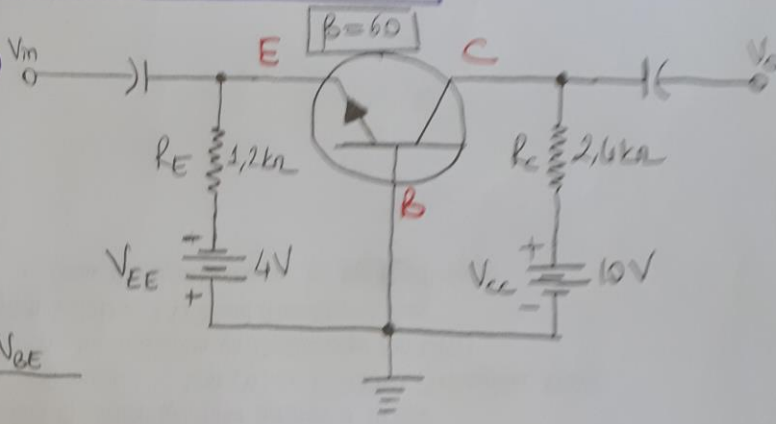
– ECE 246 HOMEWORK 2 –

– ANSWERS –

Answer 1 ⟹



$$I_E = \frac{V_{EE} - V_{BE}}{R_E}$$

$$= \frac{(4V) - (0,7V)}{(1,2k\Omega)} = \boxed{2,75mA}$$

$$I_E = (\beta+1) I_B \longrightarrow \frac{2,75mA}{60+1} = \boxed{I_B = 45,08\mu A}$$

$$V_{CE} = V_{EE} + V_{CC} - I_E(R_C + R_E)$$

$$= 4V + 10V - (2,75mA)(2,4+1,2) \Longrightarrow \boxed{V_{CE} = 4,1 \text{ volt}}$$

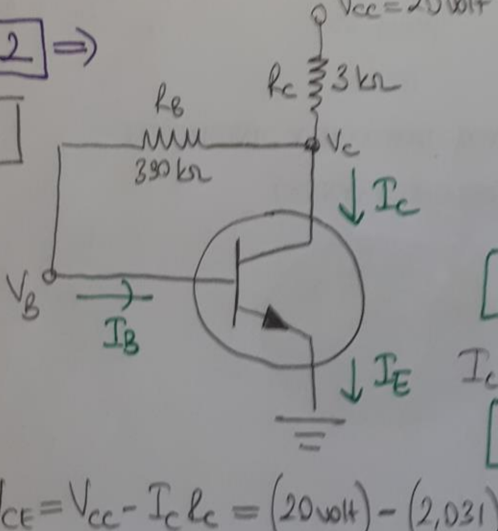
$$V_{CB} = V_{CC} - I_C R_C = V_{CC} - \beta I_B R_C$$

$$= (10 \text{ volt}) - (60)(45,08\mu A)(24k\Omega)$$

$$\boxed{V_{CB} = 3,51 \text{ volt}}$$

Answer 2 ⟹

β=60



$$I_B = \frac{V_{CC} - V_{BE}}{R_B + \beta R_C}$$

$$I_B = \frac{20 - 0,7}{(390k\Omega) + 60.(3k\Omega)}$$

$$\boxed{I_B = 33,85\mu A}$$

$$I_C = \beta I_B = 60(33,85\mu A)$$

$$\boxed{I_C = 2,031 mA}$$

$$V_{CE} = V_{CC} - I_C R_C = (20 \text{ volt}) - (2,031).(3k\Omega) = \underline{13,907 \text{ volt}}$$

$V_B = V_{BE} = 0,7$ volt

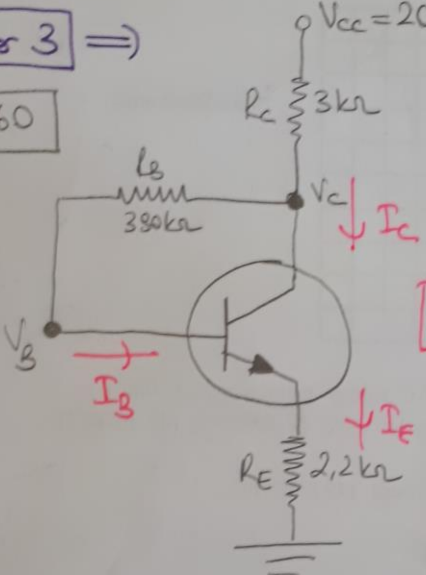
$V_E = 0$ volt

$V_C = V_{CE} = 13,307$ volt

$I_E = (\beta+1)\, I_B = (60+1)(33,85\,\mu A) = 2,0654\ mA$

Answer 3 $\Longrightarrow$

$\beta = 60$



$$I_B = \frac{V_{cc} - V_{BE}}{R_B + \beta(R_C + R_E)}$$

$$I_B = \frac{20 - 0,7}{(380k\Omega) + 60(3k\Omega + 2,2k\Omega)}$$

$I_B = 0,0274\ mA = 27,4\ \mu A$

$I_C = \beta I_B = 60(27,4\,\mu A)$

$I_C = 1,64\ mA$

$I_E = (\beta+1)\, I_B = (60+1)(27,4\,\mu A)$

$I_E = 1,67\ mA$

$V_{CE} = V_{cc} - I_C(R_C + R_E)$

$= (20V) - (1,64mA)(3k\Omega + 2,2k\Omega)$

$V_{CE} = 11,472$ volt

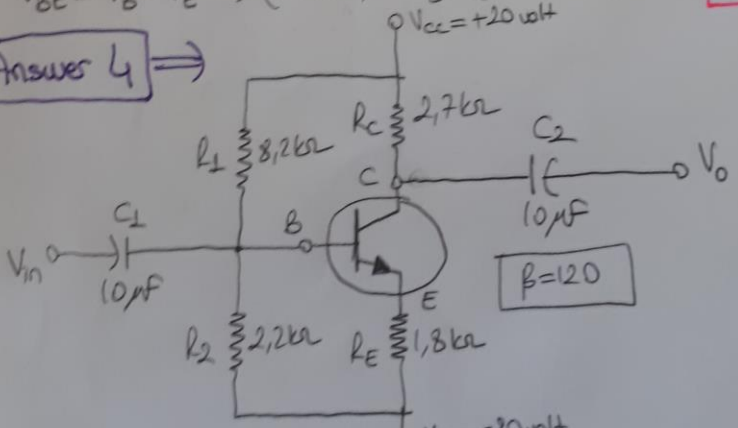
$V_E = I_E R_E = (1,67mA)(2,2k\Omega)$

$V_E = 3,674$ volt

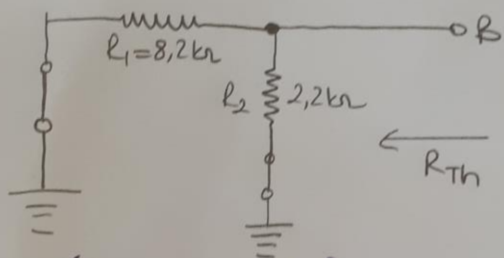
$V_{CE} = V_C - V_E = (11,472) + (3,674) = 15,146$ volt

$V_{BE} = V_B - V_E \Rightarrow (0,7\ volt) = V_B - (3,674\ volt) \longrightarrow V_B = 4,374$ volt

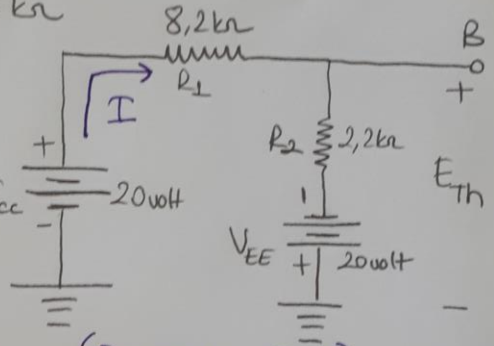
Answer 4 $\Longrightarrow$



$$R_{Th} = (8{,}2\,k\Omega) \,//\, (2{,}2\,k\Omega) = 1{,}73\,k\Omega$$



(Determining R_{Th})



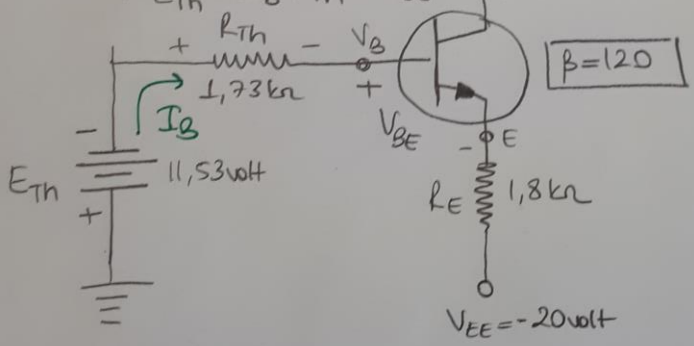
(Determining E_{Th})

$$I = \frac{V_{CC} + V_{EE}}{R_1 + R_2} = \frac{20V + 20V}{(8{,}2k\Omega) + (2{,}2k\Omega)} = 3{,}85\ mA$$

$$E_{Th} = (I R_2) - V_{EE} = (3{,}85\,mA)(2{,}2k\Omega) - 20 = -11{,}53\ volt$$

The network can then be redrawn as shown in figure, where the application of Kirchoff's Voltage Law results in

$$-E_{Th} - I_B R_{Th} - V_{BE} - I_E R_E + V_{EE} = 0$$



Substituting $I_E = (\beta + 1) I_B$ gives

$$V_{EE} - E_{Th} - V_{BE} - (\beta+1) I_B R_E - I_B R_{Th} = 0$$

$$I_B = \frac{V_{EE} - E_{Th} - V_{BE}}{R_{Th} + (\beta+1) R_E} = \frac{(20V) - (11{,}53V) - (0{,}7V)}{(1{,}73k\Omega) + (121)(1{,}8k\Omega)}$$

$I_B = 35{,}39\ \mu A$

$$I_C = \beta I_B = 120\,(35{,}39\,\mu A)$$

$I_C = 4{,}25\ mA$

$$V_C = V_{CC} - I_C R_C = (20\ volt) - (4{,}25\,mA)(2{,}7k\Omega)$$

$V_C = 8{,}53\ volt$

$$V_B = -E_{Th} - I_B R_{Th} = -(11{,}53) - (35{,}39\,\mu A)(1{,}73)$$

$V_B = -11{,}59\ volt$