

$$h_{FE} = 100 \quad \forall Q_i \quad i=1..3$$

$$I_{B1} = I_{B3} = x$$

$$I_1 = ? = h_{FE} x + I_{B2}$$

$$I_{E2} = (h_{FE} + 2)x$$

$$I_{B2} = \frac{I_{E2}}{h_{FE} + 1}$$

$$I_1 = h_{FE} x + \frac{h_{FE} + 2}{h_{FE} + 1} x = \frac{h_{FE} + 1}{h_{FE} + 1} x = \frac{V_{EE} - 2V_{EBON}}{R_1} = 5,3 \text{ mA}$$

$$x = 52,47 \mu\text{A}$$

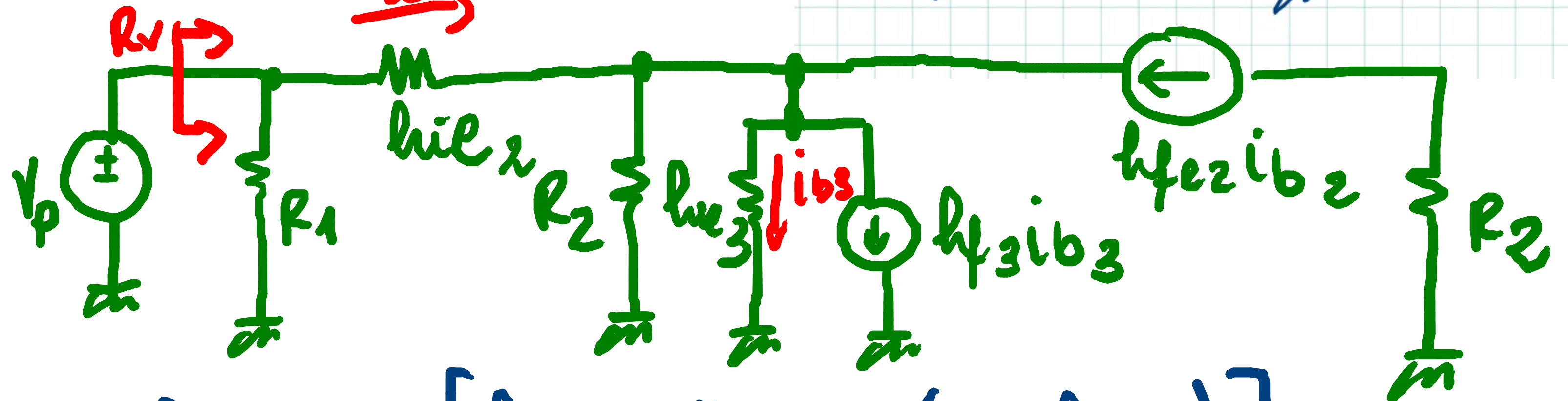
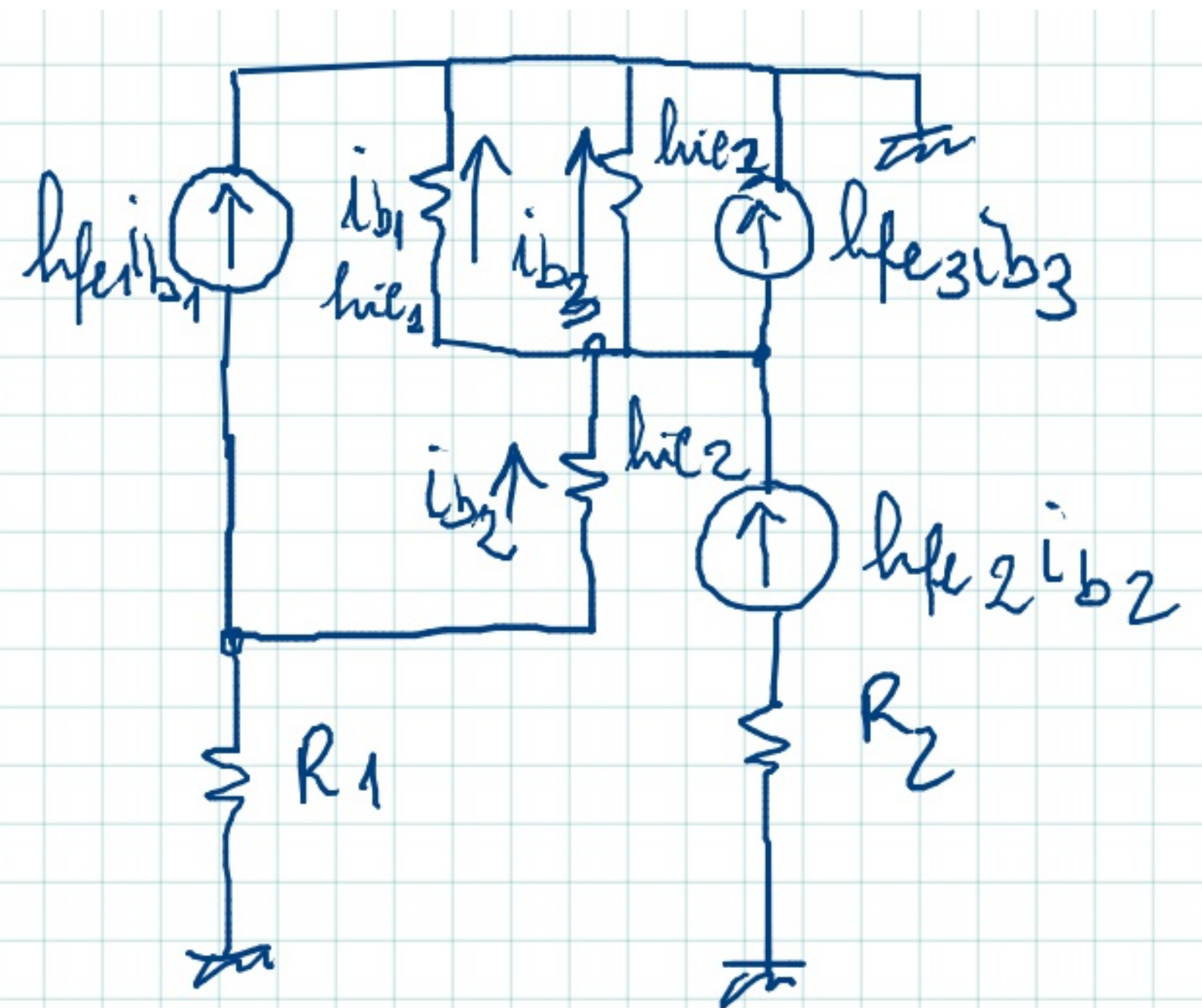
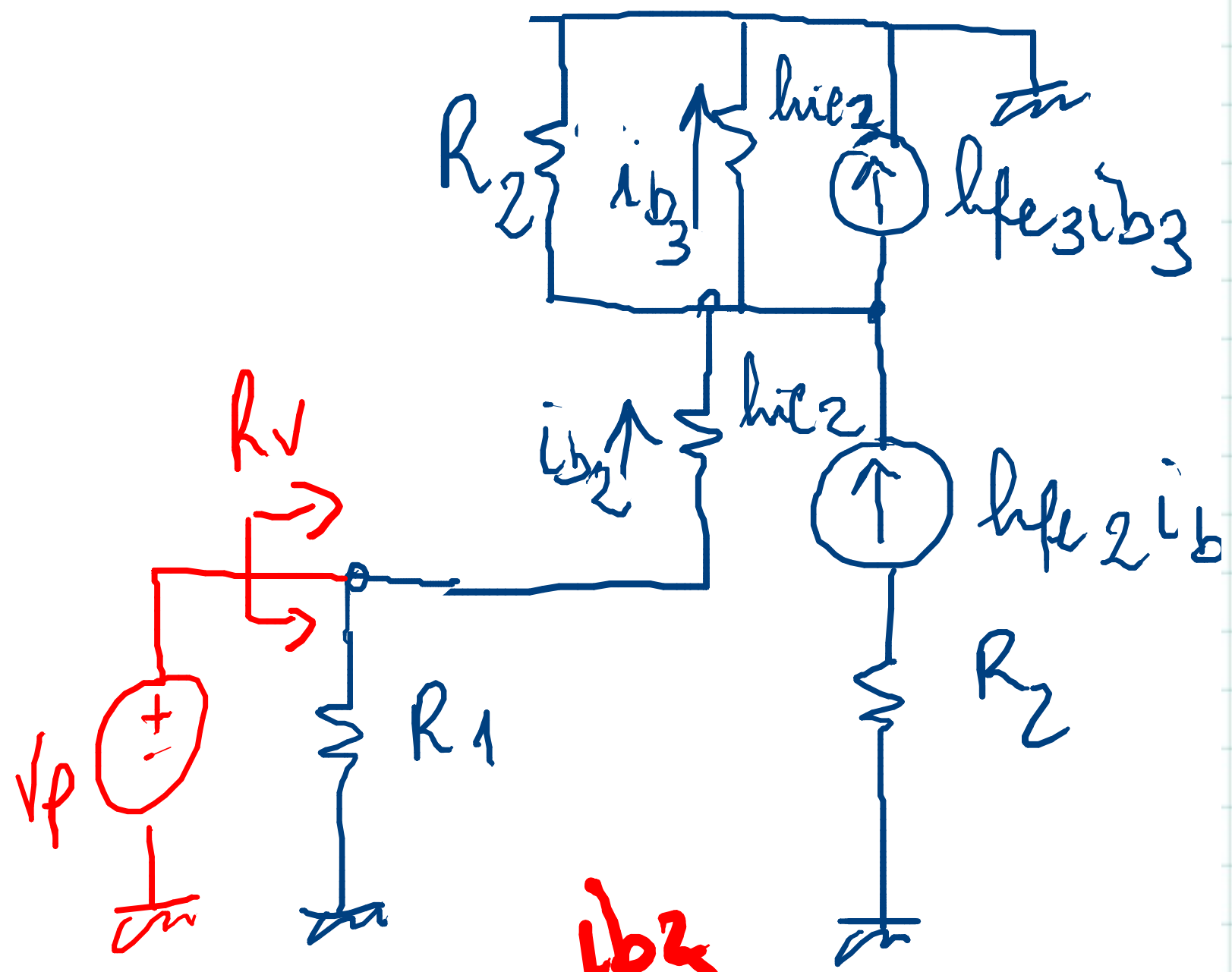
$$I_{C1} = I_{C3} = 5,247 \text{ mA}$$

$$I_2 = h_{FE} \frac{h_{FE} + 2}{h_{FE} + 1} x = 5,299 \text{ mA}$$

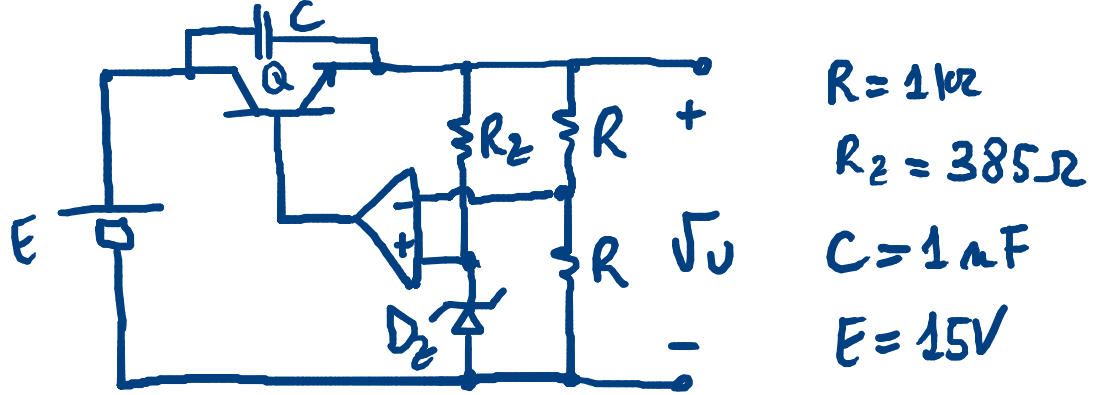
$$\frac{I_1}{I_2} = \frac{h_{FE}^2 + 2h_{FE} + 2}{h_{FE}^2 + 2h_{FE}} = 1,000196$$

$$V_{EC3} = 0,7 \text{ V} ; \quad V_{EC1} = 1,4 \text{ V}$$

$$V_{EC2} = V_{EE} - V_{EBON} - R_2 I_2 = 6,0 \text{ V}$$



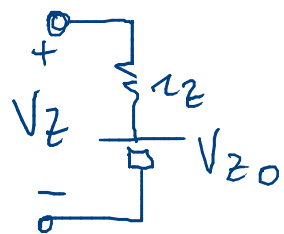
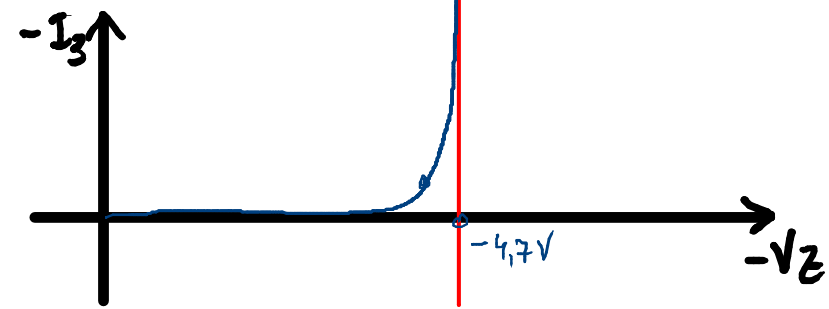
$$R_v = R_1 \parallel \left[h_{ie2} + (h_{fe2} + 1) \cdot \left(R_2 \parallel \frac{h_{ie3}}{h_{fe3} + 1} \right) \right]$$



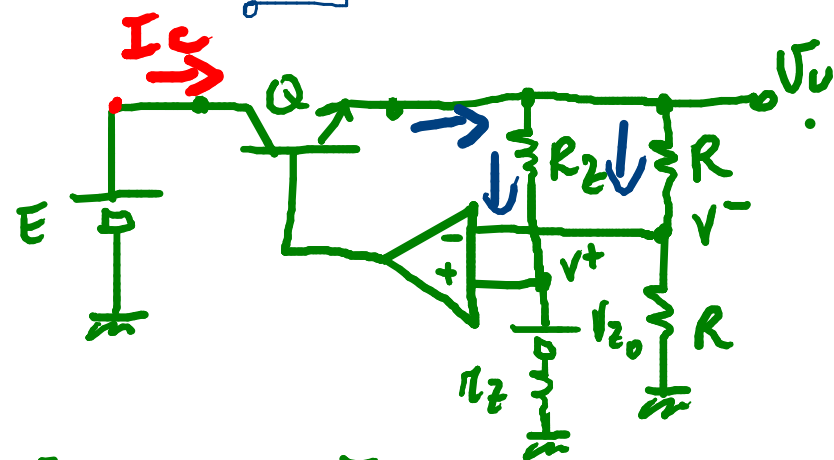
$D_2 : V_Z = 4,7V, r_z = 100\Omega @ I_Z = 10mA$

$r_{zk} = 10k\Omega @ I_{zk} = 0,1mA$

$Q : h_{FE} = 100 \quad OP : IDEALE$



$V_{Z0} = V_Z - r_z \cdot I_Z = 3,7V$



$V^- = \frac{V_U R}{R+R} = \frac{V_U}{2} \quad V^- = V^+$

$V^+ = \frac{r_z}{r_z + R_2} V_U + \frac{R_2}{R_2 + r_z} V_{Z0}$

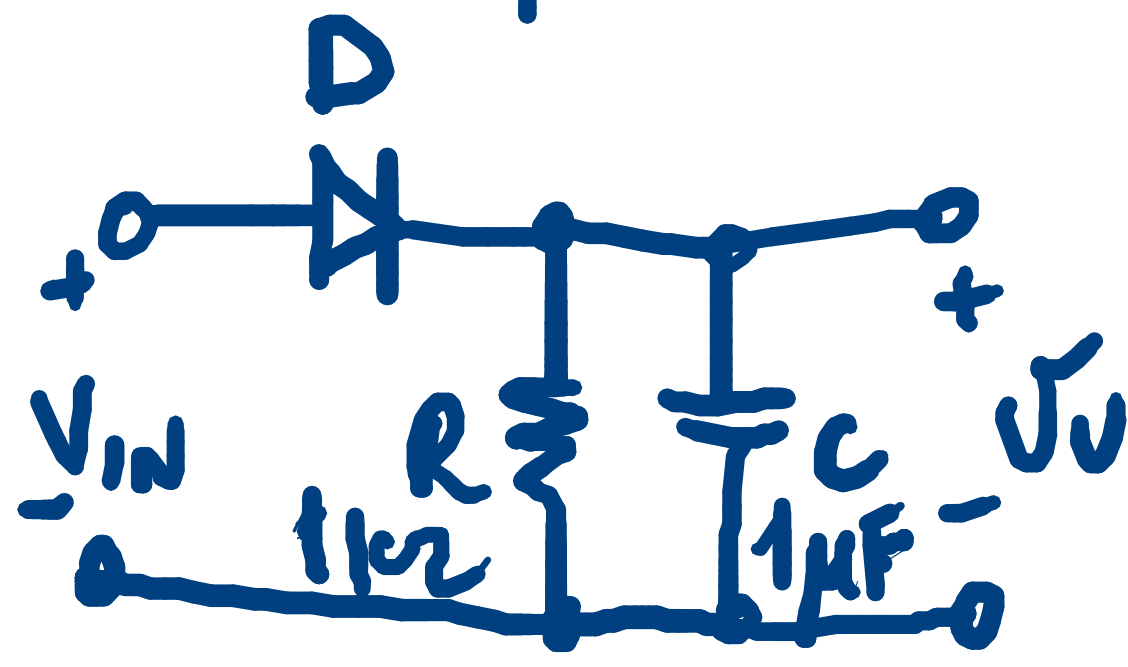
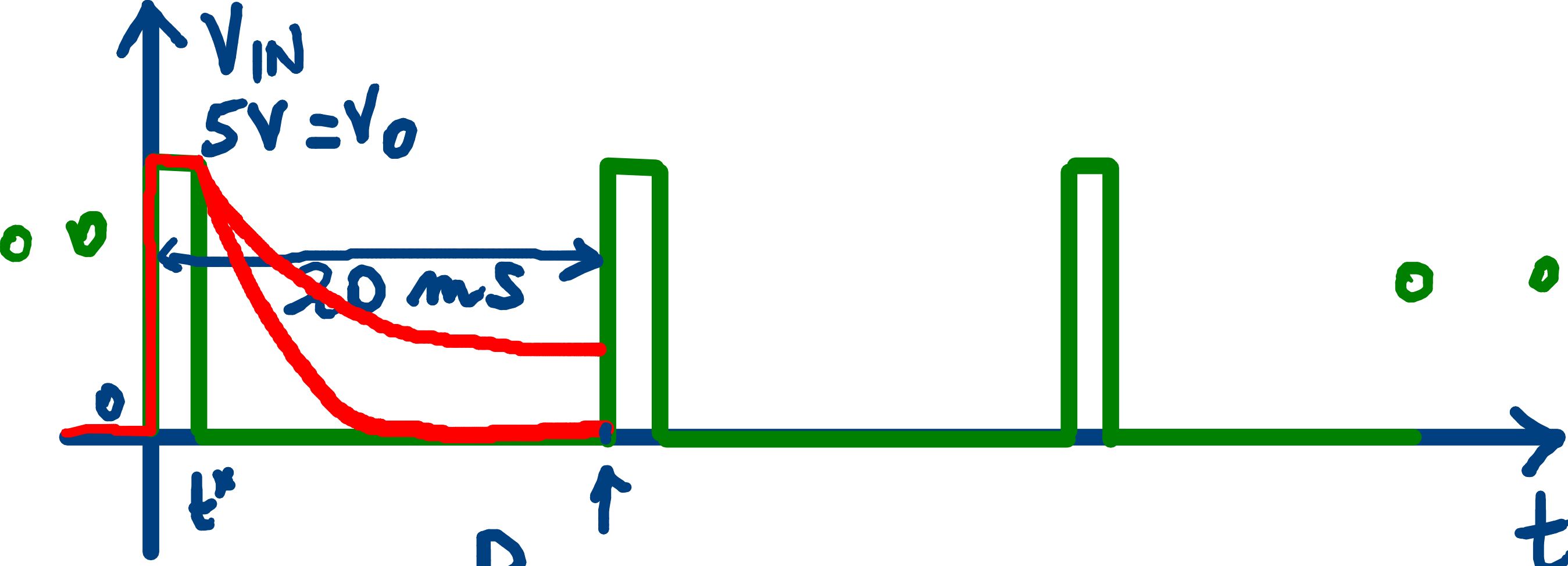
$V_U = \frac{V_{Z0} R_2}{\frac{r_z + R_2}{2} - r_z} = 10V = V_E$

$V_{CE} = V_C - V_E = E - V_E = 5V$

$I_C = \frac{I_E}{h_{FE} + 1} h_{FE}$

$I_E = \frac{V_U}{2R} + \frac{V_U - V_{Z0}}{R_2 + r_z}$

$I_C = 14,8mA$



$$V_O(t) = V_0 e^{-\frac{t-t^*}{\tau}} \quad t \geq t^*$$

$$\tau = RC = 1\text{ms}$$