Advantages of Instrumentation Amp

1) $G_D = 1 + \frac{R_1}{R_2}$

$G_{cm} = 1$ if $\frac{R_1}{R_2} >> 1$

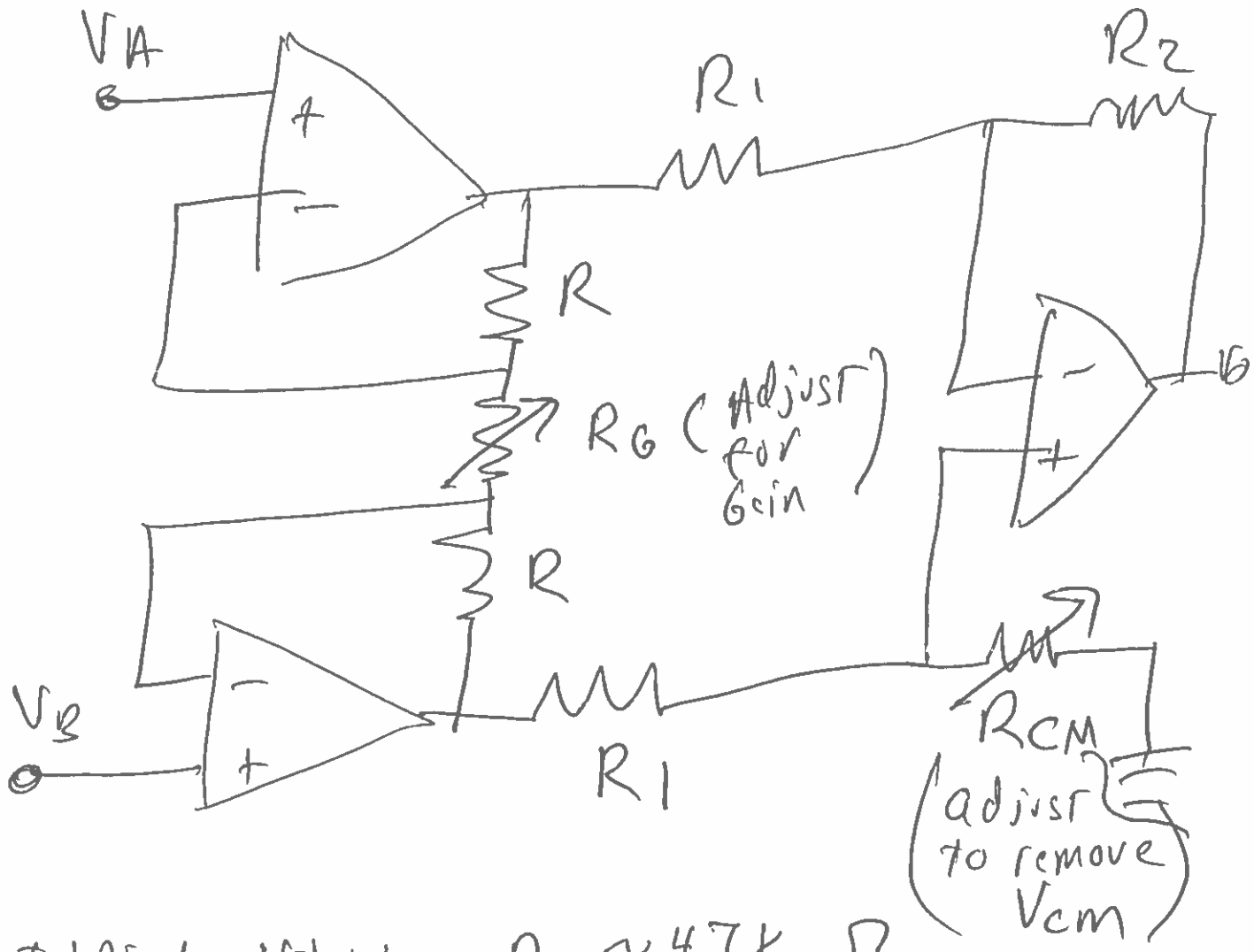
$G_D >> G_{cm}$

$\Rightarrow$ CMRR will be Good

CMRR is independent of internal resistances which normal difference Amplifier is not.

Using modified voltage follower before difference Amp in the instrumentation Amp creates large impedances for input voltages keeping ideal OP Amp Behavior.

Finally Resistor matching not so critical!



Typical Values $R \sim 47K\Omega$

$R_G \sim 10\,K\Omega$ Variable

$R_1 \sim 470\Omega$

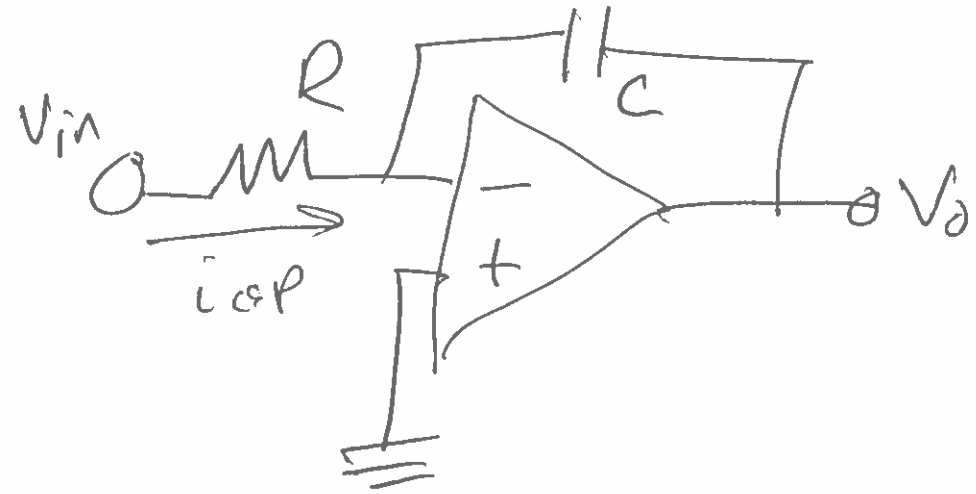
$R_2 \sim 4.7K\Omega$

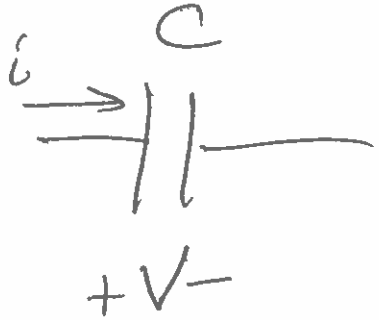
$R_{cm} \sim 10K\Omega$ Variable

Short $V_A - V_B$

Adjust R_{cm} TO

Get $V_o = 0$.





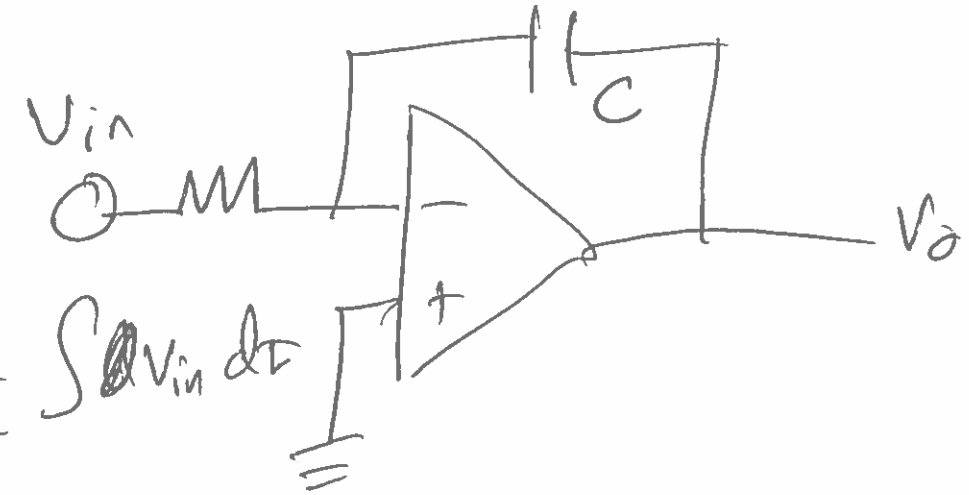
$$i_{cap} = \frac{dQ}{dt} = \frac{d(CV)}{dt}$$

~~$$i_{cap} = C \frac{dV_{out}}{dt}$$~~

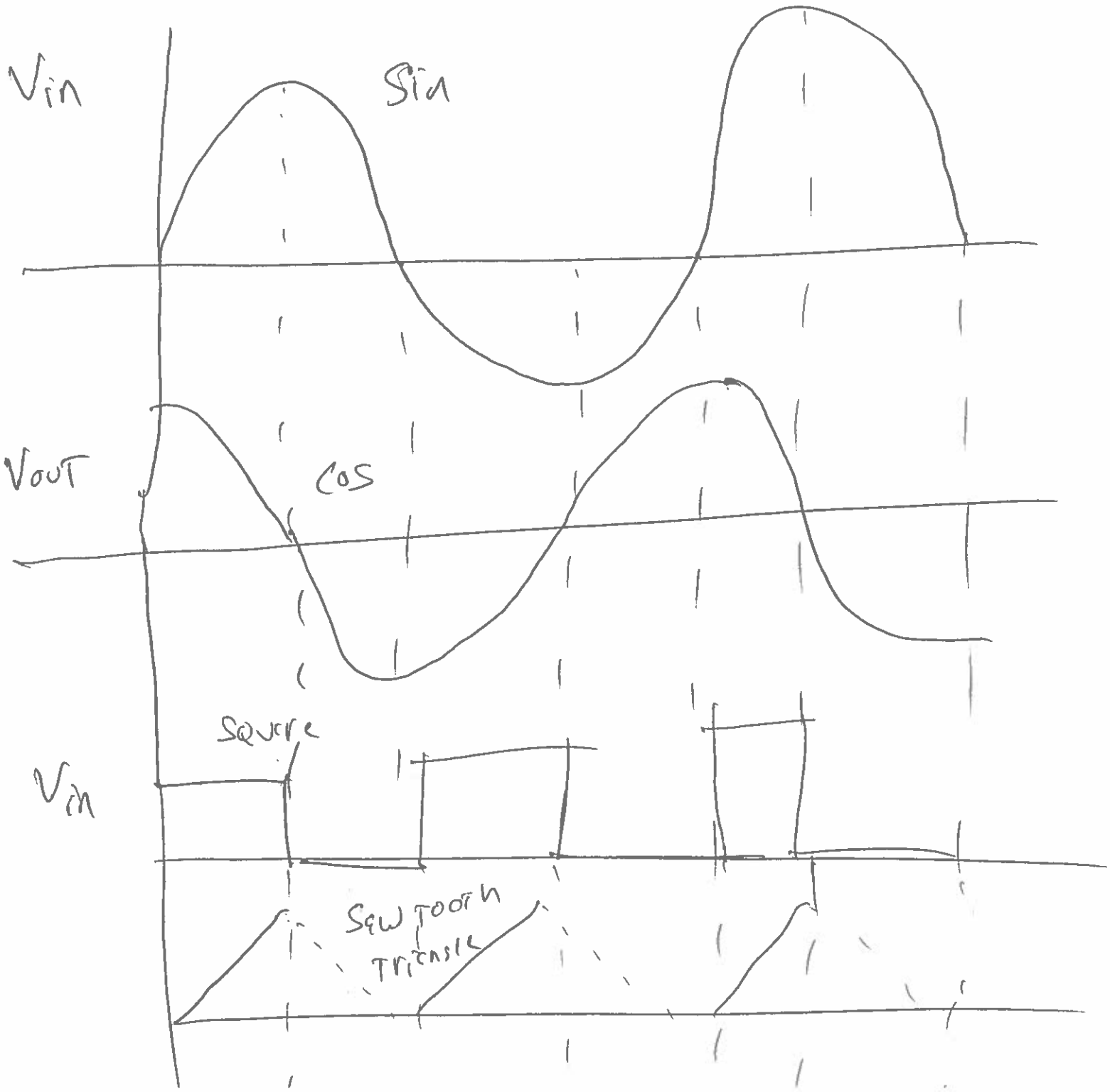
$$i_{cap} = C \frac{d}{dt}(-V_{out}) = \frac{V_{in} - 0}{R}$$

$$\frac{d}{dt} V_{out} = -\frac{1}{RC} V_{in}$$

$$V_{out} = -\frac{1}{RC} \int V_{in}\, dt \Rightarrow \text{Integrator}$$



$$V_{OUT} = \frac{-1}{RC} \int V_{in}\, dt$$



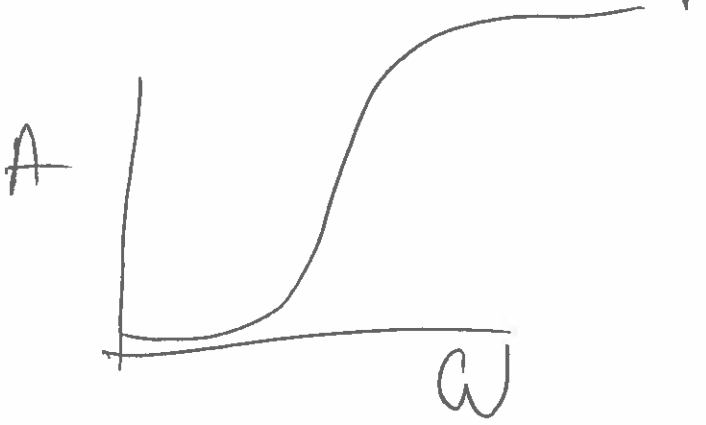
A capacitor accepts charge until the voltage across capacitor equals voltage trying to put charge onto capacitor.

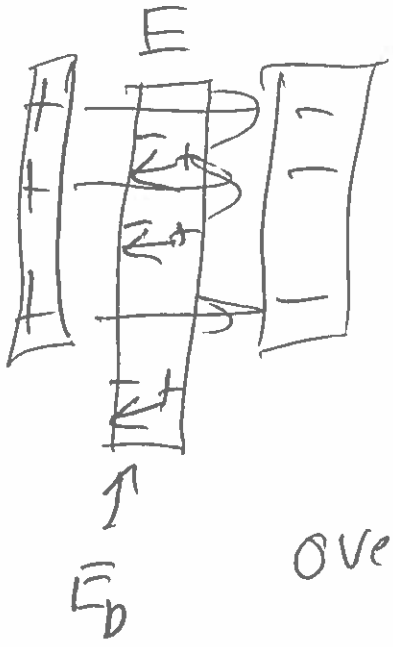
If voltage our side capacitor goes below voltage across capacitor, capacitor gives up the charge.

Low frequency will lead to periods of stasis. (unchanging)

$\Rightarrow$ This circuit passes high frequency signals $\Rightarrow$ high pass filter.

$$\omega = \frac{1}{\sqrt{LC}}$$





overall $E \downarrow$ $\quad E \propto \frac{V}{d}$

for A.C. $\quad X_c = \frac{\sqrt{-1}}{\omega C} = \frac{i}{\omega C}$ = capacitive reactance

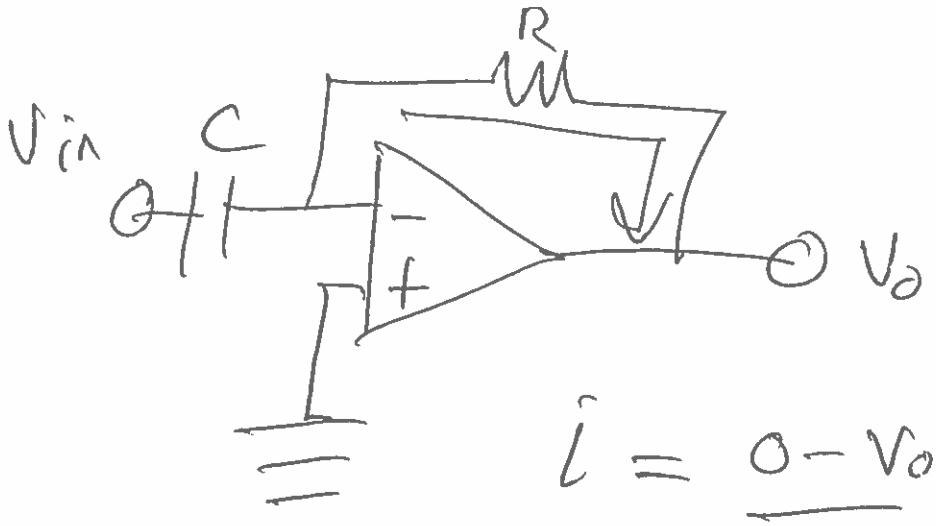
which is opposition to current flow

$$i = \frac{V}{X_c} = \omega C V$$

as $\omega \to 0 \quad i \to 0$

if $\omega \to \infty \quad i \to \infty$

$$Q = CV$$



$$i = \frac{0 - V_o}{R} = -\frac{V_o}{R}$$

$$i = \frac{dq}{dt} = c\frac{dV_{in}}{dt} = -\frac{V_o}{R}$$

$$V_o = -Rc\frac{dV_{in}}{dt}$$ Differentiator

and Low Pass filter