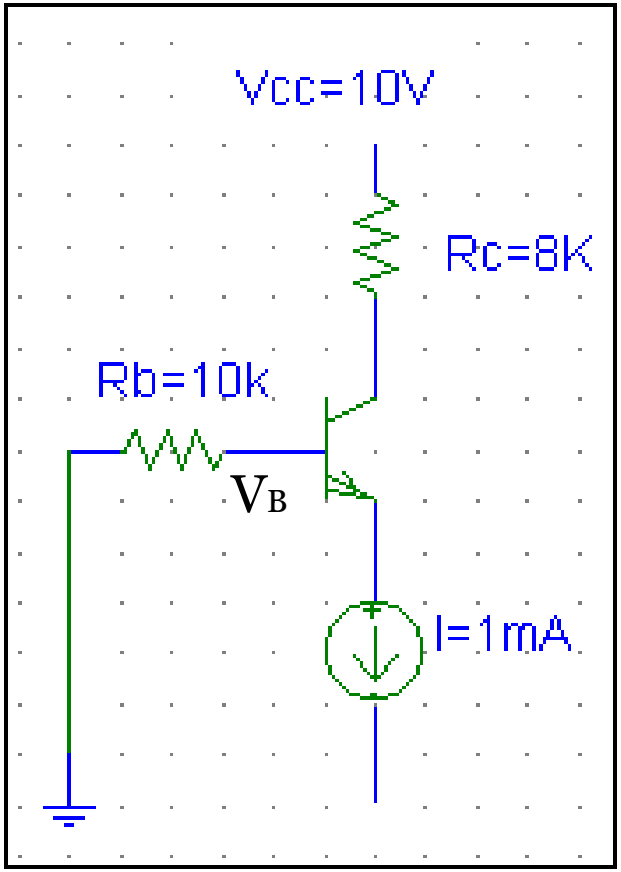
BJT transistors

Exercise

(a) Find V_C, V_B, and V_E, given: $\beta = 100$, $V_A = 100V$



$I_E = 1\ mA$

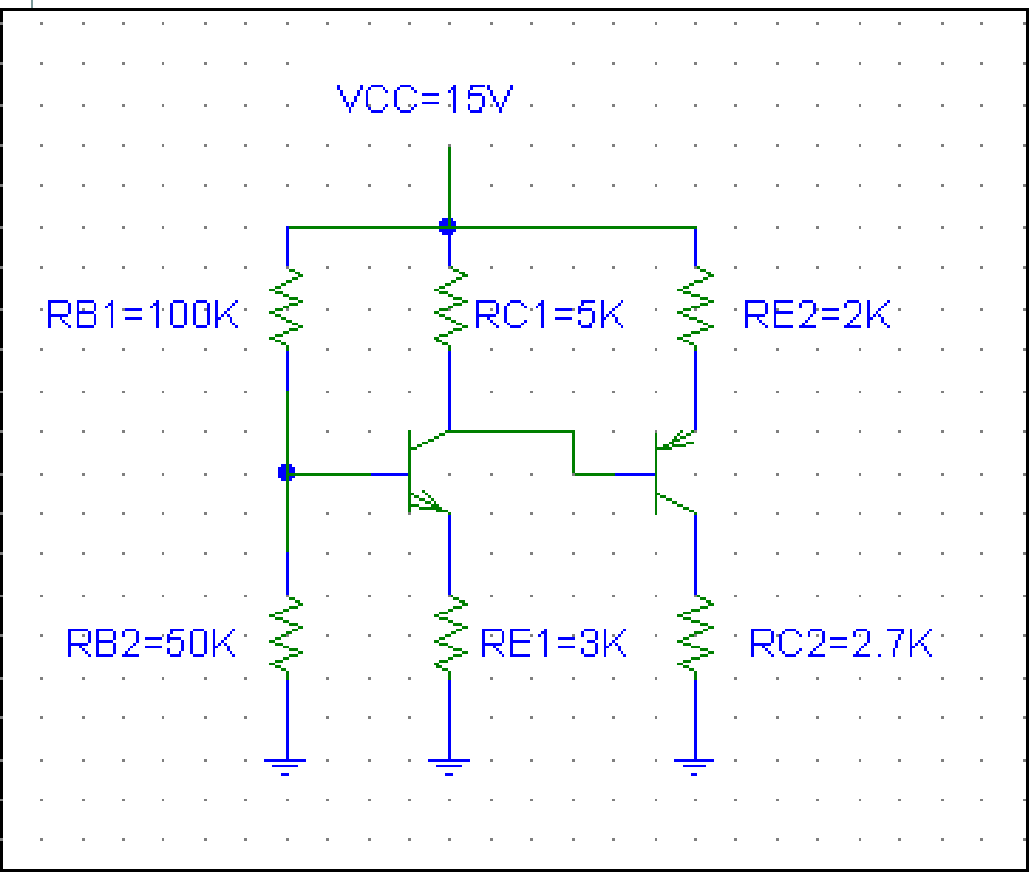
$I_B \approx I_E/\beta = 0.01mA$

$V_B = 0 - I_B 10K = -0.1V$

$V_E = V_B - V_{BE} = -0.1 - 0.7 = -0.8V$

$V_C = 10V - I_C 8K = 10 - 1(8) = 2V$

Example 1



- 2-stage amplifier, 1st stage has an npn transistor; 2nd stage has an pnp transistor.

$I_C = \beta I_B$

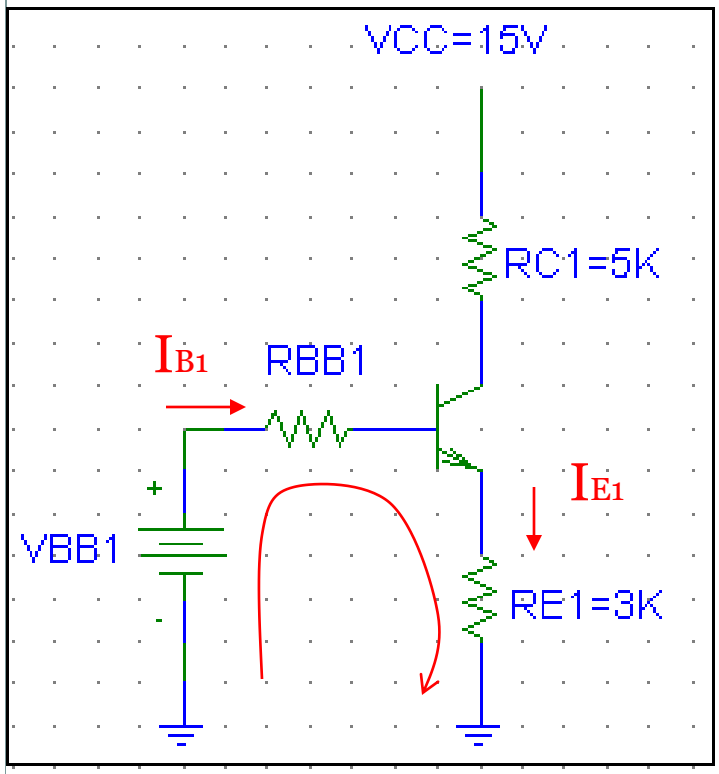
$I_C \approx I_E$

$V_{BE} = 0.7_{(npn)} = -0.7_{(pnp)}$

$\beta = 100$

Find I_{C1}, I_{C2}, V_{CE1}, V_{CE2}

- Use Thevenin circuits.



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

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

Stage 1

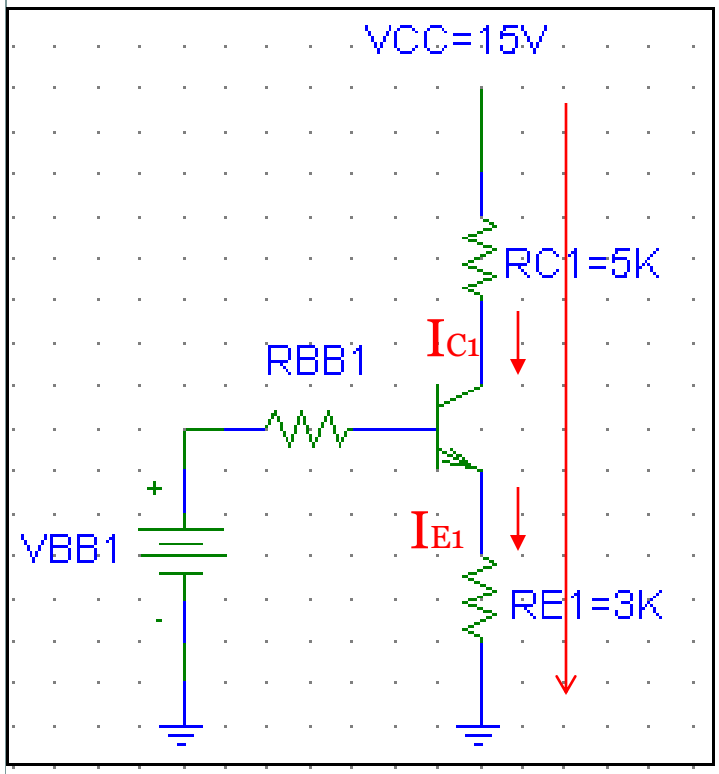
- B-E loop

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

Use $I_{B1} \approx I_{E1}/\beta$

$5 = I_{E1}33K/100 + .7 + I_{E1}3K$

$I_{E1} = 1.3mA$



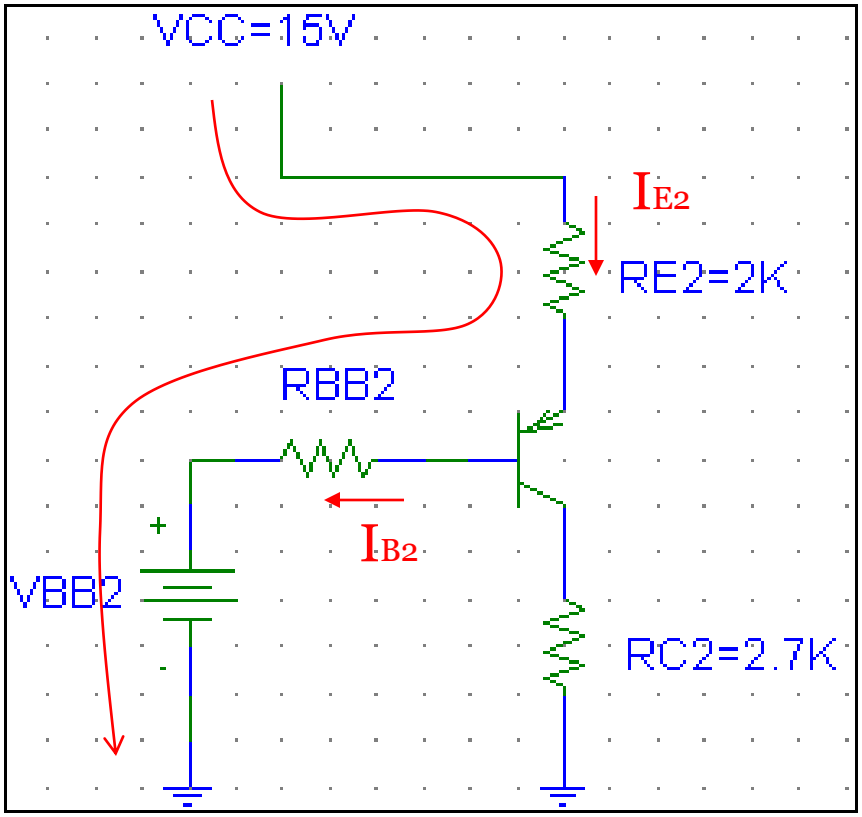
C-E loop

neglect IB2 because it is IB2 << IC1

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

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

$V_{CE1} = 4.87V$



Stage 2

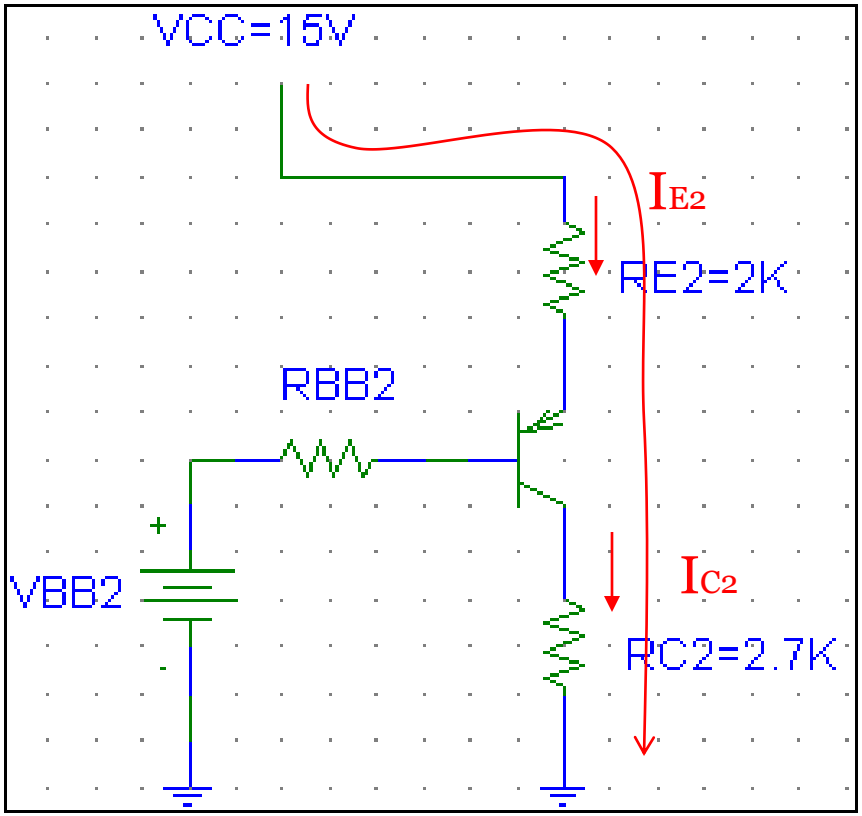
- B-E loop

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

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

Use $I_{B2} \approx I_{E2}/\beta$, solve for I_{E2}

$I_{E2} = 2.8mA$



Stage 2

•C-E loop

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

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

solve for V_{EC2}

$V_{CE2} = 1.84V$