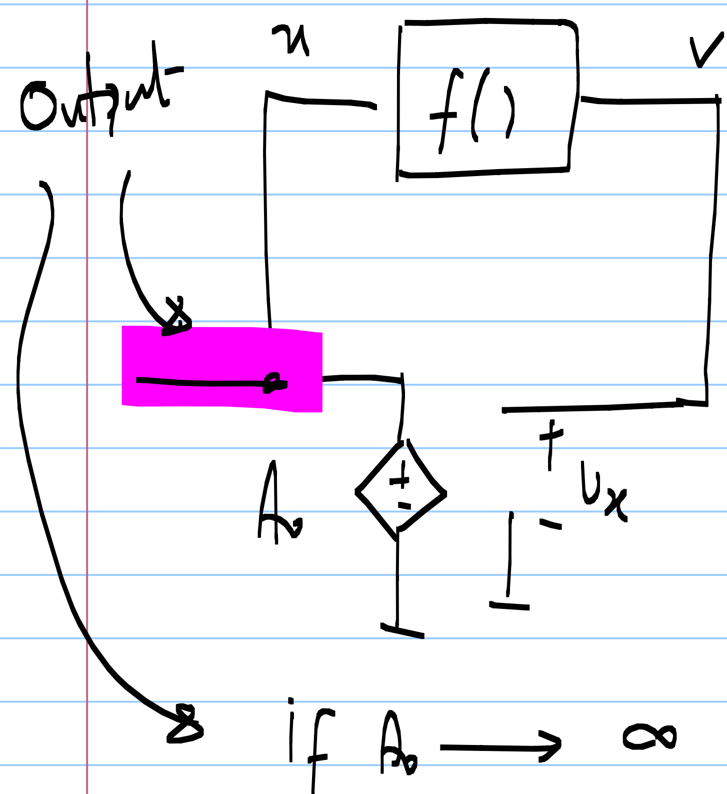
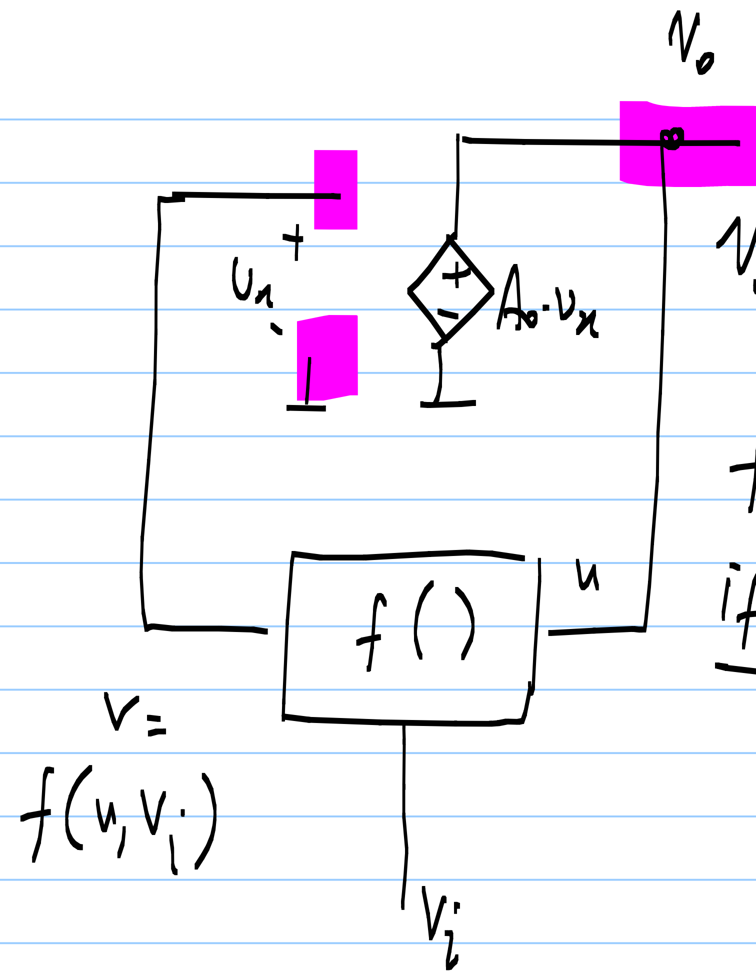
Lecture 19

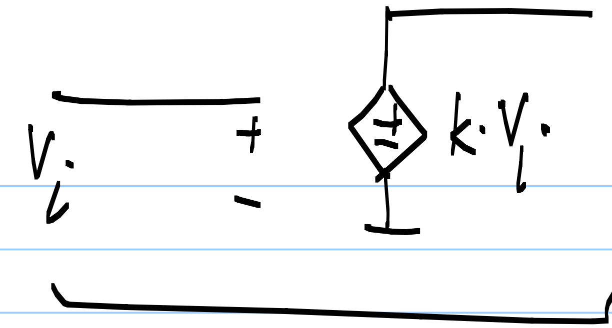




N_o : such that $f(u, v_i) = 0$ if $A_o \longrightarrow \infty$

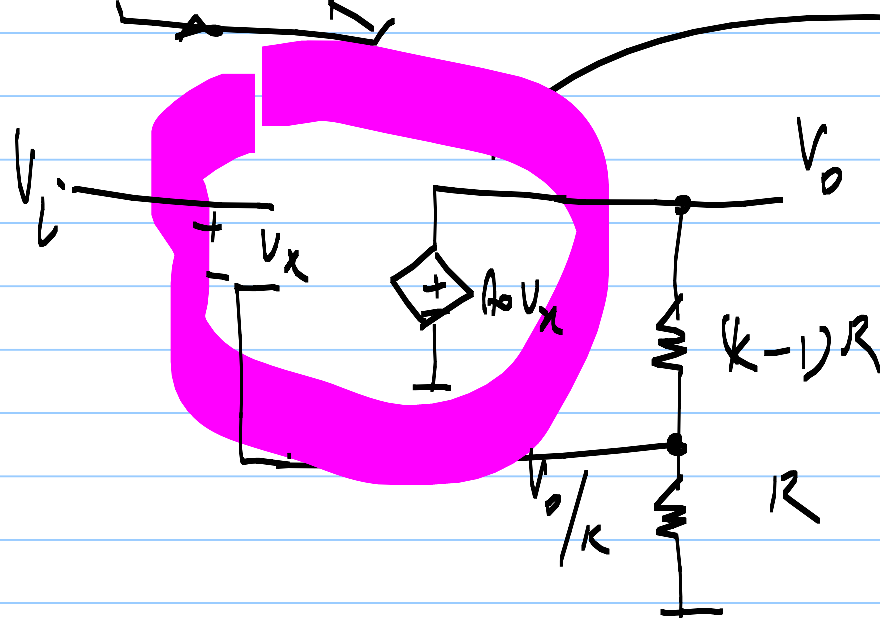
Amplifier:

$$V_o = k \cdot V_i$$

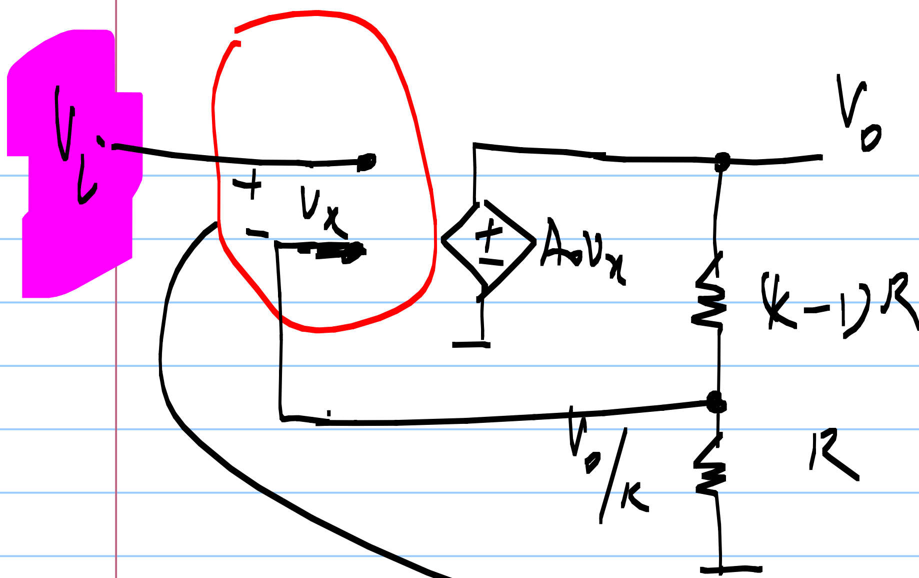


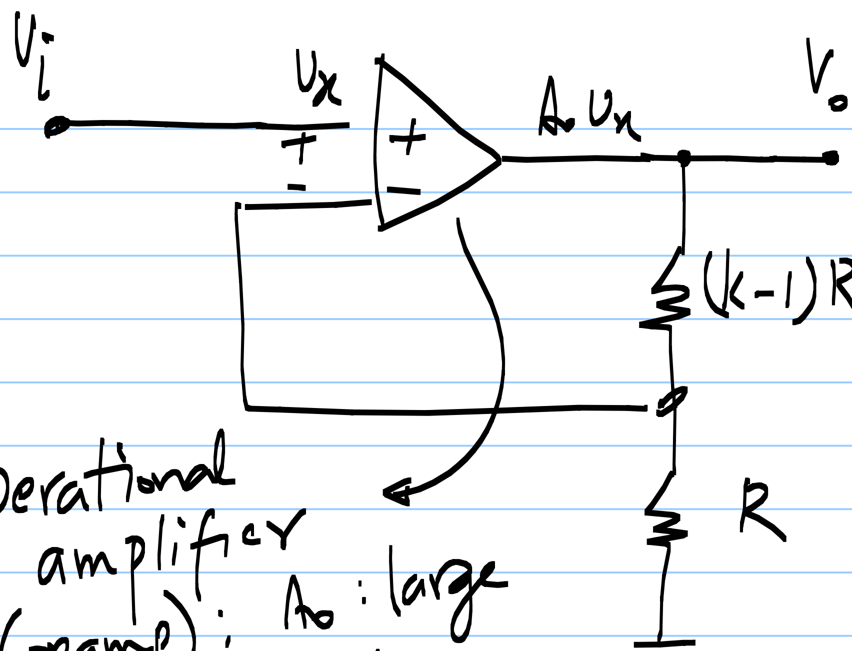
$$\frac{V_o}{k} - V_i = 0 \qquad V_o - kV_i = 0$$

$$V_i - \frac{V_o}{k} = 0$$



$$\frac{V_o}{V_i} = \frac{k}{1 + \left(\frac{k}{A_o}\right)}$$





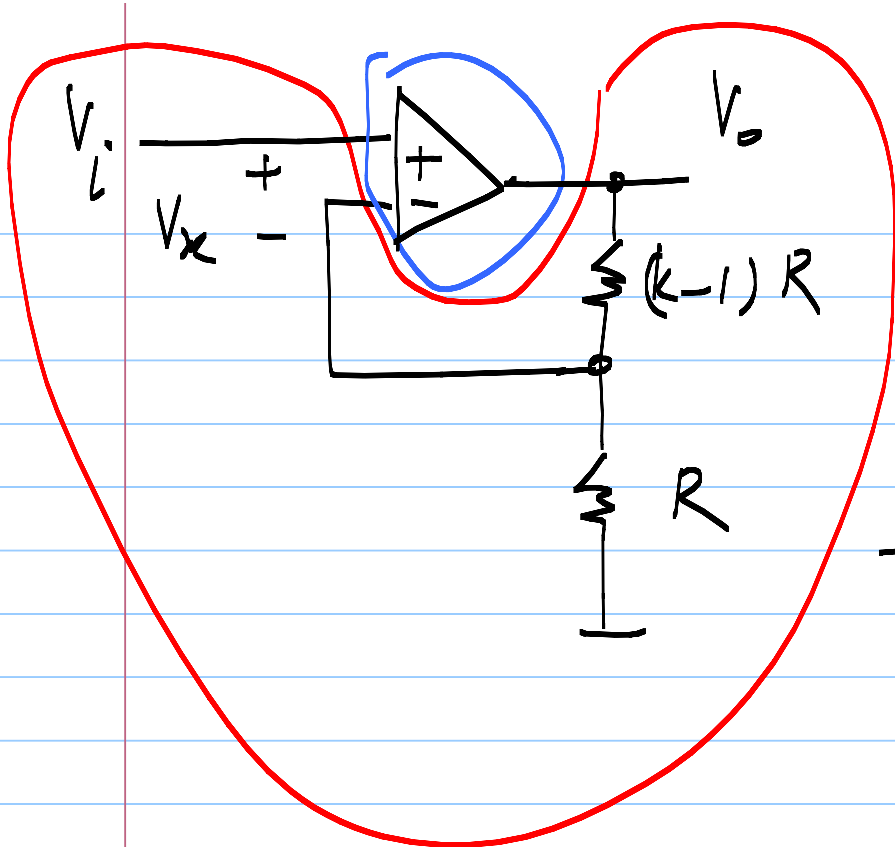
operational amplifier (opamp): A_o : large

$A_o \gg 1$

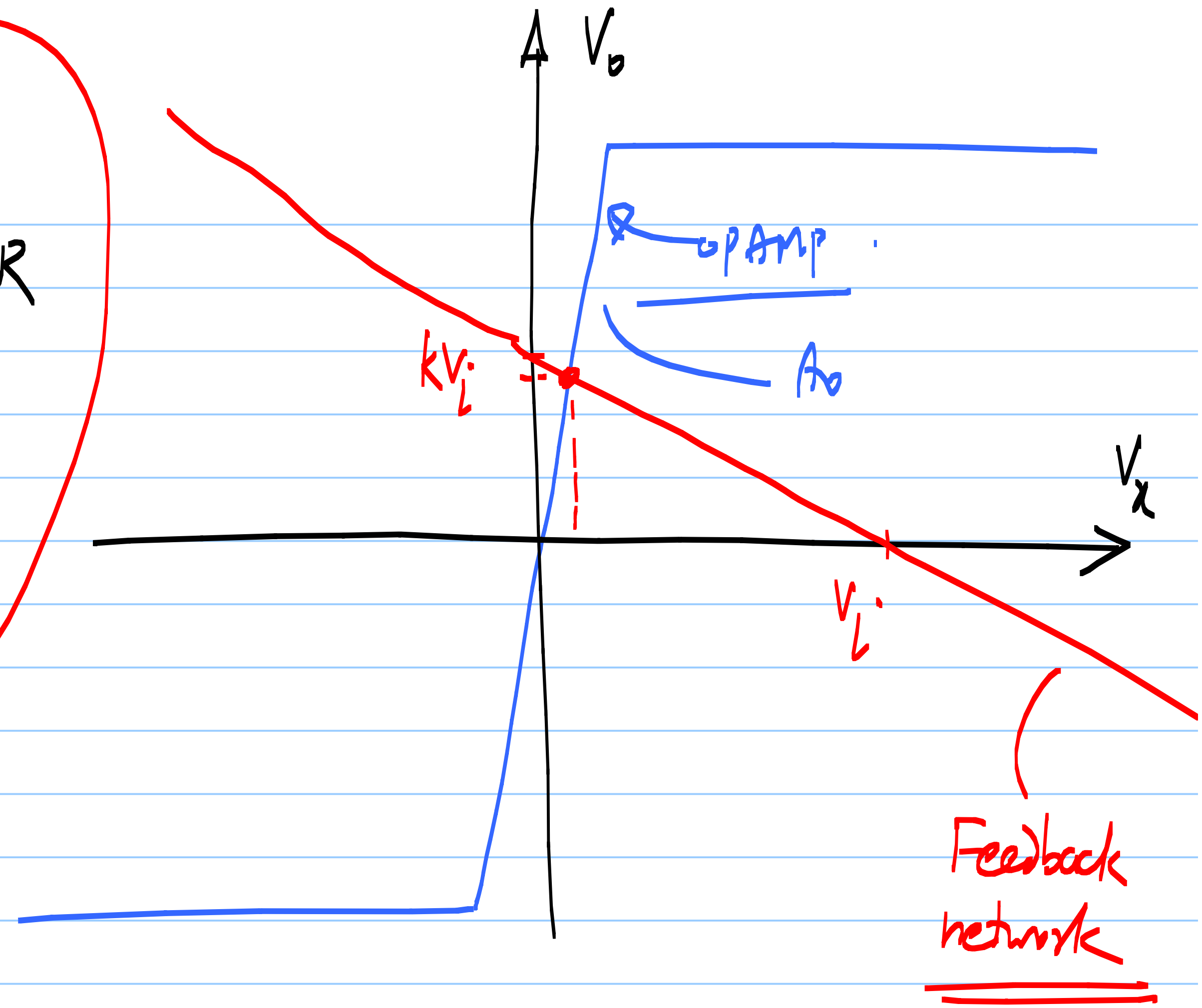
$$\frac{V_o}{V_i} = \frac{k}{1 - \frac{k}{A_o}}$$

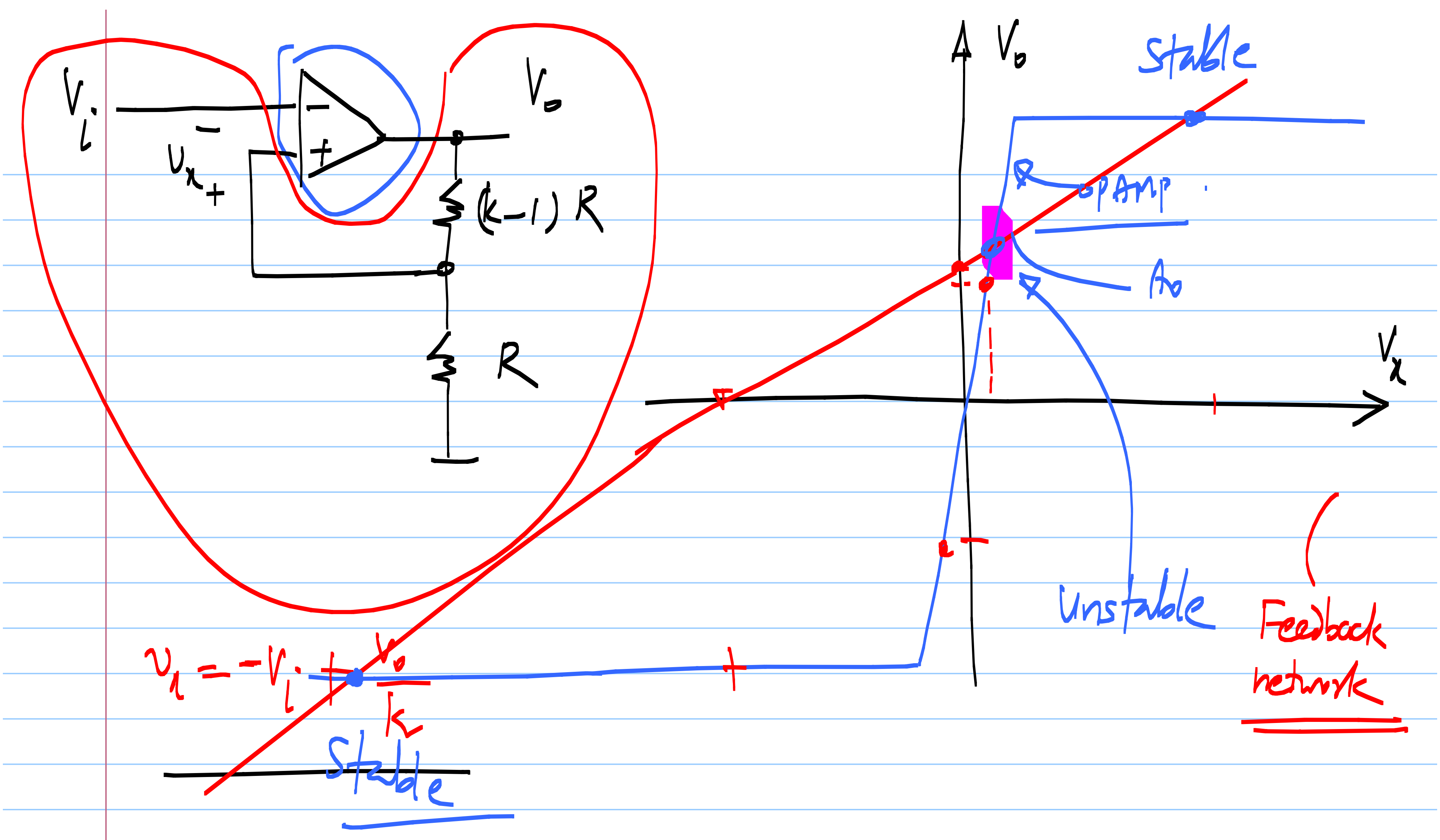
$$\left(V_i - \frac{V_o}{k}\right) = V_i - \frac{A_o \cdot v_x}{k}$$

$$V_i + \frac{A_o v_x}{k}$$

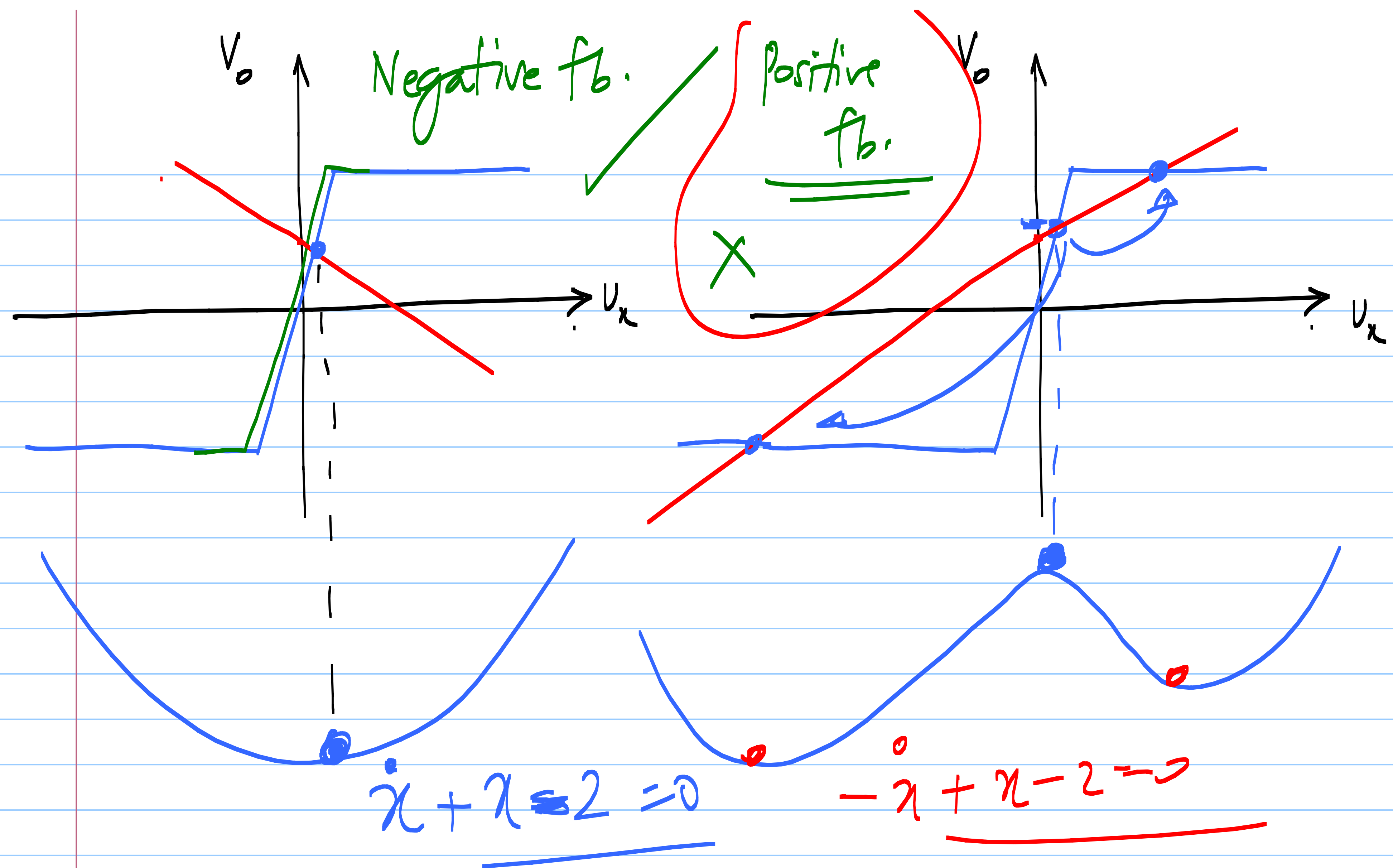


$$v_x = V_i - \frac{V_o}{k}$$





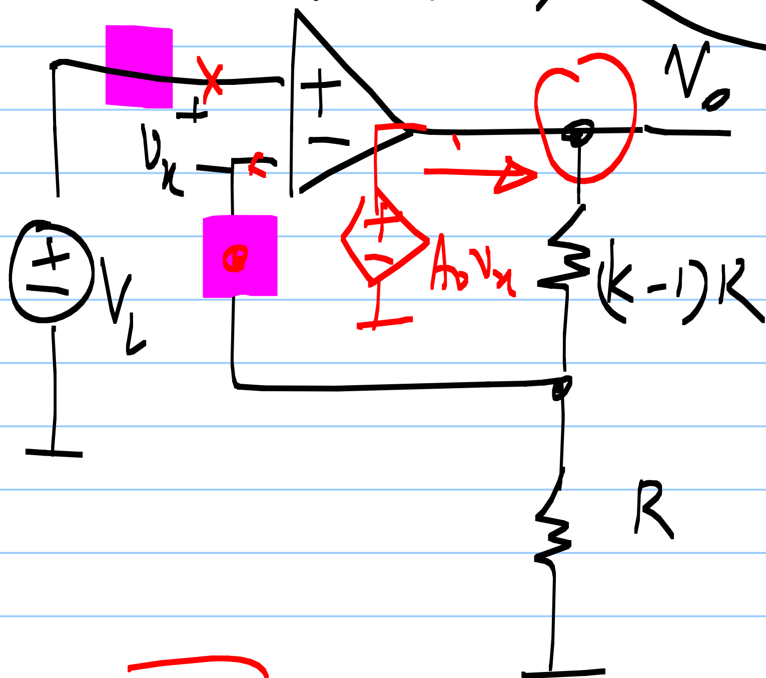
V_i
V_o
V_x
(k−1) R
R
Stable
OpAmp
Po
Unstable
Feedback network
$v_x = -V_i$
$\frac{v_o}{k}$
Stable



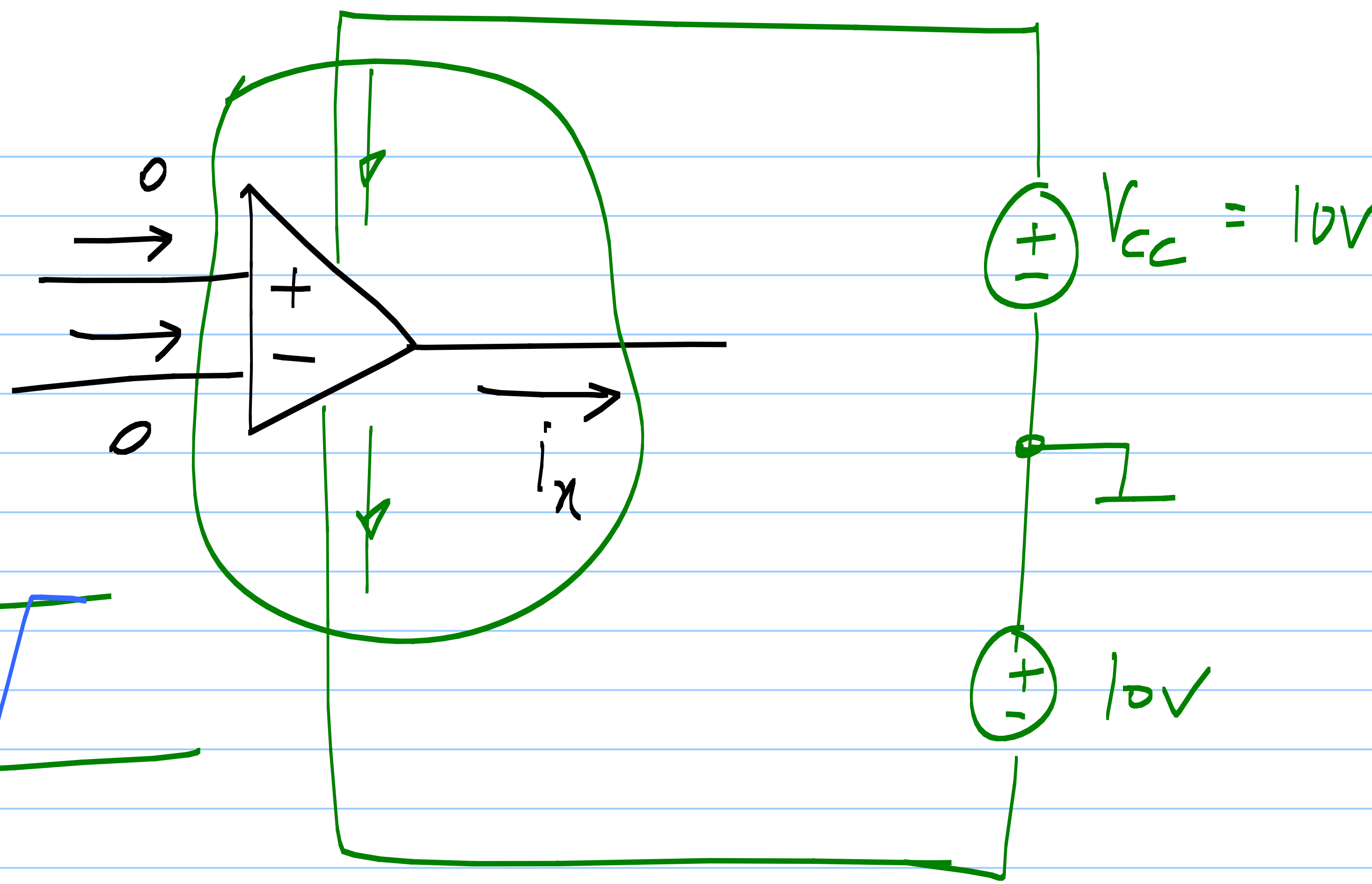
V_o
Negative fb.
V_x
Positive fb.
V_o
V_x
$\dot{x} + x - 2 = 0$
$-\dot{x} + x - 2 = 0$

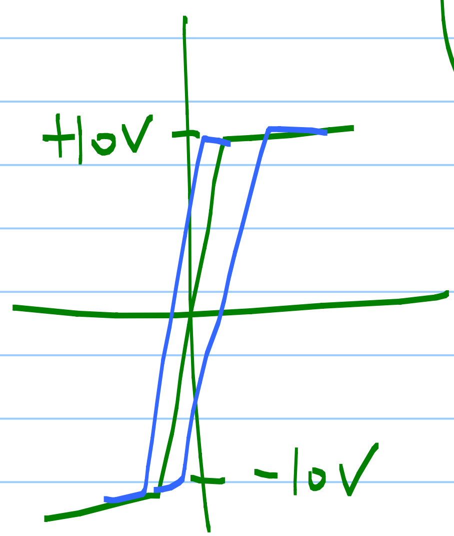
$(A_0 \to \infty)$ ideal opamp $\Rightarrow$ $v_x = 0$

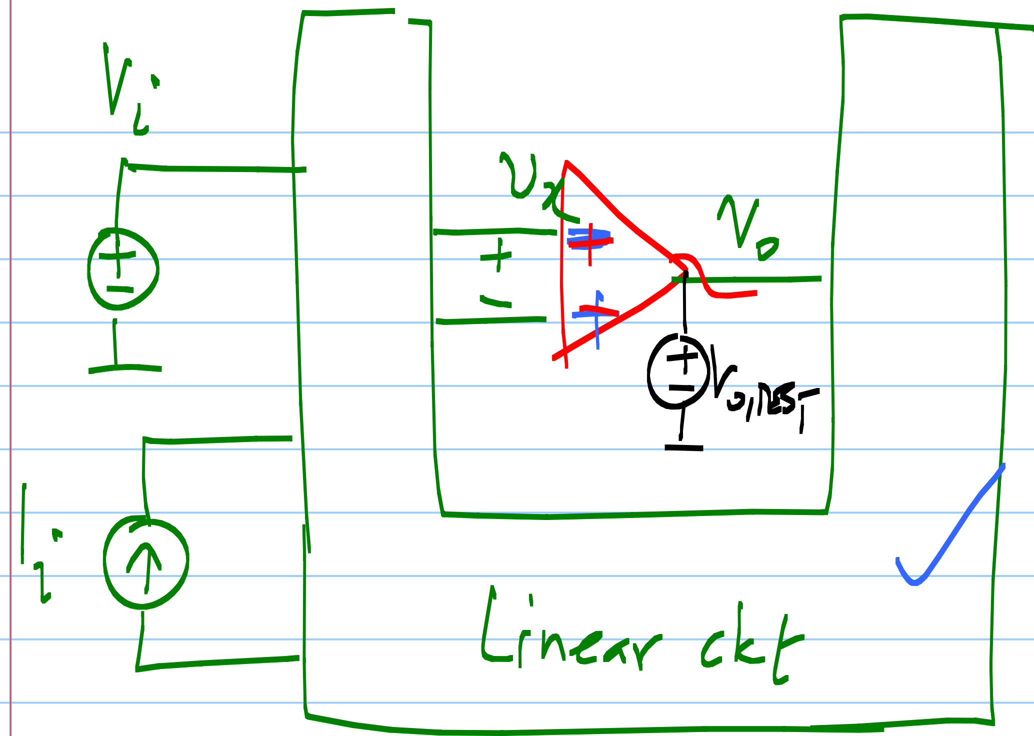
Virtual short



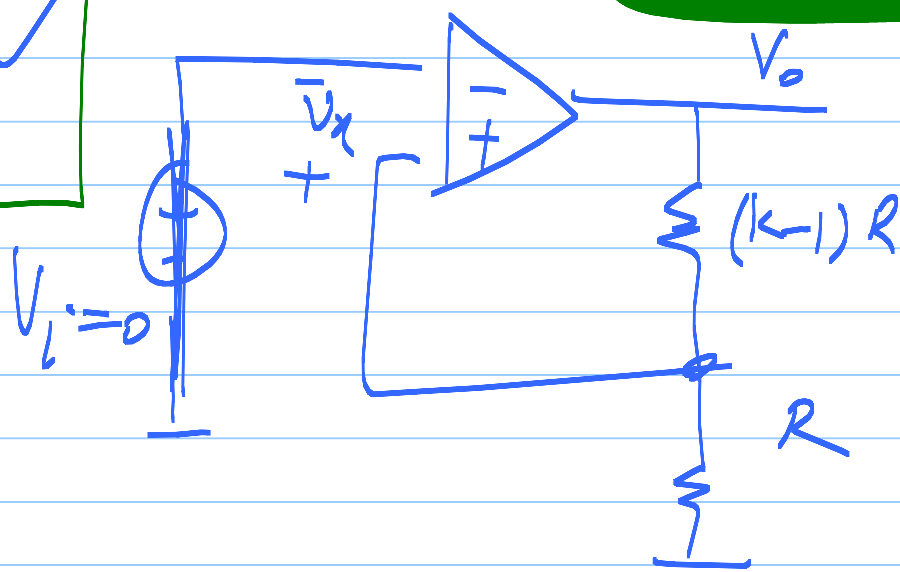
ONLY IF THERE IS −VE FB


0
+
−
0
i_x
V_{cc} = 10V
+
−
10V


+10V
−10V

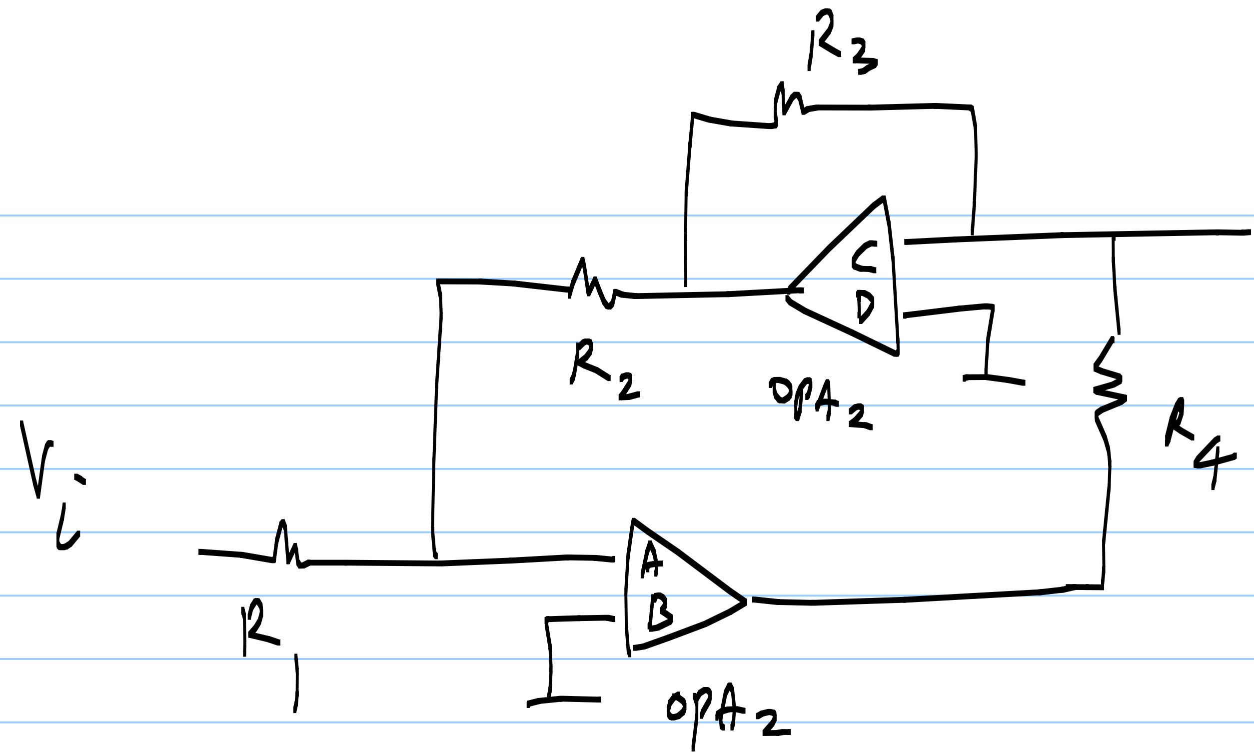


$$v_x = \alpha \cdot V_{o,TEST} + \beta V_i + \gamma \cdot I_i$$



$$v_x = \frac{V_o}{k} - V_i \quad \times$$

$$v_x = V_o/k$$



V_i
R_1
R_2
R_3
R_4
A
B
C
D
OPA2
OPA2