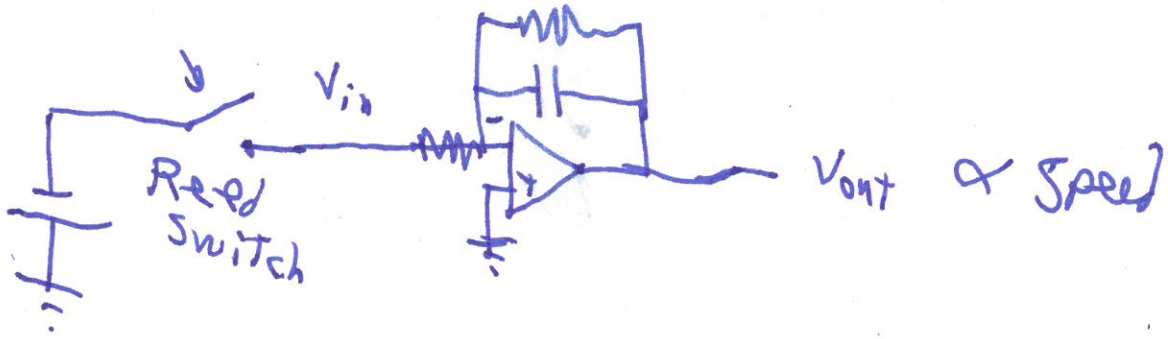
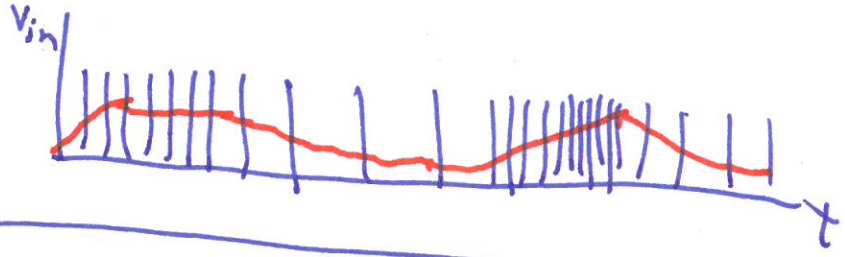
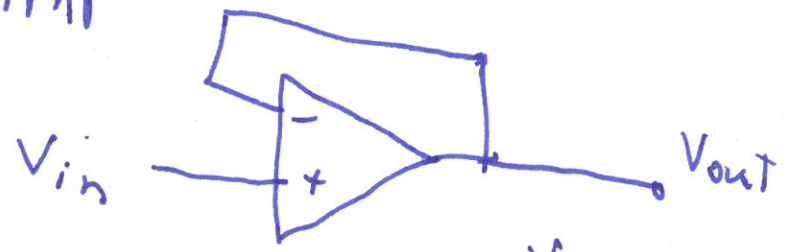




Buffer Amp



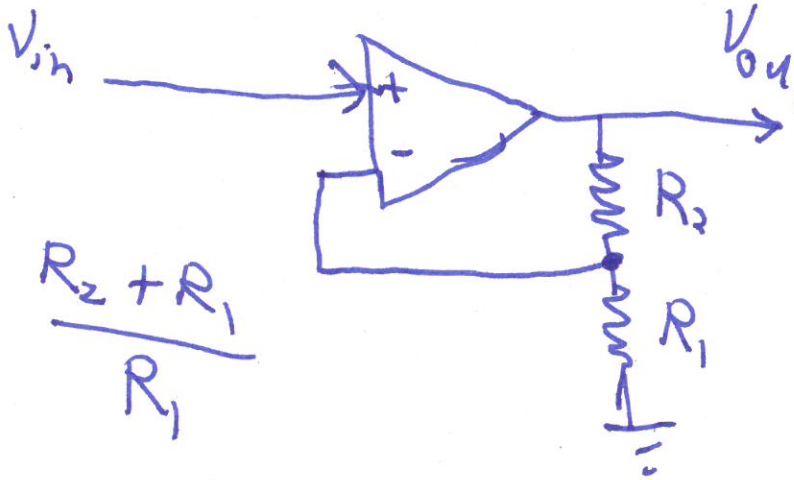
$A_v = 1$

$V_{out} = V_{in}$

$R_{in} \to \infty$

$R_{out} \to 0$

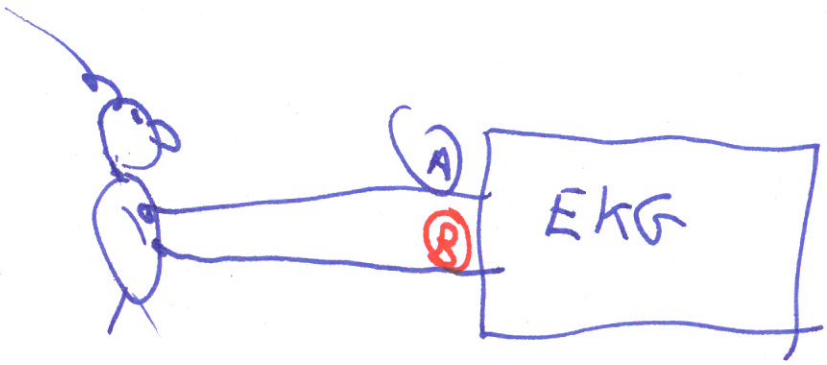
High impedance input

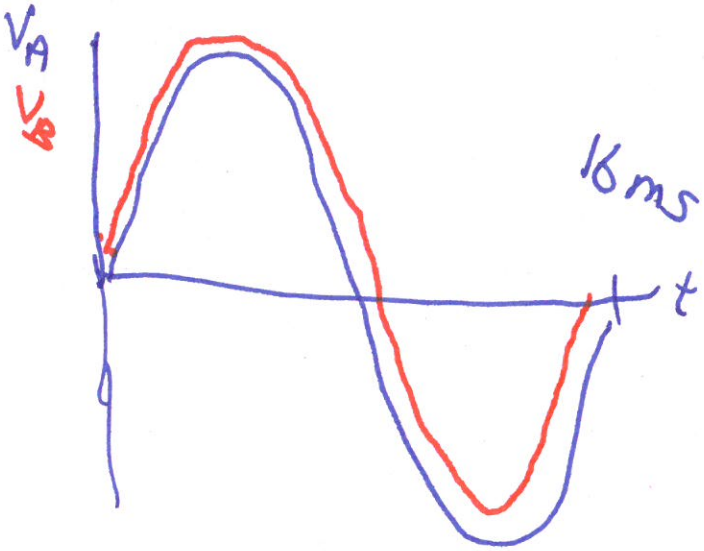


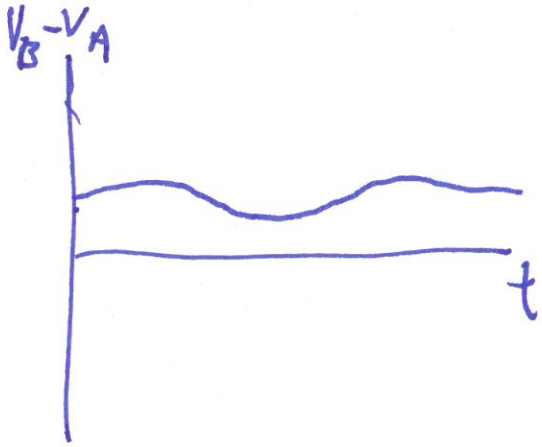
$$A_v = \frac{R_2 + R_1}{R_1}$$

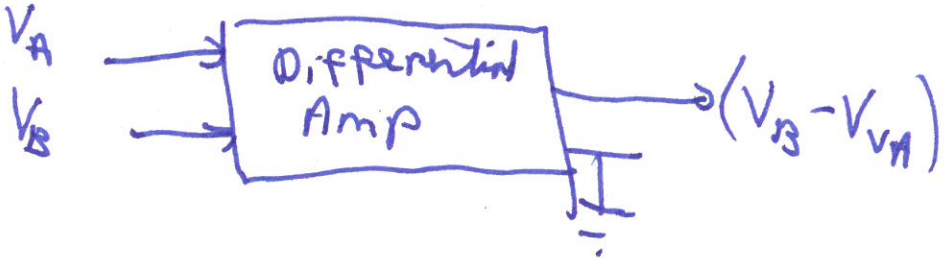
$R_{in} \to \infty$

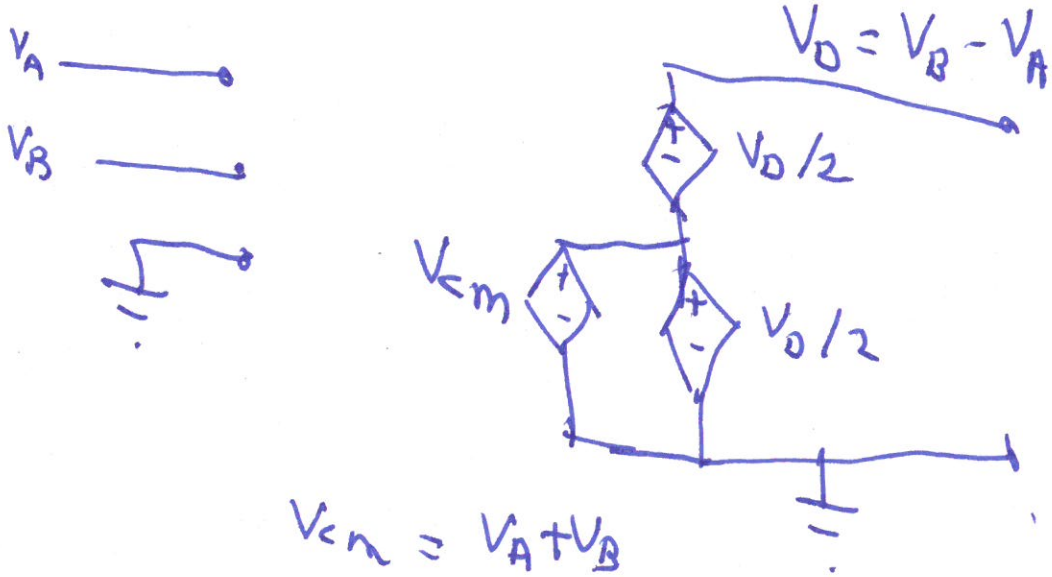
$R_{out} \to 0$











$$V_{cm} = \frac{V_A + V_B}{2}$$

$V_{cm(in)} = 100\,V$

$V_{D(in)} \approx 1\,mV$

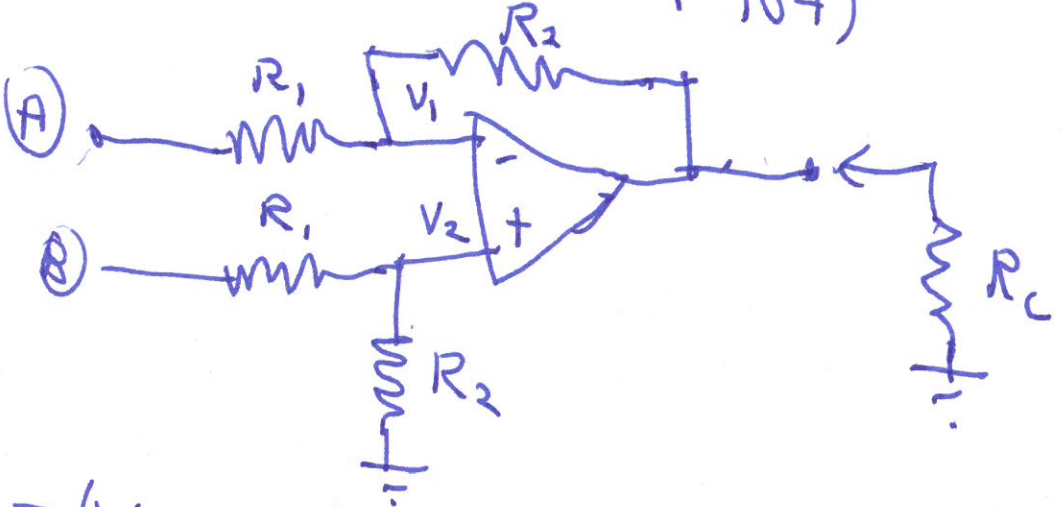
$A_{v\,cm} \leq 10^{-4} \rightarrow V_{cm\,out} = 10\,mV$

$A_{v\,D} = 1000 \rightarrow V_{D\,out} = 1\,Volt$

Common mode Rejection Ratio

$$CMRR = \left| \frac{A_D}{A_{vcm}} \right|^2$$

$$CMRR = 20 \log_{10}\left(\frac{1000}{10^{-4}}\right) = 140\,dB$$



$$V_1 = (V_{out} - V_A) \times \frac{R_1}{R_1 + R_2} + V_A$$

$$= V_A \frac{R_2}{R_1 + R_2} + V_{out} \frac{R_1}{R_1 + R_2}$$

$$V_{REF} = V_B \frac{R_2}{R_1+R_2}$$

$$V_{out} \frac{R}{R_1+R_2} + V_A \frac{R_2}{R_1+R_2} = V_2 \frac{R_2}{R_1+R_2}$$

$$V_{OUT} = \frac{V_B R_2 - V_A R_2}{R_1}$$

$$V_{out} = \frac{R_2}{R_1}(V_B - V_A)$$ Good Diff Amp.

Transfer function $A_v(f)$ Phasors

Phasor Notation

$$A_v = \frac{V_{out}}{V_{in}}$$ (complex)

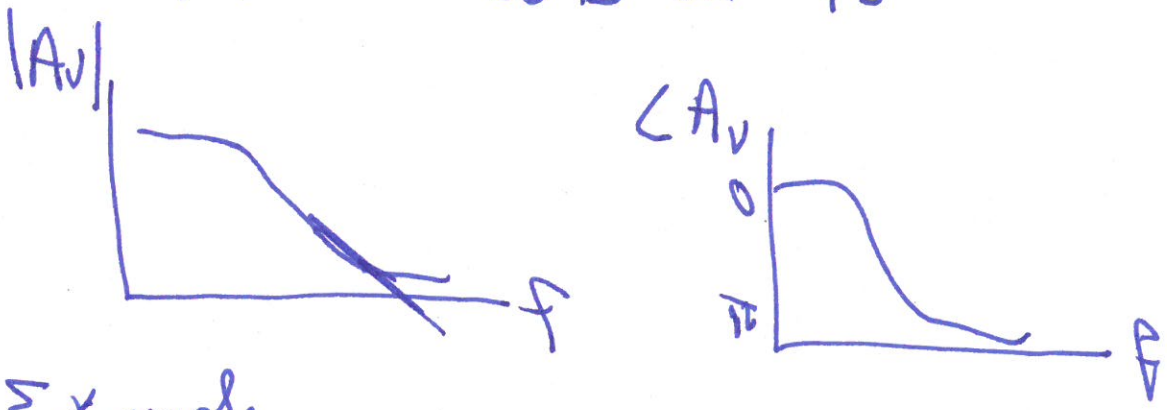
$v_i = 0.1\,V \cos(2000\pi t - 30^\circ)$ (radians, deg)

$V_{in} = 0.1\,V\angle -30^\circ$ or $0.1e^{j\pi/6}$

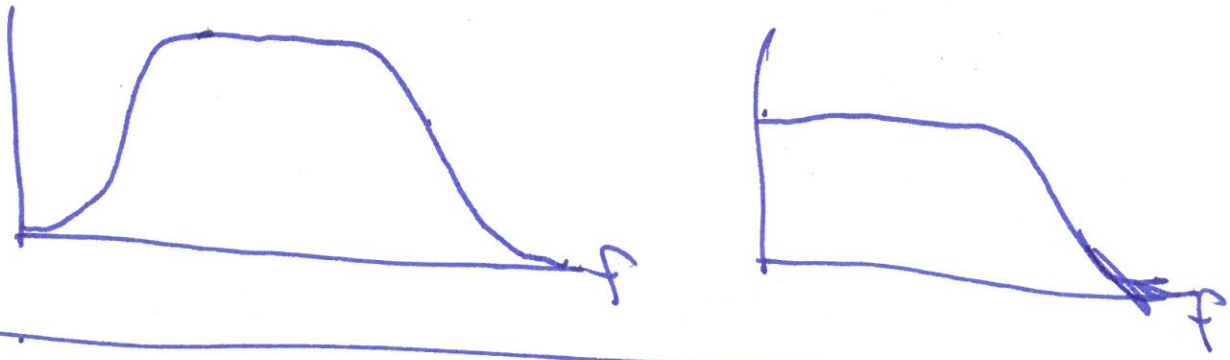
$V_{out} = 10V \angle 15^\circ$ or $10e^{j\pi/12}$

$A_v = 100 \angle 45^\circ$ or $100e^{j\pi/4}$

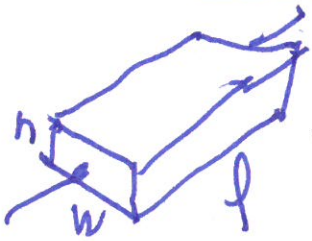
$A_v = 20dB$ at $45°$



Example



Resistors



$$R = \rho \frac{l}{hw}$$

↑ resistivity

typical resistors few kΩ