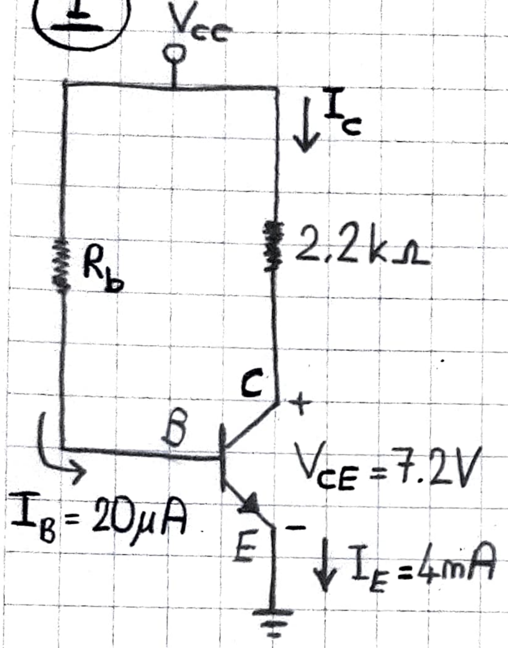
Hw4

$V_{BE} \cong 0.7V$

$I_E = (\beta+1) I_B \cong I_C$

$I_C = \beta I_B$

1



a) $I_C = 3.98mA$

b) $V_{CC} = 15.956V$

c) $\beta = 199$

d) $R_B = 437,8k\Omega$

* $20\mu A = \dfrac{V_{CC} - 0.7V}{R_B} \Rightarrow (20\mu A).(R_B) = (15.956) - (7.2)$

$\Rightarrow R_B = 437,8k\Omega$

* $I_C = \dfrac{V_{CC} - 7.2V}{2.2k} \Rightarrow (3.98mA).(2.2k) = V_{CC} - 7.2V$

$\Rightarrow V_{CC} = 8.756 + 7.2$

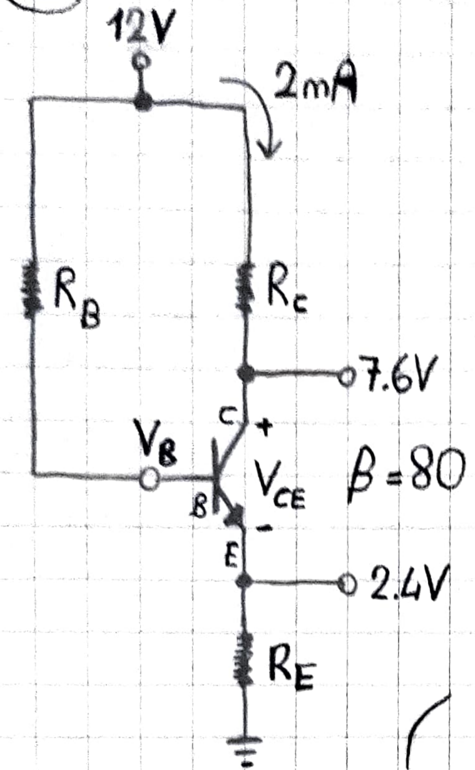
$= 15.956V$

* $4mA = (\beta+1).20\mu A$

$\beta = 199$

* $I_C = \beta . I_B = 199 . 20\mu A = 3,98mA$

(2)



a) $R_c = 2.2k\Omega$

b) $R_E = 1.2k\Omega$

c) $R_B = 356k\Omega$

d) $V_{CE} = 5.2V$

e) $V_B = 3.1V$

$V_{BE} \cong 0.7V$

$I_E = (\beta+1).I_B$

$I_C = \beta.I_B$

* $R_C = \dfrac{12-7.6}{2mA} = 2.2k\Omega$

* $I_C = \beta . I_B \Rightarrow 2mA = 80 . I_B \Rightarrow I_B = 25\mu A$

* $I_E = (\beta+1).I_B \Rightarrow I_E = (80+1).25\mu A \Rightarrow I_E \cong 2mA\ (2{,}025mA)$

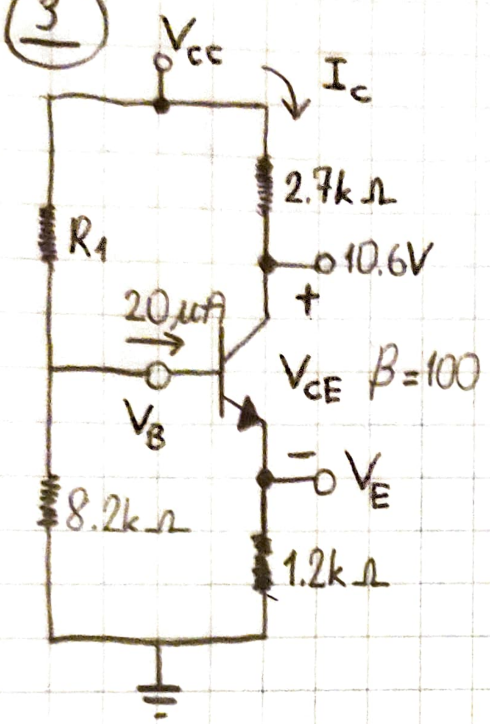
* $R_E = \dfrac{2.4}{2mA} = 1.2k\Omega$

* $V_{BE} = V_B - V_E \Rightarrow 0.7 = V_B - 2.4 \Rightarrow V_B = 3.1V$

* $V_{CE} = V_C - V_E \Rightarrow V_{CE} = 7.6 - 2.4 \Rightarrow V_{CE} = 5.2V$

* $R_B = \dfrac{V_{cc} - V_B}{I_B} \Rightarrow R_B = \dfrac{12-3.1}{25\mu A} \Rightarrow R_B = 356k\ \Omega$

3



a) $I_C = 2mA$

b) $V_E = 2.4V$

c) $V_{CC} = 16V$

d) $V_{CE} = 8.2V$

e) $V_B = 3.1V$

f) $R_1 = 6.515k$

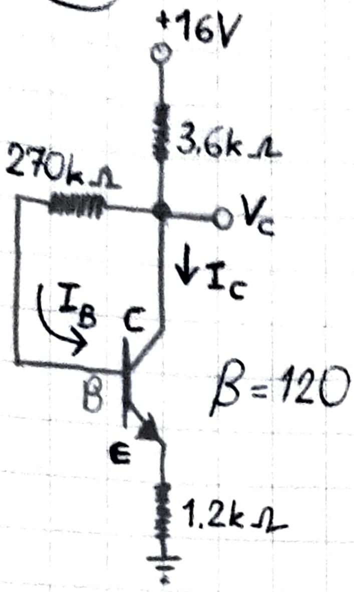
$V_{BE} \cong 0.7V$

$I_E = (\beta+1).I_B$

$I_C = \beta.I_B$

* $I_E = (\beta+1).I_B \Rightarrow I_E = (100+1).20\mu A \Rightarrow I_E \cong 2mA$
* $V_E = (1.2k).I_E \Rightarrow V_E = 2.4V$
* $I_C = \beta.I_B \Rightarrow I_C = 100.20\mu A \Rightarrow I_C = 2mA$
* $V_{CC} - 10.6 = I_C.2.7k \Rightarrow V_{CC} = 5.4 + 10.6 \Rightarrow V_{CC} = 16V$
* $V_{CE} = V_C - V_E \Rightarrow V_{CE} = 10.6 - 2.4 \Rightarrow V_{CE} = 8.2V$
* $V_{BE} = V_B - V_E \Rightarrow 0.7 = V_B - 2.4 \Rightarrow V_B = 3.1V$
* $I_{R_1} = I_E - 20\mu A \Rightarrow I_{R_1} = 1.98mA$
* $R_1 = \dfrac{V_{CC} - V_B}{I_{R_1}} \Rightarrow R_1 = \dfrac{16 - 3.1}{1.98mA} \Rightarrow R_1 = 6.515k$

4



a) $I_E = 2{,}178 mA$

b) $V_c = 8.16V$

c) $V_{CE} = 5.546V$

$V_{BE} \cong 0.7V$

$I_E = (\beta + 1).I_B$

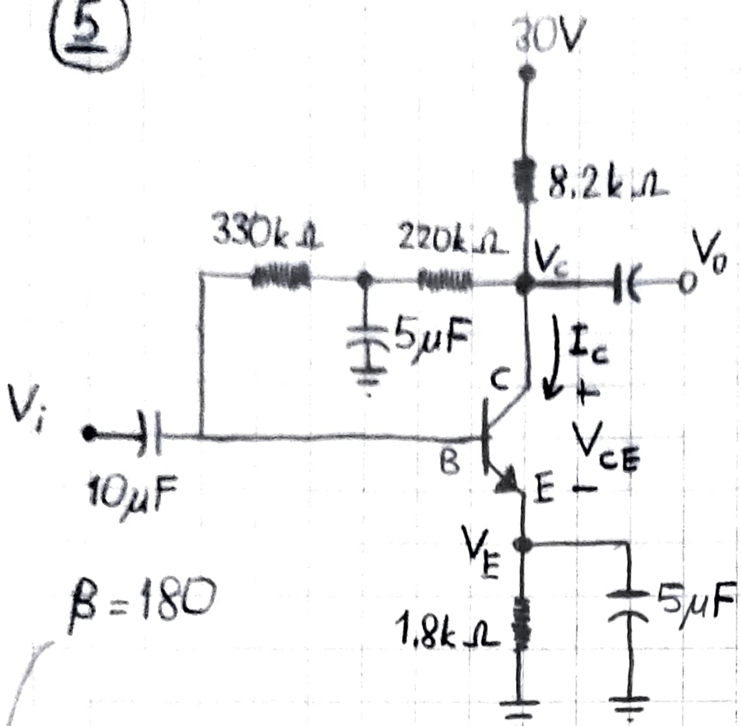
$I_c = \beta . I_B$

$\beta = 120$

* $16 = (3.6k).(I_B + I_c) + (270k).(I_B) + V_{BE} + (1.2k).(I_E)$
* $I_E = 121x \;,\; I_B = x \;,\; I_c = 120x$
* $16 = (3.6k).(121x) + (270k).(x) + 0.7 + (1.2k).(121x)$
* $16 = x\,(435.6k + 270k + 145.2k) + 0.7$
* $15.3 = x\,(850.8k) \Rightarrow x \cong 18\mu A$
* $I_E = 121x \Rightarrow I_E = 2.178 mA$
* $16 - V_c = (3.6k).(I_B + I_c) \Rightarrow 16 - V_c = (3.6k).(2.178mA) \Rightarrow V_c = 8.16V$
* $V_E = I_E.(1.2k) \Rightarrow V_E = (2.178mA).(1.2k) \Rightarrow V_E \cong 2.614V$
* $V_{CE} = V_c - V_E \Rightarrow V_{CE} = (8.16) - (2.614) \Rightarrow V_{CE} = 5.546V$

⚠ Treating capacitors like they're open circuit

(5)



$\beta = 180$

$V_{BE} \cong 0.7V$

$I_E = (\beta+1) . I_B$

$I_c = \beta . I_B$

a) $I_c = 2.232 mA$

b) $V_c = 11.6V$

c) $V_E = 4.04V$

d) $V_{CE} = 7.56V$

* $30 = (8{,}2k).(I_B + I_c) + (550k).(I_B) + V_{BE} + (1.8k).(I_E)$

* $I_E = 181x \; , \; I_c = 180x \; , \; I_B = x$

* $30 = (8.2k).(181x) + (550k).(x) + 0.7 + (1{,}8k).(181x)$

* $29.3 = x(1484{,}2k + 550k + 325{,}8k) \Rightarrow x = \dfrac{29.3}{2360k} \cong 12.4 \mu A$

* $I_c = 180x \Rightarrow I_c = 2.232 mA$

* $30 - V_c = (8.2k).(I_B + I_c) \Rightarrow V_c = 30 - (8{,}2k).(2.244mA) = 11.6V$

* $V_E = I_E . (1{,}8k) \Rightarrow V_E = (2.244).(1.8k) \Rightarrow V_E \cong 4.04V$

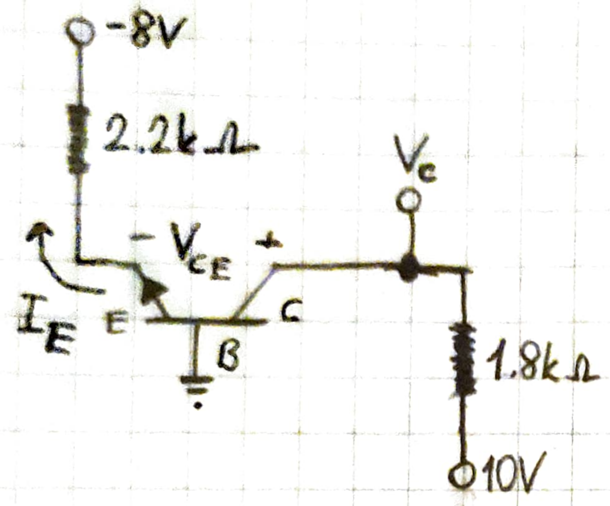
* $V_{CE} = V_c - V_E \Rightarrow V_{CE} = 11.6 - 4.04 \Rightarrow V_{CE} = 7.56V$

6

$V_{BE} \cong 0.7V$

$I_E = (\beta+1) . I_B$

$I_c = \beta . I_B$



a) $I_E = 3.318mA$

b) $V_c = 4.028V$

c) $V_{CE} = 4.728V$

* $-8 = (2.2k).(-I_E) - V_{BE} \Rightarrow 8 = (2.2k).(I_E) + 0.7 \Rightarrow I_E = 3.318mA$

* $10 = (1.8k).(I_c) + V_{CE} + (2.2k).(I_E) - 8$

→ let's say $I_c \cong I_B$;

* $18 = (4k).(I_E) + V_{CE} \Rightarrow V_{CE} = 4.728V$

* $10 - V_c = (1.8k).(I_c) \Rightarrow V_c = 10 - 5.972 \cong 4.028V$