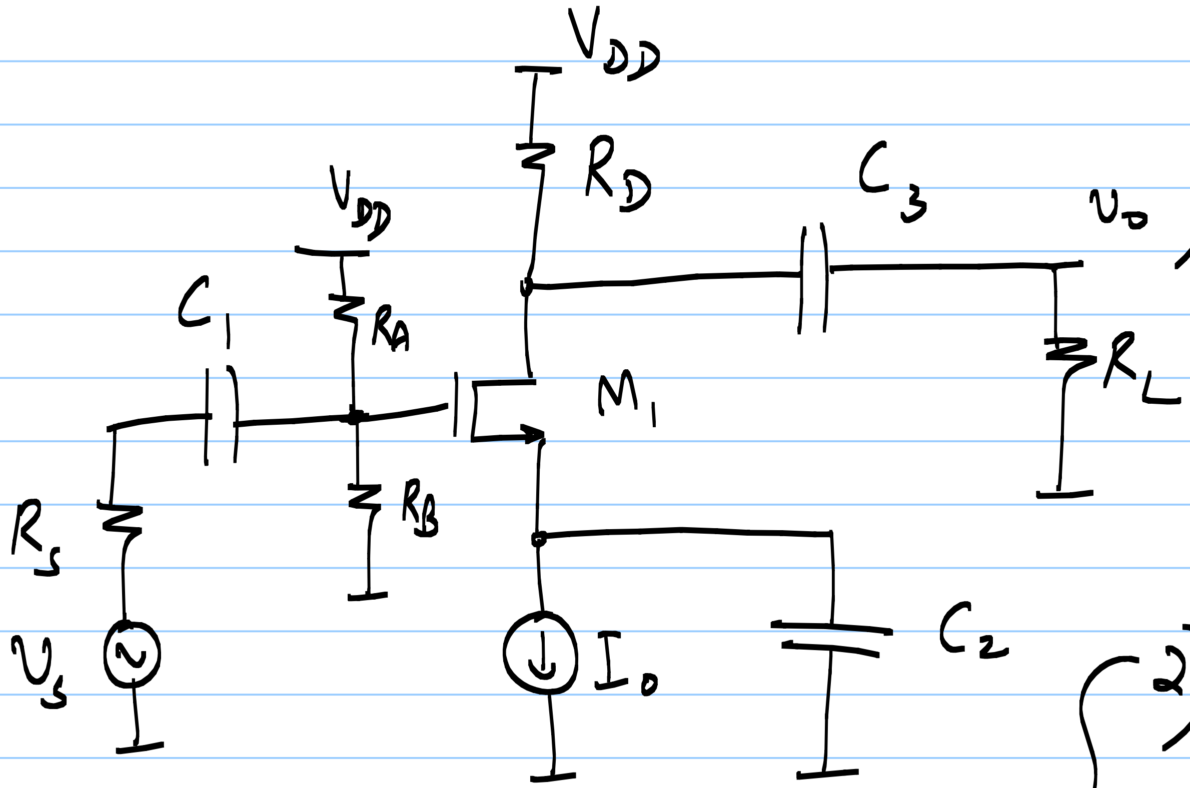
3/9/20

Lecture 18

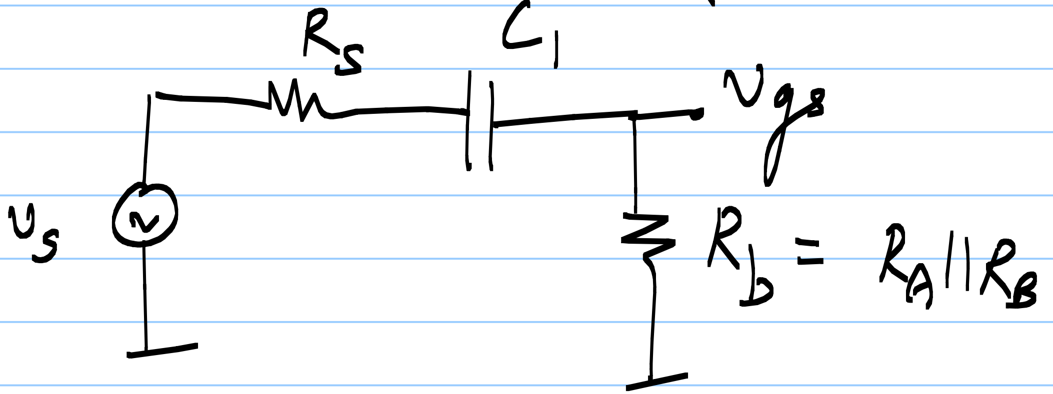


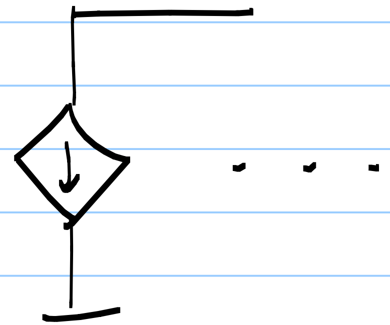
So far: $C_1, C_2, C_3 = \infty$

1) Choose C_1 based on ac resistance @ freq. of operation
⇒ small ac resistance

2) Eg. @ input, you have HPF → plot Bode curves & choose based on freq. response ✓

SS eq. ckt. @ input: (assume $C_2 = \infty$, $C_3 = \infty$)





Want $\rightarrow |v_{gs}| = |v_s|$ $(R_b \gg R_s)$

$\rightarrow |v_o| = g_m(R_D \| R_L) \cdot |v_s|$

$$v_{gs} = \frac{R_b \cdot v_s}{R_s + R_b + \frac{1}{j\omega C_1}} = \frac{j\omega C_1 R_b}{1 + j\omega C_1 (R_s + R_b)} \cdot v_s$$

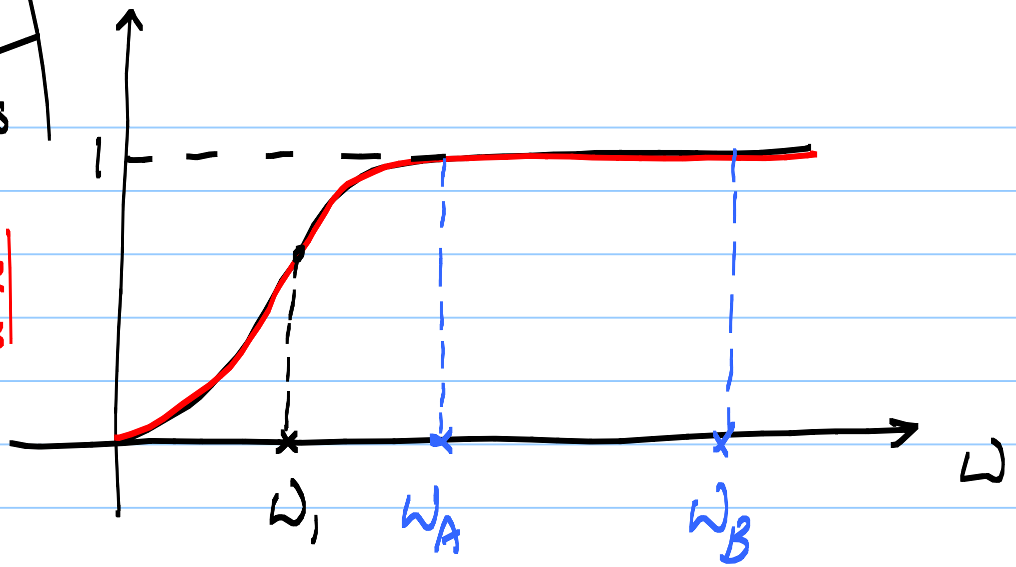
Plot $\left| \frac{v_{gs}}{v_s} \right|$

for C_1: $\left|\frac{v_{gs}}{v_s}\right|$

$\frac{1}{g_m(R_D||R_L||r_{ds})} \cdot \left|\frac{v_o}{v_s}\right|$

for C_3:

for C_2: HW3



ω_1 = −3 dB freq of HPF $\{C_1$ & $R_S + R_b\}$

* choose $\omega_1 \ll \omega_A$ e.g. $\omega_1 = \frac{1}{10}\omega_A$ or $\frac{1}{20}\omega_A$ etc.

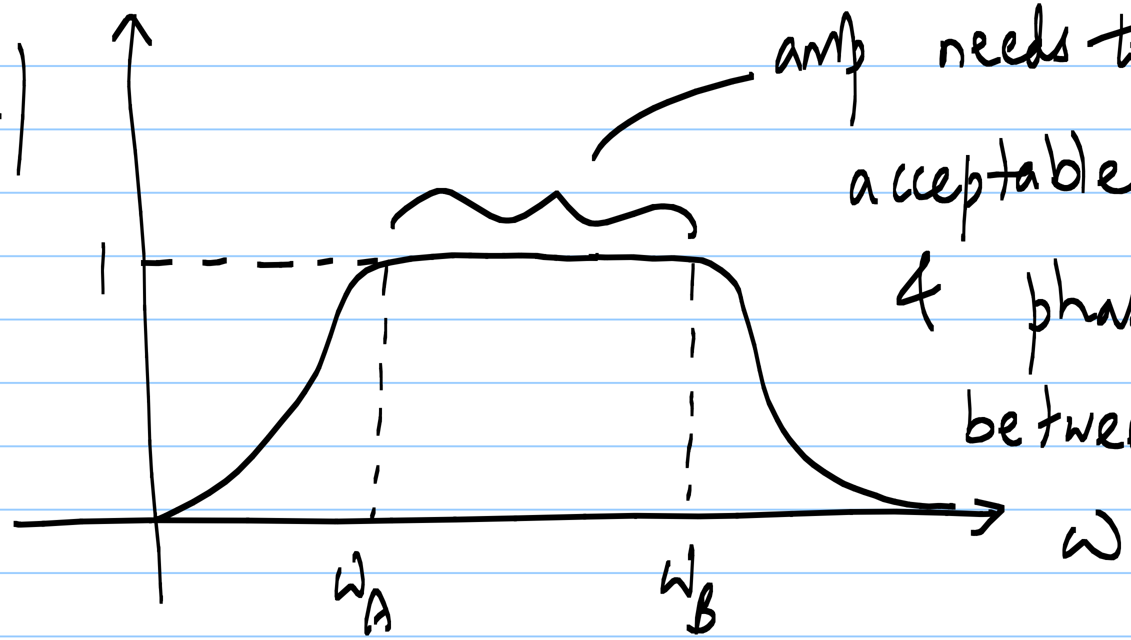
* pole for C_3 depends on R_D, R_L & r_{ds}

r_{ds} − $f(\lambda, I_D)$

λ − $f(L)$

* pole for C_2 depends on ? HW3

$$\frac{1}{g_m(R_D \| R_L \| r_{ds})} \cdot \left| \frac{v_o}{v_s} \right|$$



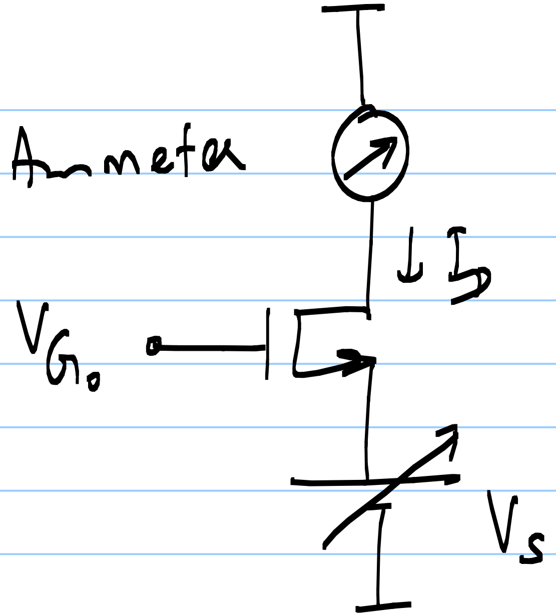
amp needs to have acceptable magnitude & phase response between ω_A & ω_B

Bias stab.

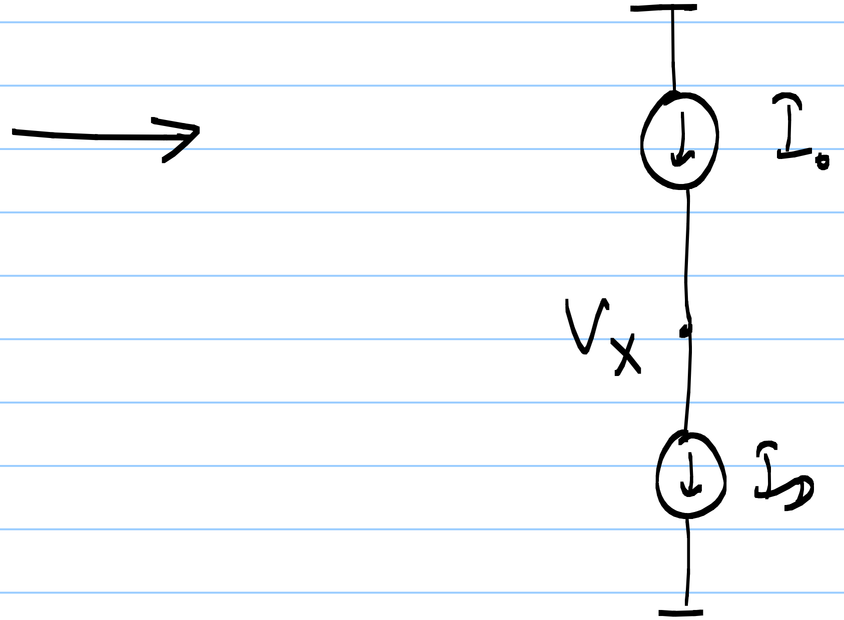
case 1 : Measure I_D, f.b. to V_G

case 2 : Measure I_S, f.b. to V_S

case 3 : Measure I_D, f.b. to V_S



tune V_s so that $I_D = I_0$



$I_0 < I_D$: $V_x \downarrow$

$I_0 > I_D$: $V_x \uparrow$

$I_0 = I_D$: $V_x \leftrightarrow$

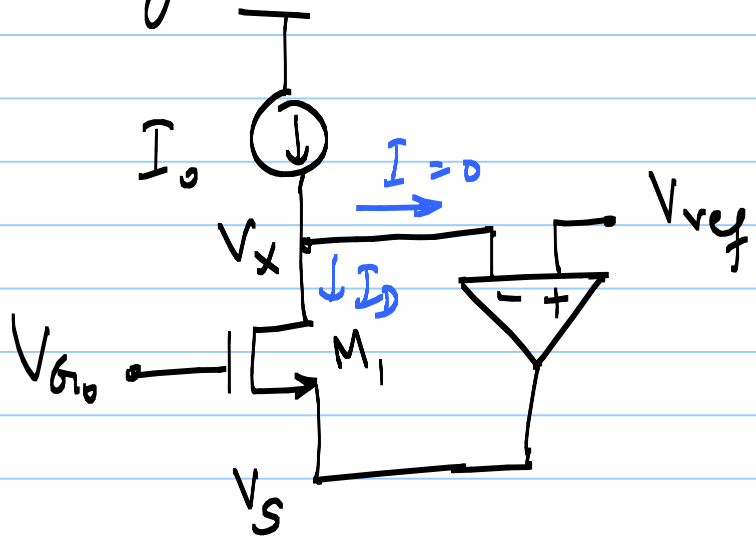
e.g. $I_0 < I_D$: $V_x \downarrow$

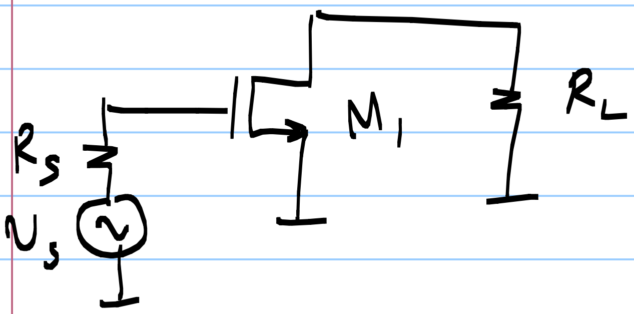
We want to $\downarrow V_{GS} \Rightarrow \uparrow V_s$ } change in direction of control

||

inversion in polarity of f.b.

DC biasing for case 3:



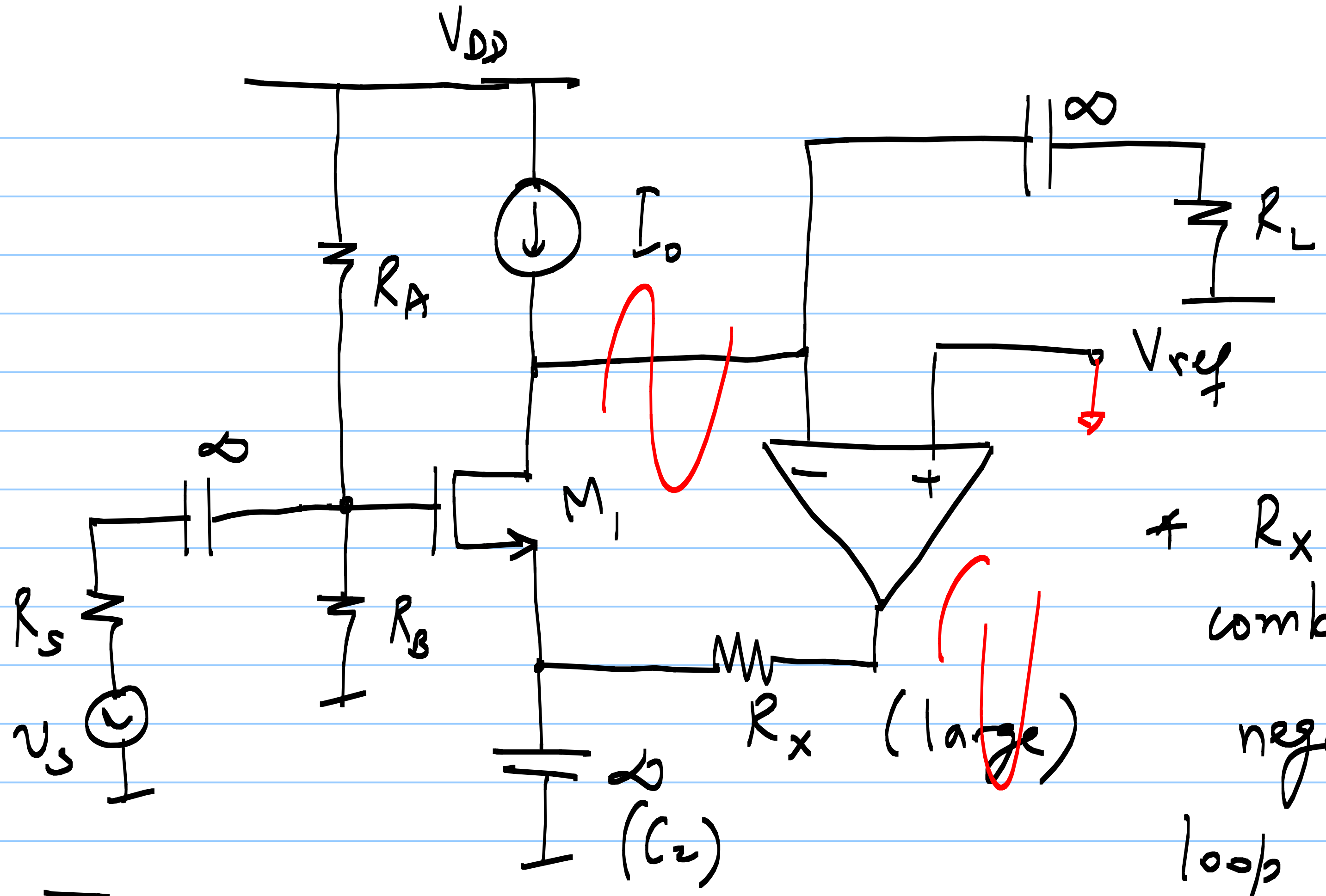


no opamp

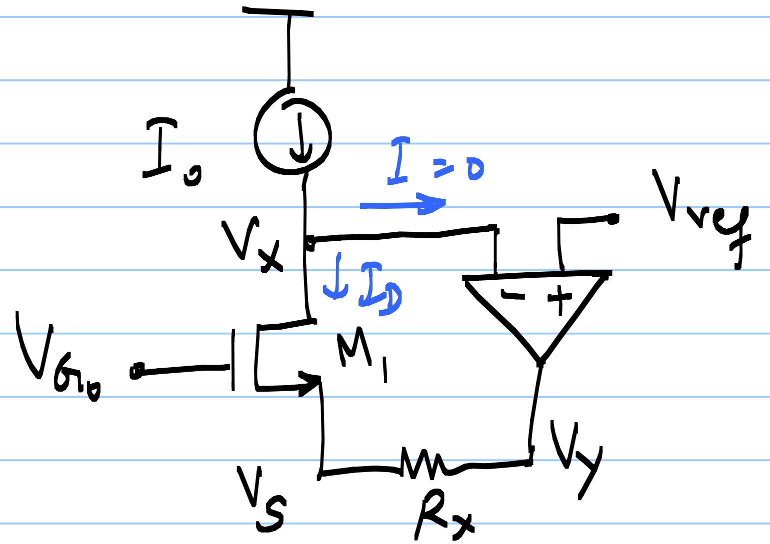
Ideal

* opamp changes V_S to a value so that $V_X = V_{ref}$ in steady state
* $V_S = V_{G_o} - V_{GS}\big|_{I_o}$
* opamp only for DC stab.
* V_{ref} chosen so that M_1 is biased in sat.

$$V_{ref} \geq V_{G_o} - V_T$$

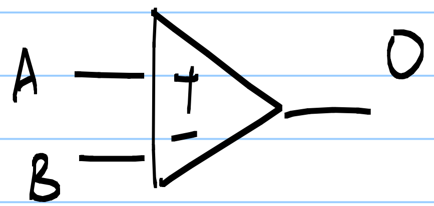


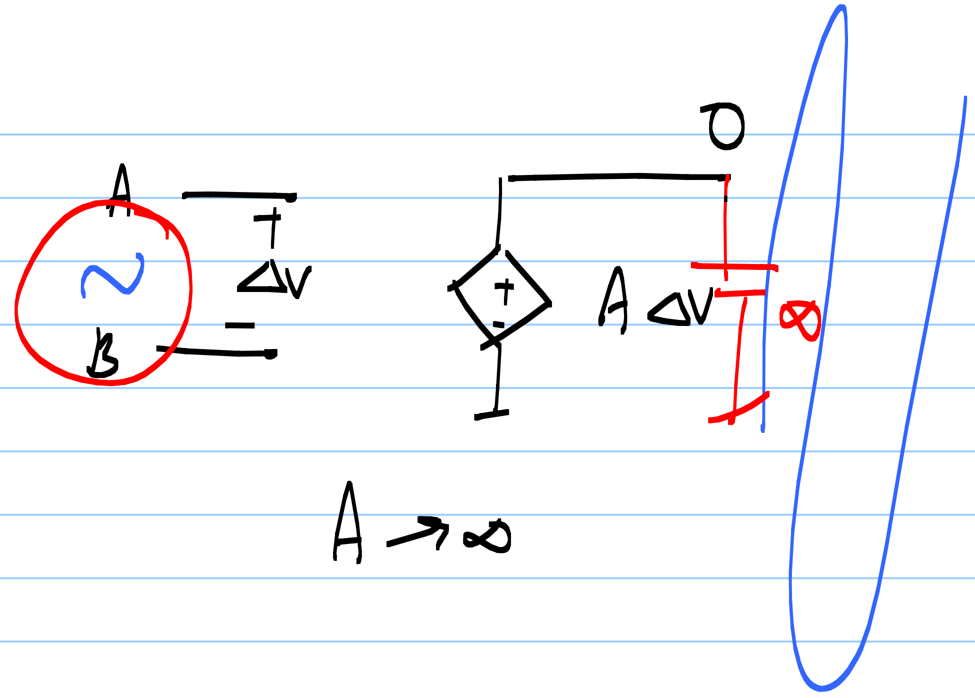
+ R_x + C_2 combo break negative f.b. loop for small signal operation



$$V_y = V_S - I_o R_x$$

as $R_x \uparrow$, $V_y \downarrow$


A
B
+
−
O


A
B
+
ΔV
−
O
A ΔV
∞
A → ∞