

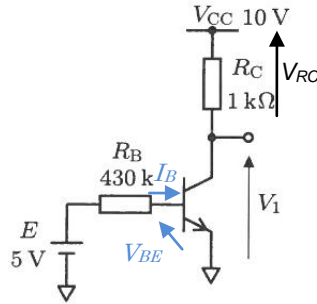
# 演習問題解答

2.4-1

$$(1) I_B = \frac{E - V_{BE}}{R_B} = \frac{5 - 0.7}{430 \times 10^3} = 10 \mu\text{A}$$

$$I_C = h_{FE} I_B = 1 \text{mA}$$

$$V_1 = V_{CC} - V_{R_C} = V_{CC} - I_C R_C = 9 \text{V}$$

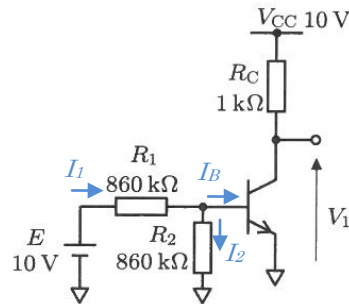


$$(2) I_1 = \frac{E - V_{BE}}{R_1}$$

$$I_2 = \frac{V_{BE}}{R_2}$$

$$I_B = I_1 - I_2 = 10 \mu\text{A}$$

$$V_1 = V_{CC} - V_{R_C} = V_{CC} - I_C R_C = 9 \text{V}$$



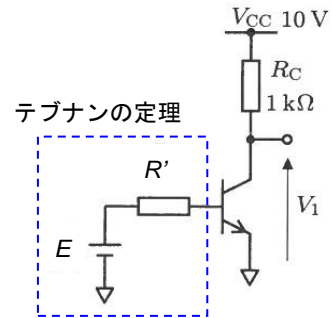
(2) 別解

$$E' = \frac{R_2}{R_1 + R_2} E = 5 \text{V}$$

$$R' = \frac{R_1 R_2}{R_1 + R_2} = 430 \text{k}\Omega$$

$$I_B = \frac{E' - V_{BE}}{R'} = 10 \mu\text{A}$$

$$V_1 = V_{CC} - V_{R_C} = V_{CC} - I_C R_C = 9 \text{V}$$

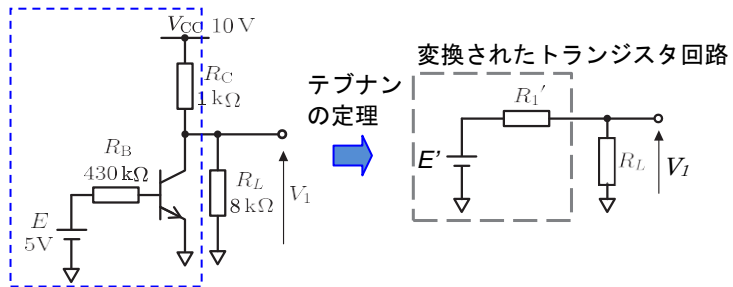


(3)

$$(1) \text{より } E' = 9 \text{V}$$

$$R' = R_C = 1 \text{k}\Omega$$

$$V_1 = \frac{R_L}{R' + R_L} E' = 8 \text{V}$$



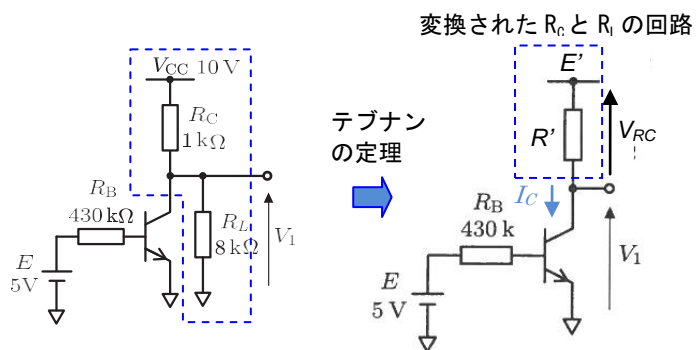
(3) 別解

$$E' = \frac{R_L}{R_L + R_C} V_{CC} = \frac{80}{9} \text{V}$$

$$R' = \frac{R_L R_C}{R_L + R_C} = \frac{8}{9} \text{k}\Omega$$

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

$$V_1 = E' - V_{R_C} = E' - I_C R_C = 8 \text{V}$$

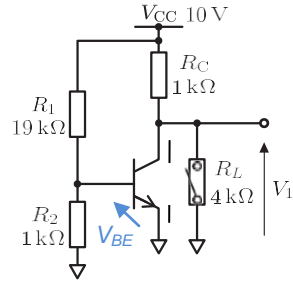


(4)  $V_{BE} < 0.7V$

$I_B = 0\mu A$

トランジスタは、スイッチOFFとして動作

$$V_1 = \frac{R_L}{R_C + R_L} V_{CC} = 8V$$



(5)

テブナンの定理より

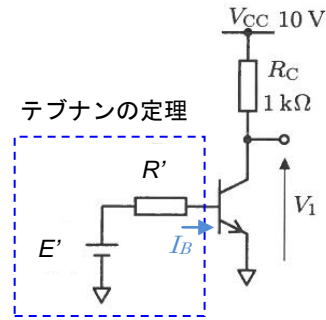
$$E' = \frac{R_2}{R_1 + R_2} E = \frac{190}{20} V$$

$$R' = \frac{R_1 R_2}{R_1 + R_2} = \frac{19}{20} k\Omega$$

$$I_B = \frac{E' - V_{BE}}{R'} = 9.3mA$$

$$I_C = 930mA$$

$$V_1 = V_{CC} - I_C R_C = -920V$$



トランジスタはスイッチングONの状態で作

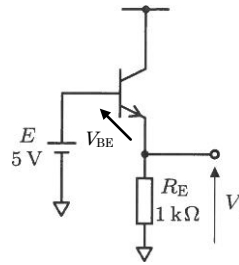
$V_1 \geq 0$ より

$V_1 = 0V$

(6)

$$V_1 = E - V_{BE} = 4.3V$$

$R_E$  は  $V_1$  に関係しない



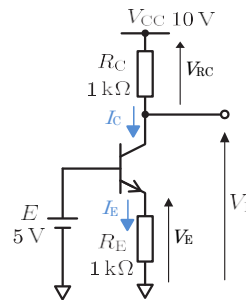
(7)

$$V_E = E - V_{BE} = 4.3V$$

$$I_E = V_E / R_E = 4.3mA$$

$$I_E \approx I_C$$

$$V_1 = V_{CC} - V_{RC} = V_{CC} - I_C R_C = 5.7V$$



(8)

コンデンサは直流を通さないため

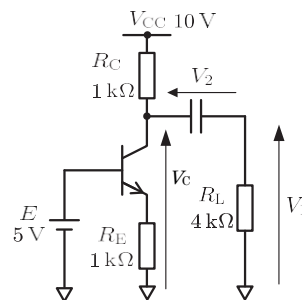
$V_1 = 0V$

$$V_C = V_1 + V_2$$

$$V_2 = V_C - V_1$$

(7)より  $V_C = 5.7V$

$$V_2 = 5.7V$$

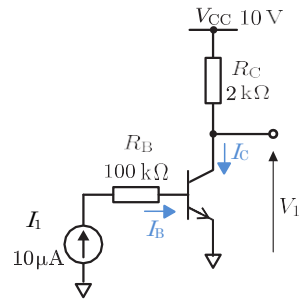


(9)

$$I_B = I_1 = 10 \mu\text{A} \quad (R_B \text{ は } I_1 \text{ に関係せず})$$

$$I_C = h_{FE} I_B = 1\text{mA}$$

$$V_1 = V_{CC} - I_C R_C = 8\text{V}$$



(10)

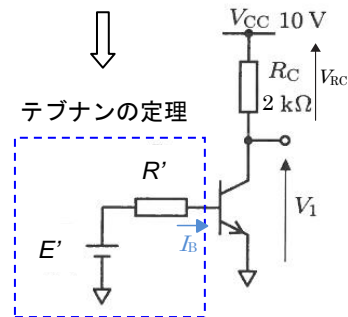
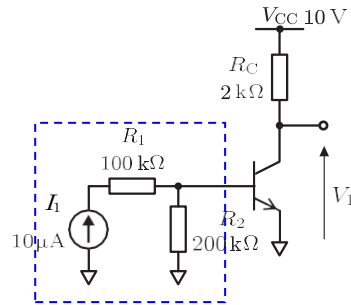
$$R' = R_2 = 200\text{k}\Omega \quad (\text{電流源は開放にして考える})$$

$$E' = I_1 R_2 = 2\text{V}$$

$$I_B = \frac{E' - V_{BE}}{R'} = 6.5 \mu\text{A}$$

$$I_C = h_{FE} I_B = 0.65\text{mA}$$

$$V_1 = V_{CC} - V_{RC} = 8.7\text{V}$$



## 2.4-2

(1) a.  
 $E < 0.7\text{V}$  のとき  
 $I_B = 0\text{A}$

$E \geq 0.7\text{V}$  のとき

$$I_B = \frac{E - V_{BE}}{R_B}$$

b.

$$I_C = h_{FE} I_B$$

c.

$E < 0.7\text{V}$  のとき

$$I_C = 0\text{A}, \quad V_1 = V_{CC} = 10\text{V}$$

$E \geq 0.7\text{V}$  のとき

$$V_1 = V_{CC} - I_C R_C \quad (1)$$

$E = 1.5\text{V}$  のとき, 式(1)より

$$V_1 = 5\text{V}$$

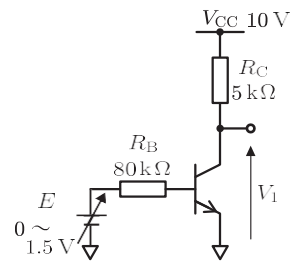
d.

式(1)より,

$$I_C = \frac{V_{CC} - V_1}{R_C}$$

cのグラフより

$$5\text{V} \leq V_1 \leq 10\text{V}$$



(2)

a.

$E < 0.7V$  のとき

$I_B = 0A, V_1 = 0V$

$E \geq 0.7V$  のとき

$$V_1 = E - V_{BE} \quad (1)$$

b.

$$I_E = \frac{V_1}{R_E}$$

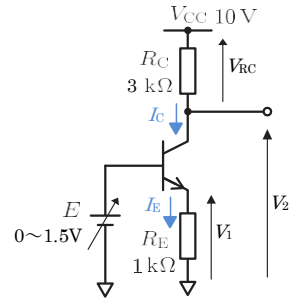
$$I_C \approx I_E$$

$$V_{RC} = I_C R_C = \frac{R_C}{R_E} V_1 = 3V_1$$

$$\text{式(1)より, } V_{RC} = 3(E - V_{BE})$$

c.

$$V_2 = V_{CC} - V_{RC}$$



(3)

$$V_1 = V_{CC} - R_C I_C$$

$$V_1 = V_{CC} - R_C h_{FE} I_B$$

$$V_1 = V_{CC} - R_C h_{FE} I_1 \quad (1)$$

$$I_1 = 0A \text{ のとき} \quad \text{式(1)より} \quad V_1 = V_{CC} = 10V$$

$$V_1 = 0V \text{ のとき} \quad \text{式(1)を変形して} \quad I_1 = \frac{V_{CC}}{R_C h_{FE}} = 50\mu A$$

