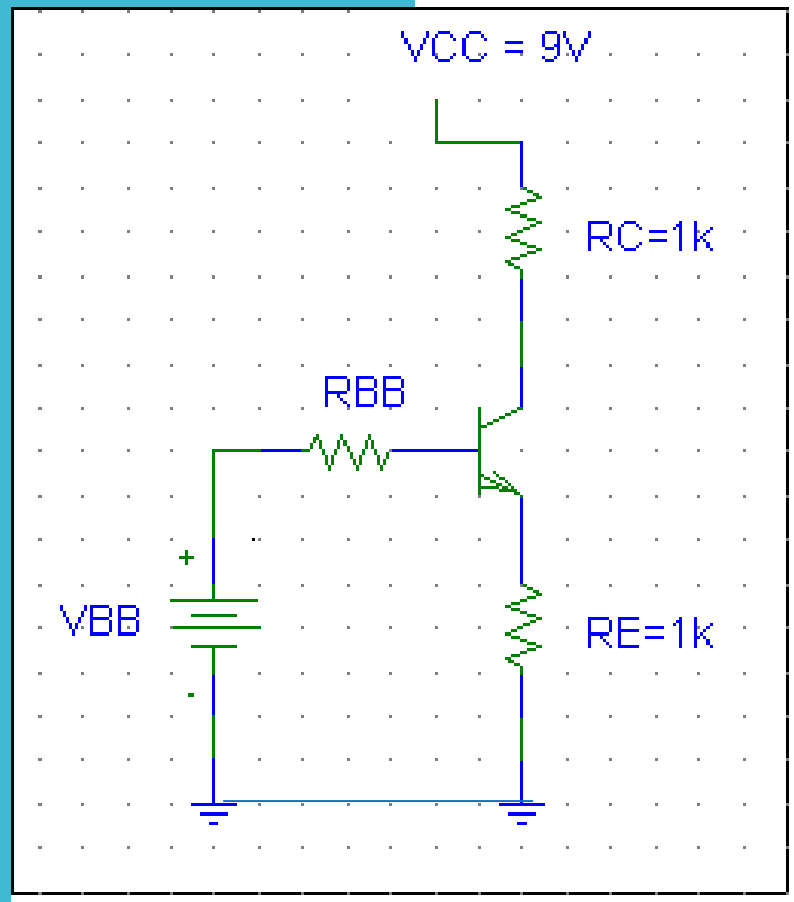
και

$V_B = V_{CC}[R_{B2}/(R_{B1} + R_{B2})]$

$3 = 9 [R_{B2}/(R_{B1} + R_{B2})]$, Λύνοντας ως προς R_{B1} και R_{B2}.

R_{B1} = 30KΩ, και R_{B2} = 15KΩ.

Ασκηση 3



Σημείο λειτουργίας του BJT

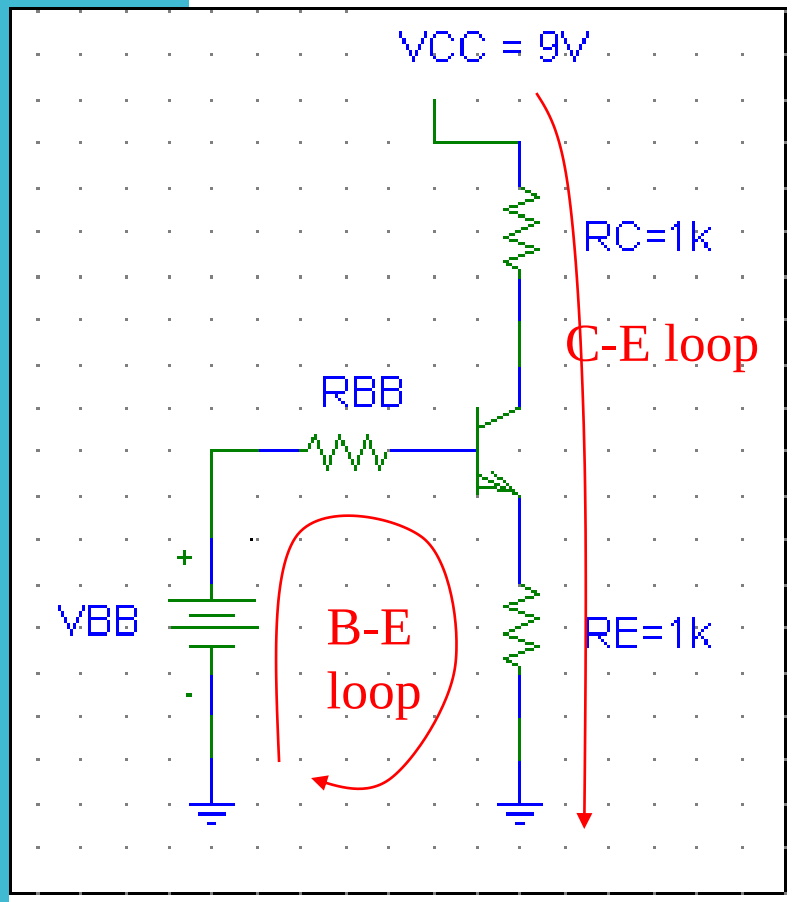
- Χρησιμοποιώ το Thevenin

- Makes the circuit simpler

- $V_{BB} = V_B = 3V$

- $R_{BB} = R_{B1} || R_{B2} = 30K\Omega || 15K\Omega = .10K\Omega$

Λύση με βρόχους



B-E βρόχος

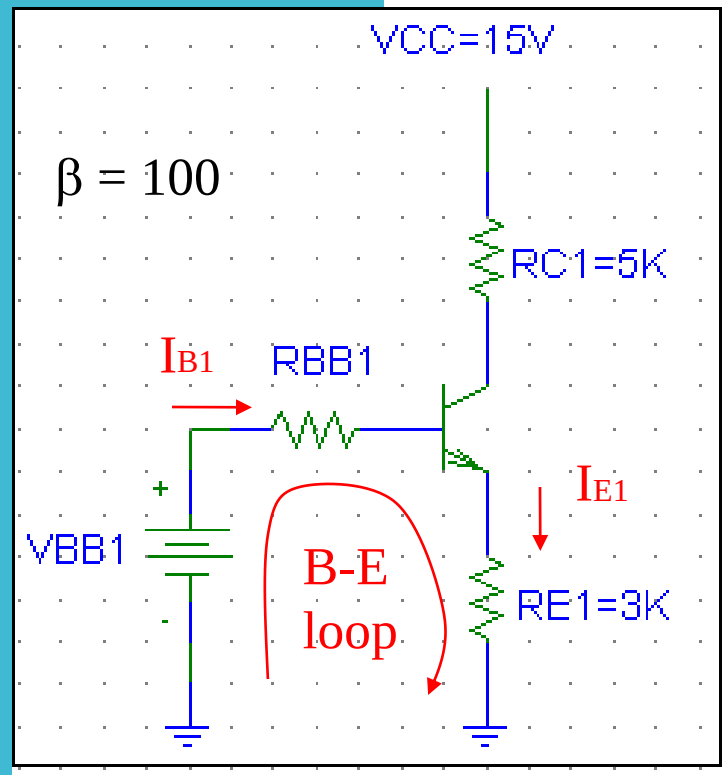
$V_{BB} = I_B R_{BB} + V_{BE} + I_E R_E$

C-E βρόχος

$V_{CC} = I_C R_C + V_{CE} + I_E R_E$

Λύνουμε ως προς I_C, V_{CE}, και I_B.

Παράδειγμα



- $R_{BB1} = R_{B1}||R_{B2} = 50\ ||100 = 33K$
- $V_{BB1} = V_{CC}[R_{B2}/(R_{B1}+R_{B2})]$

$V_{BB1} = 15[50K/150K] = 5V$

Βήμα 1

- B-E βρόχος

$V_{BB1} = I_{B1}R_{BB1} + V_{BE} + I_{E1}R_{E1}$

Εάν έστω $I_{B1} \approx I_{E1}/\beta$

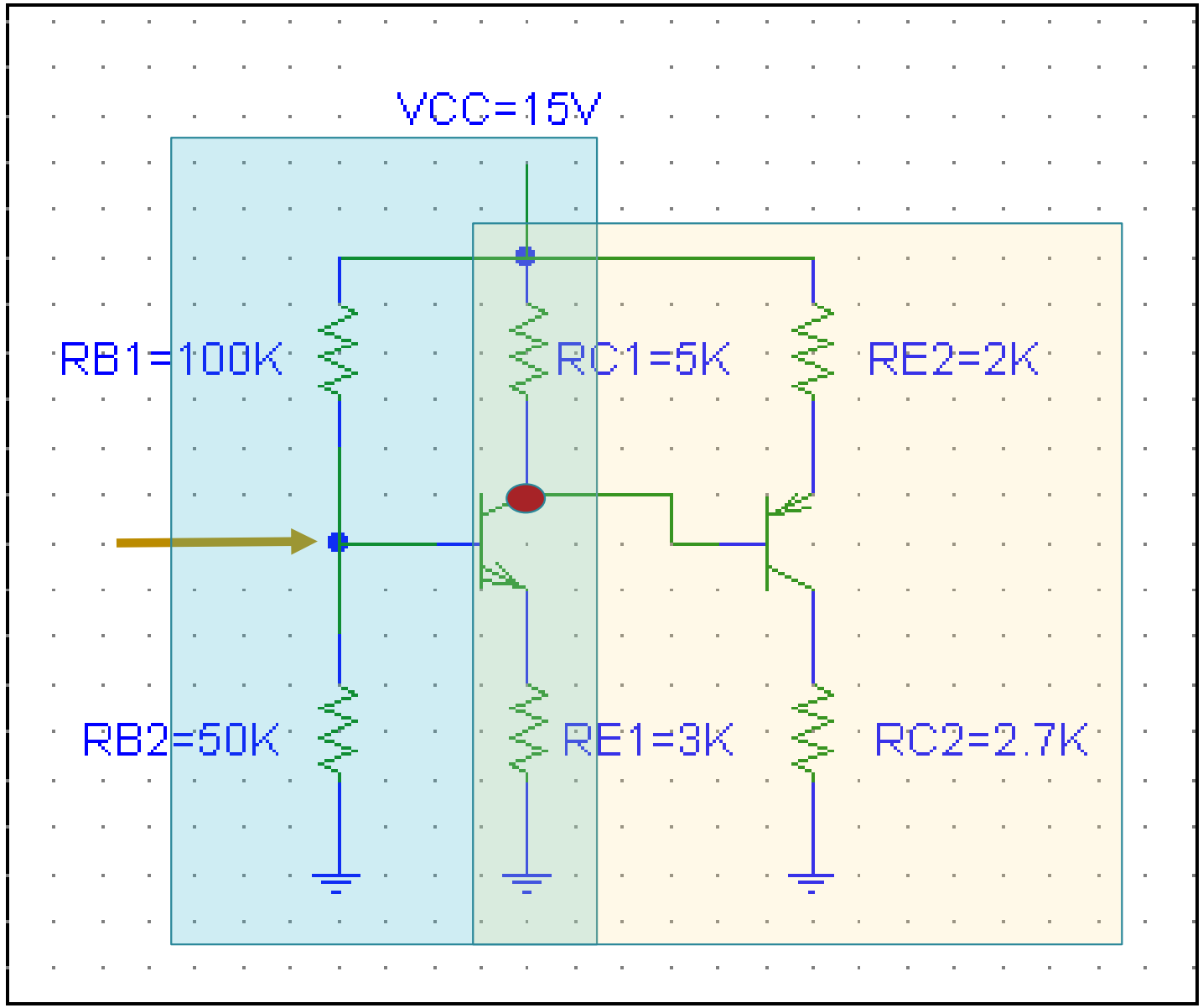
$5 = I_{E1}\,33K / 100 + 0.7 + I_{E1}3K$

και συνεπώς: $I_{E1} = 1.3mA$

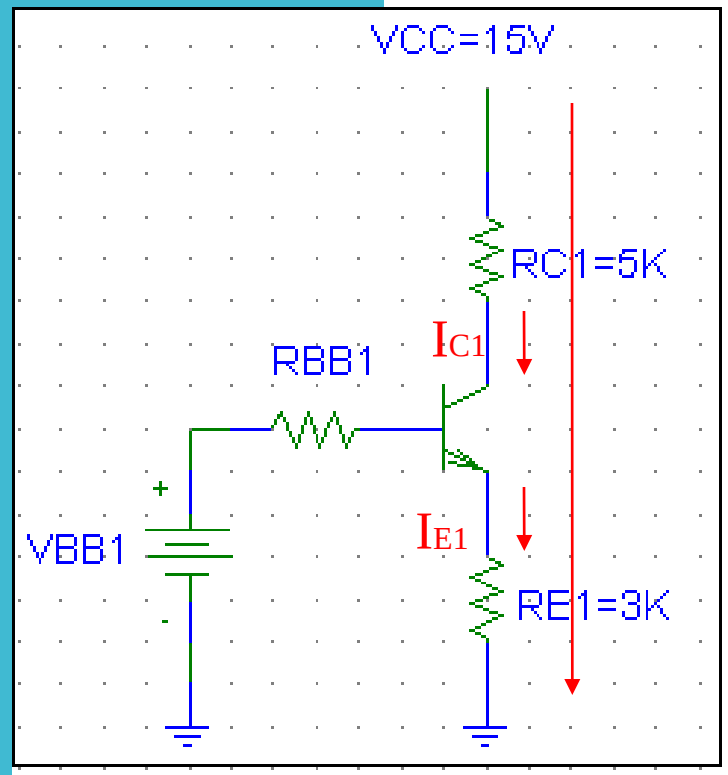
Αν θέλω μπορώ να βρω και το I_{B1}

Κύκλωμα διπλών BJT

(NPN και PNP)



Παράδειγμα



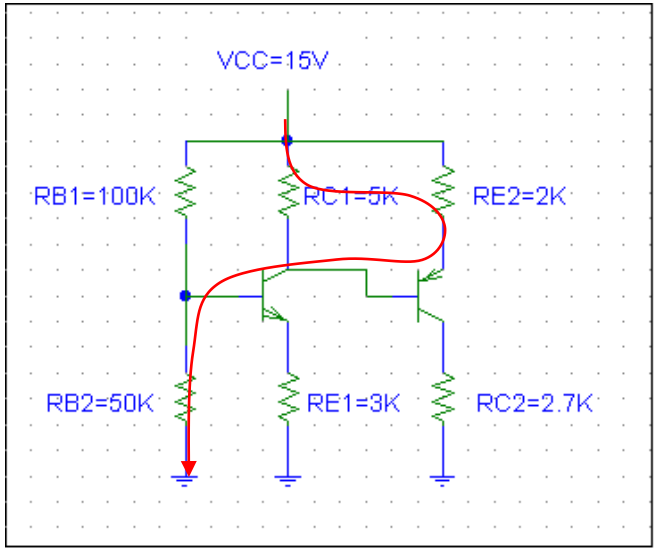
C-E βρόχος

$V_{CC} = I_{C1} R_{C1} + V_{CE1} + I_{E1} R_{E1}$

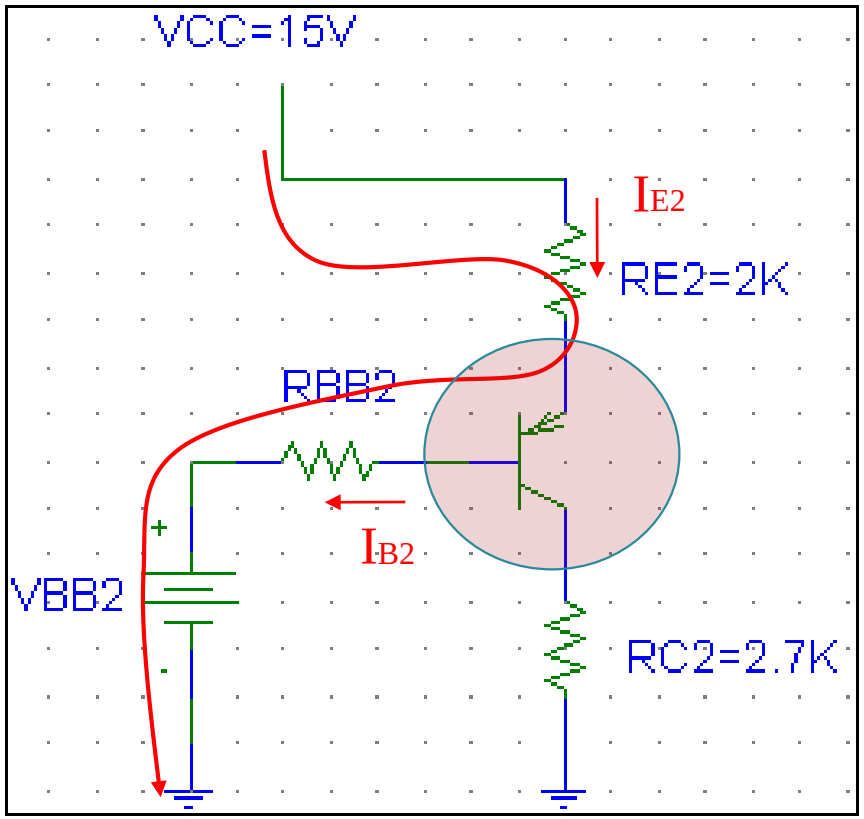
$15 = 1.3(5) + V_{CE1} + 1.3\ (3)$

$V_{CE1} = 4.87V$

Το αρχικό κύκλωμα της σελ.7



Παράδειγμα



- B-E βρόχος

$V_{CC} = I_{E2}R_{E2} + V_{EB} + I_{B2}R_{BB2} + V_{BB2}$

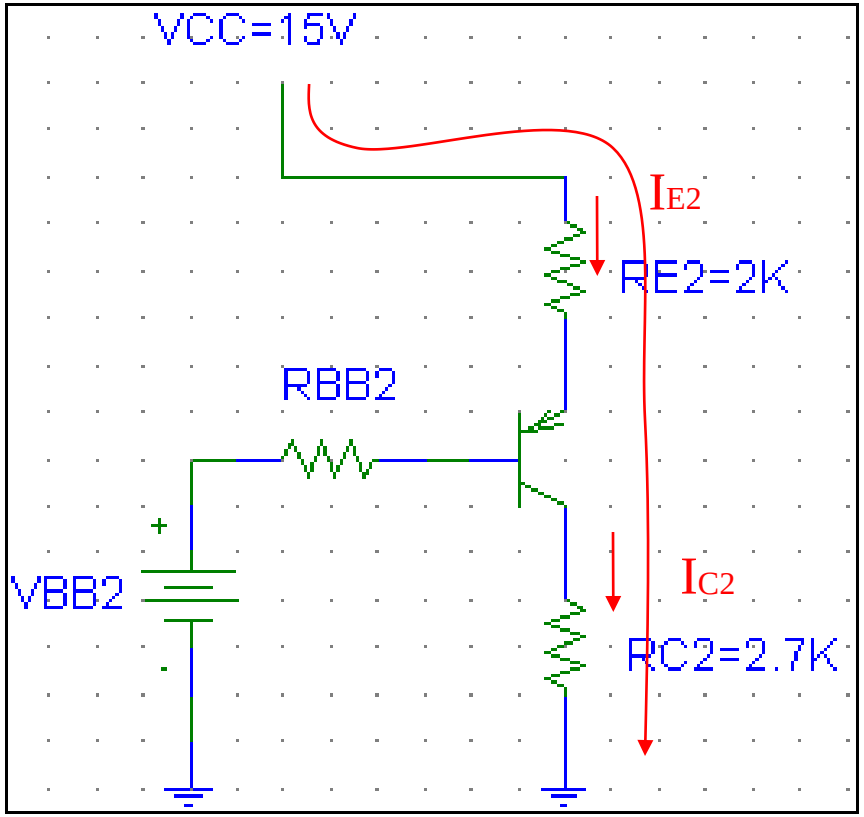
$15 = I_{E2}(2K) + .7 + I_{B2}(5K) + 4.87^* + 1.3mA(3K)$

$I_{B2} \approx I_{E2}/\beta$, και λύνω ως προς I_{E2}

$I_{E2} = 2.8mA$

* Βλέπε σελ.8

Παράδειγμα



Βήμα 2

•C-E βρόχος

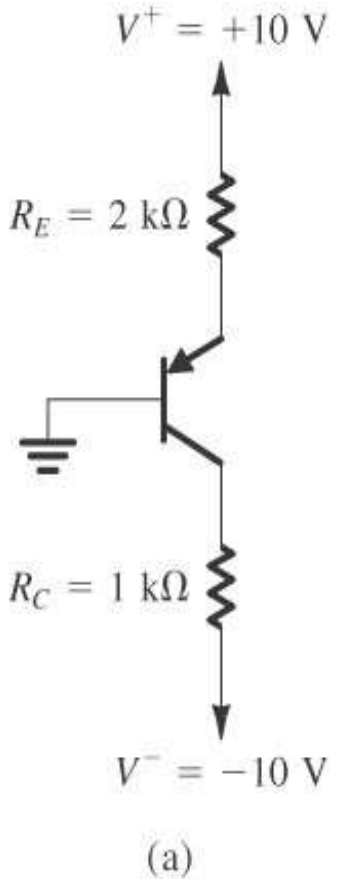
$V_{CC} = I_{E2}R_{E2} + V_{EC2} + I_{C2}R_{C2}$

$15 = 2.8(2) + V_{EC2} + 2.8\,(2.7)$

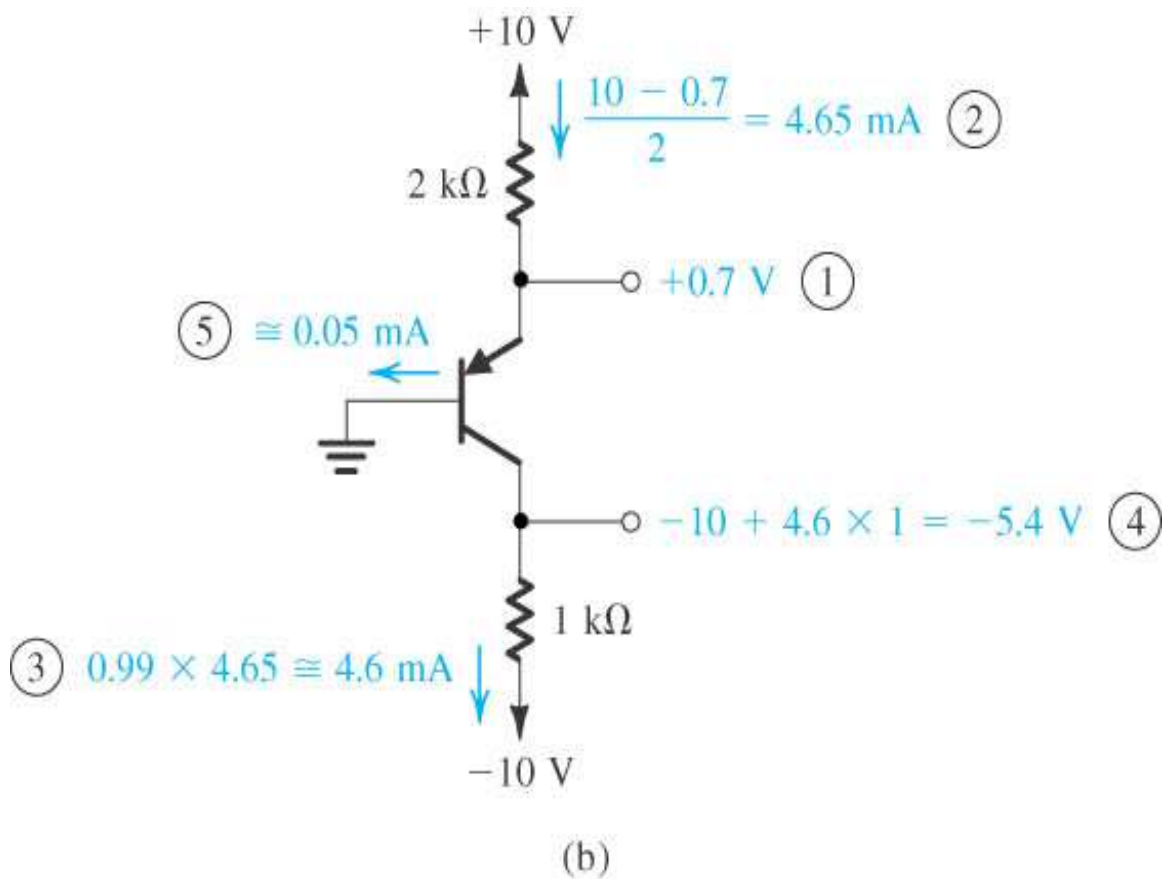
Λύνοντας ως προς V_{EC2}

$V_{CE2} = 1.84V$

(PNP)

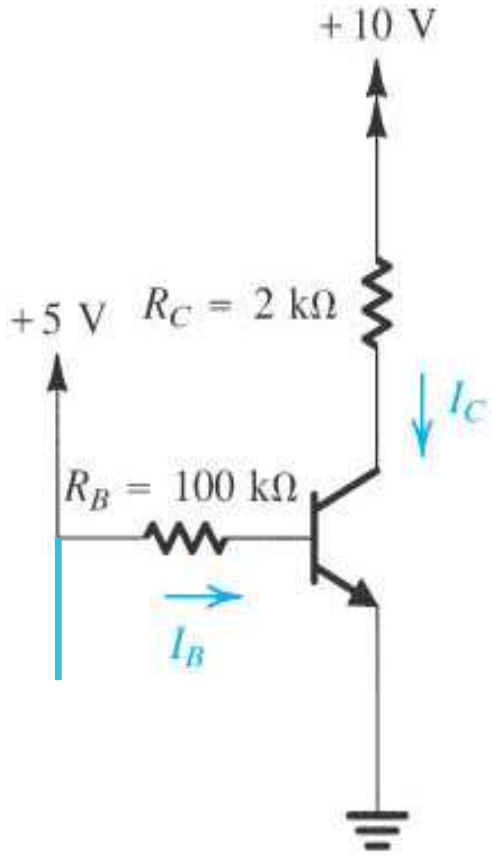

$V^+ = +10$ V
$R_E = 2$ kΩ
$R_C = 1$ kΩ
$V^- = -10$ V

(a)

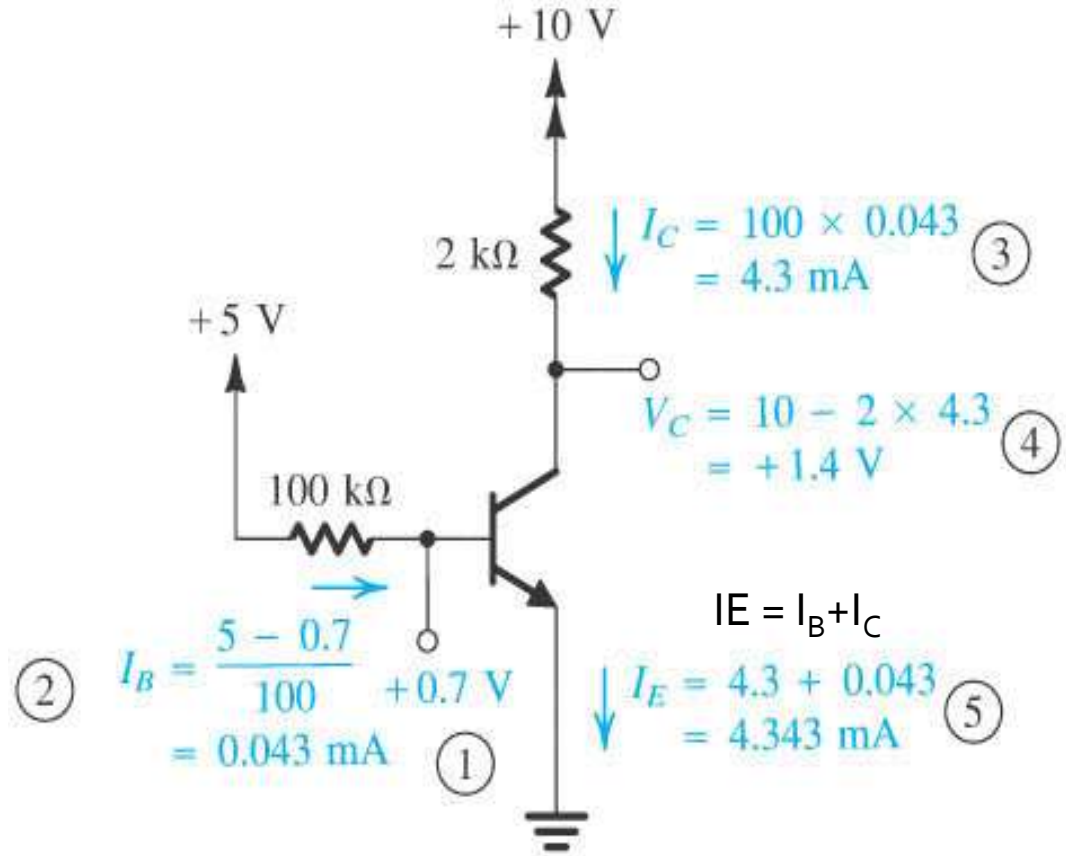

+10 V
$\frac{10 - 0.7}{2} = 4.65$ mA (2)
2 kΩ
+0.7 V (1)
(5) ≅ 0.05 mA
−10 + 4.6 × 1 = −5.4 V (4)
1 kΩ
(3) 0.99 × 4.65 ≅ 4.6 mA
−10 V

(b)

β=100

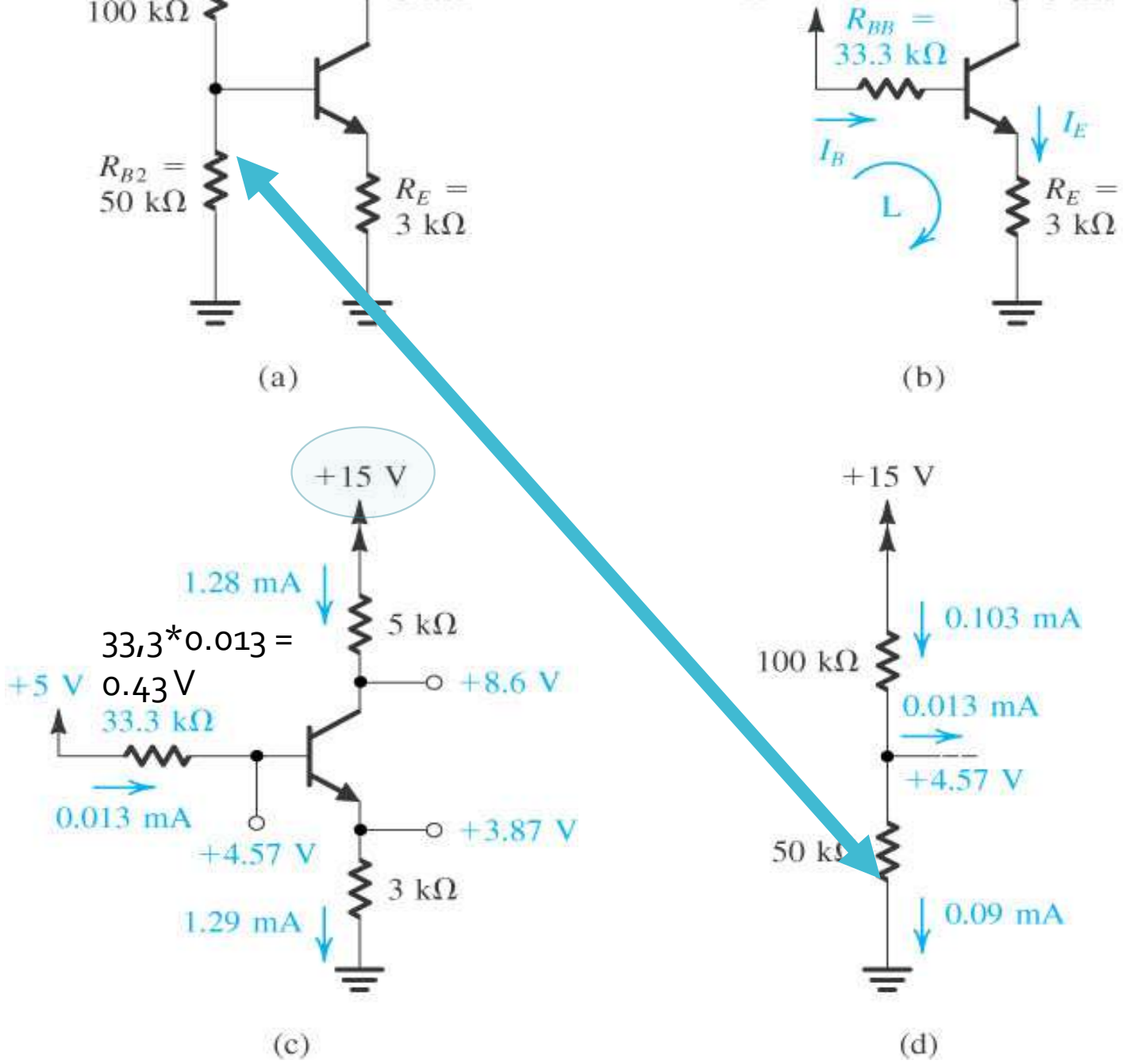

+10 V
+5 V
R_C = 2 kΩ
I_C
R_B = 100 kΩ
I_B

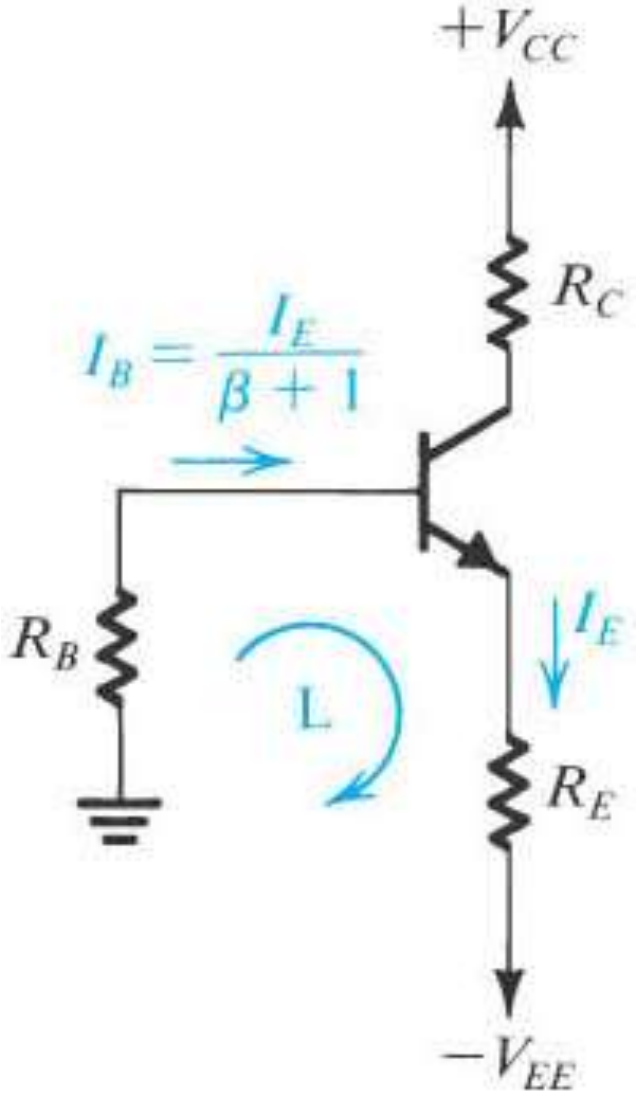
(a)


+10 V
2 kΩ
$I_C = 100 \times 0.043$
$= 4.3$ mA
3
+5 V
$V_C = 10 - 2 \times 4.3$
$= +1.4$ V
4
100 kΩ
IE = I_B+I_C
2
$I_B = \frac{5 - 0.7}{100}$
$= 0.043$ mA
+0.7 V
1
$I_E = 4.3 + 0.043$
$= 4.343$ mA
5

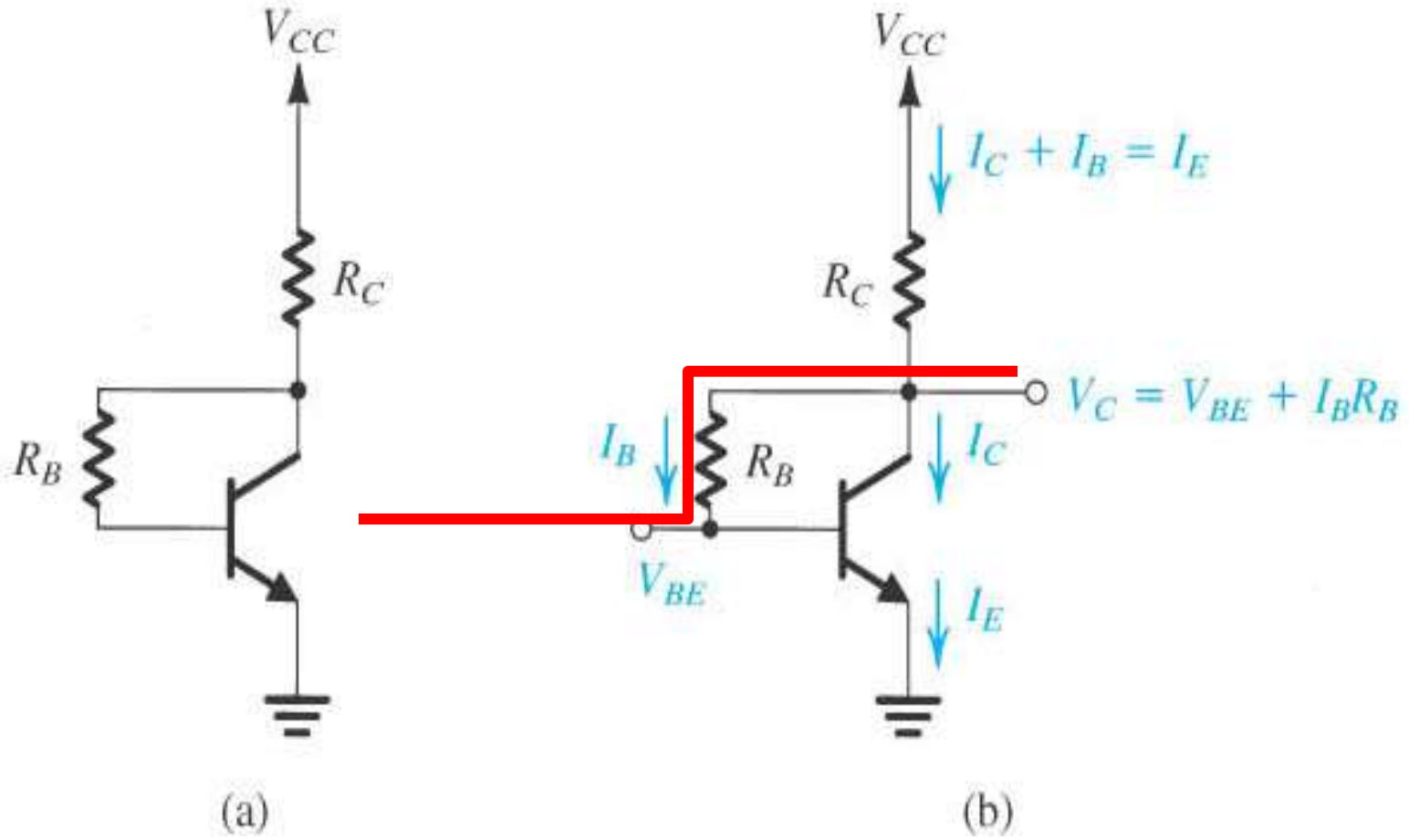
(b)

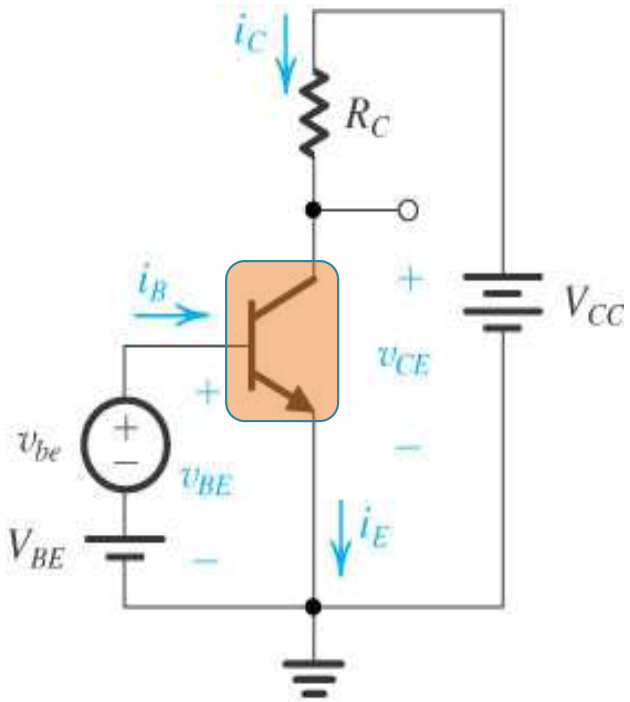
V_{BB}= Rb2/(RB1+RB2)) * Vcc = 50/150 *15 = .33*15 V =5V



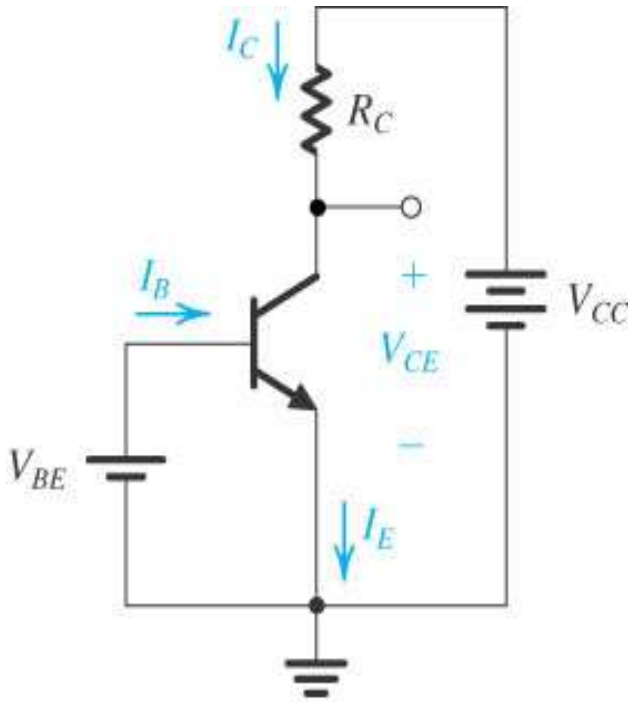

$+V_{CC}$
R_C
$I_B = \frac{I_E}{\beta + 1}$
R_B
L
I_E
R_E
$-V_{EE}$

Ανάδραση





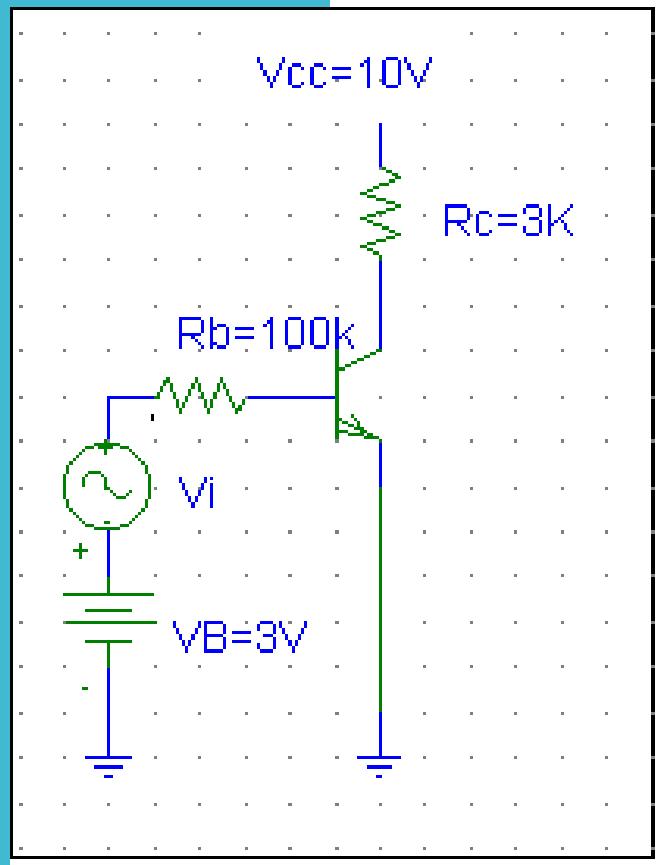
(a)



(b)

Παράδειγμα

Να υπολογίσετε το v_{out}/v_{in}, (Δίνεται β = 100)



DC problem

Να υπολογίσετε τα I_C και V_{CE}

B-E βρόχος

$3 = I_B R_B + V_{BE}$

$I_B = (3 - .7)/R_B = 0.023mA$

C-E βρόχος

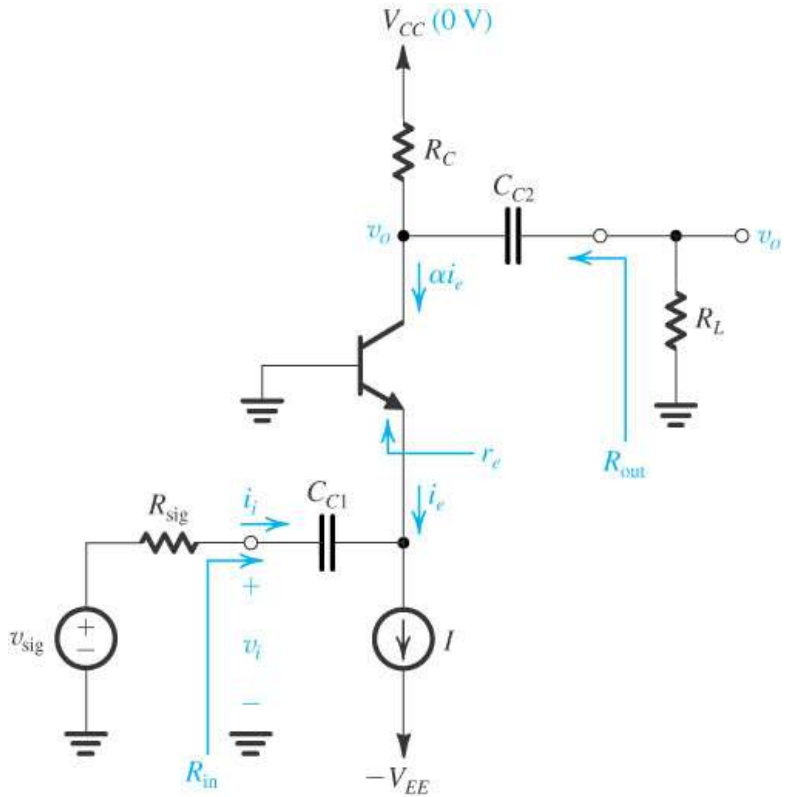
$V_{CE} = 10 - I_C R_C$

$V_{CE} = 10 - (2.3*)(3)$

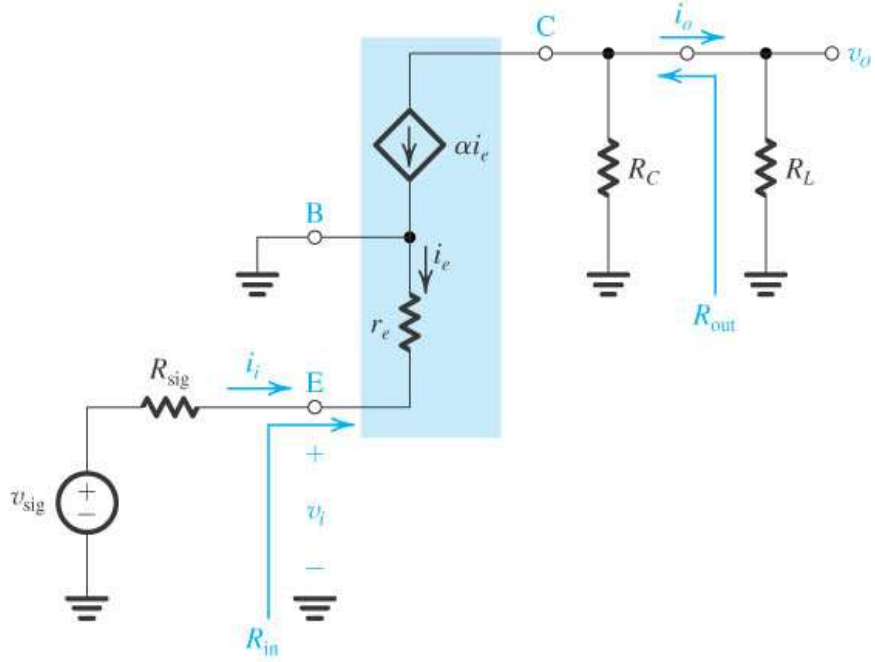
$V_{CE} = 3.1V$

Q σημείο: $V_{CE} = 3.1V$,

$*I_C = 2.3mA = (100*0,023)$ $(\beta * I_\beta)$


V_{CC} (0 V)
R_C
C_{C2}
v_o
v_o
αi_e
R_L
r_e
R_{out}
R_{sig}
i_i
C_{C1}
i_e
v_{sig}
v_i
I
R_{in}
$-V_{EE}$

(a)


C
i_o
v_o
αi_e
R_C
R_L
B
i_e
r_e
R_{out}
R_{sig}
i_i
E
v_{sig}
v_i
R_{in}

(b)

Ανάλυση μεγάλου σήματος