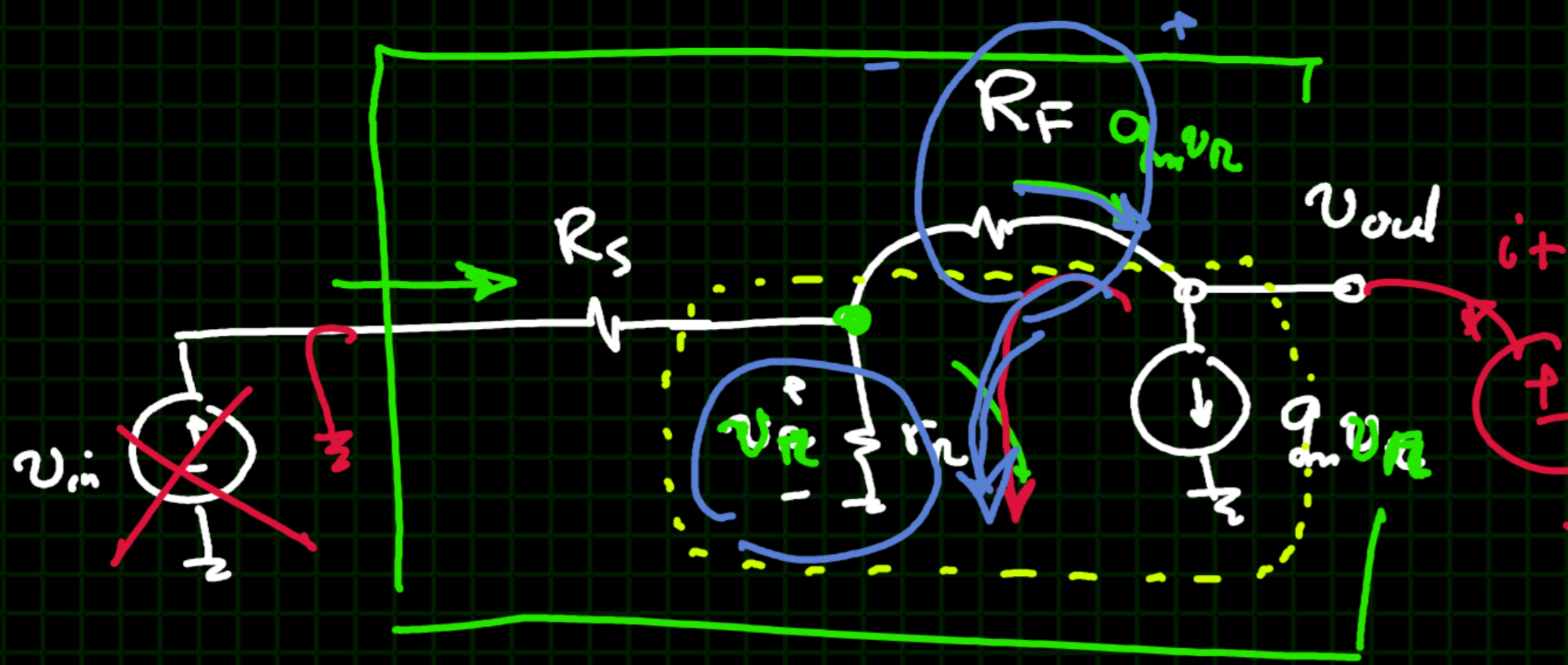


d)



$$\frac{v_{in} - v_{\pi}}{R_s} = v_{\pi} \left\{ \frac{1}{r_{\pi}} + g_m \right\} + \frac{1}{R_s}$$

$$v_{in} = v_{\pi} \left(1 + R_s (g_m + \frac{1}{r_{\pi}}) \right)$$

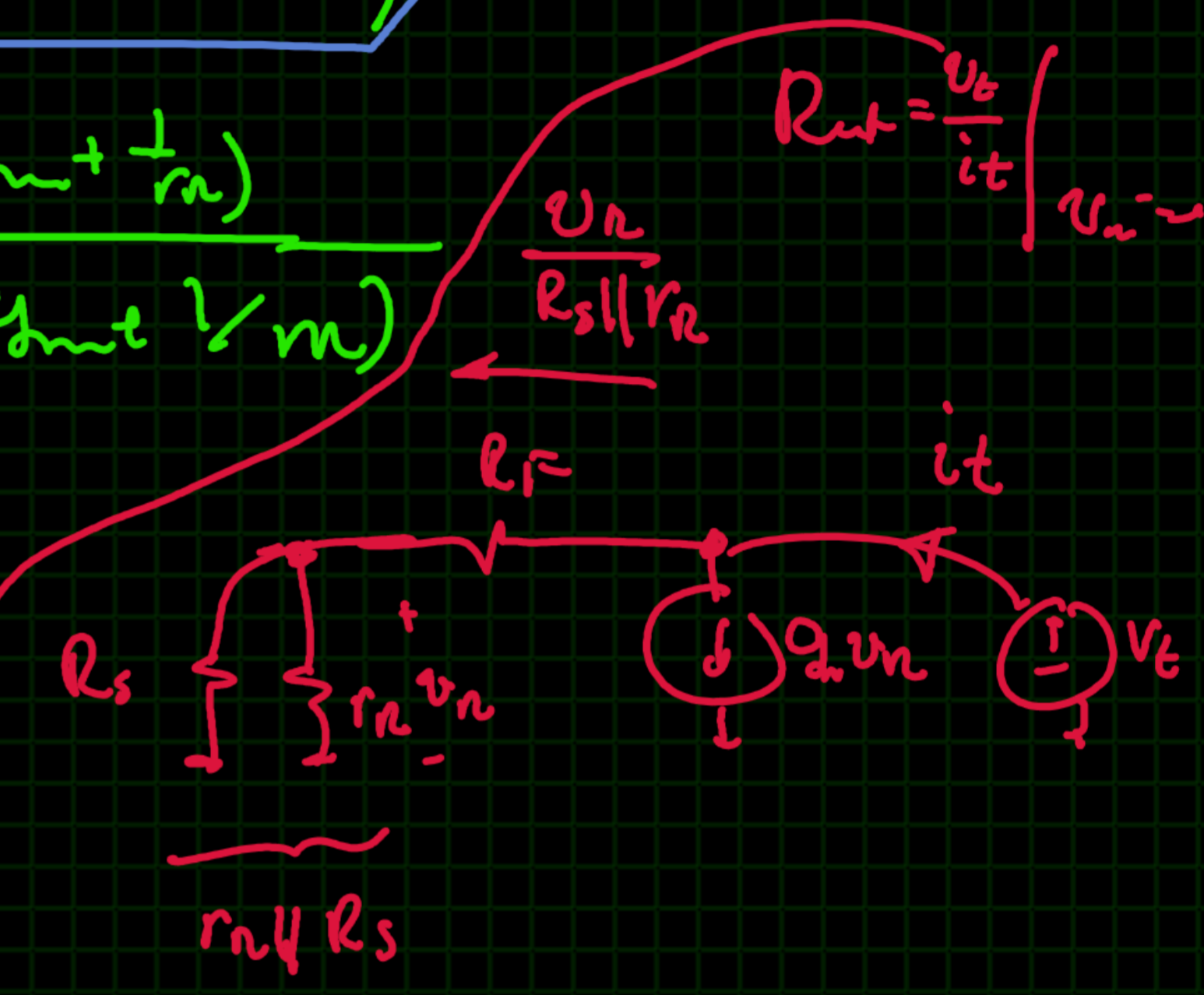
$$i_{in} = \frac{v_{in} - v_{\pi}}{R_s}$$

$$R_{in} = \frac{v_{in}}{i_{in}} = R_s \frac{1 + R_s (g_m + \frac{1}{r_{\pi}})}{R_s (g_m + \frac{1}{r_{\pi}})}$$

$$v_{out} = v_{\pi} \rightarrow g_m v_{\pi} R_F$$

$$A_{v_o} = \frac{v_{out}}{v_{in}} = \frac{1 - g_m R_F}{1 + R_s (g_m + \frac{1}{r_{\pi}})}$$

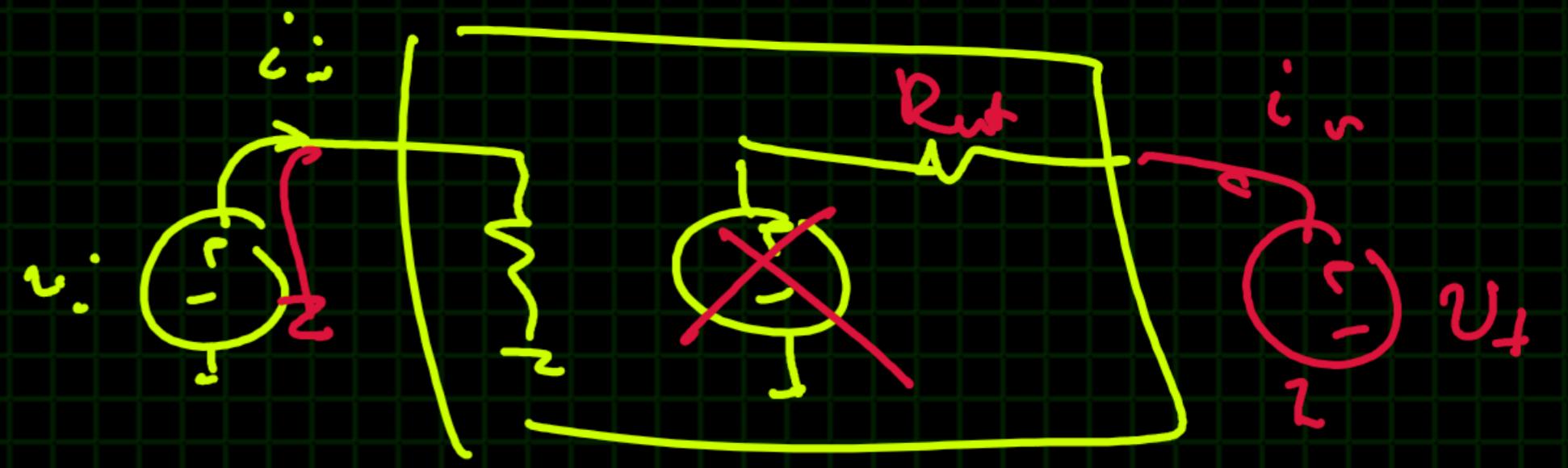
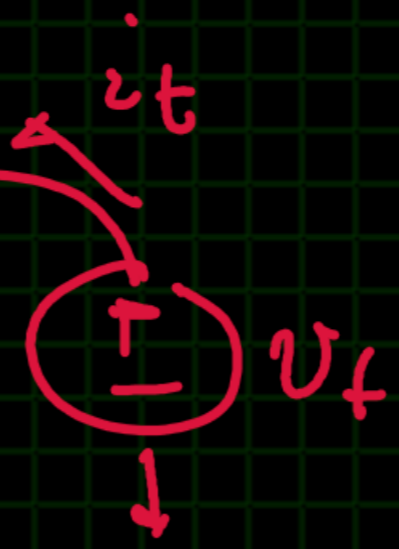
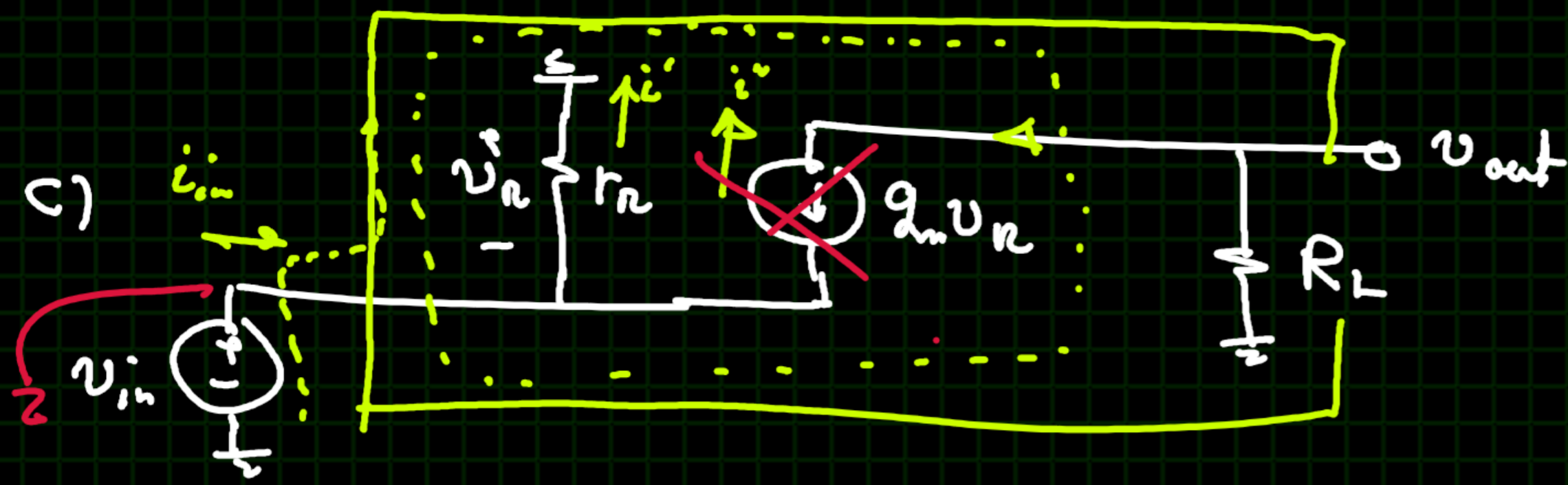
$$v_{in} = v_{\pi} (\dots)$$



$$i_t = g_m v_{\pi} + \frac{v_{\pi}}{r_{\pi} \parallel R_s}$$

$$R_{out} = \frac{R_s \parallel R_L \parallel R_F}{1 + g_m (R_s \parallel R_L)}$$

$$v_t = v_{\pi} + \frac{R_F}{R_s \parallel r_{\pi}} v_{\pi}$$

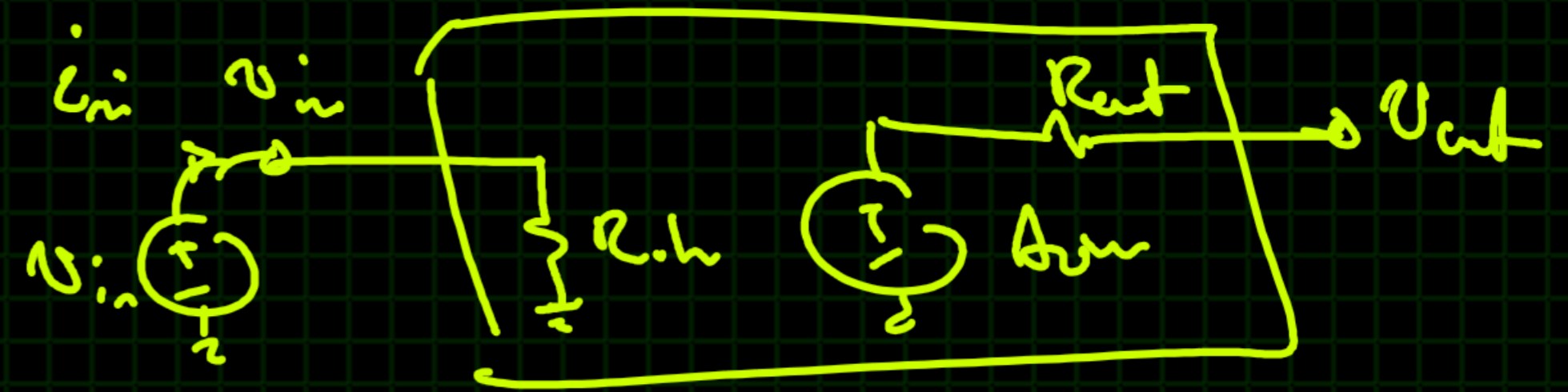
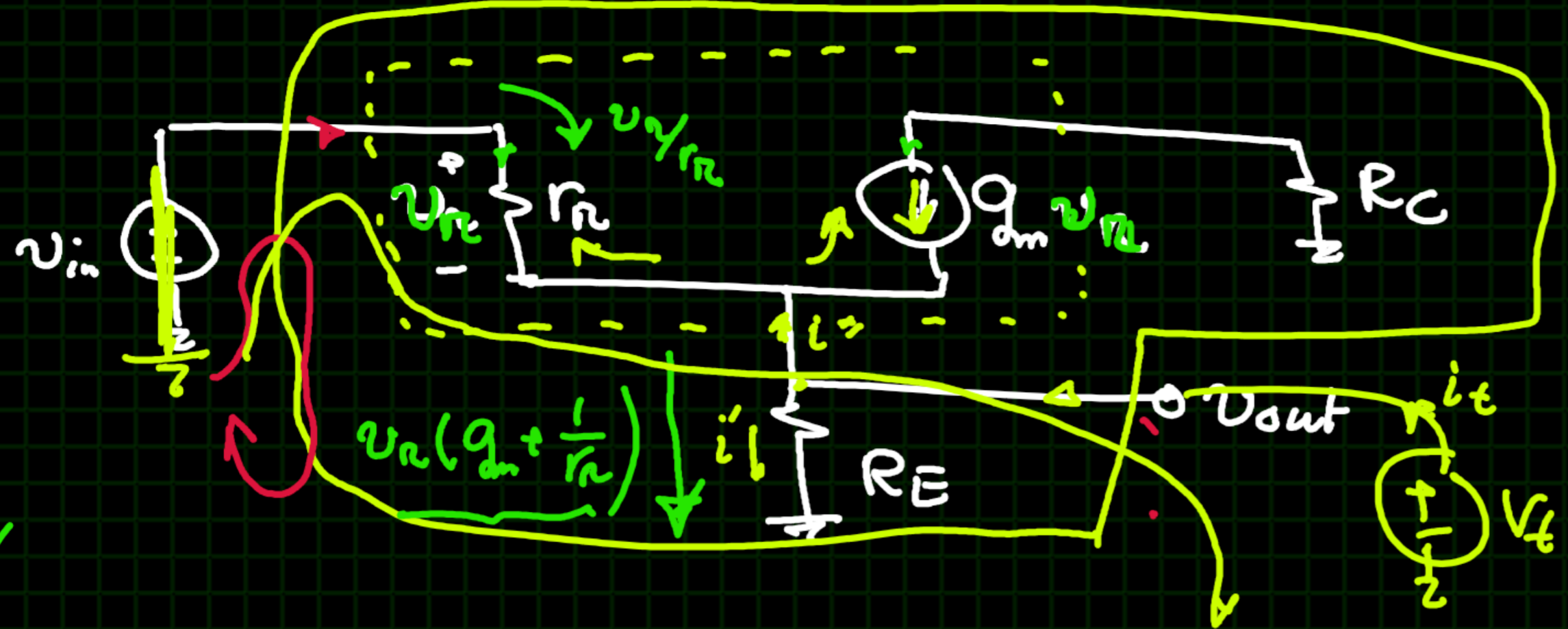


$$\frac{v_t}{i_t} = R_L = R_{out}$$

$$v_{\pi} = -v_{in} \quad v_{out} \approx -g_m v_{\pi} R_L = \underbrace{g_m R_L}_{A_{vo}} v_{in}$$

$$i_{in} = \frac{v_{in}}{r_{\pi}} + g_m v_{in} \quad \rightarrow \quad \frac{v_{in}}{i_{in}} = \frac{1}{\frac{1}{r_{\pi}} + g_m} = \frac{r_{\pi}}{1 + g_m r_{\pi}}$$

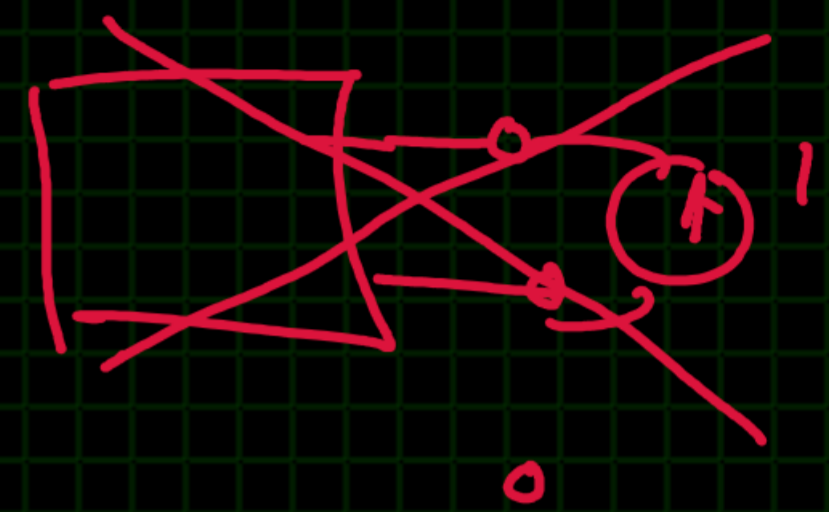
b)



v_{π}

$$v_{in} = v_{\pi} + v_{\pi} R_E (g_m + \frac{1}{r_{\pi}}) \quad i_{in} = \frac{v_{\pi}}{r_{\pi}}$$

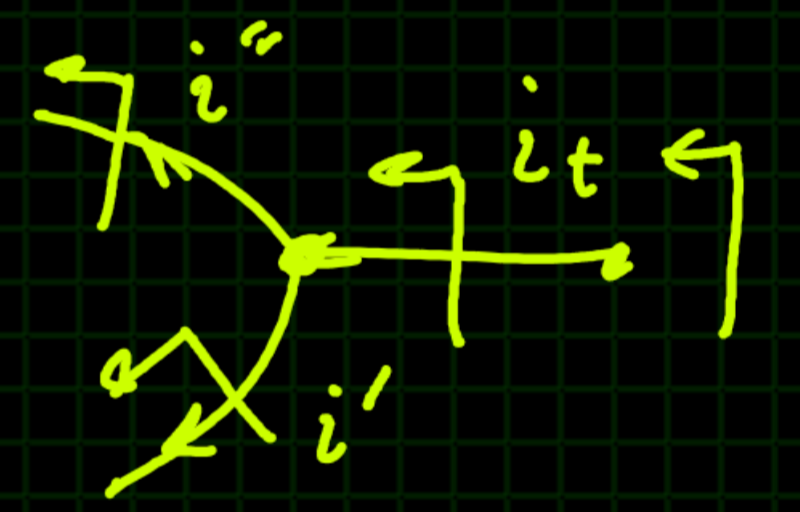
$$A_{V_0} = \frac{v_{out}}{v_{in}} = \frac{R_C (g_m + \frac{1}{r_{\pi}})}{R_C (g_m + \frac{1}{r_{\pi}}) + 1}$$



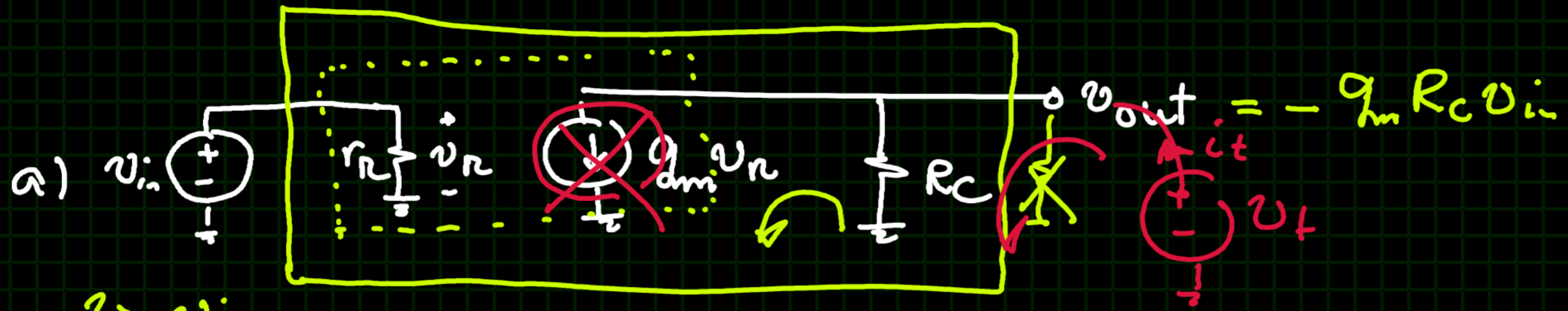
$$R_{in} = \frac{v_{in}}{i_{in}} = \frac{1 + R_E (g_m + \frac{1}{r_{\pi}})}{\frac{1}{r_{\pi}}} = r_{\pi} + R_E (1 + g_m r_{\pi})$$

$$= \frac{R_E (1 + g_m r_{\pi})}{r_{\pi} + R_E (1 + g_m r_{\pi})}$$

$$v_{\pi} = -v_t \quad i_t = i' + i'' \quad R_{out} = \left(\frac{v_t}{i'} \right) \parallel \left(\frac{v_t}{i''} \right) = R_E \parallel \left(\frac{1}{\frac{1}{r_{\pi}} + g_m} \right)$$



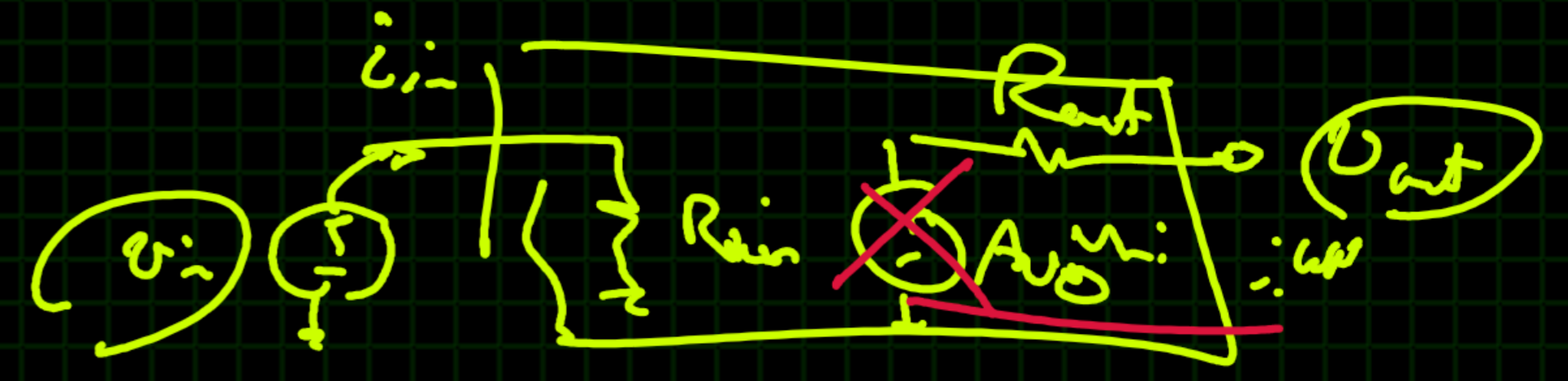
$$i'' = \frac{v_t}{r_{\pi}} + g_m v_t$$



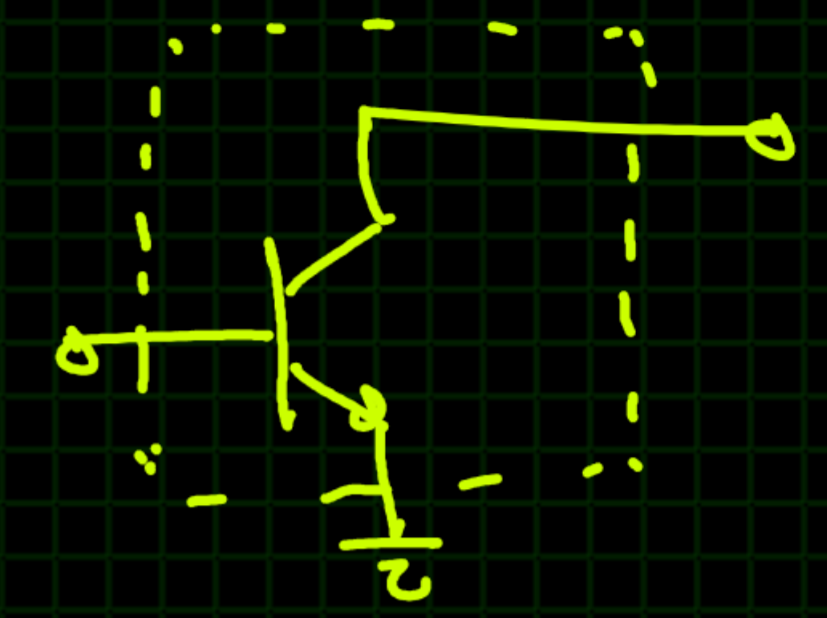
$v_{in} = v_{in}$

$R_{in} = r_{\pi}$

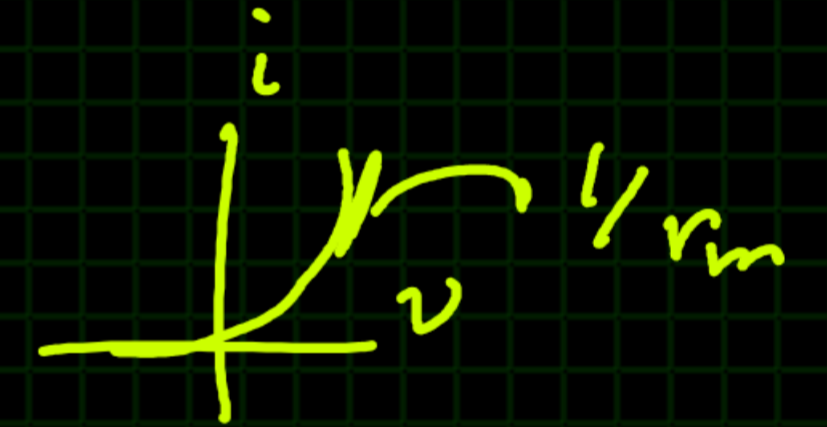
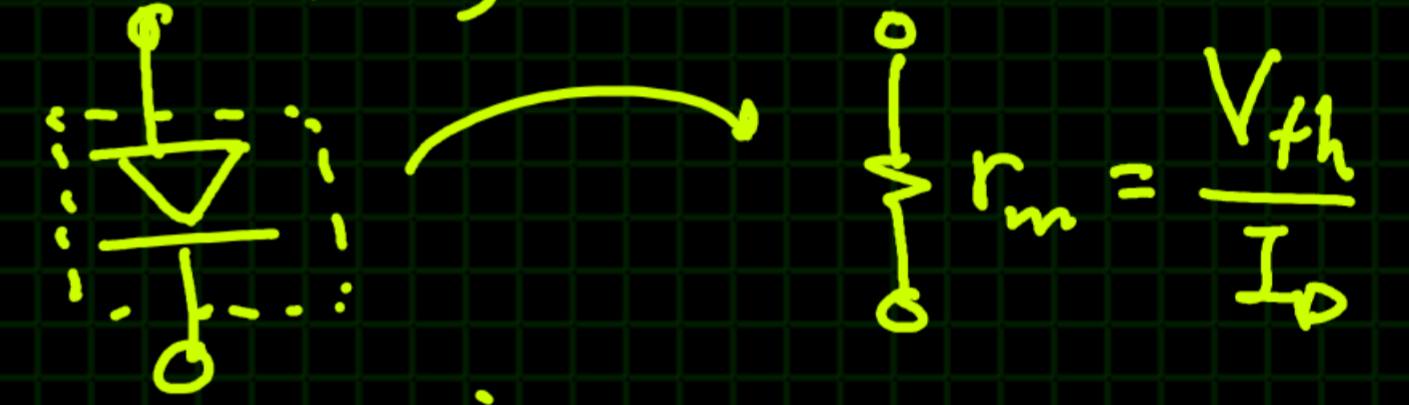
$A_{v0} = -g_m R_C$



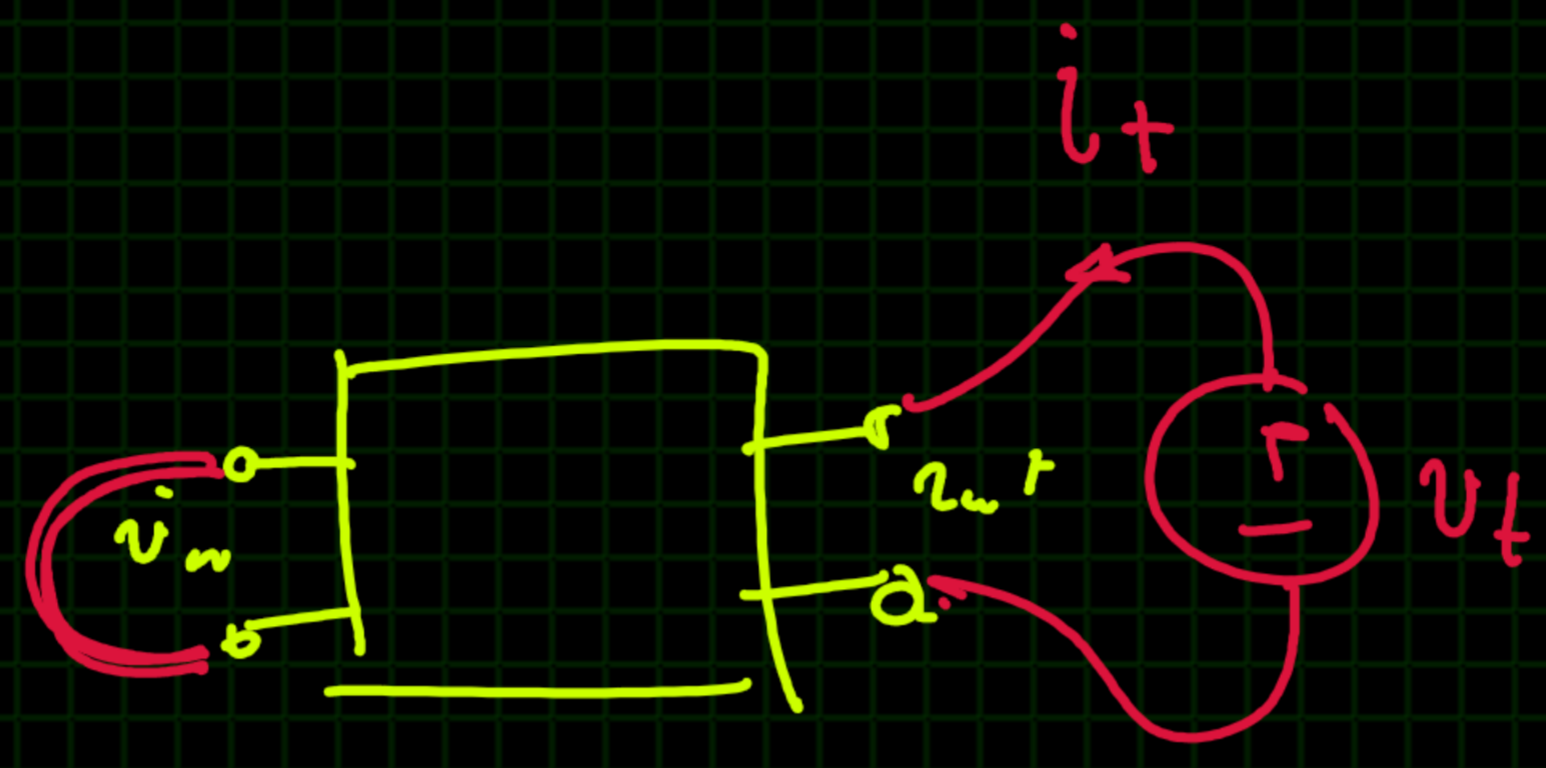
در صورتی که v_{in} را حذف کنیم



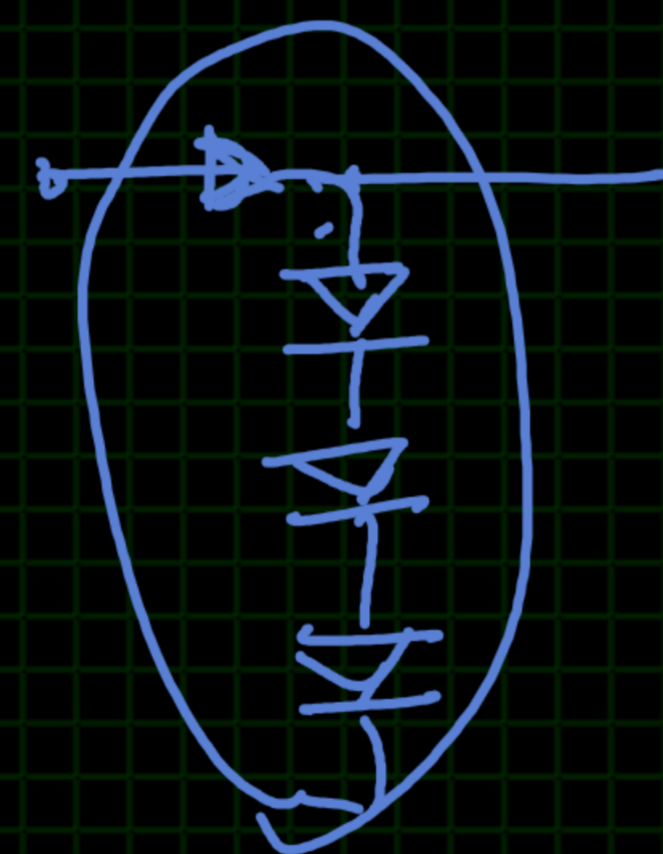
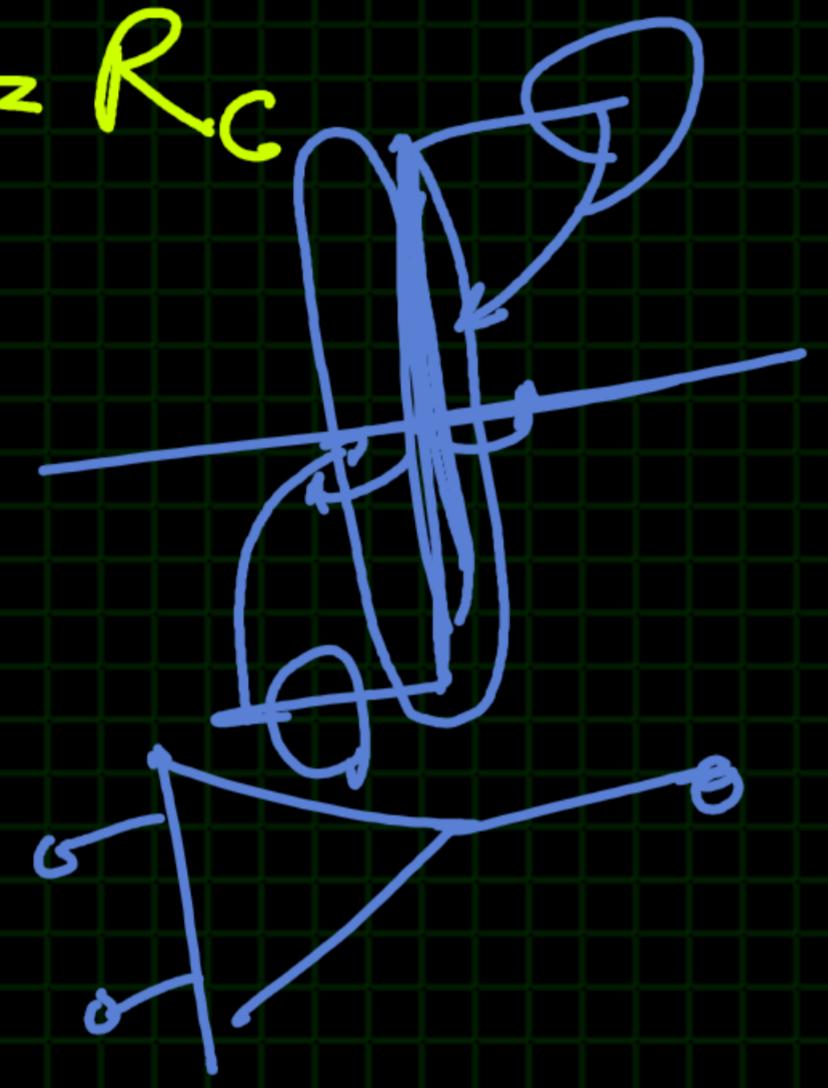
در صورتی که v_{in} را حذف کنیم



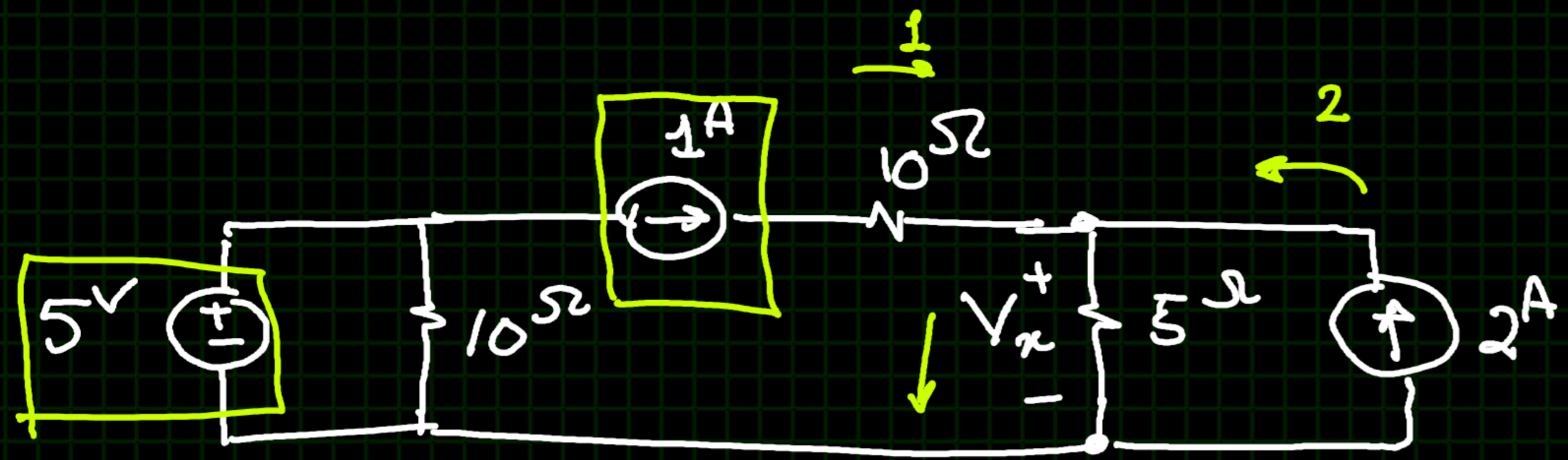
$R_{out} = R_C$



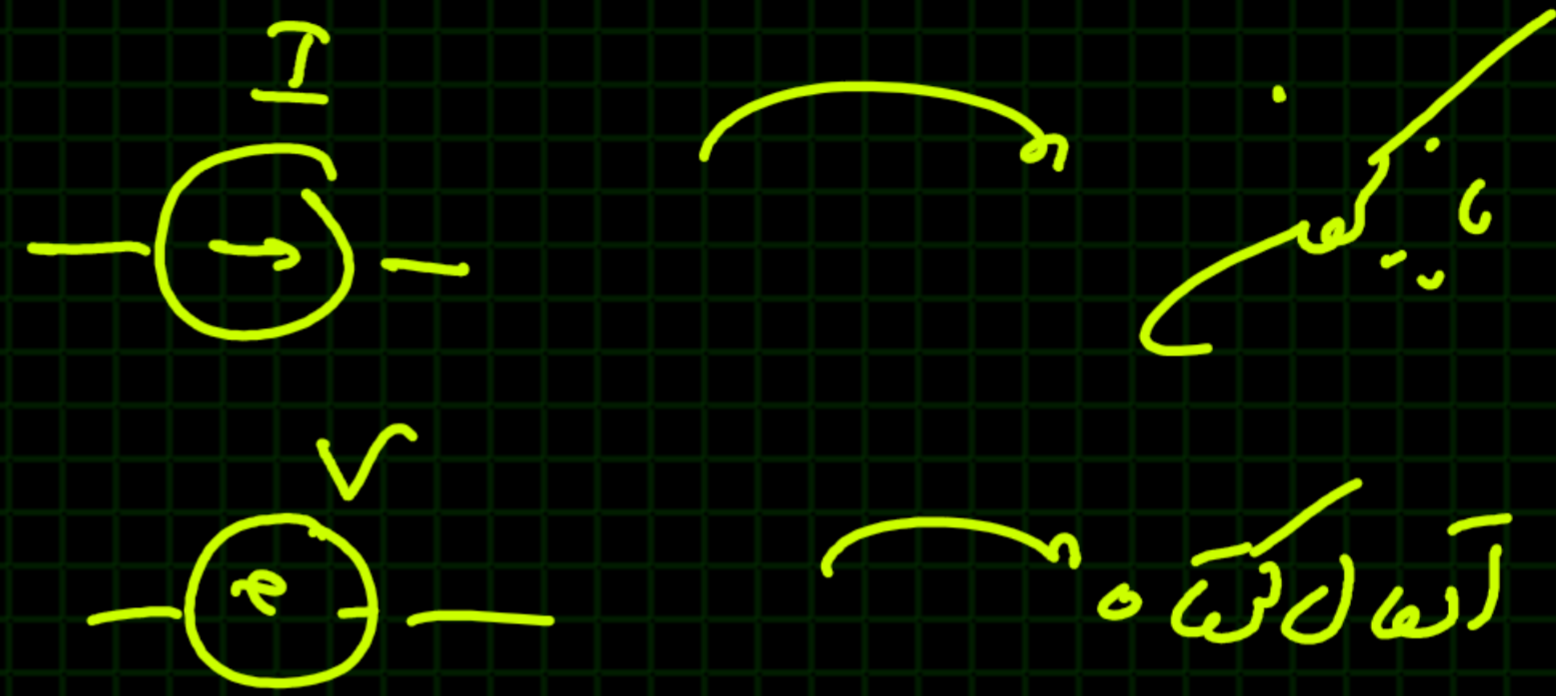
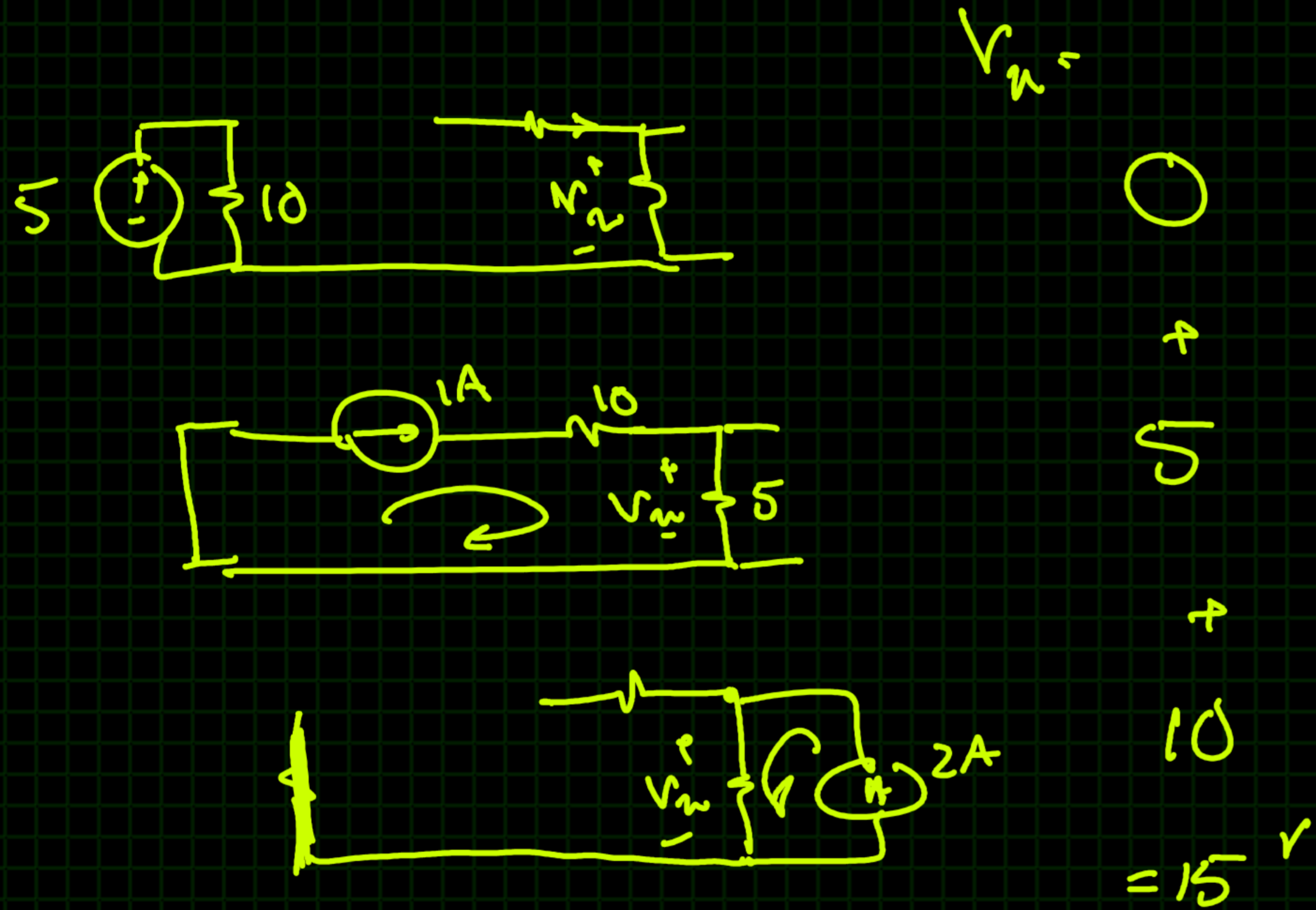
$\left. \frac{v_t}{i_t} \right|_{v_{in}=0} = R_{out}$

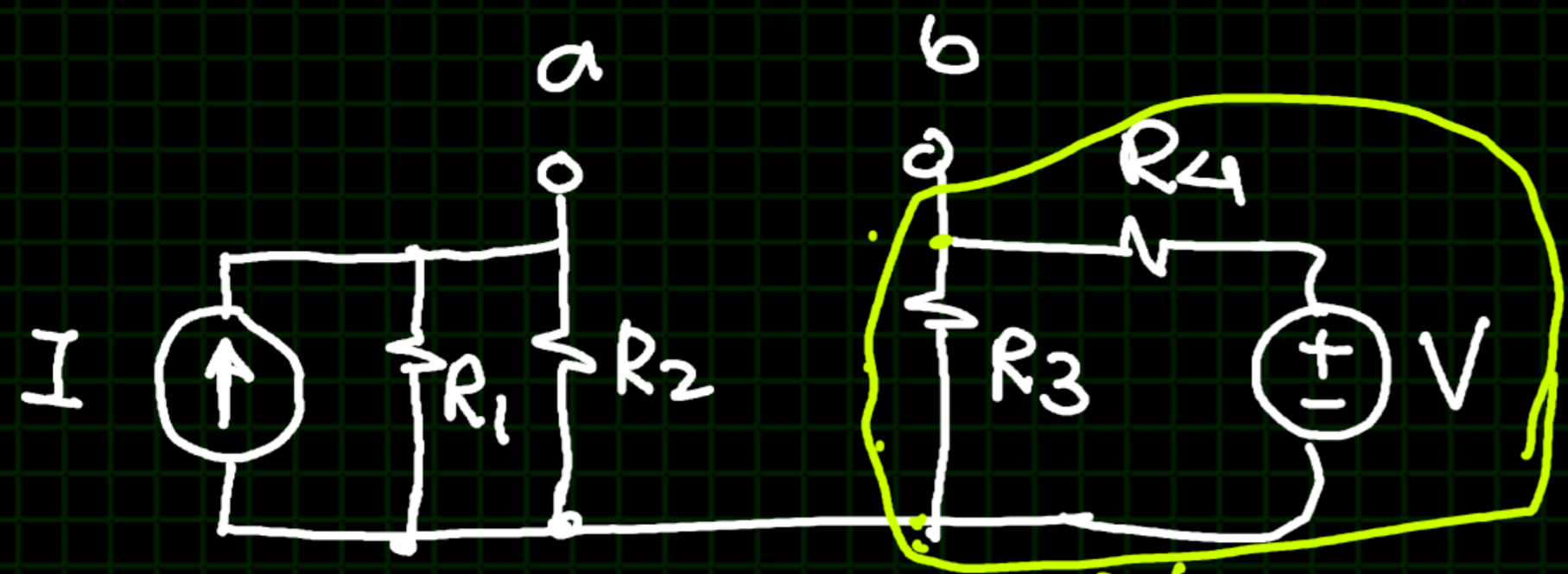


۳- ولتاژ را با استفاده از جمع آثار (مانند قانون ابراهام) بدست آورید

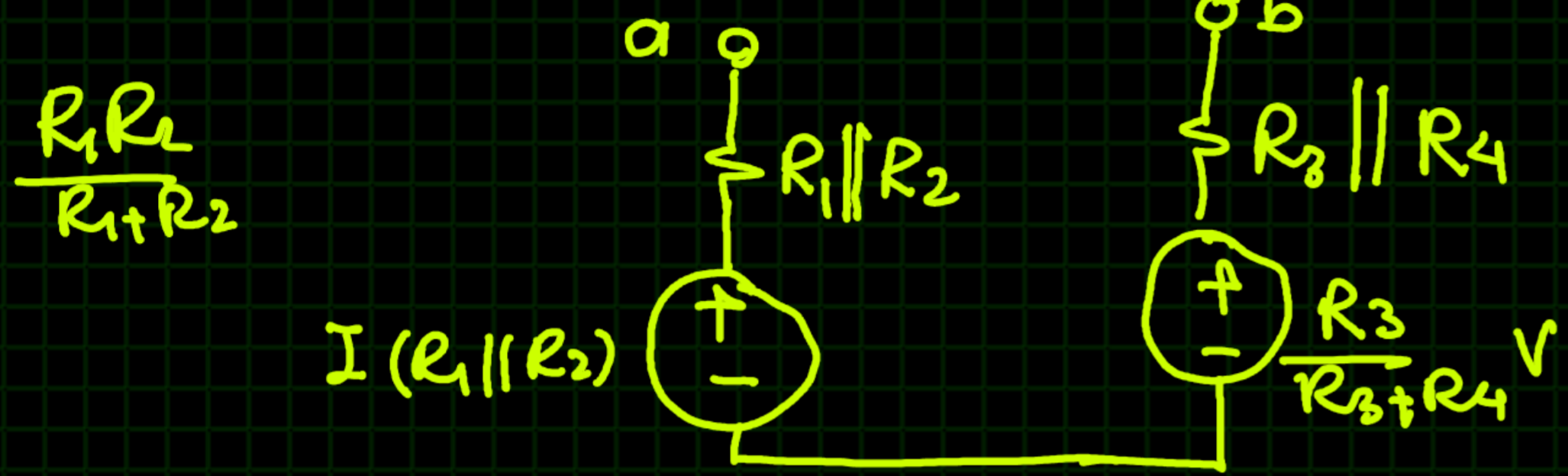
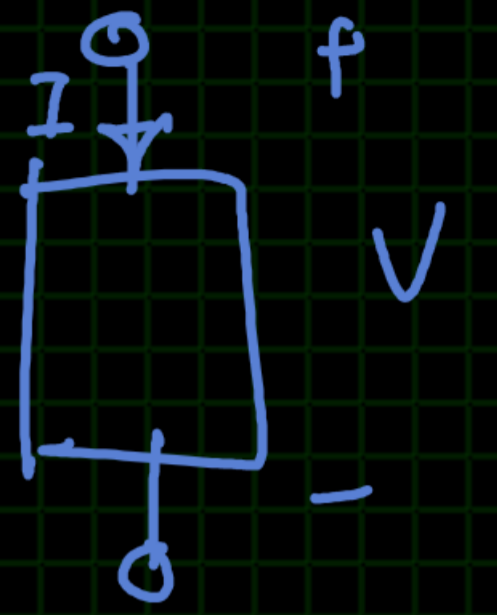


$$V_n = 3 \times 5 = 15V$$



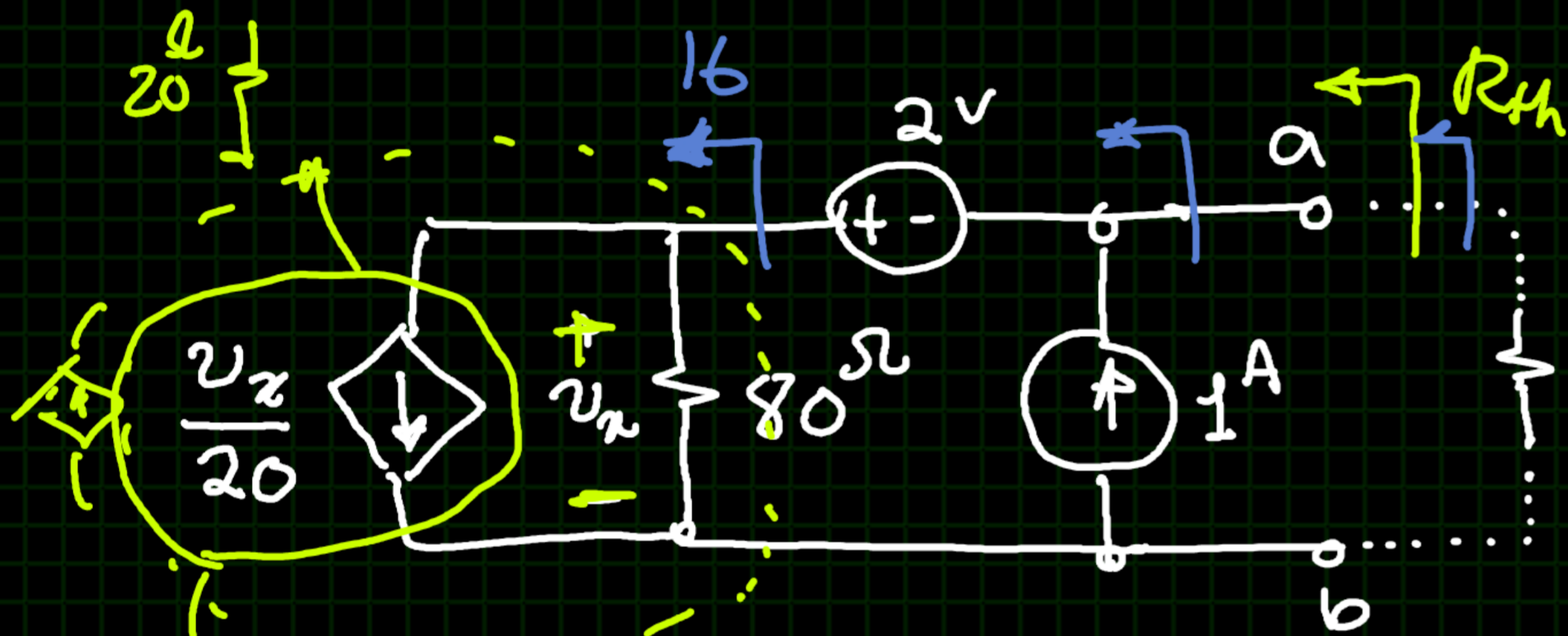


۱- معادل تون برمیآید $a-b$ را برابر R_{th}

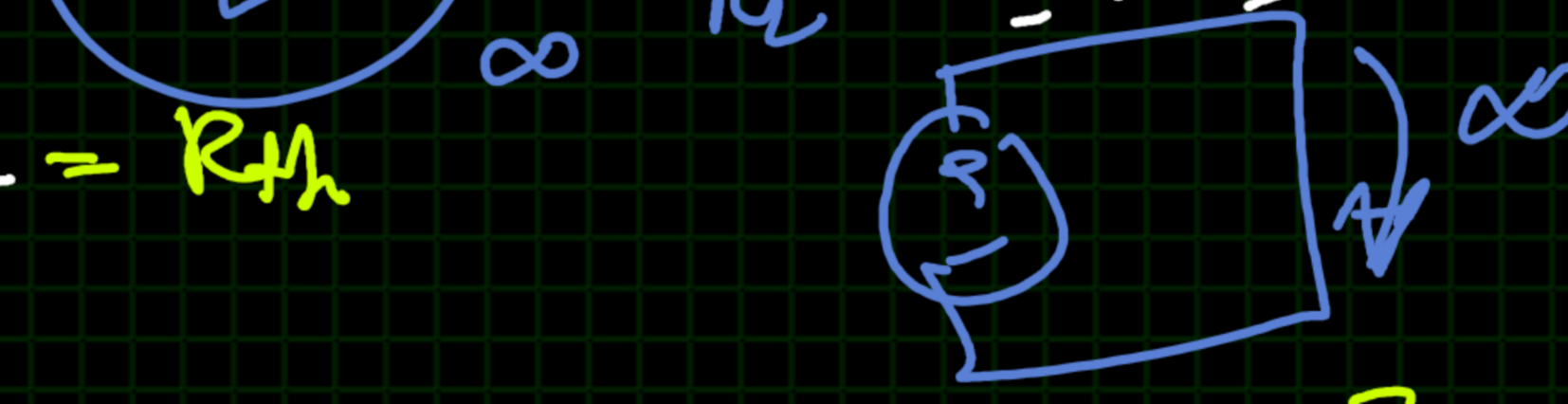


$$V_{th} = V_{ab} = I(R_1 || R_2) - \frac{R_3}{R_3 + R_4} V$$

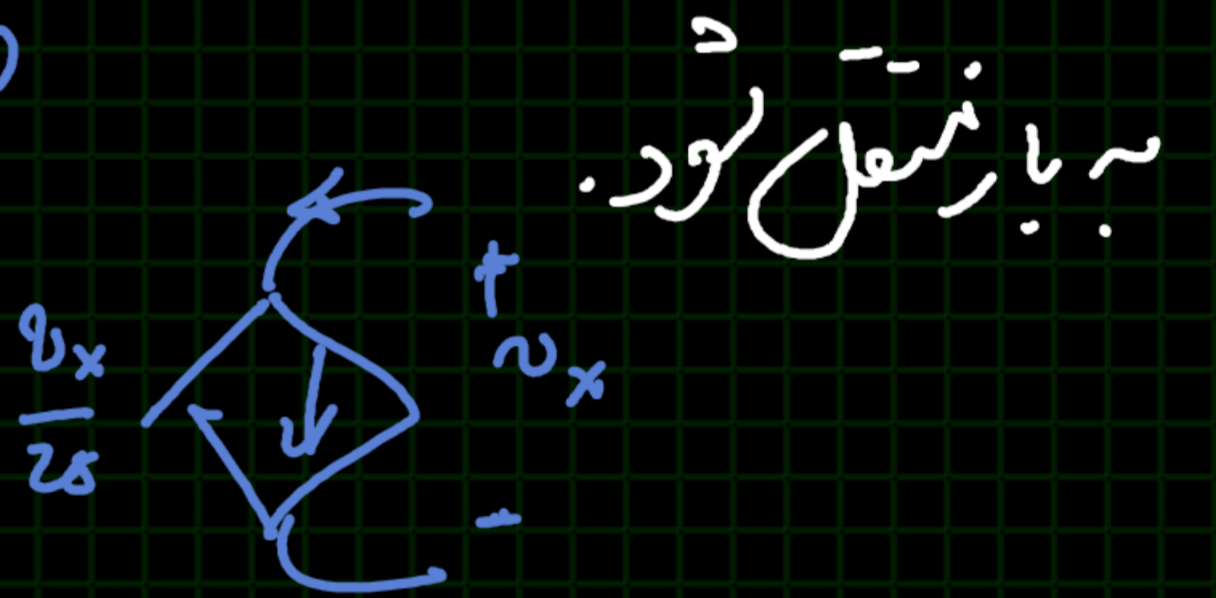
$$R_{ab} = R_1 || R_2 + R_3 || R_4$$



۲- در مدار بود R_2 را طوری تعین کنند که تون R_{th} را پیدا کنند



$$R_{th} = 20 || 80 = 16 \Omega$$

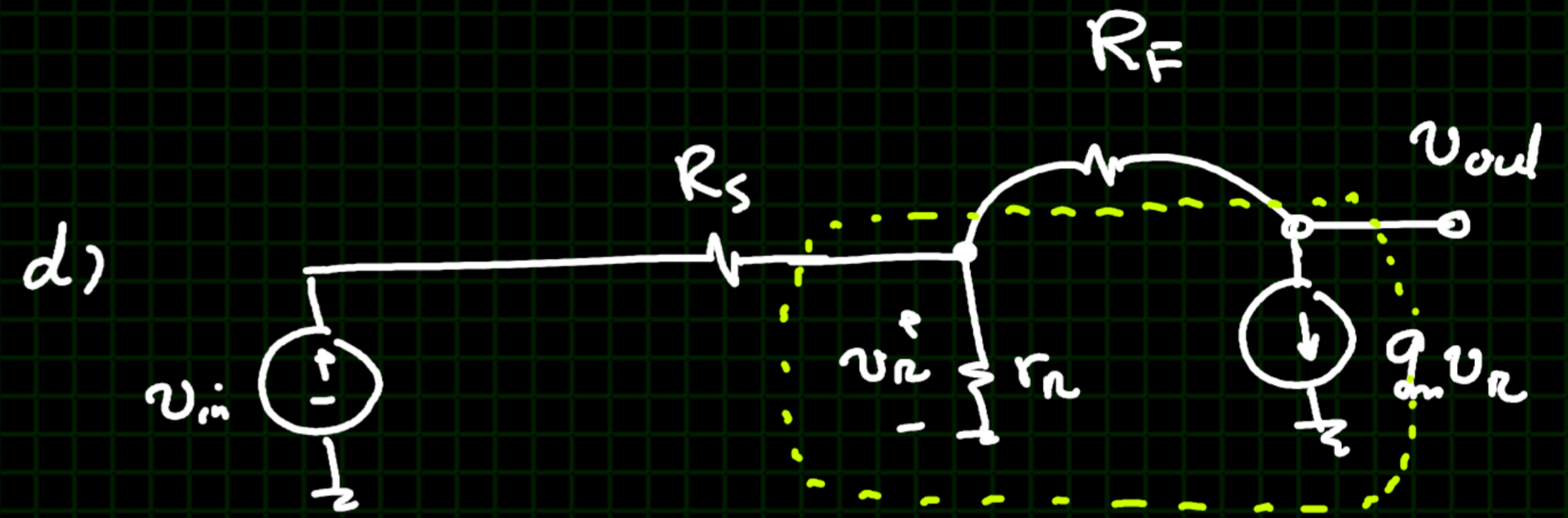
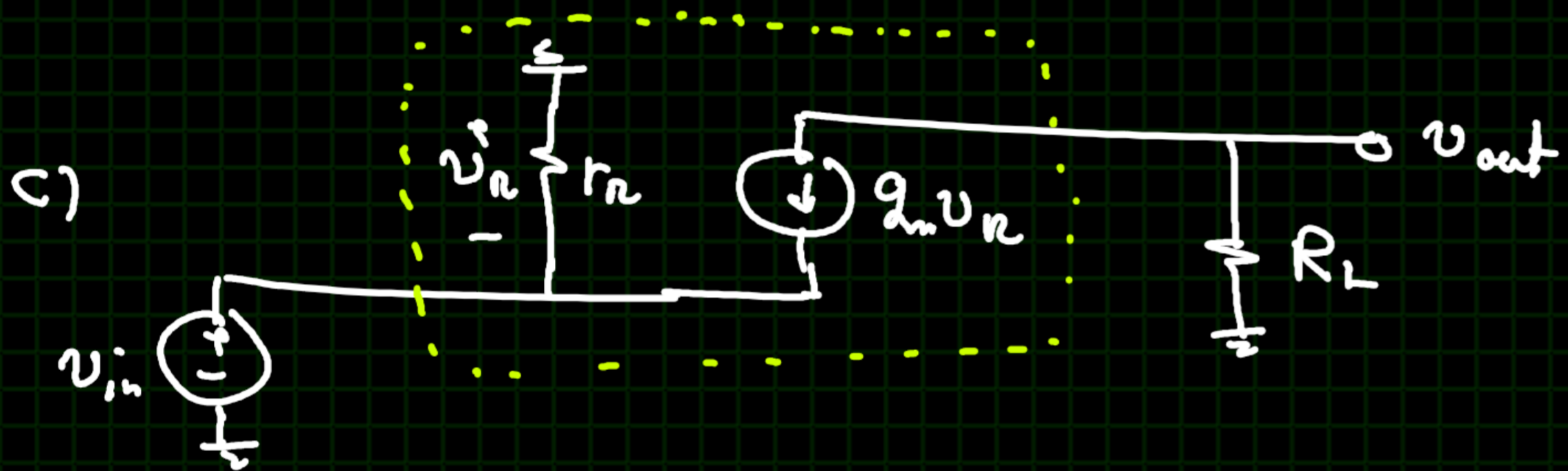
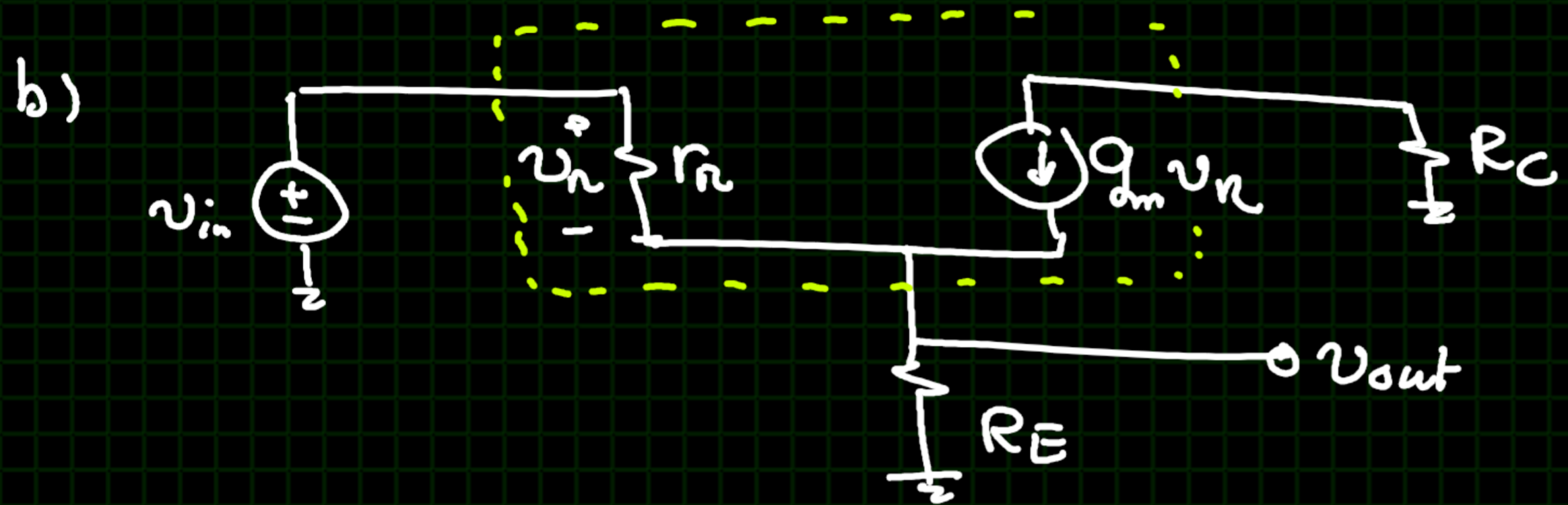
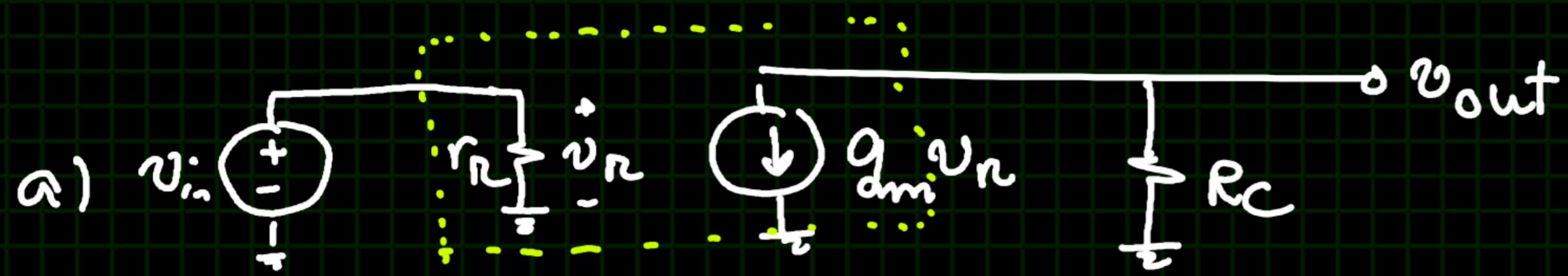


$$\frac{v_{th}}{v_x/20} = 20$$

$$\frac{v_x}{v_x/20} = 20 \Omega$$

به با انتقال شود.

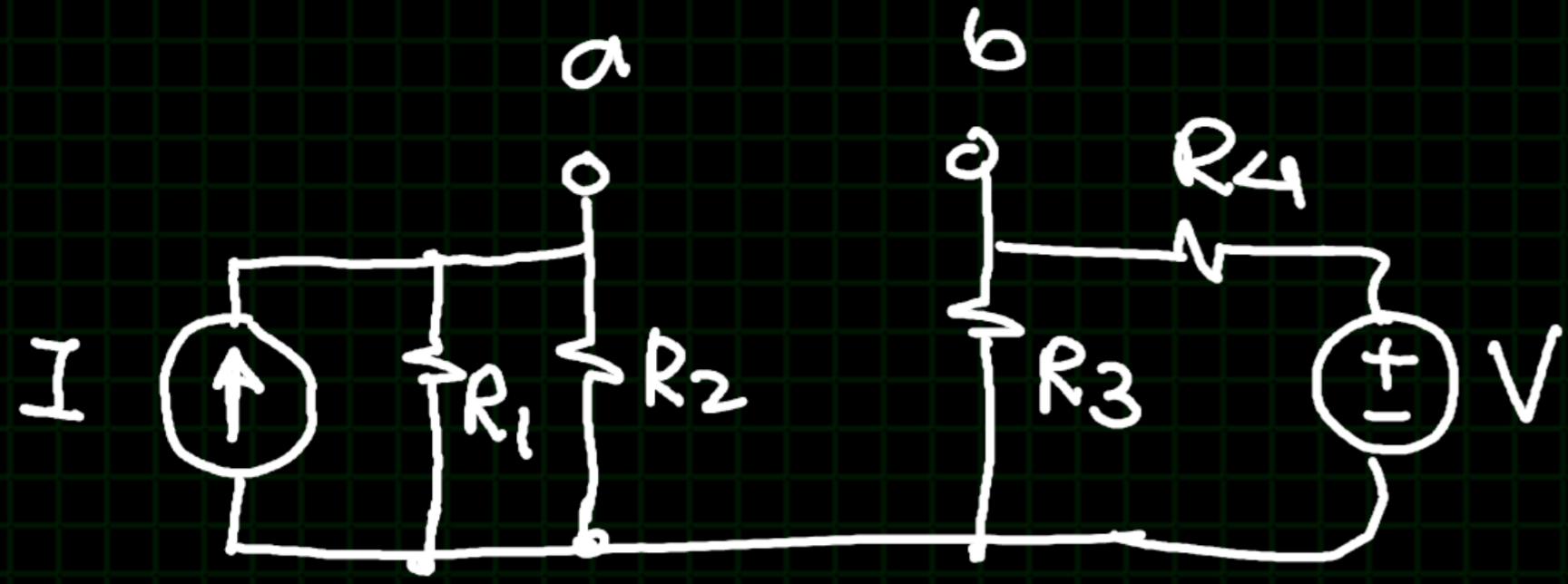
۴. مدارهای زیر را تقویت کننده، رالهورت، تقویت کننده ولتاژ-ولتاژ مدل کنید (R_{in} , A_{vo} , R_{out} بدست آورید)



الکترونیک ۱ - تمرین شماره ۵ - یادآوری درس مدله

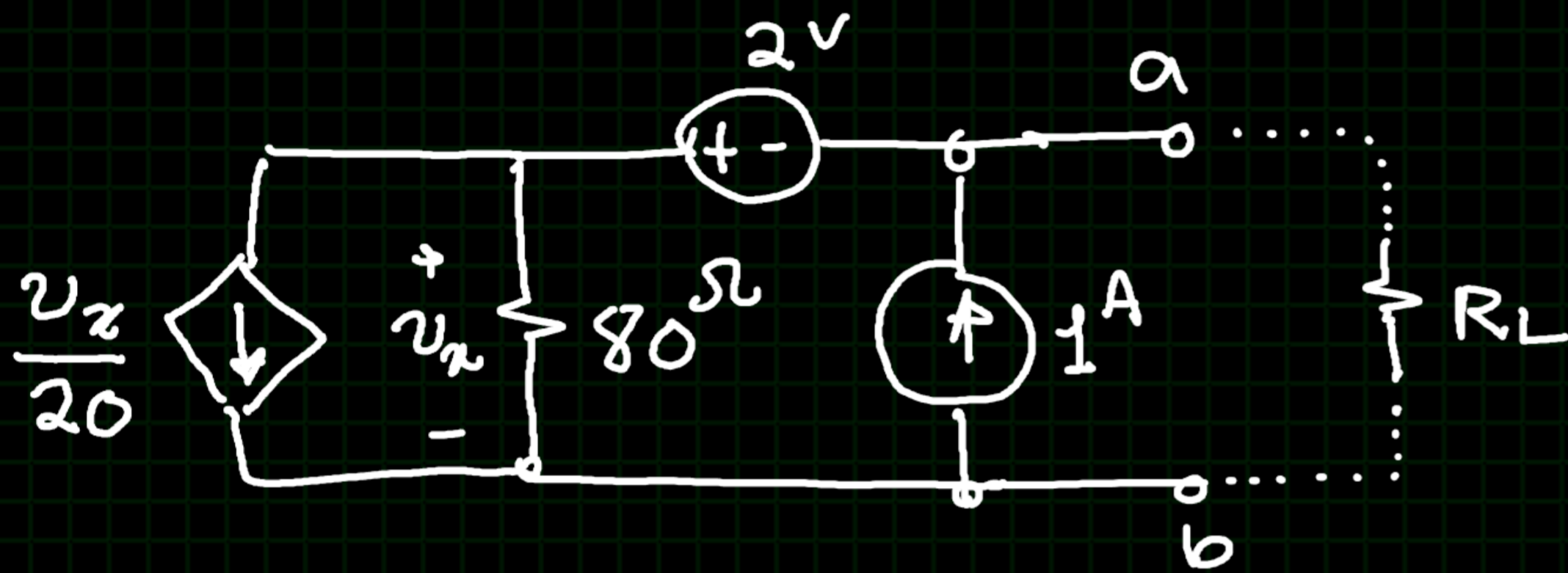
۱- معادل نون

۱- معادل نون در سبای a-b را بنامد



۲- در مدار وجود R_L را طوری تعیین کنید که ولتاژ

به بیشترین مقدار شود.



۳- V_x را با استفاده از جمع آثار (مانندشان دارن مراحل)

بدست آید

