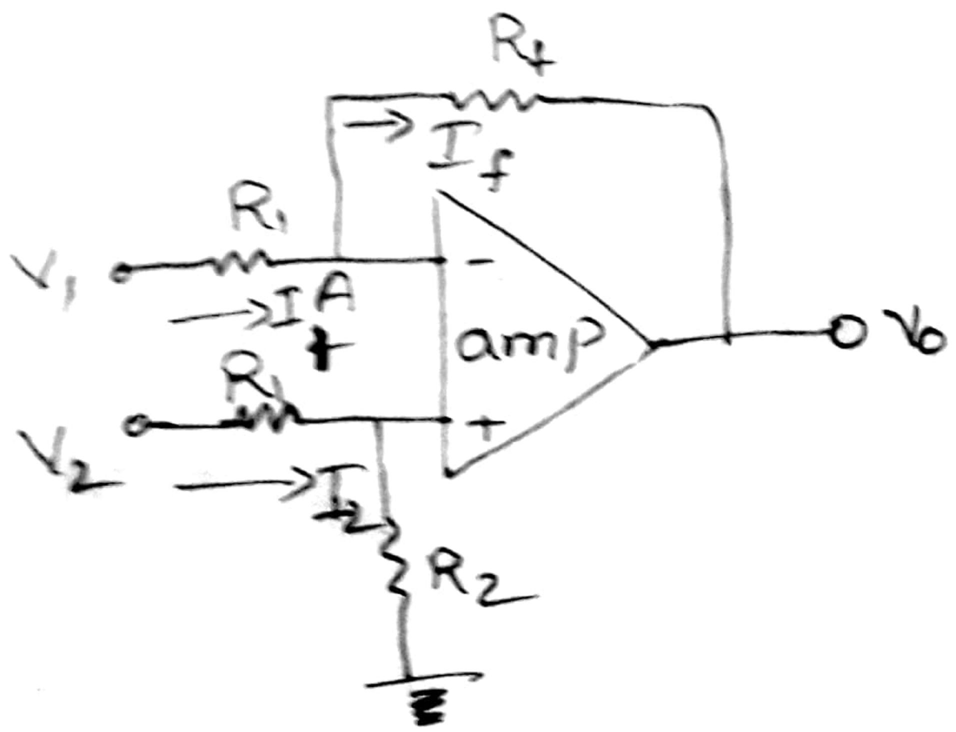
Difference Amplifier (substractor):-

→ The difference amp gives an o/p which is proportional to the difference in voltages applied to Inverter and Non-Inverter i/p

→ The difference amp V_1 is applied to the Inverter i/p through a resistance R_1. The 2nd voltage is applied to the non-Inverter i/p through a resistance R_1.

→ R_f is the usual feed back resistance R_2 is another resistance Connected between the non-Inverter i/p and ground.



→ Let the potential of node "B" be V_B. The potential of node "A" is same as B. (By using virtual ground concept)

ie $V_A = V_B$

Applying KCL at node B, we obtain

$$\frac{V_2 - V_B}{R_1} = \frac{V_B - 0}{R_2}$$

$$\frac{V_2}{R_1} = \frac{V_B}{R_1} + \frac{V_B}{R_2}$$

$$\frac{V_2}{R_1} = V_B\left[\frac{1}{R_1} + \frac{1}{R_2}\right]$$

Voltage at node "A", $V_A = V_B$

$$\therefore V_B = \frac{V_2}{R_1\left[\frac{1}{R_1} + \frac{1}{R_2}\right]}$$

$$V_B = \frac{V_2}{\left[1 + \frac{R_1}{R_2}\right]} \longrightarrow (1)$$

Applying KCL at node A, we have

$$\frac{V_1 - V_A}{R_1} = \frac{V_A - V_0}{R_2}$$

$$\frac{V_1}{R_1} - \frac{V_A}{R_1} = \frac{V_A}{R_2} - \frac{V_0}{R_2}$$

$$\frac{V_1}{R_1} = \frac{V_A}{R_2} + \frac{V_A}{R_1} - \frac{V_0}{R_2}$$

$$\frac{V_1}{R_1} = V_A\left[\frac{1}{R_1} + \frac{1}{R_2}\right] - \frac{V_0}{R_2}$$

$$V_1 = V_A\left[1 + \frac{R_1}{R_2}\right] - V_0\frac{R_1}{R_2} \longrightarrow (2)$$

Since $V_A = V_B$ thus substitute V_B value in eq (2)

$$V_1 = \frac{V_2}{1 + \frac{R_1}{R_2}}\left[1 + \frac{R_1}{R_2}\right] - V_0\frac{R_1}{R_2}$$

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

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

$$(V_2 - V_1) = V_0\left[\frac{R_1}{R_2}\right]$$

$$V_0 = \frac{R_2}{R_1}[V_2 - V_1]$$

That the o/p voltage is proportional to the difference b/w the two i/p voltages.

Thus it acts as substractor or Differential amp.