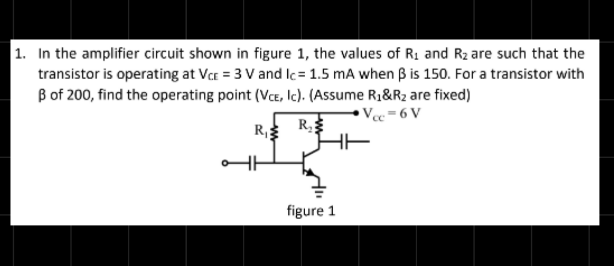
$\alpha = \frac{I_C}{I_B}$ Common emmiter

$\beta = \frac{I_C}{I_E}$ Common base

$\gamma = \frac{I_E}{I_B}$ Common collector

$\alpha = \frac{\beta}{\beta+1}$, $\beta = \frac{\alpha}{1-\alpha}$

Q1)



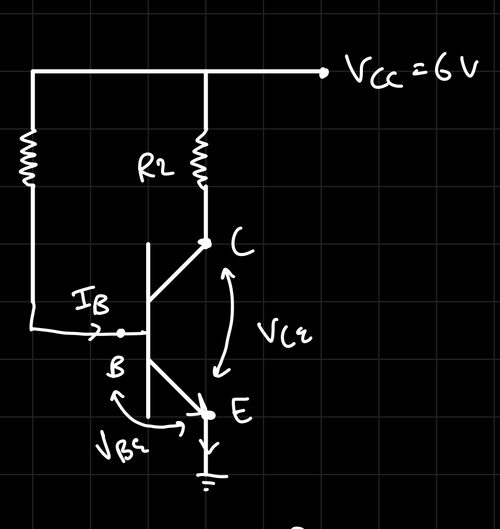
given: amplifier
so, active mode
$V_{BE} > 0$: FB
$V_{CB} < 0$: RB

given: $V_{CE} = 3V$ $I_C = 1.5mA$

for active mode, $I_C = \beta I_B + (\beta+1) I_{CBO}$

removing all the capacitors because we have DC biasing

$V_{BE} = 0.7V$ for Si



$V_{BE} = V_B - V_E$
$V_B = V_{BE} + V_E$

$V_{CC} + I_B R_1 + 0.7 + I_E = 0$ $I_C = \beta I_B$
$6 + 10^{-5} R_1 + 0.7 = 0$
$R_1 = -6.7 \times 10^5 \Omega$ X
$I_B = \frac{1.5}{150} mA = 0.01mA$

$6 + I_C R_2 + V_{CE} + I_E = 0$
$6 + 1.5mA \cdot R_2 + 3 + 0 = 0$
$R_2 \cdot 1.5\times10^{-3} = -9$ X

$\frac{6 - V_B}{R_1} = I_B \Rightarrow R_1 = (6 - 0.7 - V_E)10^5$

KVL: ① $-6 + I_C R_2 + 3 = 0$
$1.5m \cdot R_2 = 3$
$R_2 = 2K\Omega$

② $-6 + I_B R_1 + V_{BE} = 0$
$-6 + 0.01m \cdot R_1 + 0.7 = 0$
$R_1 = 530k\Omega$

② $\beta = 200$

$I_C = 1.5mA$
$I_C = \beta I_B + (\beta+1) I_{CBO}$ → let this be negligible because not given

X { $I_C = \beta I_B$
$I_B = \frac{1.5}{2} A \times 10^{-5}$
$I_B = 7.5\mu A$ }

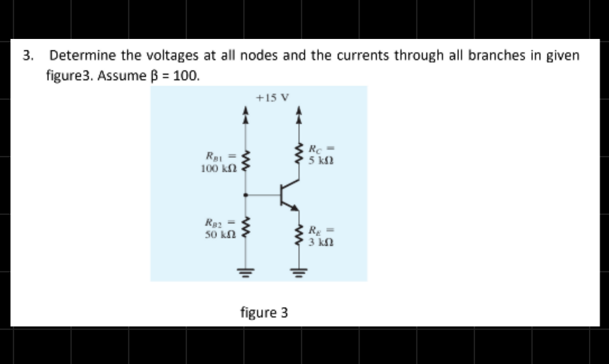
I_C not known

$-6 + R_1 I_B + V_{BE} = 0$
$530k \cdot I_B = 5.3$
$I_B = \frac{5.3}{530} mA = 0.01mA$

$I_C = \beta(0.01m) = 2mA$

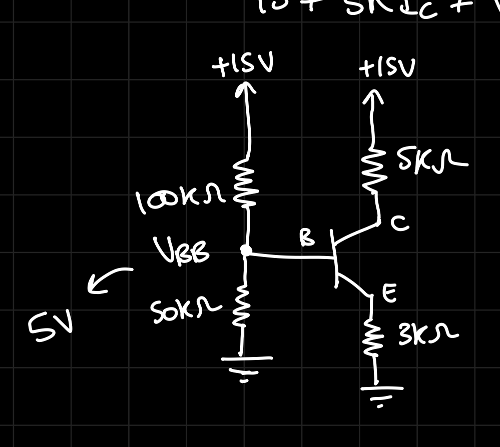
$-6 + I_C \cdot R_2 + V_{CE} = 0$
$V_{CE} = 6 - 2.2 = 2V$

Q3)



$\beta = 100$

$-15 + I_C R_C + V_{CE} + I_E R_E = 0$
$-15 + 5K I_C + V_{CE} + I_E \cdot 3K = 0$



$-15 + 5k(I_C) + V_{CE} + 3k I_E$

$V_{BB} = \frac{50k}{150k} \cdot 15 = 5V$

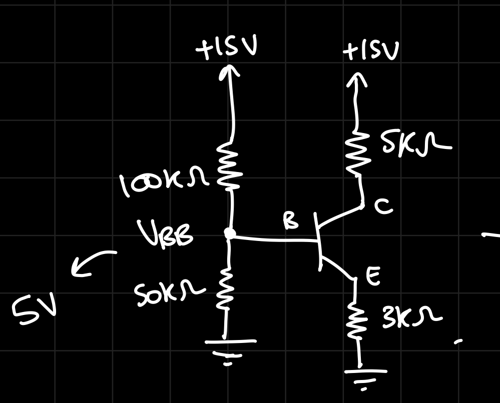
$I_B \neq 0$ practically

R_{B1} and R_{B2} are in parallel?

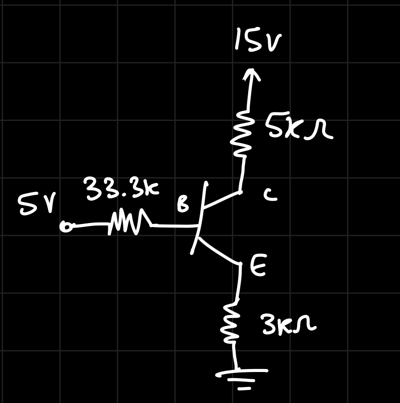
$\frac{1}{100k} + \frac{1}{50k}$

$\frac{100k}{3} = 33.3k\Omega$

$V_{CE} = -49V$



→



$-5 + 33.3k I_B + 0.7 + I_E 3k = 0$
$-15 + 5k \cdot I_C + V_{CE} + I_E 3k = 0$
$I_C = \beta I_B = 100 I_B$

$-15 + 5k \cdot 100 I_B + V_{CE} + I_E 3k = 0$

$10 + (33300 - 5100) I_B + 0.7 - V_{CE} = 0$

$\Rightarrow I_B = \frac{V_{CE} - 10.7}{282} mA$

$I_B = \frac{5 - 0.7}{33.3} mA = 0.128mA$

$I_C = 12.8mA$

$V_{CE} = 282(0.13) + 10.7 = 47.36V$

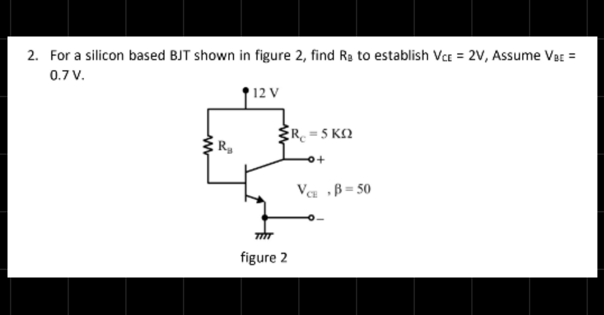
$-15 + 5k \cdot I_C + V_{CE} + 3k \cdot I_E = 0$

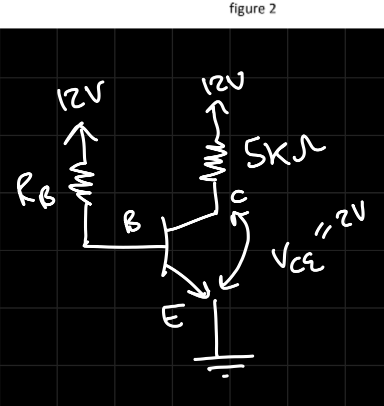
$-5 + 33.3k I_B + 0.7 + I_E 3k = 0$
$-5 + 33.3(0.128) + 0.7 + I_E \cdot 3k = 0$
$4.3 - 4.2624 = I_E \cdot 3k$
$I_E = 112.8A$ X

$\alpha = \frac{I_C}{I_E}$ $\alpha = \frac{\beta}{\beta+1} = \frac{100}{101} = 0.99$

$I_E = \frac{12.8}{0.99} mA = 12.92mA$

Q)





$V_{BE} = 0.7V$

$\beta = 50$

$-12 + I_B R_B + V_{BE} = 0$

$I_C = \beta I_B$

$I_B R_B = 11.3V$

$-12 + I_C(5k) + V_{CE} = 0$

$I_C = \frac{10}{5} mA = 2mA$

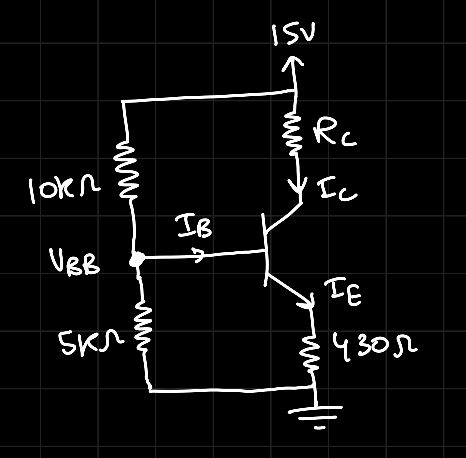
$I_B = \frac{2mA}{50} = 0.04 mA$

$R_B = \frac{11.3}{0.04} k\Omega = \frac{1130}{4} k\Omega$
$= 282.5k\Omega$

Q4) active Region

$\beta >>>$ $V_{BE} = 0.7V$

$I_C = ?$



① { $-15 + R_C I_C + V_{CE} + I_E \cdot 430 = 0$ }

since $\beta >>>$
and $\beta = \frac{I_C}{I_B}$ so, assume $I_B \sim 0$

$V_{BB} = \frac{5k}{15k} \times 15 = 5V$

$-15 + I_B \cdot 10k + V_{BE} + I_E \cdot 430 = 0$

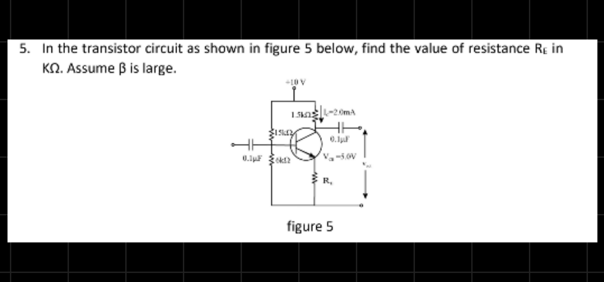
$I_B \cdot 10k + I_E \cdot 430 = 14.3$ ($I_B \cdot 10k \sim 0$)

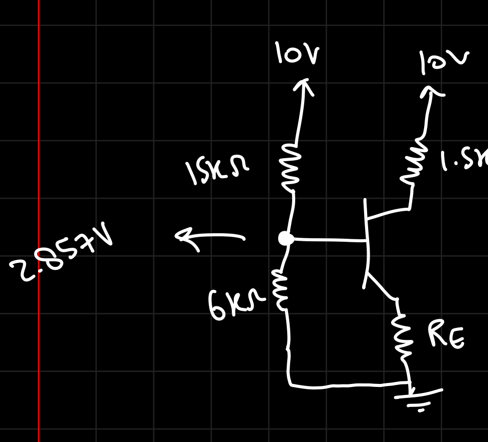
$I_E = \frac{14.3}{430} = 0.03A$
$= 3mA$

for finding R_{Th} →

we remove all the independent srces so the two resistances are in parallel

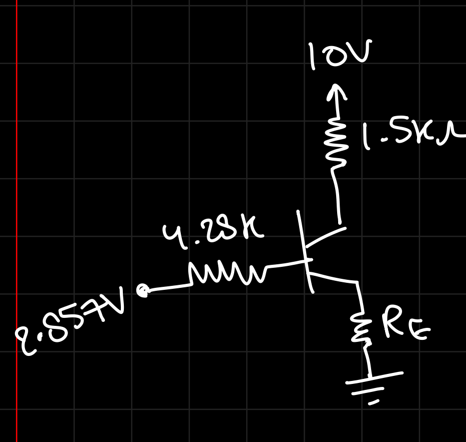
Q5)





$\Rightarrow I_E \sim I_C$
$I_B \sim 0$
$\beta >>$

$\frac{15 + 6}{15k \cdot 6} \Rightarrow \frac{15k \cdot 2}{7} \Rightarrow \frac{30k}{7} = 4.28k\Omega$



$I_B = \frac{2.857 - 0.7}{4.28} mA$

$I_B = 0.5mA$