28th Jan 22

Unity gain for Inverting op-amp :-

$$\text{Volt. gain} = \frac{V_o}{V_i} = \frac{-R_f}{R_1}$$

If $R_f = R_1$.

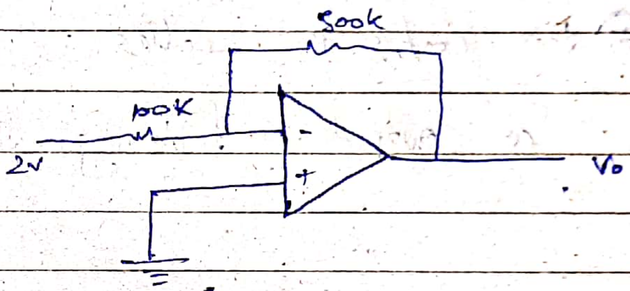
$$\Rightarrow \boxed{\text{Volt. gain} = -1}$$

Q. Design an inverting opamp with gain 10.

$$R_F = 10R_1$$

$$\text{volt. gain} = \frac{-R_F}{R_1} = -10$$

Eg $V_o = ?$

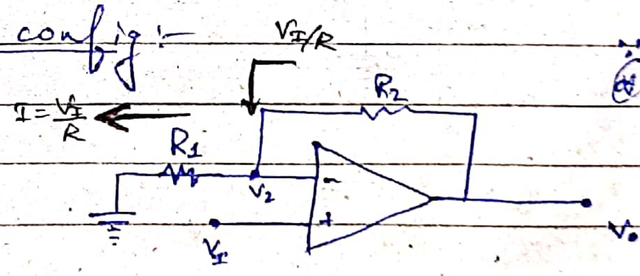


Sol $V_o = \frac{-R_f}{R_i} \times V_i$

$$= \frac{-500k}{100k} \times 2V$$

$$\boxed{V_o = -10V}$$

Non-Inverting config :-



Resistance of opamp = ∞.

$$I = \frac{V_I}{R}$$

$$\rightarrow \boxed{V_o = V_I + \left(\frac{V_I}{R}\right)R_2} \boxed{= V_I\left(1 + \frac{R_2}{R_1}\right)}$$

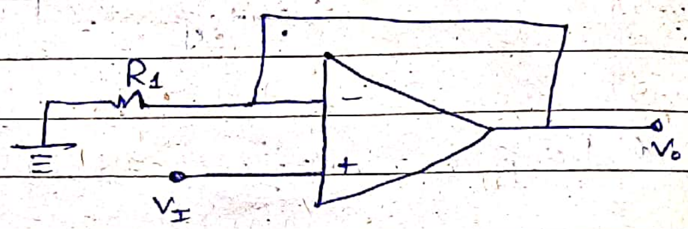
Since + and - terminals are virtually short circuited Hence $V_2 = V_i$

$$\boxed{G = \frac{V_o}{V_i} = \left(1 + \frac{R_2}{R_1}\right)}$$

↳ Gain for non-inverting config.

(3) for unity gain :-

$R_2 \to 0$



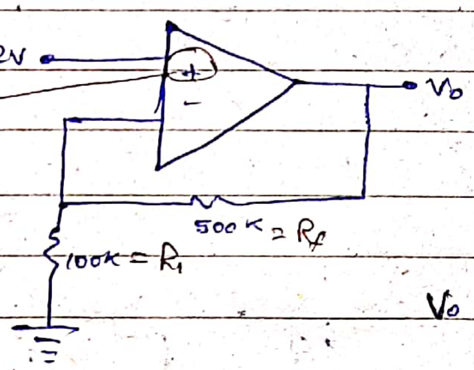
$G = \frac{V_o}{V_i} = \frac{1 + R_o}{R_1}$

$\Rightarrow \frac{V_o}{V_I} = 1$

$\Rightarrow \boxed{V_o = V_i}$

(4) this config is called 'Unity follower' as output is following the input.

Q.



+ ve input is liye non-inverting

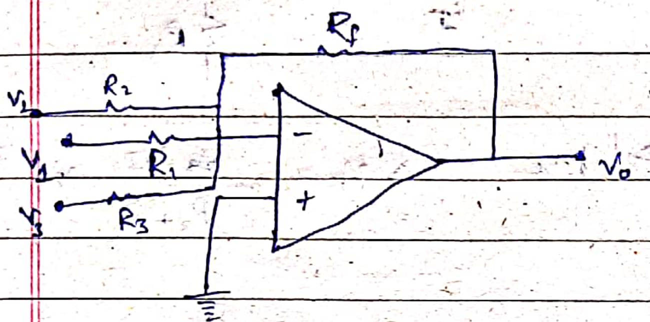
$V_o = ?$

Sol. $G = \frac{V_o}{V_i} = 1 + \frac{R_2}{R_1}$

$V_o = \left(1 + \frac{500}{100}\right)(2V) = \boxed{12V}$ Ans

Summing Amplifier (Summer):-

Both inverting and non-inverting used together.



$$V_o = -\frac{R_f}{R_1}V_1 - \frac{R_f}{R_2}V_2 - \frac{R_f}{R_3}V_3$$

$$\Rightarrow \boxed{V_o = -\left[\frac{R_f}{R_1}V_1 + \frac{R_f}{R_2}V_2 + \frac{R_f}{R_3}V_3\right]}$$

Q. Calculate v_o?

$R_f = 1M\Omega$, $V_1 = -2V$, $V_2 = +3V$, $V_3 = +1V$

$R_1 = 200k$, $R_2 = 500k$, $R_3 = 1M\Omega$

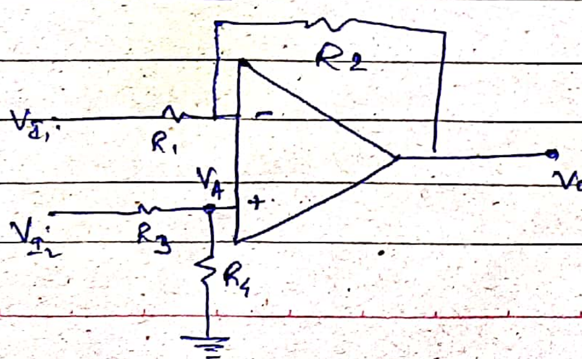
Sol

$$V_o = -\left[\frac{10^6}{2\times10^5}\times(-2V) + \frac{10^6}{5\times10^5}\times 3 + \frac{10^6}{10^6}\times 1\right]$$

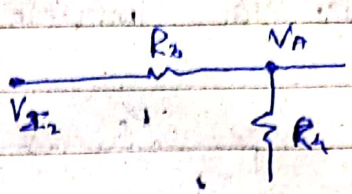
$$= -\left[\cancel{3} - 10 + 6 + 1\right] = 3V \text{ Ans}$$

Difference Amplifier:-

due to V_{I_1} $V_{o_1} = -\frac{R_2}{R_1}\times V_{I_1}$



$V_{o_2} = \left(1+\frac{R_2}{R_1}\right)V_{I_2}$



$\Rightarrow V_{o_2} = \left(1+\frac{R_2}{R_1}\right)\left(\frac{R_4}{R_3+R_4}\right)V_{I_2}$ put here $\Rightarrow \boxed{V_A = \frac{\cancel{V_3}\, V_{I_2}}{R_3+R_4} \times R_4}$

$= \left(\frac{R_1+R_2}{R_1}\right)\left(\frac{R_4}{R_3+R_4}\right)V_{I_2}$ $\left[\because \frac{R_4}{R_3} = \frac{R_4}{R_1}\right]$

→ in case of difference amplifier

$\Rightarrow V_{o_2} = \left(\frac{R_2}{R_1}\right)V_2$

$V_o = V_{o_1} + V_{o_2}$

$= -\frac{R_2}{R_1}V_{I_1} + \frac{R_2}{R_1}V_{I_2} = \frac{R_2}{R_1}\left(V_{I_1} - V_{I_2}\right)$

→ simply the difference b/w the terminals.

$\Rightarrow \boxed{V_o = \frac{R_2}{R_1}(V_d)}$

Q. V_2 and V_3 ?