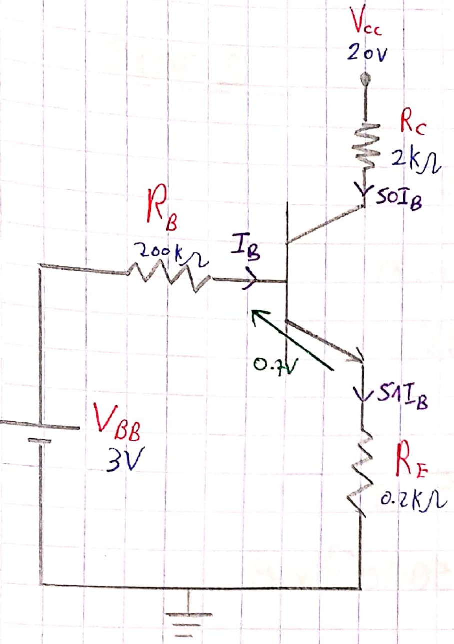
שאלה 1

א. סעיף 1:



$V_{BB} - 0 = U_{RB} + V_{BE} + U_{RE}$

$3 = 200 I_B + 0.7 + 51 I_B \cdot 0.2$

$I_B = 10.941 \cdot 10^{-3} mA$

$\boxed{I_C = 50 I_B = 0.547 mA}$

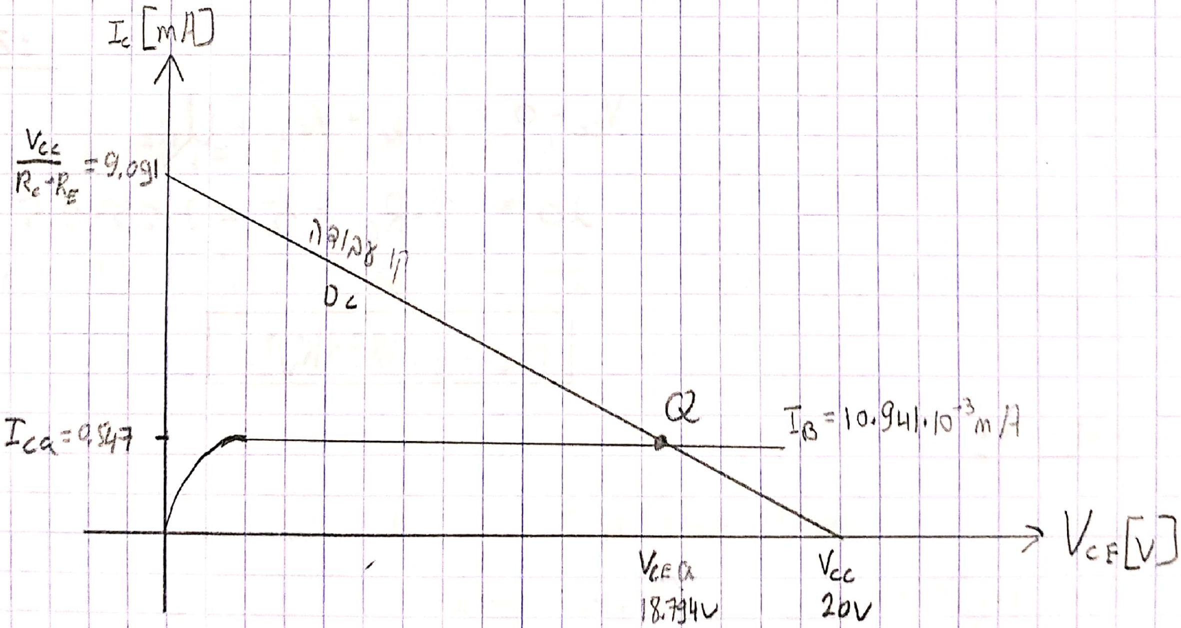
סעיף 2:

$V_{CC} - 0 = U_{RC} + V_{CE} + U_{RE}$

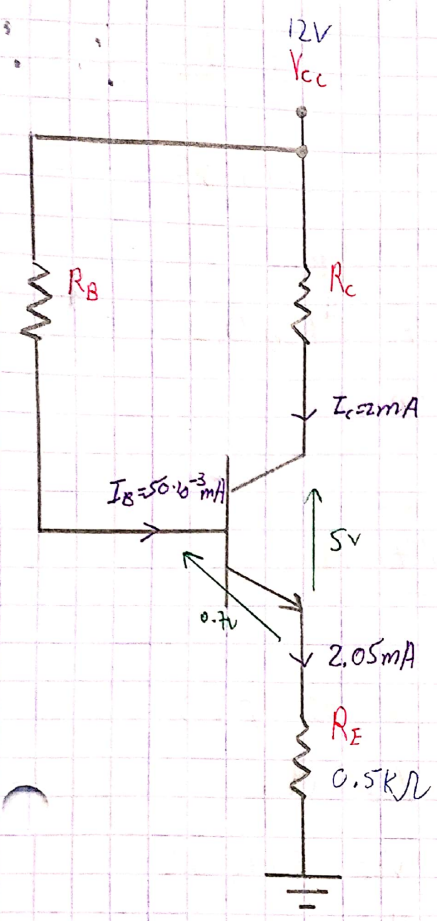
$20 = 50 I_B \cdot 2 + V_{CE} + 51 I_B \cdot 0.2$

$\boxed{V_{CE} = 18.794V}$

ב+ג.



* הטרנזיסטור במצב פעיל



שאלה 2

$\beta = 40$

$I_C = 2mA$

$I_C = \beta I_B$

$\Downarrow$

$2 = 40 I_B$

$I_B = 50 \cdot 10^{-3} mA$

מעגל 1: $V_{CC} - 0 = U_{RB} + V_{BE} + U_{RE}$

$20 = 50 \cdot 10^{-3} \cdot R_B + 0.7 + 2.05 \cdot 0.5$

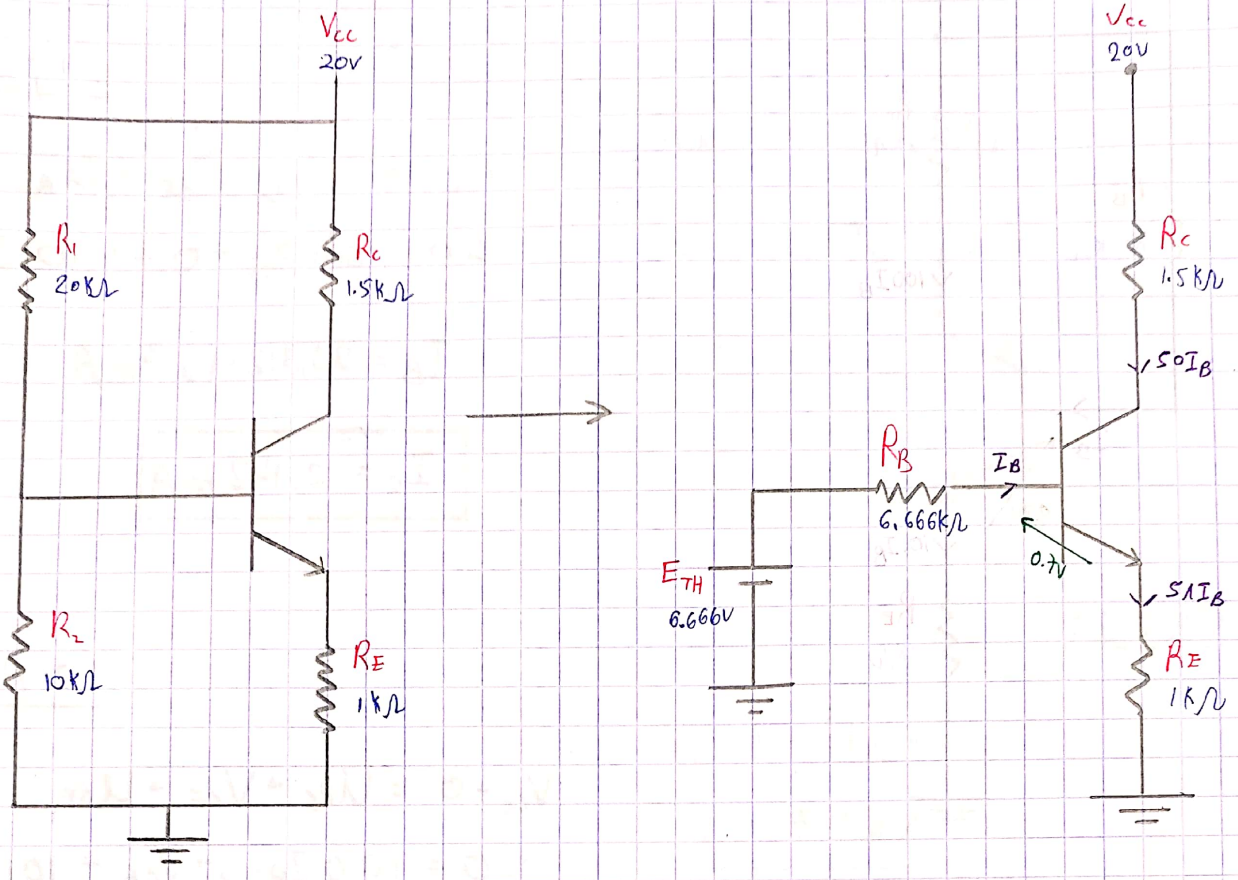
$\boxed{R_B = 365.5\ K\Omega}$

מעגל 2: $V_{CC} - 0 = U_{RC} + V_{CE} + U_{RE}$

$20 = 2 \cdot R_C + 5 + 2.05 \cdot 0.5$

$\boxed{R_C = 6.9875 K\Omega}$

שאלה 3



$$R_{TH} = R_2 \| R_1 = 10 \| 20 = 6.666 K\Omega$$

$$E_{TH} = U_{R2} = V_{cc} \cdot \frac{R_2}{R_2 + R_1} = 20 \cdot \frac{10}{30} = 6.666V$$

מעגל 1:

$$E_{TH} - 0 = U_{RB} + V_{BE} + U_{RE}$$

$$6.666 = 6.666 I_B + 0.7 + 51 I_B \cdot 1$$

$$I_B = 103.468 \cdot 10^{-3} mA$$

$$\boxed{I_c = 5.173 mA}$$

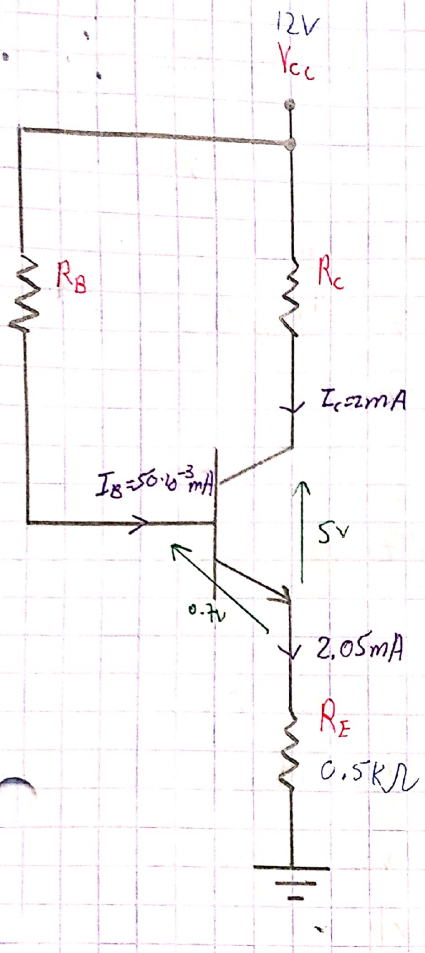
מעגל 2:

$$V_{cc} - 0 = U_{Rc} + V_{CE} + U_{RE}$$

$$20 = 50 I_B \cdot 1.5 + V_{CE} + 51 I_B \cdot 1$$

$$\boxed{V_{CE} = 6.963 V}$$

שאלה 2



$\beta = 40$

$I_C = 2mA$

$I_C = \beta I_B$

$\Downarrow$

$2 = 40 I_B$

$I_B = 50 \cdot 10^{-3} mA$

$V_{CC} - 0 = U_{RB} + V_{BE} + U_{RE}$:1 לולאה

$20 = 50 \cdot 10^{-3} \cdot R_B + 0.7 + 2.05 \cdot 0.5$

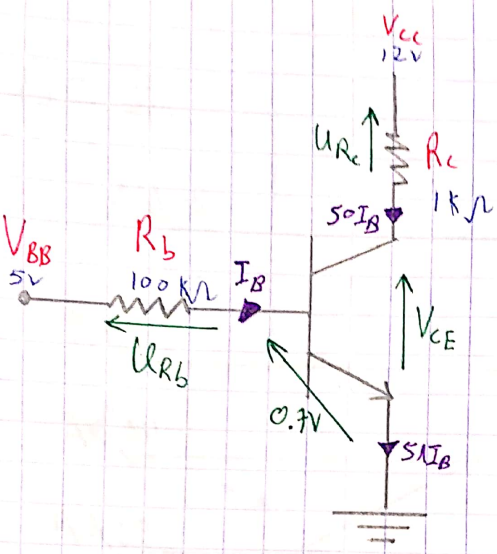
$\boxed{R_B = 365.5\ K\Omega}$

:2 לולאה

$V_{CC} - 0 = U_{RC} + V_{CE} + U_{RE}$

$20 = 2 \cdot R_C + 5 + 2.05 \cdot 0.5$

$\boxed{R_C = 6.9875 K\Omega}$



שאלה 5

סעיף 1:

$$V_{BB} - 0 = U_{R_b} + V_{BE}$$

$$5 = 100I_B + 0.7$$

$$\boxed{I_B = 43 \cdot 10^{-3}\,mA}$$

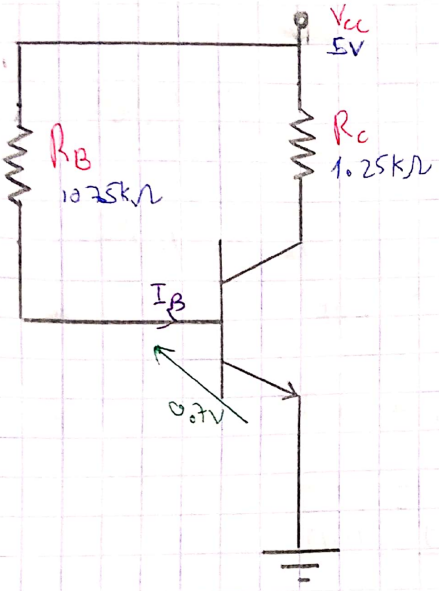
$$\boxed{I_c = 50I_B = 2.15\,mA}$$

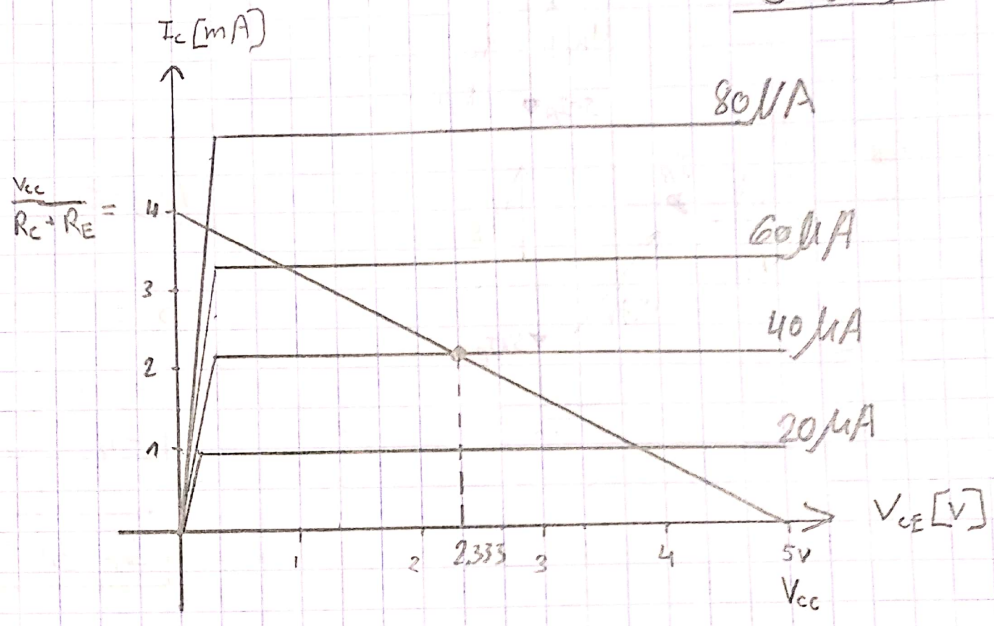
סעיף 2:

$$V_{cc} - 0 = U_{R_c} + V_{CE}$$

$$12 = 50I_B \cdot 1 + V_{CE}$$

$$\boxed{V_{CE} = 9.85V}$$





ב. מעגל 1

$$V_{cc} - 0 = U_{RB} + V_{BE}$$

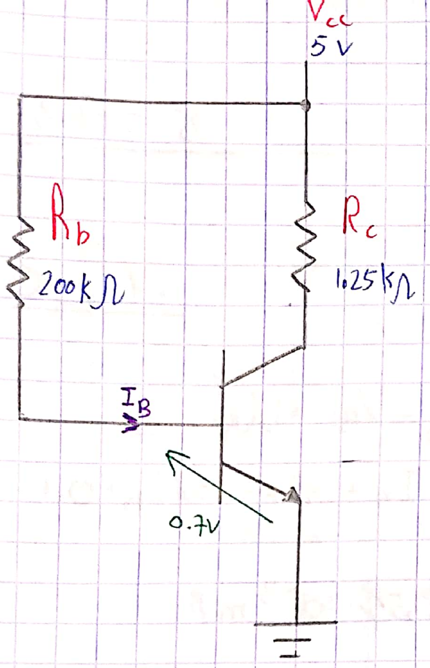
$$5 = 107.5 I_B + 0.7$$

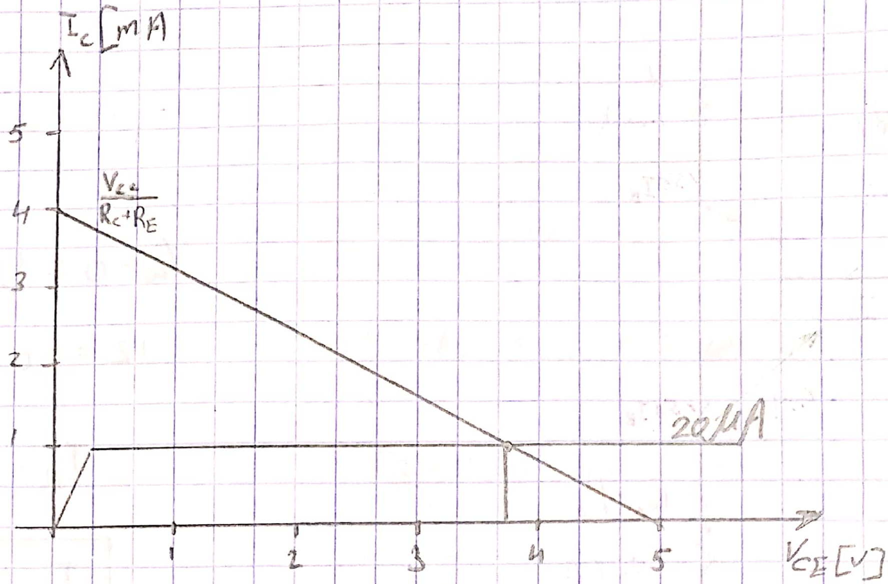
$$\boxed{I_B = 0.04mA}$$

$$\boxed{I_B = 40 \cdot 10^{-3} mA}$$

ג. $V_{CE} = 2.333V$

שאלה 7





ב. סעיף א:

$$V_{cc} - 0 = U_{Rb} + V_{BE}$$

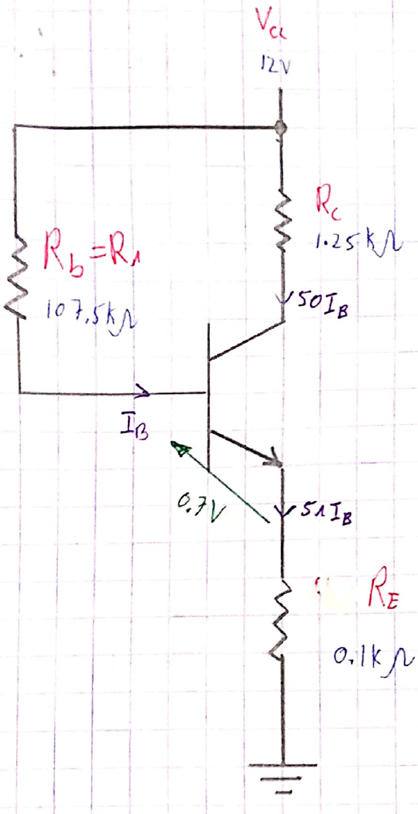
$$5 = 200 I_B + 0.7$$

$$\boxed{I_B = 21.5 \cdot 10^{-3} mA} \approx 20 \cdot 10^{-3} mA$$

ג. $\boxed{V_{CE} = 3.7V}$

עדיף V_{CE} כמה שיותר קרוב ל $\frac{1}{2}V_{cc}$
ולכן הפתרון בשאלה 6 יותר עדיף
כי כך נוכל לעשות הגבר יותר גדול
מבלי לקבל קטימה.

שאלה 8



סעיף 1:

$$V_{cc} - 0 = U_{Rb} + V_{BE} + U_{RE}$$

$$12 = 107.5 I_B + 0.7 + 51 I_B \cdot 0.1$$

$$I_B = 100.355 \cdot 10^{-3}\, mA$$

$$\boxed{I_c = 5.017\, mA}$$

סעיף 2:

$$V_{cc} - 0 = U_{Rc} + V_{CE} + U_{RE}$$

$$12 = 1.25 \cdot 50 \cdot I_B + V_{CE} + 0.1 \cdot 51 \cdot I_B$$

$$\boxed{V_{CE} = 5.215 V}$$

ב. מהקשר הבא: (סעיף 2)

$$12 - 1.25 \cdot 50 I_B - 0.1 \cdot 51 \cdot I_B = V_{CE}$$

במידה ורוצים להגדיל את V_{CE} ל- 6

ולכן נדרש להקטין את I_B (יחס הפוך). ומהקשר של סעיף 1

כדי ש I_B יקטן R_b/R_1 יגדל

ג.

סעיף 1:

$$V_{cc} - 0 = U_{Rb} + V_{BE} + U_{RE}$$

$$12 = R_1 \cdot I_B + 0.7 + 0.1 \cdot 51 I_B$$

$$I_B(5.1 + R_1) = 11.3$$

סעיף 2:

$$V_{cc} - 0 = U_{Rc} + V_{CE} + U_{RE}$$

$$12 = 50 \cdot I_B \cdot 1.25 + 6 + 51 I_B \cdot 0.1$$

$$I_B(62.5 + 5.1) = 6$$

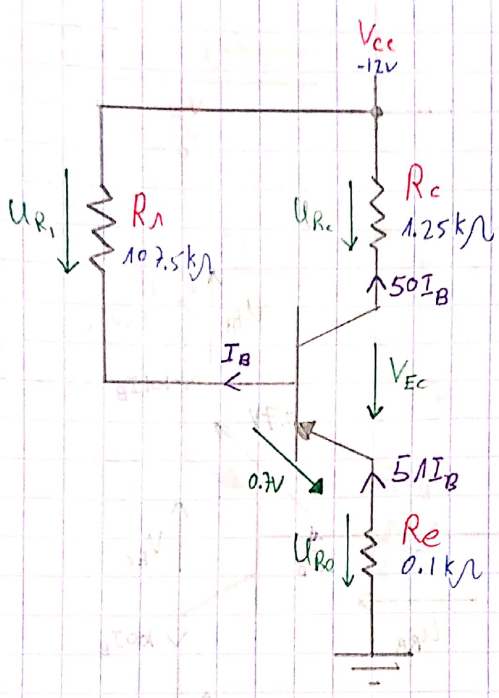
$$67.6 \cdot I_B = 6$$

$$I_B = 88.757 \cdot 10^{-3}\, mA$$

$$I_B(5.1 + R_1) = 11.3$$

$$88.757 \cdot 10^{-3}(5.1 + R_1) = 11.3$$

$$\boxed{R_1 = 122.213 k\Omega}$$



שאלה 9:

.Ic

סוללה 1:

$$V_{cc} - 0 = -U_{R_1} - V_{EB} - U_{Re}$$

$$-12 = -107.5 I_B - 0.7 - 51 I_B \cdot 0.1$$

$$I_B = 100.355 \cdot 10^{-3}\ mA$$

$$\downarrow$$

$$\boxed{I_c = 5.017\ mA}$$

סוללה 2:

$$V_{cc} - 0 = -U_{R_c} - V_{EC} - U_{Re}$$

$$-12 = -50 I_B \cdot 1.25 - V_{EC} - 51 I_B \cdot 0.1$$

$$\boxed{V_{EC} = 5.216\ V}$$

ב. נקודת פעולה מתקבלת כאשר: $V_{EC} = 6V$ / $V_{CE} = -6V$

סוללה 1:

$$V_{cc} - 0 = -U_{R_1} - V_{EB} - U_{Re}$$

$$-12 = -R_1 \cdot I_B - 0.7 - 51 I_B \cdot 0.1$$

$$I_B(R_1 + 5.1) = 11.3 \longrightarrow 88.757 \cdot 10^{-3}(R_1 + 5.1) = 11.3$$

$$R_1 + 5.1 = 127.313$$

$$\boxed{R_1 = 122.213\ k\Omega}$$

סוללה 2:

$$V_{cc} - 0 = -U_{R_c} - V_{EC} - U_{Re}$$

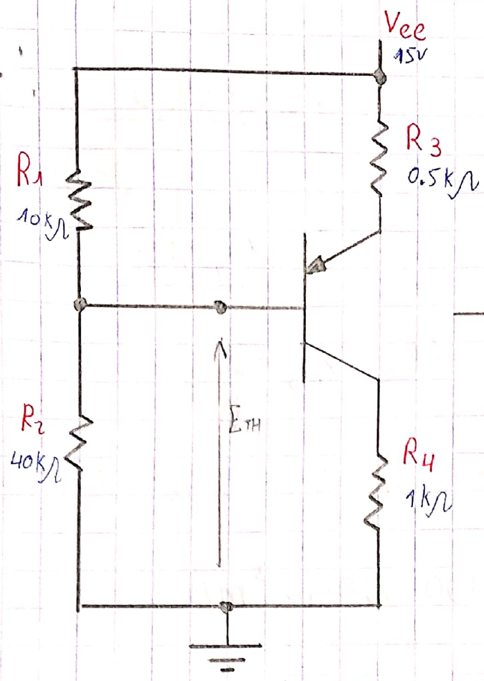
$$-12 = -50 I_B \cdot 1.25 - 6 - 51 I_B \cdot 0.1$$

$$-6 = -62.5 I_B - 5.1 I_B$$

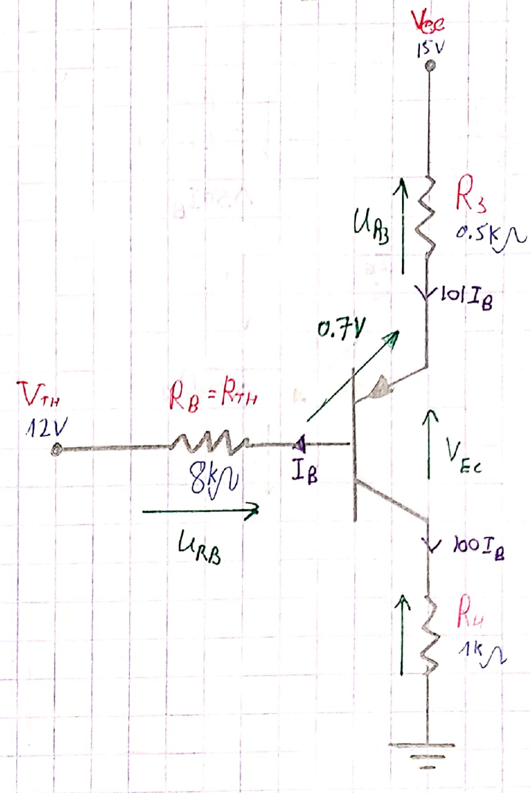
$$67.6 I_B = 6$$

$$I_B = 88.757 \cdot 10^{-3}\ mA$$

שאלה 10:



מתח תבנין בבסיס לאדמה
לא משנה סוג.



א. V_{BE} בסימן שלילי מכיוון שזהו טרנזיסטור מסוג PNP כאשר הפוטנציאל באמיטר גדול מן הפוטנציאל בבסיס

ב. סעיף 1:

$V_{ee} - V_{TH} = U_{R_3} + V_{EB} + U_{R_B}$

$15 - 12 = 101 I_B \cdot 0.5 + 0.7 + I_B \cdot 8$

$I_B = 39.316 \cdot 10^{-3}\ mA$

$I_c = 3.931\ mA$

סעיף 2:

$V_{ee} - 0 = U_{R_3} + V_{EC} + U_{R_4}$

$15 = 101 I_B \cdot 0.5 + V_{EC} + 1 \cdot 100 I_B$

$V_{EC} = 9.082V$

ג. לשנות את ערך R_4 (ישירה) / לשנות את I_B באמצעות שינוי אחד הנגדים R_1, R_2, R_3

ד. סעיף 2:

$V_{ee} - 0 = U_{R_3} + V_{EC} + U_{R_4}$

$15 = 101 I_B \cdot 0.5 + 7.5 + 100 I_B$

$7.5 = 150.5 I_B$

$I_B = 49.833 \cdot 10^{-3}\ mA$

סעיף 1:

$V_{ee} - V_{TH} = U_{R_3} + V_{EB} + U_{R_B}$

$15 - V_{TH} = 101 I_B \cdot 0.5 + 0.7 + I_B \cdot R_{TH}$

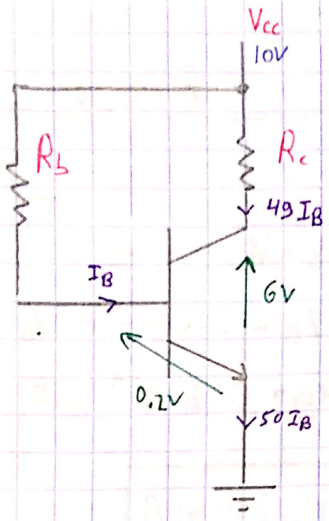
$11.783 = V_{TH} + 49.833 \cdot 10^{-3} R_{TH}$

$11.783 = 15 \cdot \left(\frac{R_2}{R_1 + R_2}\right) + 49.833 \cdot 10^{-3} (R_1 \| R_2)$

$11.783 = 15 \cdot \left(\frac{40}{40 + R_1}\right) + 49.833 \cdot 10^{-3} (40 \| R_1)$

$11.783 = \frac{600}{40 + R_1} + 49.833 \cdot 10^{-3} \left(\frac{40 R_1}{40 + R_1}\right)$

$R_1 = 13.144 k\Omega$



שאלה 11

$I_c = 49 I_B = 5mA$

$I_B = 102.04 \cdot 10^{-3} mA$

סוגיה 1:

$V_{cc} - 0 = U_{Rb} + V_{BE}$

$10 = I_B \cdot R_b + 0.2$

$102.04 \cdot 10^{-3} R_b = 9.8$

$\boxed{R_b = 96.04 k\Omega}$

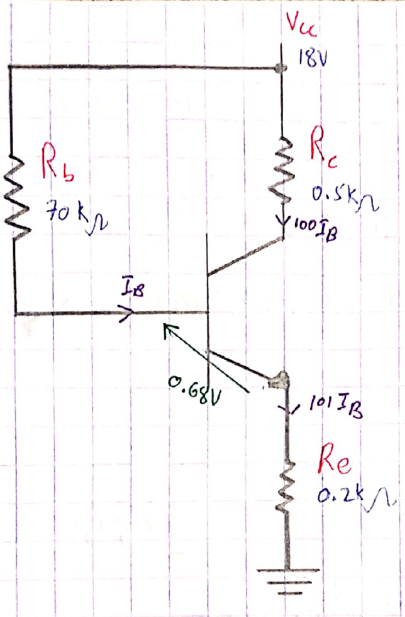
סוגיה 2:

$V_{cc} - 0 = U_{Rc} + V_{CE}$

$10 = I_c \cdot R_c + 6$

$4 = 5R_c$

$\boxed{R_c = 0.8 k\Omega}$



שאלה 12 סעיף ב':

:1 מעגל

$V_{cc} - 0 = U_{R_b} + V_{BE} + U_{R_e}$

$18 = 70 I_B + 0.68 + 101 I_B \cdot 0.2$

$I_B = 192.017 \cdot 10^{-3}$ mA

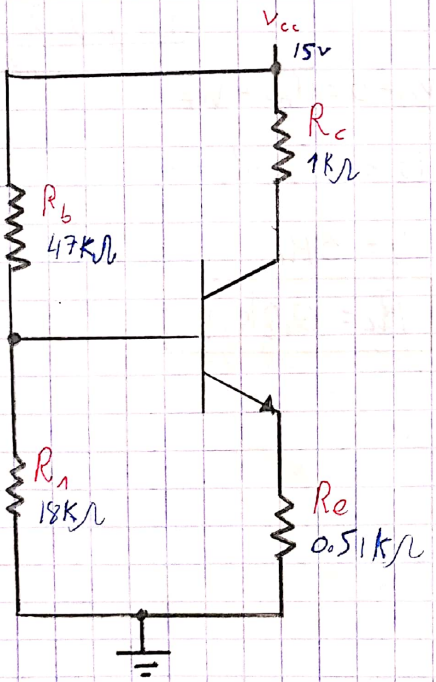
$\boxed{I_c = 19.201\,mA}$

:2 מעגל

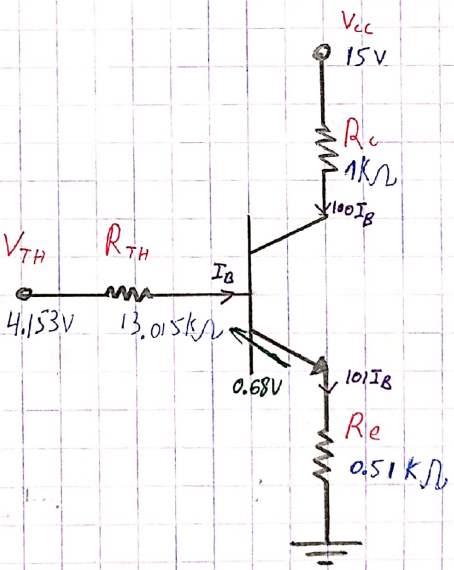
$V_{cc} - 0 = U_{R_c} + V_{CE} + U_{R_e}$

$18 = 100 I_B \cdot 0.5 + V_{CE} + 101 I_B \cdot 0.2$

$\boxed{V_{CE} = 4.52V}$



שאלה 12 סעיף ד':



:2 מעגל

$V_{cc} - 0 = U_{R_c} + V_{CE} + U_{R_e}$

$15 = 100 I_B \cdot 1 + V_{CE} + 101 I_B \cdot 0.51$

$\boxed{V_{CE} = 6.843V}$

:1 מעגל

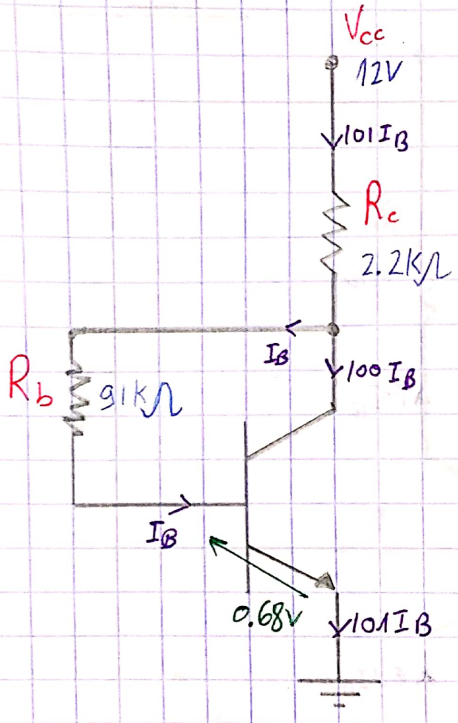
$V_{TH} - 0 = U_{R_{TH}} + V_{BE} + U_{R_e}$

$4.153 = 13.015 I_B + 0.68 + 101 I_B \cdot 0.51$

$I_B = 53.836 \cdot 10^{-3}$ mA

$\boxed{I_c = 5.383\,mA}$

שאלה 3 מבחן 12



סעיף א':

$$V_{cc} - 0 = U_{R_c} + U_{R_b} + V_{BE}$$

$$12 = 101 I_B \cdot 2.2 + I_B \cdot 91 + 0.68$$

$$I_B = 36.143 \cdot 10^{-3}\ mA$$

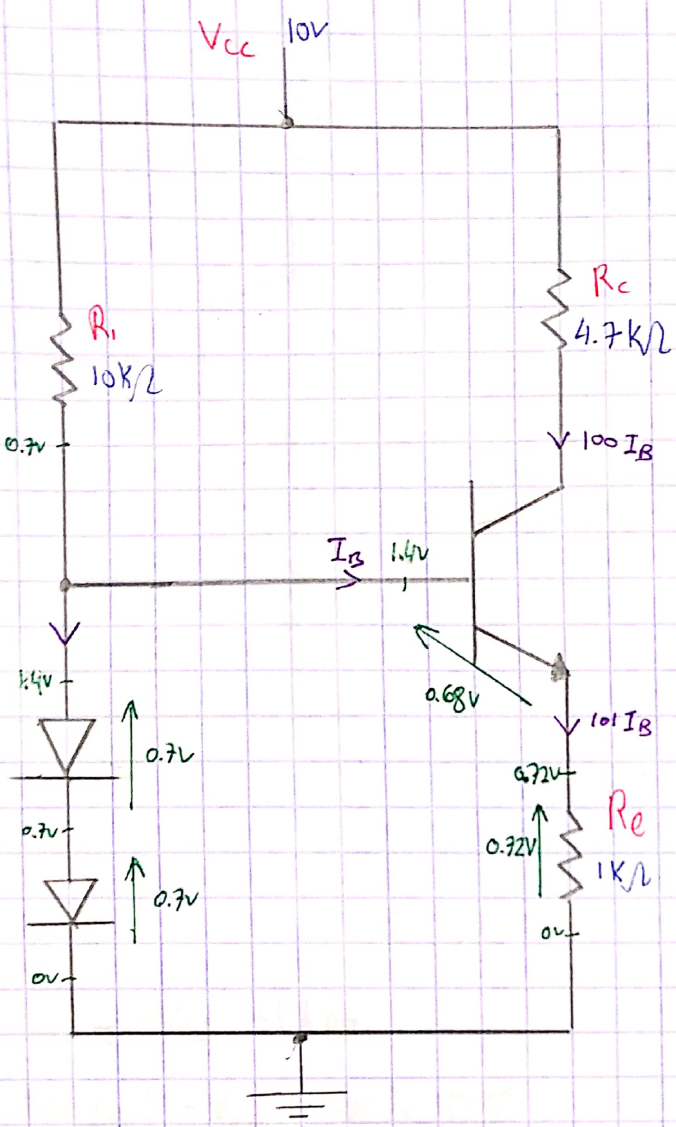
$$\boxed{I_c = 3.614mA}$$

סעיף ב':

$$V_{cc} - 0 = U_{R_c} + V_{CE}$$

$$12 = 101 I_B \cdot 2.2 + V_{CE}$$

$$\boxed{V_{CE} = 3.97V}$$



$$U_{Re} = R_e \cdot 101 I_B = 0.72$$

$$1 \cdot 101 I_B = 0.72$$

$$I_B = 7.128 \cdot 10^{-3} mA$$

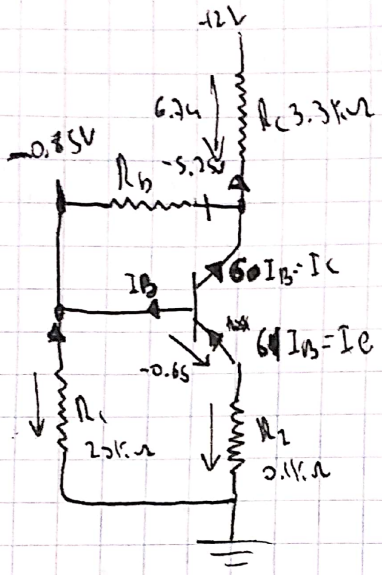
$$\boxed{I_c = 0.713\,mA}$$

סעיף 2:

$$V_{cc} - 0 = U_{R_c} + V_{EB} + U_{Re}$$

$$10 = 100 I_B \cdot 4.7 + V_{EB} + 0.72$$

$$\boxed{V_{EB} = 5.929V}$$



$I_{R_b} = 2\ mA$ $\quad \beta = 60$ $\quad V_{BE} = 0.65V$

$U_{R_2} = I_{R_e} \cdot R_2 = 2 \cdot 0.1 = 0.2V$

~~$U_{R_1} = (V_{BE} + U_{R_2}) - 0 = -0.65 - 0.2$~~

$U_{R_1} = (V_{BE} + U_{R_2}) - 0 = 0.65 + 0.2 - 0 = 0.85V$

$I_{R_1} = \frac{U_{R_1}}{R_1} = \frac{0.85}{20} = 42.5 \cdot 10^{-3}\ mA$

$I_B = \frac{I_e}{61} = \frac{2}{61} = 32.786 \cdot 10^{-3}\ mA$

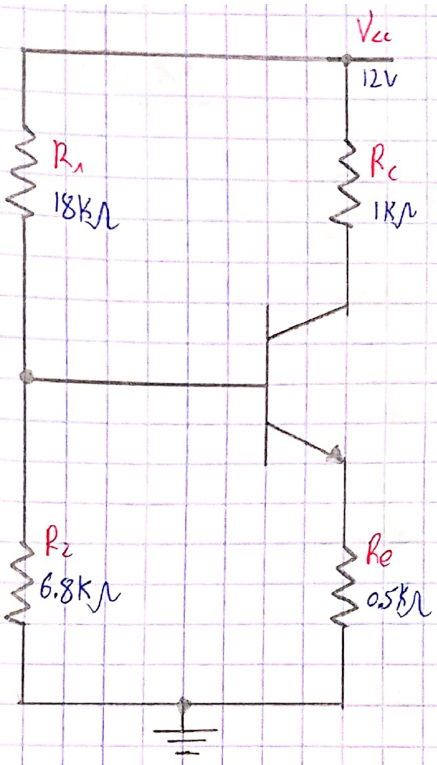
$I_{R_b} = I_B + I_{R_1} = 42.5 \cdot 10^{-3} + 32.786 \cdot 10^{-3} = 75.286 \cdot 10^{-3}\ mA$

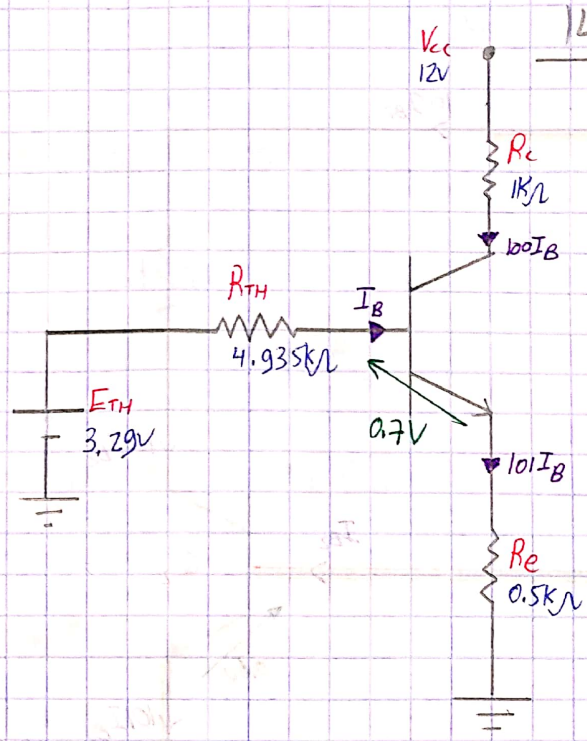
$I_{R_c} = I_{R_b} + I_c = 75.286 \cdot 10^{-3} + 60 \cdot 32.786 \cdot 10^{-3} = 2.042\ mA$

$U_{R_2} = I_{R_c} \cdot R_c = 2.042 \cdot 3.3 = 6.74V$

$U_{R_b} = -0.85 - (-5.25) = 4.41V$

$R_b = \frac{U_{R_b}}{I_{R_b}} = \frac{4.41}{75.286 \cdot 10^{-3}} = 58.575\ k\Omega$





14 שאלה

סעיף 1:

$E_{TH} - 0 = U_{R_{TH}} + V_{BE} + U_{R_e}$

$3.29 = 4.935 I_B + 0.7 + 101 I_B \cdot 0.5$

$I_B = 46.726 \cdot 10^{-3}\ mA$

$\boxed{I_C = 4.672\ mA}$

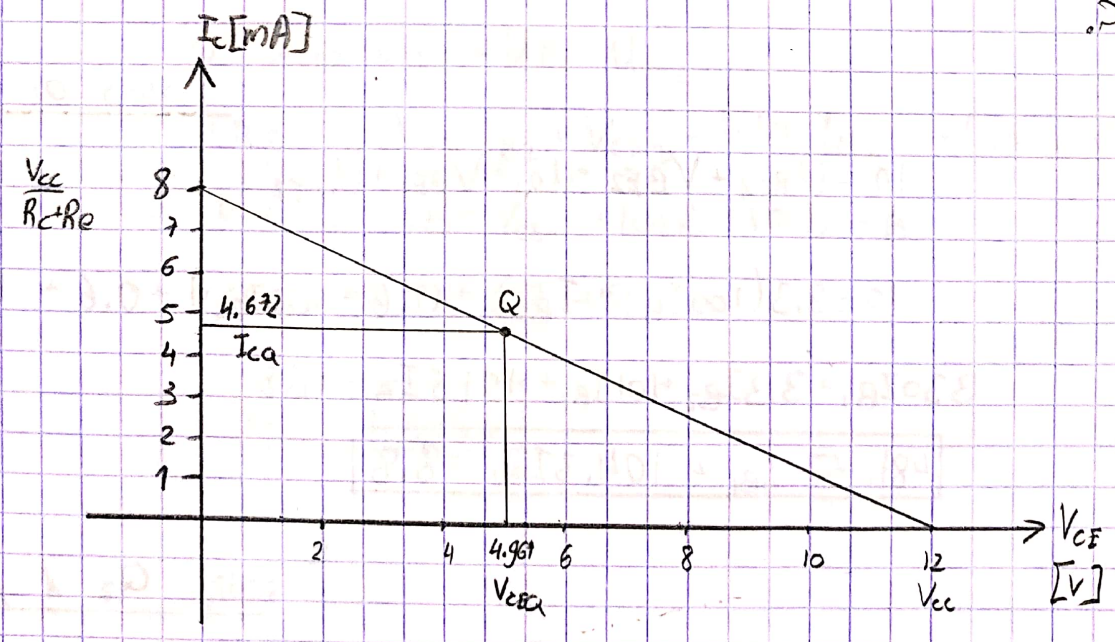
סעיף 2:

$V_{cc} - 0 = U_{R_c} + V_{CE} + U_{R_e}$

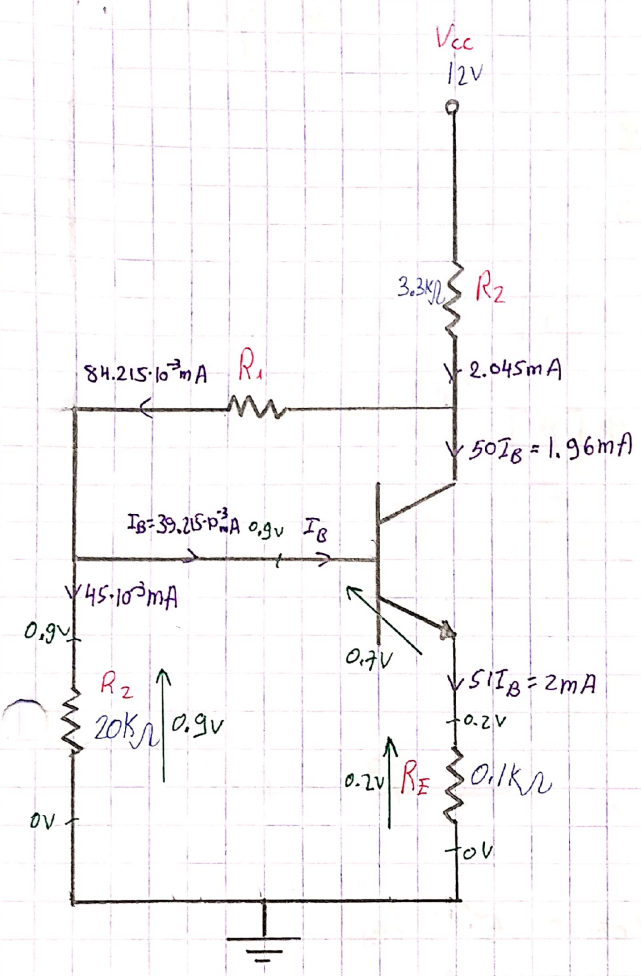
$12 = 100 I_B \cdot 1 + V_{CE} + 101 I_B \cdot 0.5$

$\boxed{V_{CE} = 4.967V}$

ב.



שאלה 2:



כלל מעגל 1:

$$V_{cc} - 0 = U_{R_2} + U_{R_1} + V_{BE} + U_{RE}$$

$$12 = 2.045 \cdot 3.3 + 84.215 \cdot 10^{-3} \cdot R_1 + 0.7 + 0.2$$

$$4.3515 = 84.215 \cdot 10^{-3} R_1$$

$$\boxed{R_1 = 51.67K\Omega}$$

$$\begin{cases} 481.5\, I_{B_1} + 104.3\, I_{B_2} = 8.8 \\ 329\, I_{B_1} + 205.3\, I_{B_2} = 9.4 \end{cases}$$

$$\begin{cases} I_{B1} = 12.802 \cdot 10^{-3}\, mA \rightarrow [A] \\ I_{B2} = 25.270 \cdot 10^{-3}\, mA \rightarrow [B] \end{cases}$$

$$\downarrow$$

$$I_{C1} = 1.280\, mA$$

$$I_{C2} = 2.527\, mA$$

סעיף 2 עבור Q_1:

$$10 = U_{Rc1} + V_{CE1} + U_{RE1}$$

$$10 = 3.3(100 I_{B1} + I_{B2}) + V_{CE1} + 1.5 \cdot 101 I_{B1}$$

$$10 = 3.3(100A + B) + V_{CE1} + 1.5 \cdot 101 \cdot A$$

$$V_{CE1} = 10 - 330A - 3.3B - 151.5A$$

$$V_{CE1} = 10 - 481.5A - 3.3B$$

$$\boxed{V_{CE1} = 3.752V}$$

סעיף 2 עבור Q_2:

$$10 = U_{Rc2} + V_{CE2} + U_{R1} + U_{R2}$$

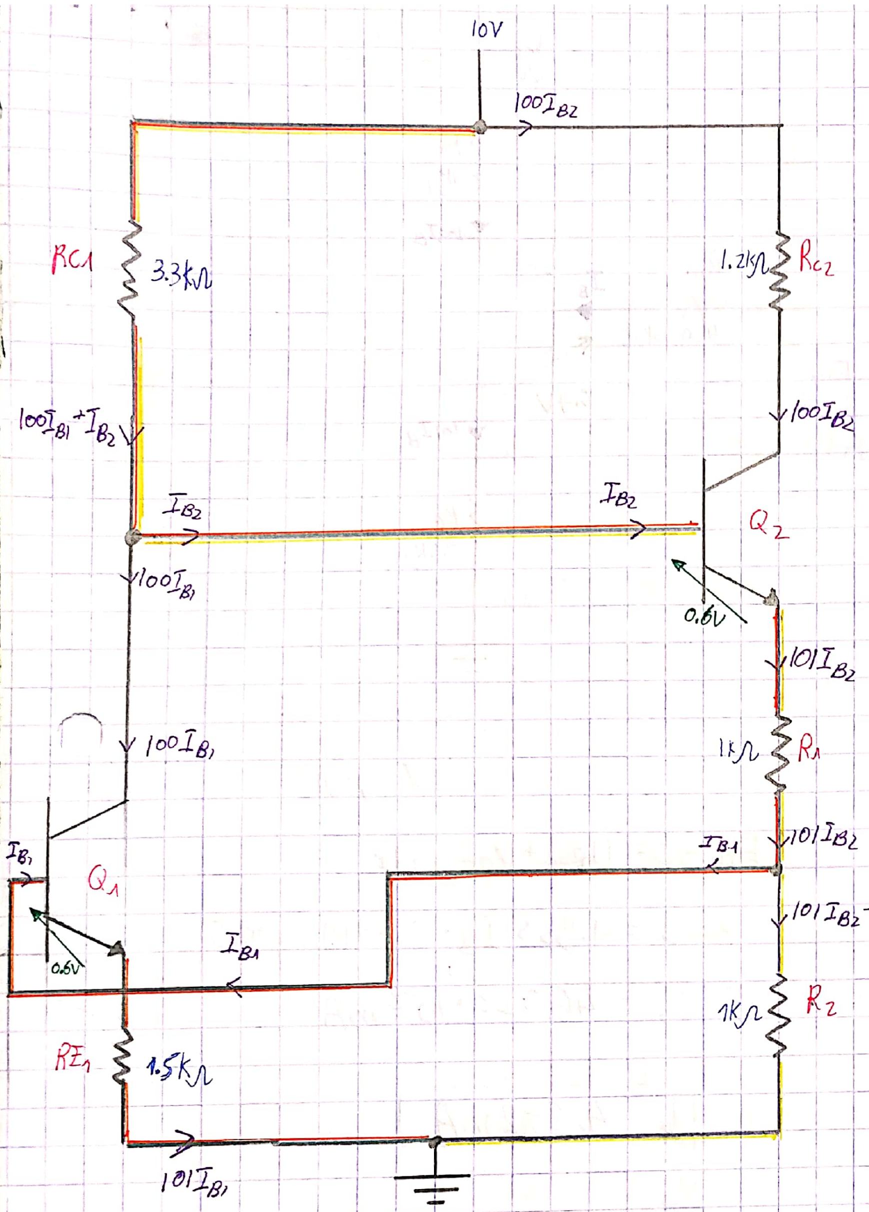
$$10 = 1.2 \cdot 100 I_{B2} + V_{CE2} + 1 \cdot 101 I_{B2} + 1 \cdot (101 I_{B2} - I_B)$$

$$10 = 1.2 \cdot 100B + V_{CE2} + 101B + 101B - A$$

$$V_{CE2} = 10 - 322B + A$$

$$\boxed{V_{CE2} = 1.875V}$$

תרגיל 1:



מסלול סגור 1 Q_1 כניסה:

$$10 = U_{RC1} + V_{BE2} + U_{R1} + V_{BE1} + U_{RE1}$$

$$10 = 3.3(100I_{B1} + I_{B2}) + 0.6 + 101I_{B2}\cdot 1 + 0.6 + 101I_{B1}\cdot 1.5$$

$$330I_{B1} + 3.3I_{B2} + 101I_{B2} + 151.5I_{B1} = 8.8$$

$$\boxed{481.5\,I_{B1} + 104.3I_{B2} = 8.8}$$

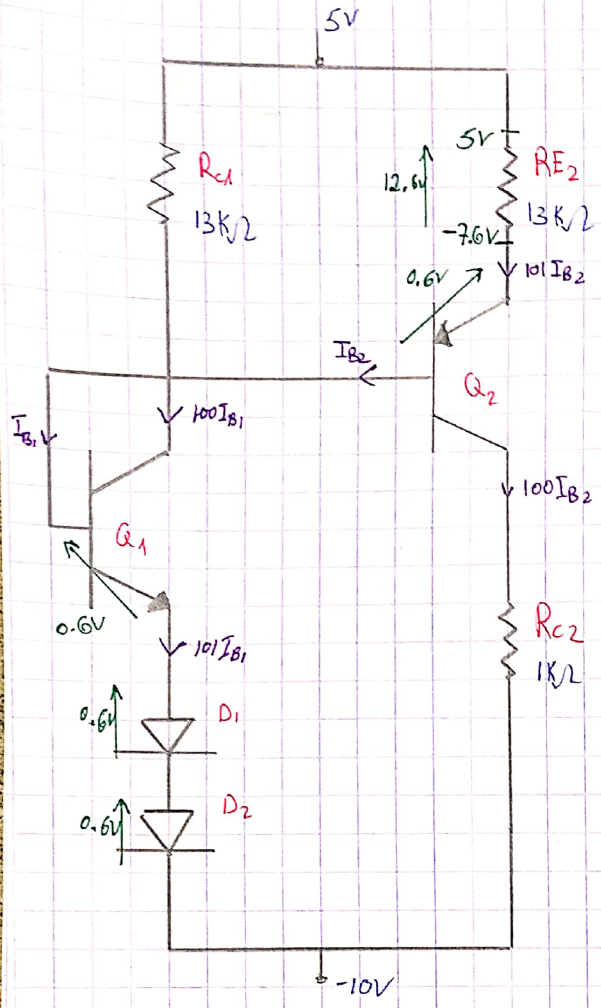
מסלול סגור 1 Q_2 במוצא:

$$10 = U_{RC1} + V_{BE2} + U_{R1} + U_{R2}$$

$$10 = (100I_{B1} + I_{B2})\cdot 3.3 + 0.6 + 1\cdot 101I_{B2} + 1\cdot(101I_{B2} - I_{B1})$$

$$330I_{B1} + 3.3I_{B2} + 0.6 + 101I_{B2} + 101I_{B2} - I_{B1} = 10$$

$$\boxed{329I_{B1} + 205.3I_{B2} = 9.4}$$



$I_{C1} = I_{C2} = 0.96mA$

$V_{CE1} = 1.324V$

$V_{EC2} = 1.44V$

5 סעיף

$I_B = I_{B1} = I_{B2}$

:1 מעגל

$5-(-10) = U_{RE} + V_{EB2} + V_{BE1} + V_D + V_D$

$15 = U_{RE_2} + 0.6 + 0.6 + 0.6 + 0.6$

$U_{RE_2} = 12.6$

$U_{RE_2} = 101 I_B \cdot 13 = 12.6$

$I_B = 9.596 \cdot 10^{-3} mA$

$I_C = I_{C1} = I_{C2} = 100 I_B = 0.96mA$

:2 מעגל

$5-(-10) = U_{RC_1} + V_{CE_1} + V_D + V_D$

$15 = 13 \cdot 100 \cdot I_B + V_{CE_1} + 0.6 + 0.6$

$V_{CE1} = 1.324V$

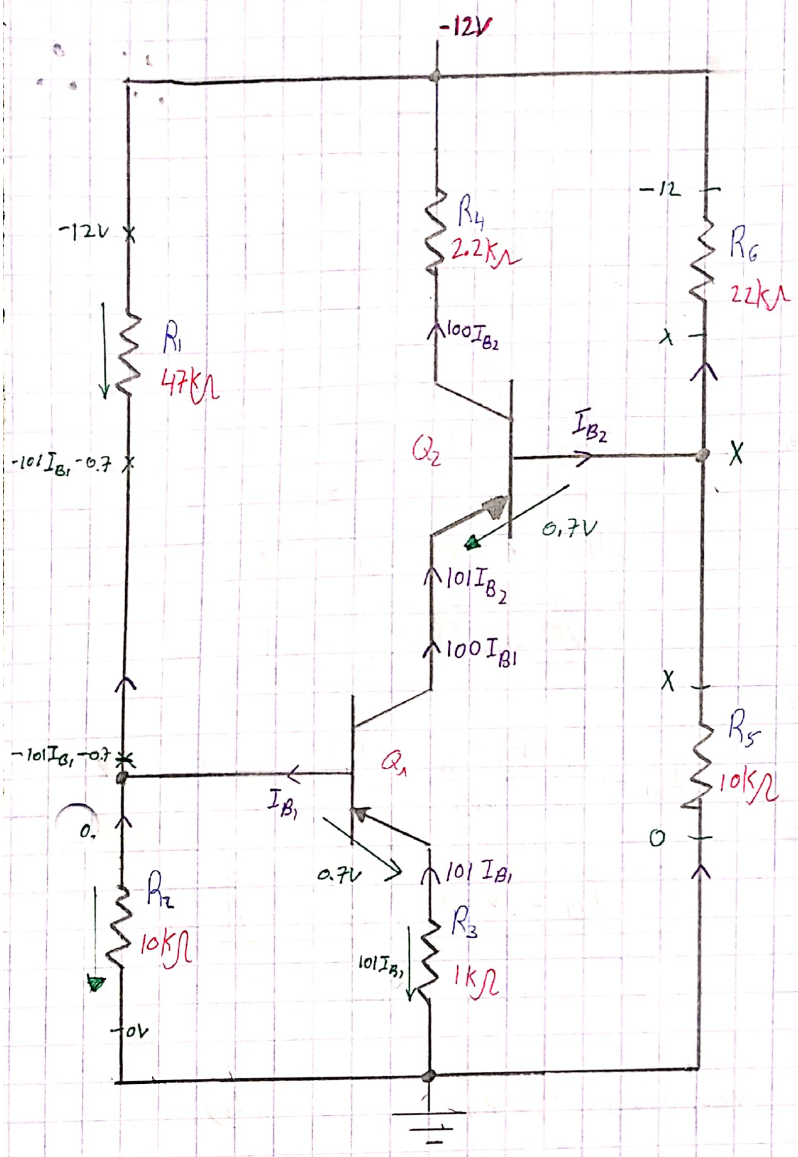
:2 מעגל

$5-(-10) = U_{RE_2} + V_{EC2} + U_{RC_2}$

$15 = 12.6 + V_{EC2} + 100 I_B \cdot 1$

$V_{EC2} = 1.44V$

:סעיף ד



שאלה 4

$$-U_{R_2} = -U_{B_3} - V_{EB}$$

$$U_{R_2} = 101 I_{B_1} + 0.7$$

$$I_{R_1} = \frac{U_{R_1}}{R_1} = \frac{-101 I_{B_1} - 0.7 - (-12)}{47}$$

$$I_{R_1} = \frac{11.3 - 101 I_{B_1}}{47}$$

$$I_{R_2} = \frac{U_{R_2}}{R_2} = \frac{101 I_{B_1} + 0.7}{10}$$

$$I_{B_1} + I_{R_2} = I_{R_1}$$

$$I_{B_1} + \frac{101 I_{B_1} + 0.7}{10} = \frac{11.3 - 101 I_{B_1}}{47}$$

$$I_{B_1} = 12.863 \cdot 10^{-3} mA$$

$$100 I_{B_1} = 101 I_{B_2}$$

$$I_{B_2} = \frac{100 I_{B_1}}{101} = 12.736 \cdot 10^{-3} mA$$

ד.

$$I_{R5} + I_{B2} = I_{R6}$$

$$\frac{-X}{10} + I_{B_2} = \frac{X+12}{22}$$

$$V_{B_2} = X = -3.662V$$

ג.

$$0 - U_{R_3} - V_{CE_1} - V_{EB_2} = X$$

$$0 - 101 I_{B_1} - V_{EC_1} - 0.7 = X$$

$$V_{EC_1} = 1.663V$$

$$(-12 - 0) = U_{R_4} + V_{EC_2} + V_{EC_1} + U_{R_3}$$

$$12 = 100 I_{B_2} \cdot 2.2 + V_{EC_2} + 1.663 + 101 I_{B_1}$$

$$V_{EC_2} = 6.236V$$

ה.

$$I_{C_1} = 100 I_{B_1} = 1.286 mA$$

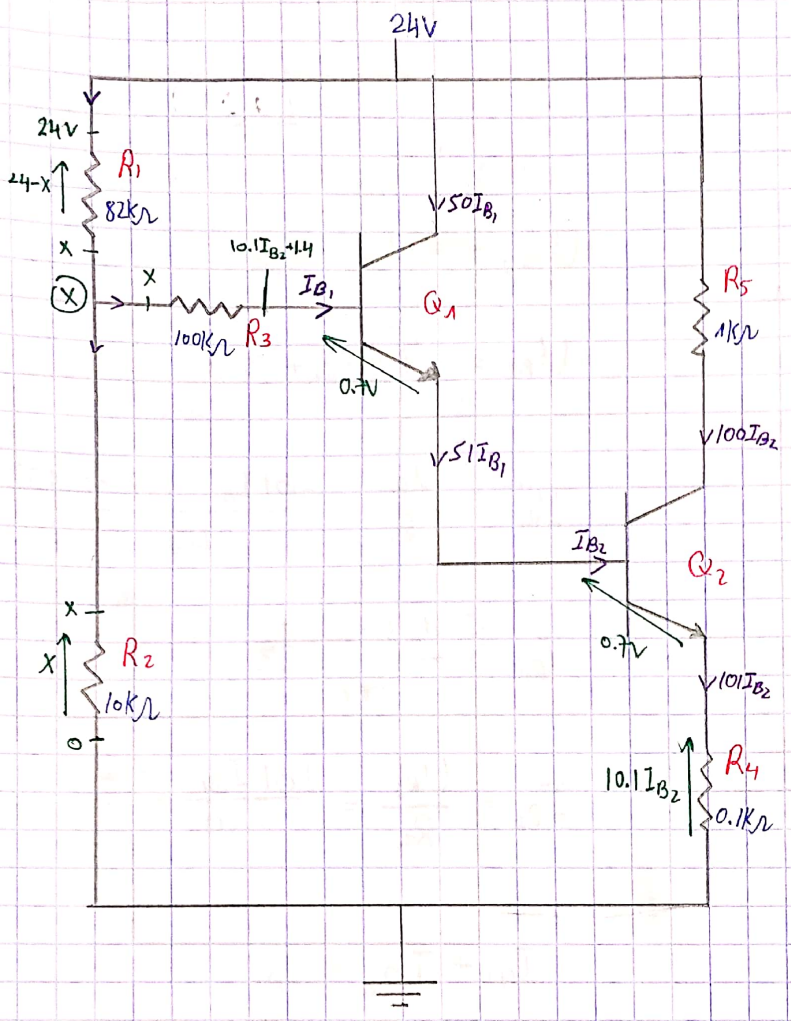
$$I_{C_2} = 100 I_{B_2} = 1.273 mA$$

$$V_{B_2} = -3.662V$$

ו.

$$V_{EC_1} = 1.663V$$

$$V_{EC_2} = 6.236V$$



3 סדקים

$$31 I_{B1} = I_{B2} \quad (1)$$

$$\frac{24-X}{82} = I_{B1} + \frac{X}{10} \quad (2)$$

$$240 - 10X = 820 I_{B1} + 82X$$

$$820 I_{B1} + 92X = 240$$

$$I_{B1} = \frac{X - (10.1 I_{B2} + 1.4)}{100} \quad (3)$$

$$100 I_{B1} = X - 10.1 I_{B2} - 1.4$$

$$24 - 0 = U_{R5} + V_{CE2} + U_{R4} \quad (5)$$

$$24 = 100 I_{B2} \cdot 1 + V_{CE2} + 101 I_{B2} \cdot 0.1$$

$$110.1 I_{B2} + V_{CE2} = 24$$

$$24 - 0 = V_{CE1} + V_{BE2} + U_{R4} \quad (4)$$

$$24 = V_{CE1} + 0.7 + 101 I_{B2} \cdot 0.1$$

$$V_{CE1} + 10.1 I_{B2} = 23.3$$

(3) (2) (1) נציב

$$\begin{cases} 820 I_{B1} + 92X = 240 \\ 615.1 I_{B1} - X = -1.4 \end{cases}$$

$I_{B1} = 1.937 \cdot 10^{-3} mA$

$X = 2.591 V$

$I_{B2} = 98.787 \cdot 10^{-3} mA$

$I_{C2} = 9.878 mA$

$I_{C1} = 96.85 \cdot 10^{-3} mA$

(5) - נציב

$110.1 I_{B2} + V_{CE2} = 24$

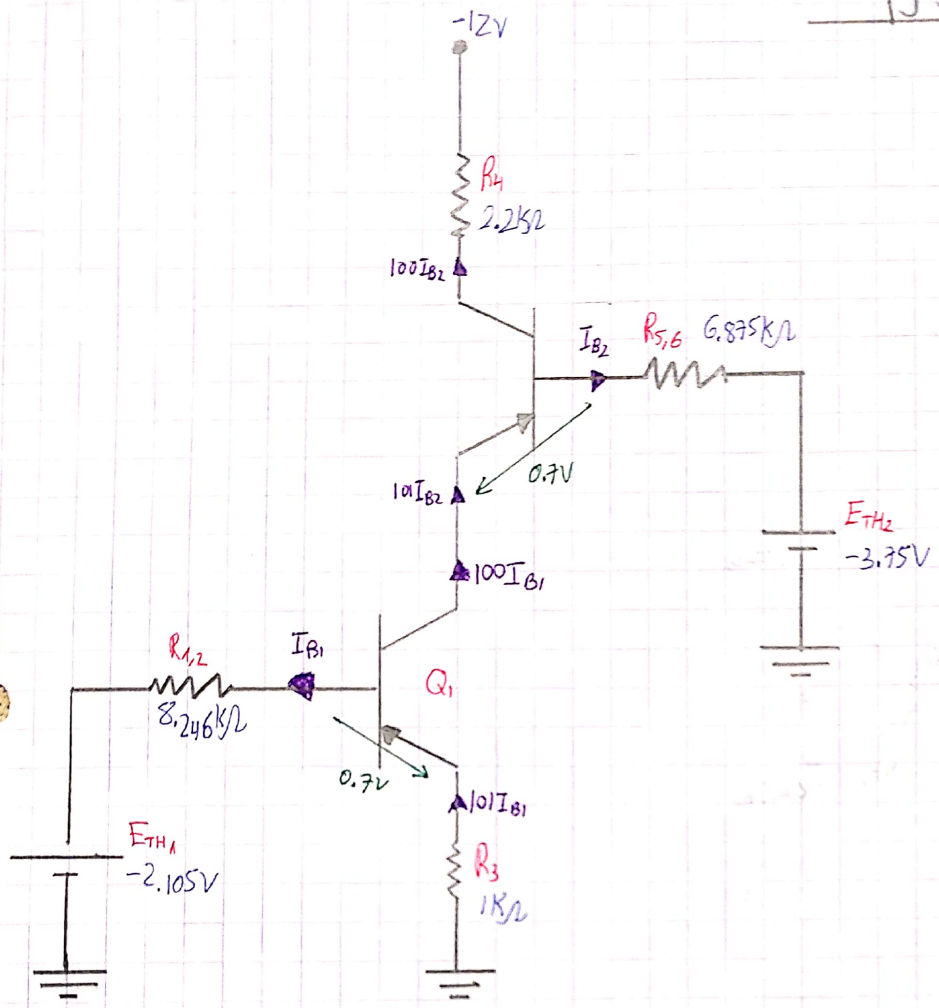
$V_{CE2} = 13.122 V$

(4) - נציב

$V_{CE1} + 10.1 I_{B2} = 23.3$

$V_{CE1} = 22.302 V$

תרגיל 4 מטלת תכנון:



$$100I_{B1} = 101I_{B2}$$

$$I_{B2} = \frac{100}{101} I_{B1}$$

(Q1) 2 חוק

$$0 - E_{TH2} = U_{R5,6} + V_{EB2} + V_{EC1} + U_{R3}$$

$$3.75 = 6.875 I_{B2} + 0.7 + V_{EC1} + 101 I_{B1} \cdot 1$$

$$\boxed{V_{EC1} = 1.663V}$$

1 חוק

$$0 - E_{TH} = U_{R1,2} + V_{EB1} + U_{R3}$$

$$2.105 = 8.246 \cdot I_{B1} + 0.7 + 101 I_{B1} \cdot 1$$

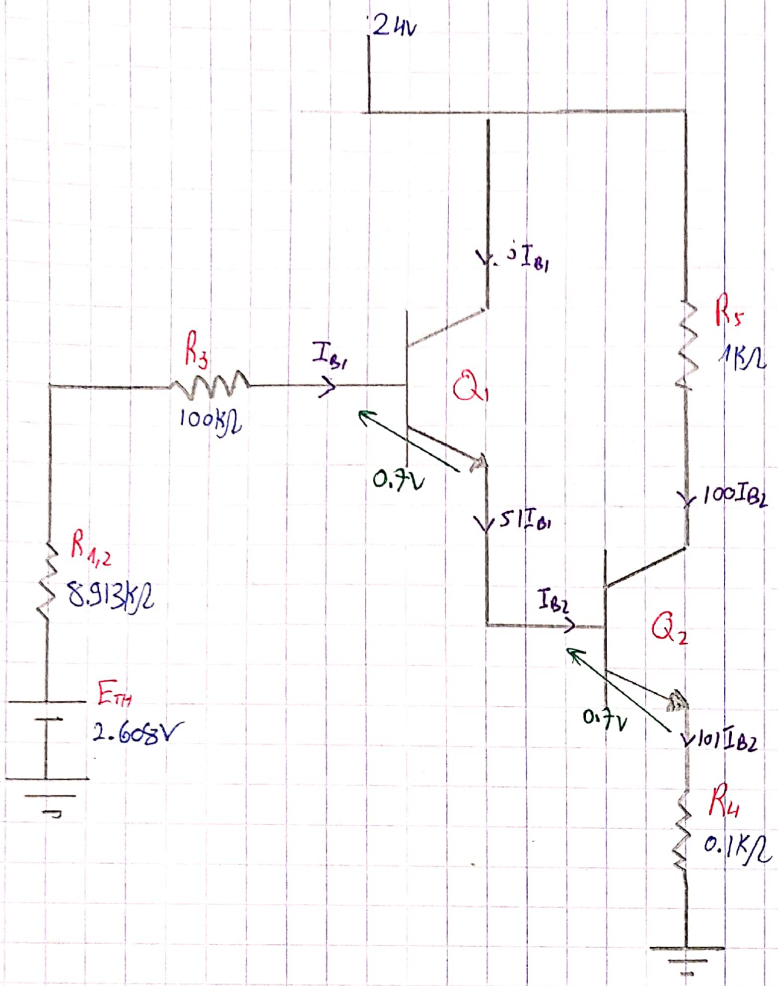
$$\boxed{\begin{aligned} I_{B1} &= 12.86 \cdot 10^{-3} mA \\ I_{C1} &= 100 I_{B1} = 1.286 mA \\ I_{B2} &= \frac{100}{101} I_{B1} = 12.733 \cdot 10^{-3} mA \\ I_{C2} &= 1.273 mA \end{aligned}}$$

(Q2) 2 חוק

$$0 - (-12) = U_{R4} + V_{EC2} + V_{EC1} + U_{R3}$$

$$12 = 100 I_{B2} \cdot 2.2 + V_{EC2} + 1.663 + 101 I_{B1} \cdot 1$$

$$\boxed{V_{EC2} = 6.236V}$$



$$I_{B2} = 51 I_{B1}$$

:1 לולאה

$$E_{TH} - 0 = U_{R1,2} + U_{R3} + V_{BE1} + V_{BE2} + U_{R4}$$

$$2.608 = 8.913 I_{B1} + 100 I_{B1} + 0.7 + 0.7 + 10.1 I_{B2}$$

$$108.913 I_{B1} + 10.1 I_{B2} = 1.208$$

$$108.913 I_{B1} + 10.1 \cdot 51 I_{B1} = 1.208$$

$$I_{B1} = 11.937 \cdot 10^{-3} mA$$

$$I_{C1} = 50 I_{B1} = 96.848 \cdot 10^{-3} mA$$

$$\Downarrow$$

$$I_{B2} = 51 I_{B1} = 98.785 \cdot 10^{-3} mA$$

$$I_{C2} = 100 I_{B2} = 9.878 mA$$

:2 לולאה

$$24 - 0 = V_{CE1} + V_{BE2} + U_{R4}$$

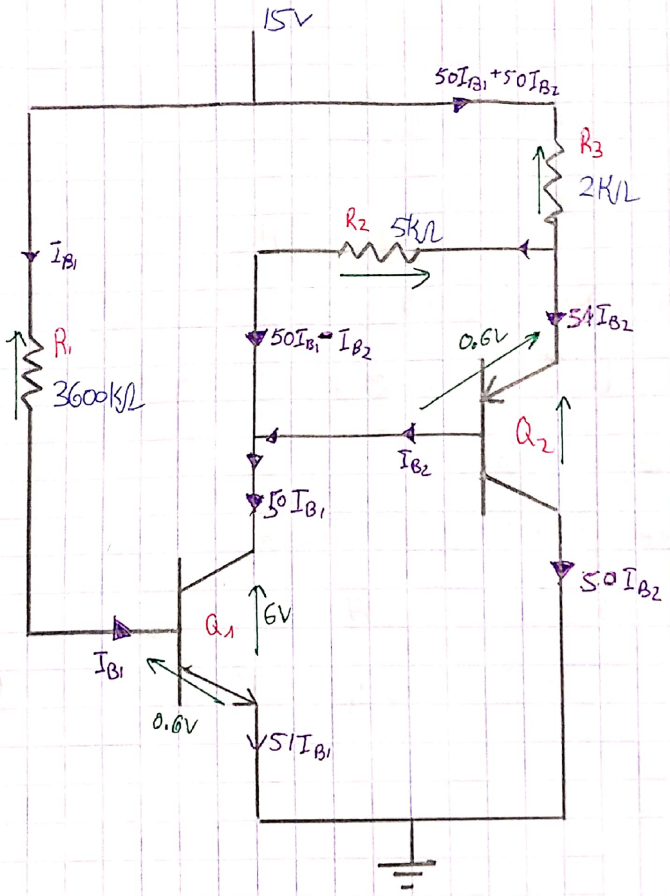
$$24 = V_{CE1} + 0.7 + 0.1 \cdot 101 I_{B2}$$

$$\boxed{V_{CE1} = 22.302V}$$

$$24 - 0 = U_{R5} + V_{CE2} + U_{R4}$$

$$24 = 100 I_{B2} \cdot 1 + V_{CE2} + 0.1 \cdot 101 I_{B2}$$

$$\boxed{V_{CE2} = 13.123V}$$



עבור (Q1) נקח מעגל 1

$15-0 = U_{R1} + V_{BE1}$

$15 = 3600I_{B1} + 0.6$

$I_{B1} = 4\cdot10^{-3}mA$

$\downarrow$

$\boxed{I_{C1} = 0.2mA}$

עבור (Q2) נקח מעגל 2

$15-0 = U_{R3} + V_{EB2}$

$\Vert$

$1k$

$15-0 = U_{R3} + U_{R2} + V_{CE1}$

$\Downarrow$

$U_{R2} = V_{EB2}$

$(50I_{B1} - I_{B2})\cdot 5 = 0.6$

$I_{B2} = 80\cdot10^{-3}mA$

$\downarrow$

$\boxed{I_{C2} = 4mA}$

$15-0 = (50I_{B1} + 50I_{B2})\cdot 2 + 0.6 + V_{CE1}$

$\boxed{V_{CE1} = 6V}$

עבור (Q2) נקח מעגל 2

$(15-0) = U_{R3} + V_{EC2}$

$\Vert$

$1k$

$V_{EC2} = V_{CE1} + V_{EB2}$

$V_{EC2} = 6 + 0.6$

$\boxed{V_{EC2} = 6.6V}$