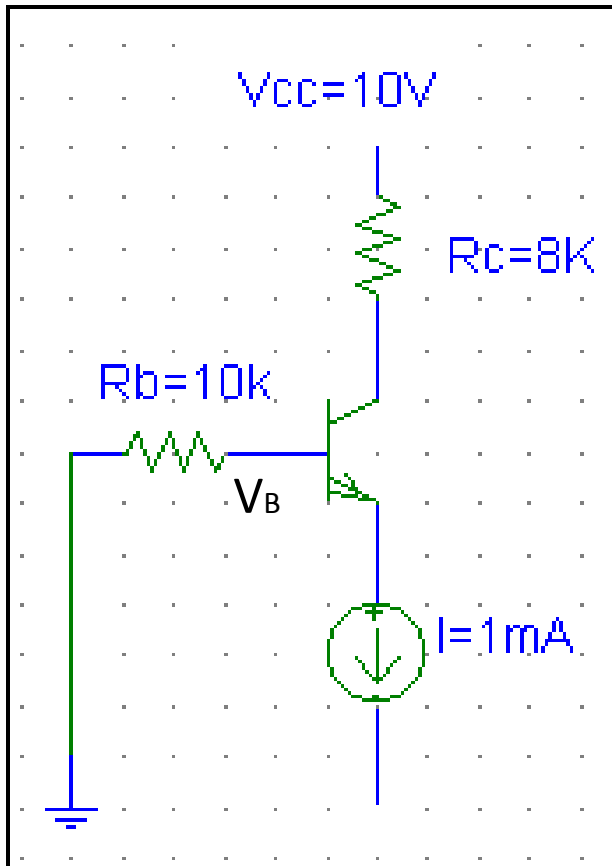


Exercise

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



$$I_E = 1 \text{ mA}$$

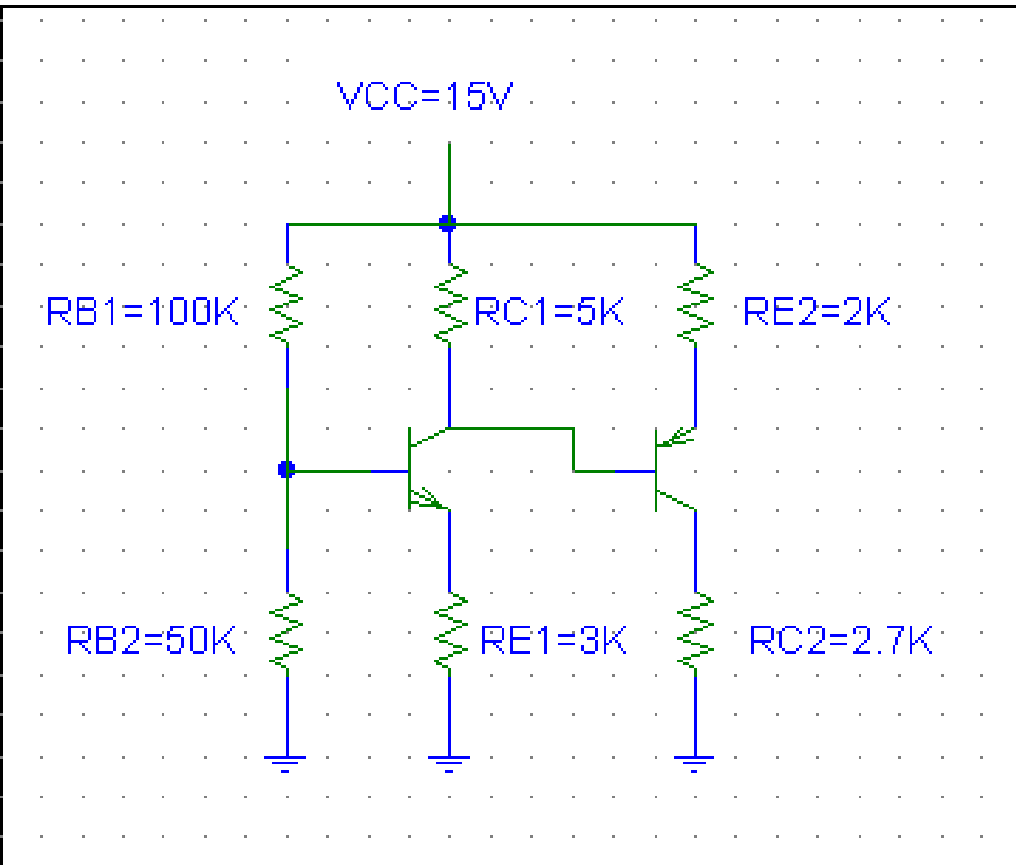
$$I_B \approx I_E / \beta = 0.01 \text{ mA}$$

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

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

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

Example 1



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

$$I_C = \beta I_B$$

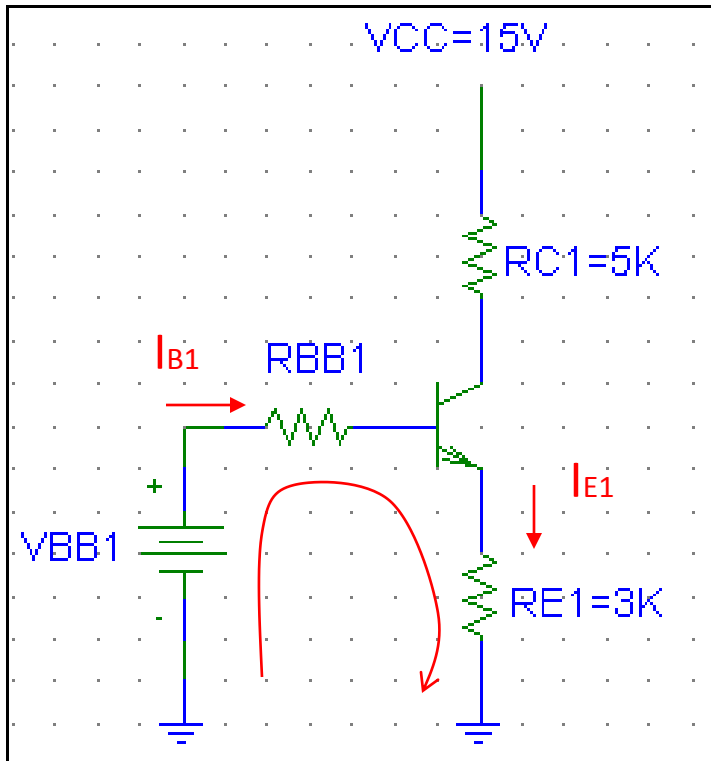
$$I_C \approx I_E$$

$$V_{BE} = 0.7_{(\text{nnp})} = -0.7_{(\text{pnp})}$$

$$\beta = 100$$

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

- Use Thevenin circuits.



- $R_{BB1} = R_{B1} \parallel R_{B2} = 33K$

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

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

Stage 1

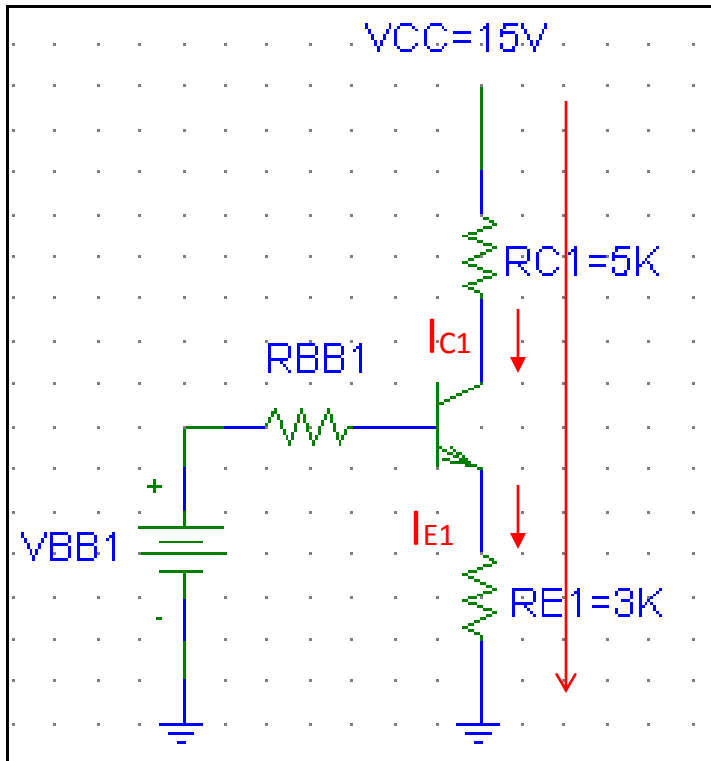
- B-E loop

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

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

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

$$I_{E1} = 1.3mA$$



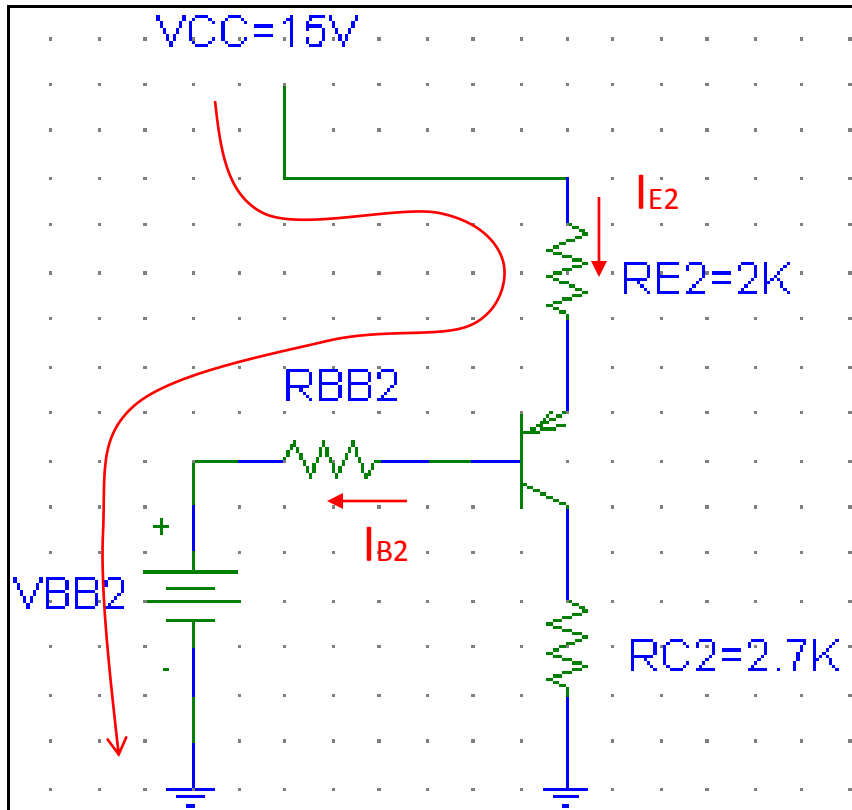
C-E loop

neglect I_{B2} because it is $I_{B2} \ll I_{C1}$

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

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

$$V_{CE1} = 4.87V$$



Stage 2

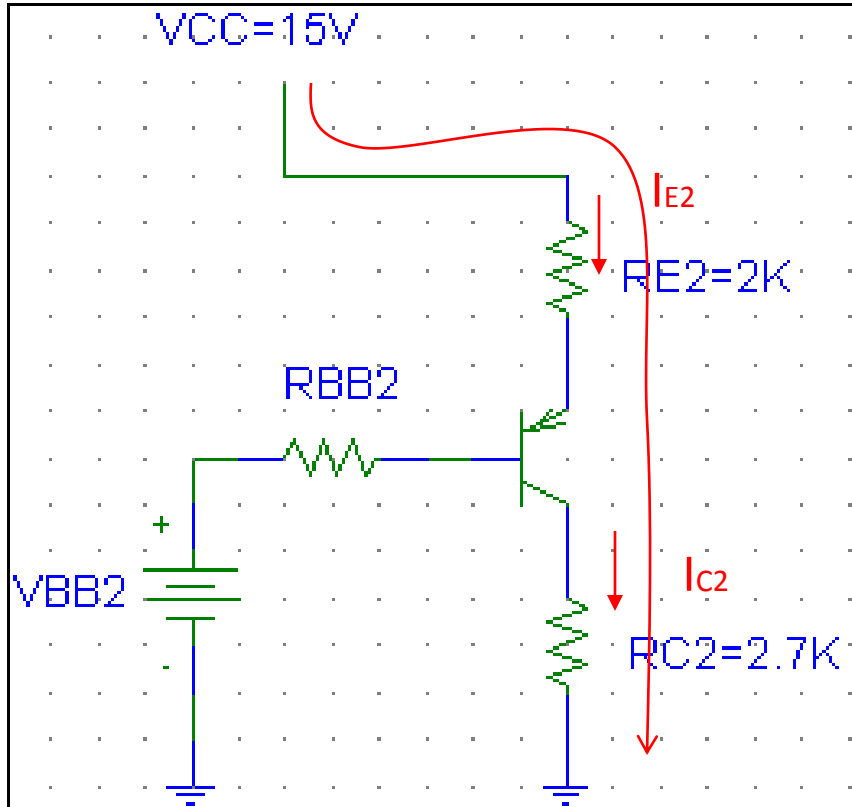
- B-E loop

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

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

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

$$I_{E2} = 2.8\text{mA}$$



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}

$$V_{CE2} = 1.84V$$