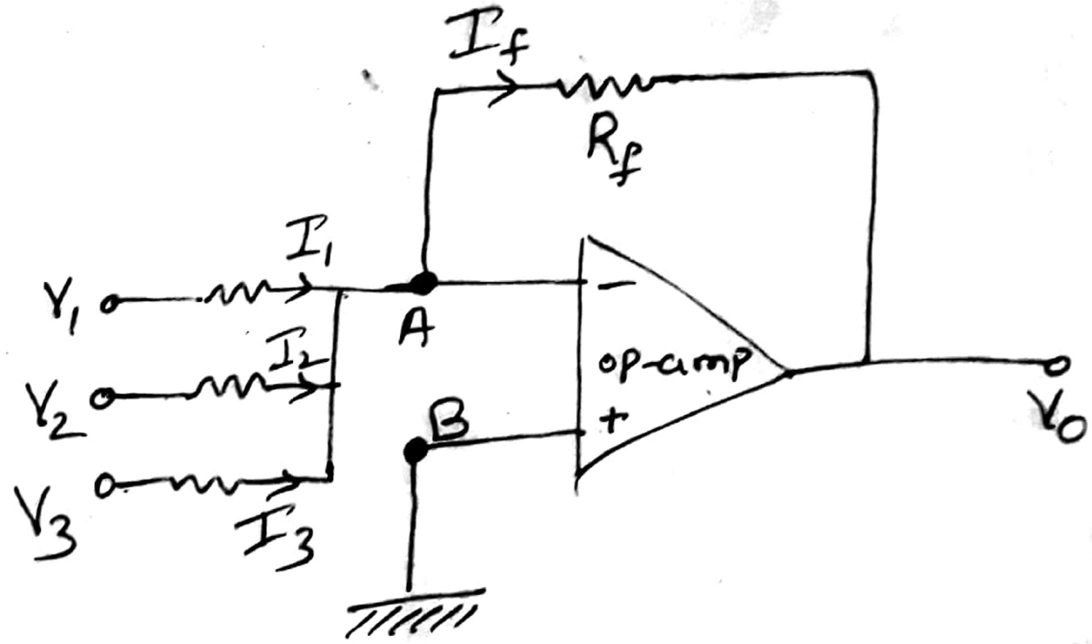
Inverting Summing Amplifier:-

→ In this ckt all the input voltage to be added are applied to the inverting terminal of the op-amp



As node B is grounded

Due to virtual ground concept, the node A is also at virtual ground potential

$$V_A = V_B = 0$$

→ Applying KCL at node A

$$I_1 + I_2 + I_3 = I_f$$

$$\frac{V_1 - V_A}{R_1} + \frac{V_2 - V_A}{R_2} + \frac{V_3 - V_A}{R_3} = \frac{V_A - V_0}{R_f}$$

Due to virtual ground concept

voltage at node "A" is zero potential

i.e $V_A = V_B$ substituting this in above equation

$$\frac{(V_1 - 0)}{R_1} + \frac{(V_2 - 0)}{R_2} + \frac{(V_3 - 0)}{R_3} = \frac{0 - V_0}{R_f}$$

$$V_0 = -\left[\frac{R_f}{R_1} V_1 + \frac{R_f}{R_2} V_2 + \frac{R_f}{R_3} V_3\right]$$

If $R_f = R_1 = R_2 = R_3$

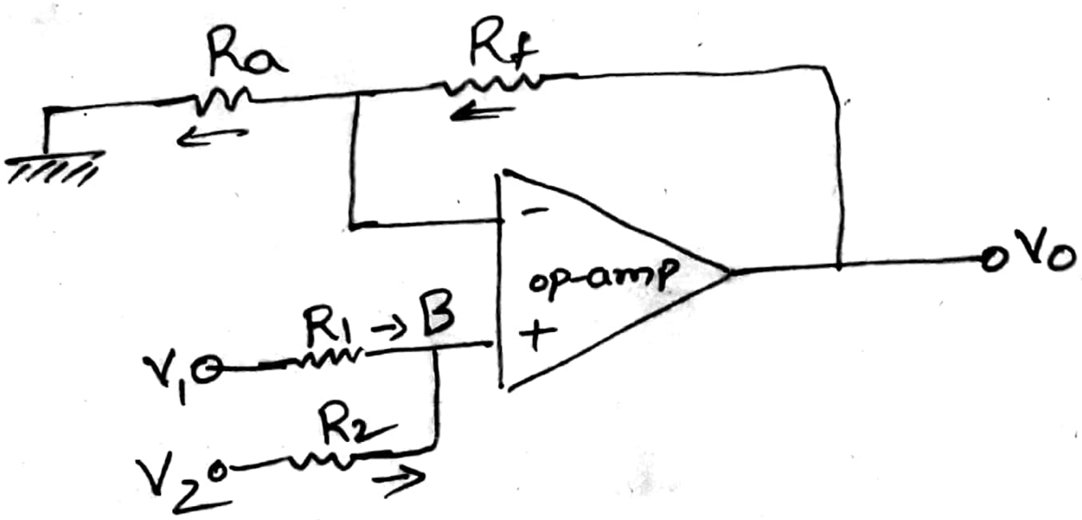
then o/p will be

$$V_0 = -\left[V_1 + V_2 + V_3\right]$$

∴ The o/p will be -ve of the sum of the i/p's. so it is called Inverting summer

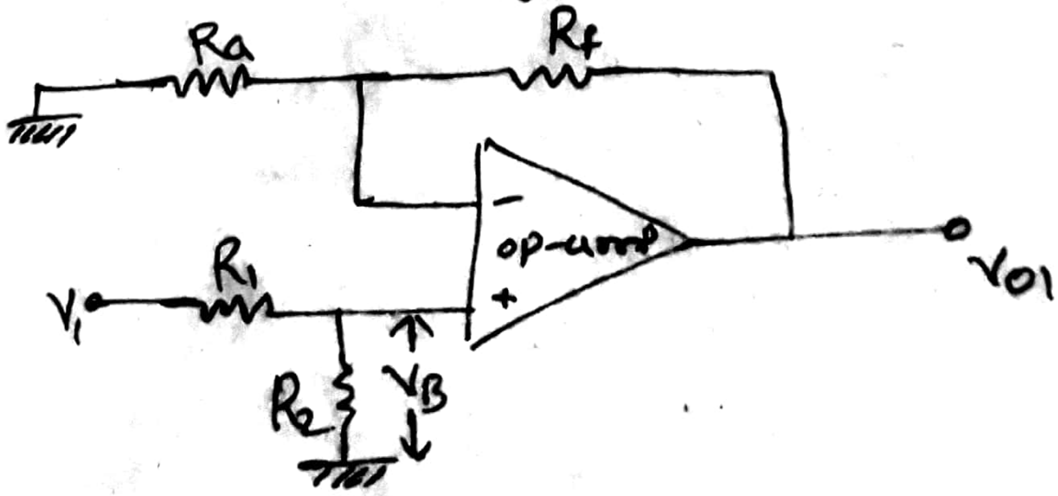
Non-Inverting summing Amplifier :- ③

In this ckt all the i/p voltage to be added are to be applied to the non-Inverting amp of an op-amp.



To obtain an expression for o/p voltage make use of superposition theorem

① Consider V_1 only make $V_2 = 0$:-



when $V_2 = 0$

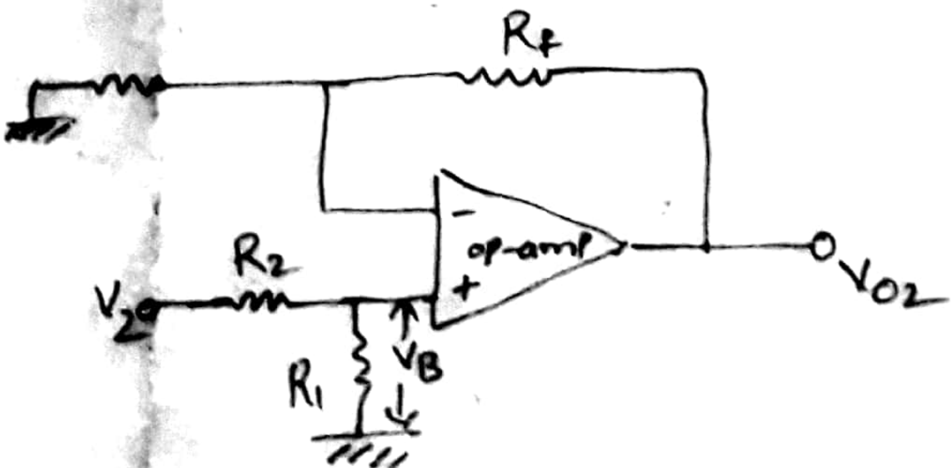
$$V_B = \frac{R_2}{R_1+R_2} V_1$$

o/p voltage for Non-inverting amp given by

$$V_{o1} = \left[1 + \frac{R_f}{R_a}\right] V_B$$

$$V_{o1} = \left[1 + \frac{R_f}{R_a}\right] \frac{R_2}{R_1+R_2} V_1 \quad \text{—— (1)}$$

(2) If $V_1 = 0$



By using voltage division rule voltage at node "B" is given by

$$V_B = \left[\frac{R_1}{R_1+R_2}\right] V_2$$

o/p voltage for non-Inverting amp?

$$V_{o2} = \left[1+\frac{R_f}{R_a}\right] V_B$$

$$V_{o2} = \left[1+\frac{R_f}{R_a}\right]\left[\frac{R_1}{R_1+R_2}\right] V_2 \quad \text{--- (2)}$$

By superposition theorem we have

$$V_o = V_{o1} + V_{o2} \quad \text{--- (3)}$$

sub eq (1) & (2) in (3) we get

~~$V_o =$~~

$$V_o = \left[1+\frac{R_f}{R_a}\right]\left[\left[\frac{R_2}{R_1+R_2}\right] V_1 + \left[\frac{R_1}{R_1+R_2}\right] V_2\right]$$

If we have $R = R_1 = R_2$ then

$$V_o = \left[1+\frac{R_f}{R_a}\right]\left[\frac{V_1+V_2}{2}\right]$$

This is required o/p of a Summing (6)
amp for $R_f = 0$ & $R_1 = R_2 = R$ we have

$$V_o = \frac{V_1 + V_2}{2}$$

||y

For four i/p summing ckt, the o/p voltage given by

$$V_o = \frac{V_1 + V_2 + V_3 + V_4}{4}$$