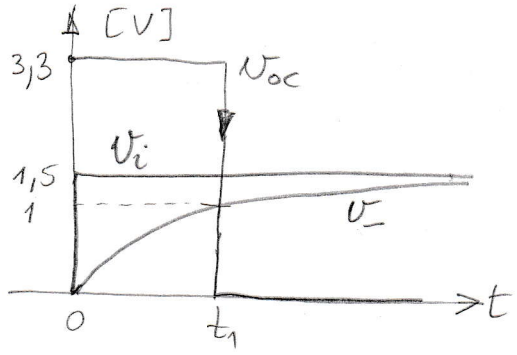
AE-20160914-1

① 

$$v_-(t) = V_i \cdot \left(1 - e^{-\frac{t}{\tau}}\right)$$

$V_i = 1{,}5\ V$

$\tau = R_1 \cdot C_1 = 220 \cdot 2{,}2 \cdot 10^{-9} = 486{,}2\ ns$

$$v_-(t_1) = 1 = 1{,}5 \cdot \left(1 - e^{-\frac{t_1}{\tau}}\right) \Rightarrow e^{-\frac{t_1}{\tau}} = 1 - \frac{1}{1{,}5} = \frac{1}{3}$$

$t_1 = \tau \cdot \ln 3 = 534\ ns$

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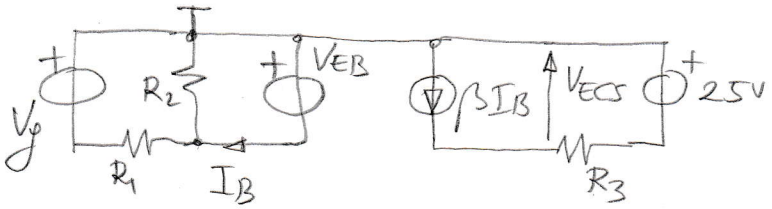
② 

$$I_B = \frac{V_g - V_{EB}}{R_1} - \frac{V_{EB}}{R_2}$$

$$V_{ECS} = 25 - R_3 \beta I_B \rightarrow \beta I_B = \frac{25 - V_{ECS}}{R_3} = \frac{25 - 0{,}6}{47} = 519\ mA.$$

$$I_B = \frac{519}{100} \cdot 10^{-3} = 5{,}19\ mA$$

$$\frac{V_g - V_{EB}}{R_1} = I_B + \frac{V_{EB}}{R_2} \Rightarrow \frac{V_g}{R_1} = I_B + \frac{V_{EB}}{R_2} + \frac{V_{EB}}{R_1} = 5{,}19 \cdot 10^{-3} + \frac{0{,}8}{330} + \frac{0{,}8}{680}$$

$\frac{V_g}{R_1} = 8{,}79\ mA$; $V_g = R_1 \cdot 8{,}79\ mA = 680 \cdot 8{,}79 \cdot 10^{-3} = 5{,}98\ V$

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③ $$\left.\begin{aligned} V_o &= (V_i - V_-) \cdot A(j\omega) \\ V_- &= V_o \cdot \frac{R_1}{R_1 + R_2} \end{aligned}\right\} \rightarrow V_o = V_i \cdot A(j\omega) - V_o \frac{R_1}{R_1 + R_2} \cdot A(j\omega)$$

$$A_r(j\omega) = \frac{V_o}{V_i} = \frac{A(j\omega)}{1 + \frac{R_1}{R_1 + R_2} A(j\omega)}$$

$$A_r(j\omega) = \frac{A_0 \frac{1}{1 + j\omega/\omega_0}}{1 + \frac{R_1}{R_1 + R_2} \cdot A_0 \frac{1}{1 + j\omega/\omega_0}} = \frac{A_0}{1 + j\omega/\omega_0 + \frac{A_0 R_1}{R_1 + R_2}}$$

$$A_r(j\omega) = \frac{A_0}{1 + \frac{A_0 R_1}{R_1 + R_2}} \cdot \frac{1}{1 + j \frac{\omega}{\omega_0 \cdot \frac{A_0 R_1}{R_1 + R_2}}} = K \cdot \frac{1}{1 + j\frac{\omega}{\omega_r}}$$

$\omega_r = \omega_0 \cdot \frac{A_0 R_1}{R_1 + R_2}$

$$\omega_r = \omega_0 \cdot \frac{A_0 R_1}{R_1 + R_2} = 2\pi \cdot 10 \cdot \frac{10^5 \cdot 10^3}{10^3 + 10^5} \approx 2\pi \cdot 10^4\ rad/s$$

$$f_r = \frac{\omega_r}{2\pi} = 10^4\ Hz = 10\ kHz$$
