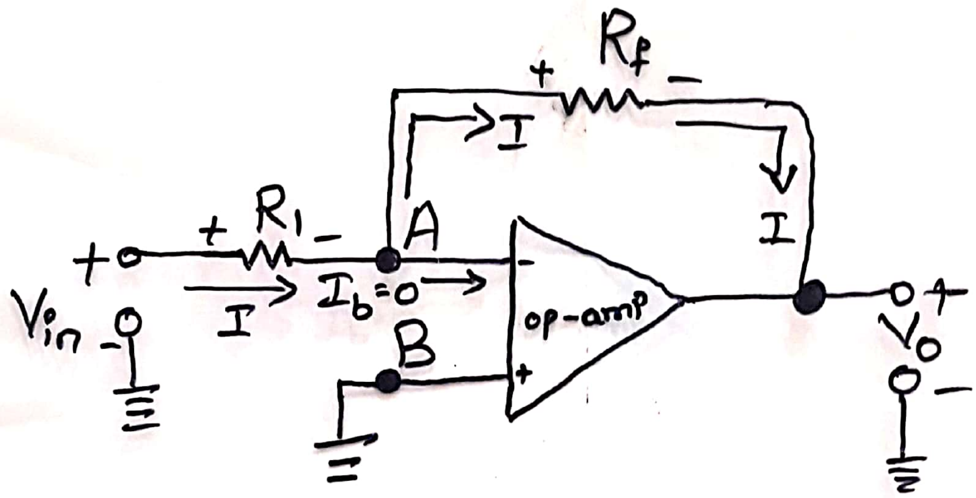
Ideal Inverting Amplifier:-



Derivation of closed loop gain:-

→ As node B is grounded, node A is also ground potential, from the Concept of virtual ground, so $V_A = 0$

$$\therefore \quad I = \frac{V_{in} - V_A}{R_1}$$

$$I = \frac{V_{in}}{R_1} \quad \text{—— (1)}$$

→ Now from the output side, Consider -ing the direction of current (I) we Can write,

$$I = \frac{V_A - V_O}{R_f}$$

$$I = \frac{-V_O}{R_f} \quad \text{—— (2)}$$

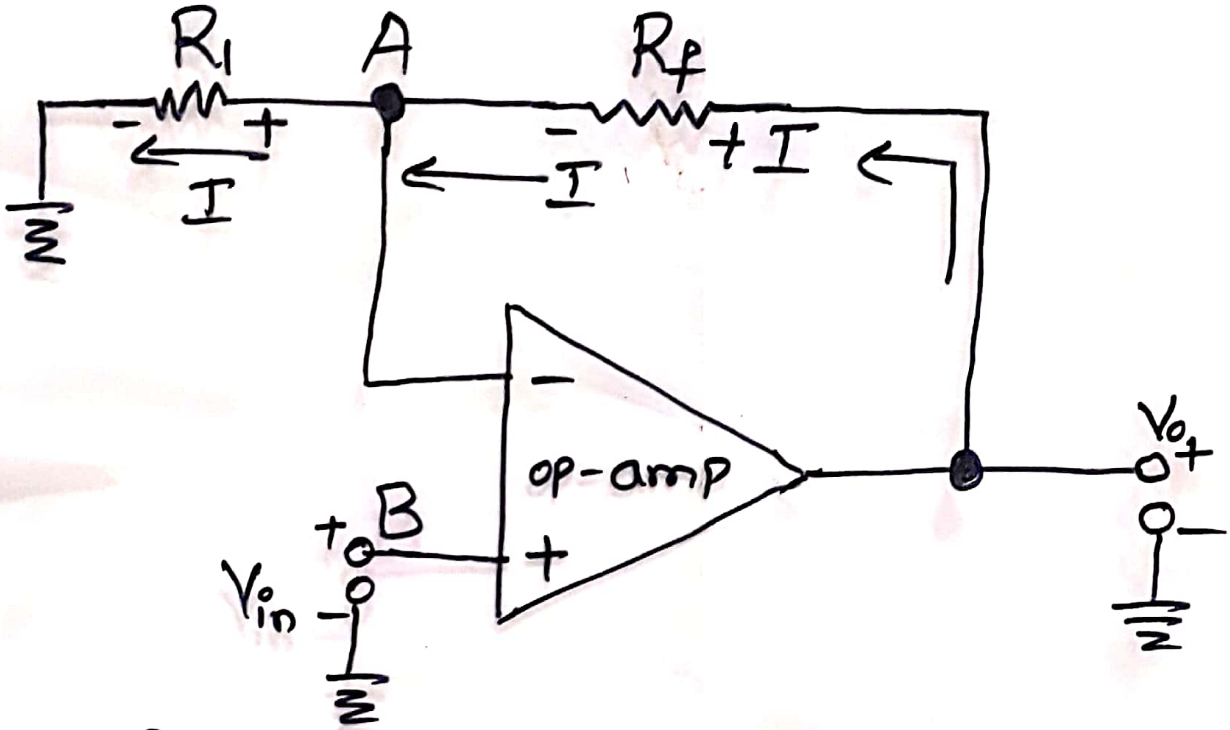
Entire current I pass through R_f as op-amp input current is zero

Equating equation (1) & (2) we get

$$\frac{V_{in}}{R_1} = \frac{-V_O}{R_f}$$

$$\boxed{\therefore A_{VF} = \frac{V_O}{V_{in}} = \frac{-R_f}{R_1} \text{ (Gain with feedback)}}$$

Ideal Non-inverting Amplifier :- ③



Derivation of cloosed loop gain :-

→ The node B is at potential V_{in}, hence the potential of point A is same as B which is "V_{in}", from the concept of virtual share.

$$V_A = V_B = V_{in}$$

From the output side we can write

$$I = \frac{V_0 - V_A}{R_f}$$

$$\therefore \quad I = \frac{V_0 - V_{in}}{R_f} \longrightarrow (1)$$

At the inverting terminal

$$I = \frac{V_A - 0}{R_1} \qquad (\because V_0 = 0)$$

$$I = \frac{V_A}{R_1} \qquad (\because V_A = V_{in})$$

$$I = \frac{V_{in}}{R_1} \longrightarrow (2)$$

Entire current passes through R_1 as input current of op-amp is zero

Equating eq 1 & 2 we get 5

$$\therefore \frac{V_0 - V_{in}}{R_f} = \frac{V_{in}}{R_1}$$

$$\frac{V_0}{R_f} = \frac{V_{in}}{R_f} + \frac{V_{in}}{R_1}$$

$$\frac{V_0}{\cancel{R_f}} = V_{in}\left[\frac{(R_1 + R_f)}{R_1 \cancel{R_f}}\right]$$

$$\frac{V_0}{V_{in}} = \frac{R_1 + R_f}{R_1}$$

$$\boxed{\therefore A_{VF} = \frac{V_0}{V_{in}} = 1 + \frac{R_f}{R_1}}$$