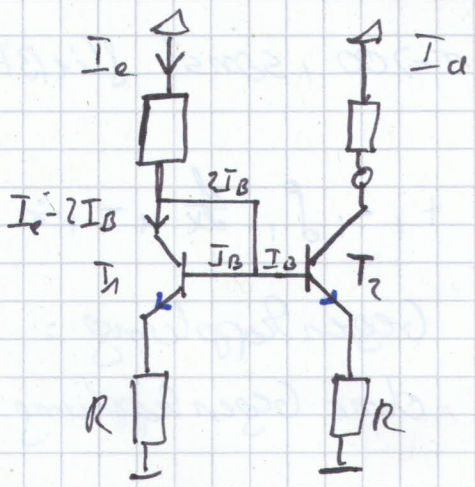
23)

a) Stromspiegel



b) $I_C = I_e - 2I_B$

$\Leftrightarrow I_e = I_C + 2I_B$

$\Leftrightarrow I_e = (1 + \frac{2}{B}) I_C$

c) $I_e = (1 + \frac{2}{B}) I_a$ $\quad (I_e = (B+2) I_B = \frac{B+2}{B} I_a)$

d) $B \to \infty$

e) $U_{RV} = I_e \cdot R_V$

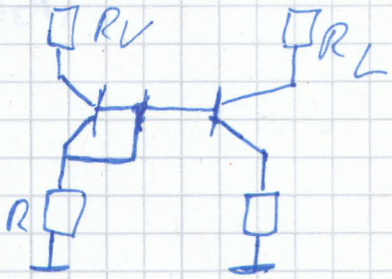
$U_0 = U_V + U_B + U_R$ $\qquad U_0 = U_{RL} + U_{B2} + U_R$

$\Rightarrow U_V = 9{,}1\ V$

mit $I_a = 10^{-3} B \Rightarrow R = 9{,}1\ k\Omega$ $\qquad \Rightarrow R = 9{,}1\ k\Omega$

$U_R = R \cdot I_R$ $\qquad I_R = (B+1) I_a$

$\Leftrightarrow \frac{U_R}{I_R} = R =$



24)

a) $U_d = 0$; $I_e = 0$ $\quad (r_E = \infty)$

b) reale OPV: Verstärkungsfaktor: 10^6

$R_E = 1\ M\Omega - 1000\ M\Omega$

$r_a = 2 - 100\ \Omega$

Untere Grenzfrequenz: 0 Hz

Unity Gain Frequenzbreite: 7100 MHz

Gleichtaktverstärkung V_{gl}: ca. 0,2

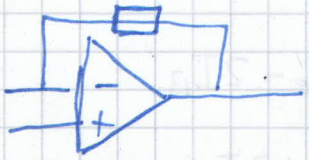
Gleichtaktunterdrückung : $5 \cdot 10^6$

Rauschausgangsspannung : $3\ \mu V$

c) $r \to \infty$, sonst fließt Strom

d) $+, \cdot, \int, \frac{d}{dx}, -, \div$

e) Gegenkopplung:



ohne Gegenkopplung kein linearer Bereich

25)

d) subtrahiere

$$I_2 = \frac{U_A - U_-}{R_2} = -I_1 = \frac{U_- - U_1}{R_1}$$

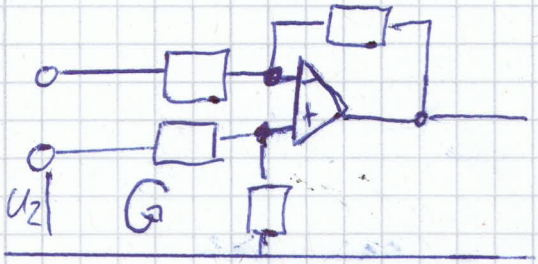
$$\Rightarrow (U_a - U_-) R_1 = (U_- - U_1) R_2$$

$$U_a R_1 = U_2 \left(\frac{R_4}{R_3 + R_4} \right) \cdot (R_1 + R_2) - U_A R_2 \quad | : R_1$$

$$U_a = U_2 \frac{R_4}{R_1} \cdot \frac{1}{R_3 + R_4} \cdot (R_1 \| R_2) - U_A \frac{R_2}{R_1}$$

$$= U_2 \left(\frac{R_4 \cdot R_1}{R_3 + R_4} + \frac{R_4 \cdot R_2}{R_3 + R_4} \right) - U_A \frac{R_2}{R_1}$$

Aufgabe 25



Subtrahierer

$$u_1 - u_{R1} - u_{R2} - u_A = u_2 - u_{R3} - u_{R4}$$
$$u_1 - I_1 R_1 - u_{R2} - u_A = u_2 - I_2 R_3 - I_2 R_4$$

$u_- = u_+ \Rightarrow u_{R3} = u_2 - u_+$ $\qquad u_{R1} = u_1 - u_+$

$$I_2 = \frac{u_2 - u_+}{R_3} \qquad I_1 = \frac{u_1 - u_+}{R_1}$$

$$u_A + u_1 = \frac{u_1 - u_+}{R_1}(R_1 + R_2) = u_2 - \frac{u_2 - u_+}{R_3}(R_3 + R_4)$$

$$\frac{R_2}{R_1}(u_1 - u_+) + u_A = \frac{R_4}{R_3}(u_2 - u_+)$$

$$\Rightarrow u_A = \frac{R_2}{R_1}(u_2 - u_1 + u_+ - u_+)$$