RRB JE | SSE 2023

Foundation Batch

Analog Electronics

Day-7

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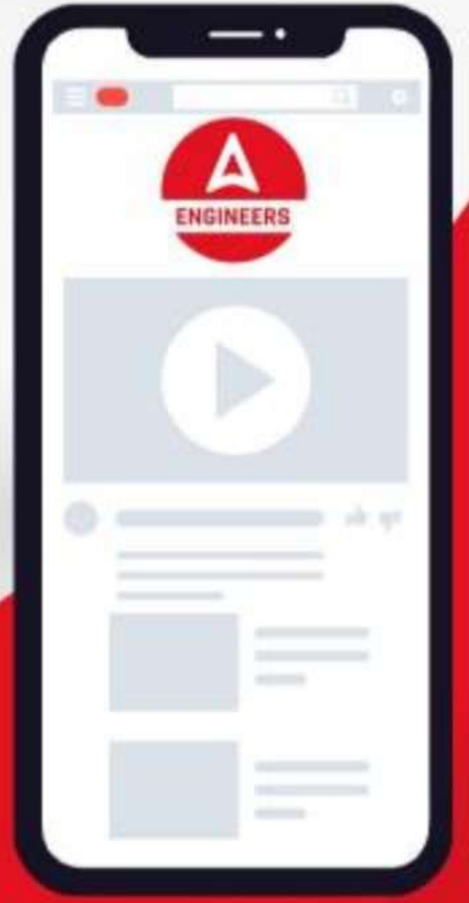

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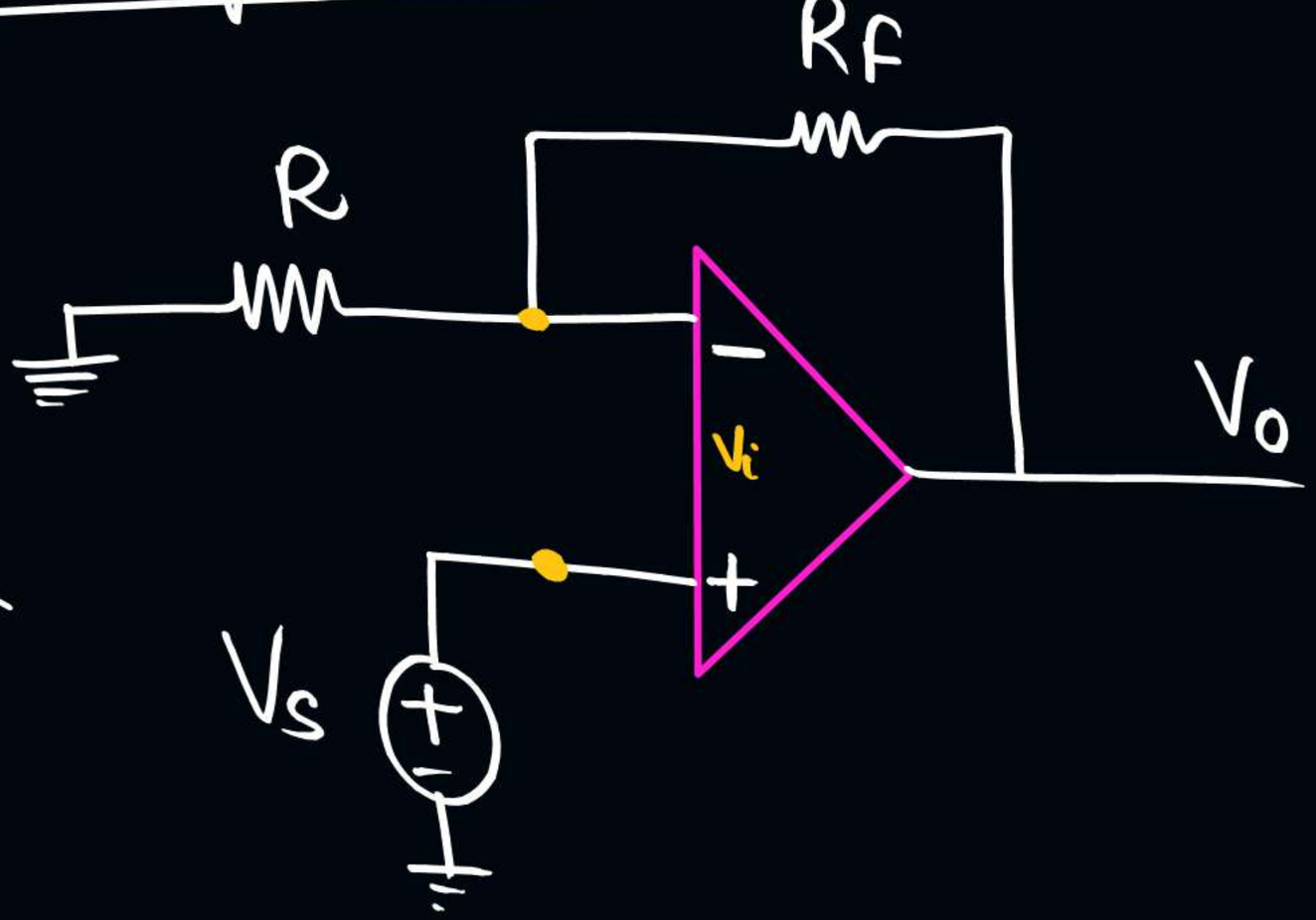
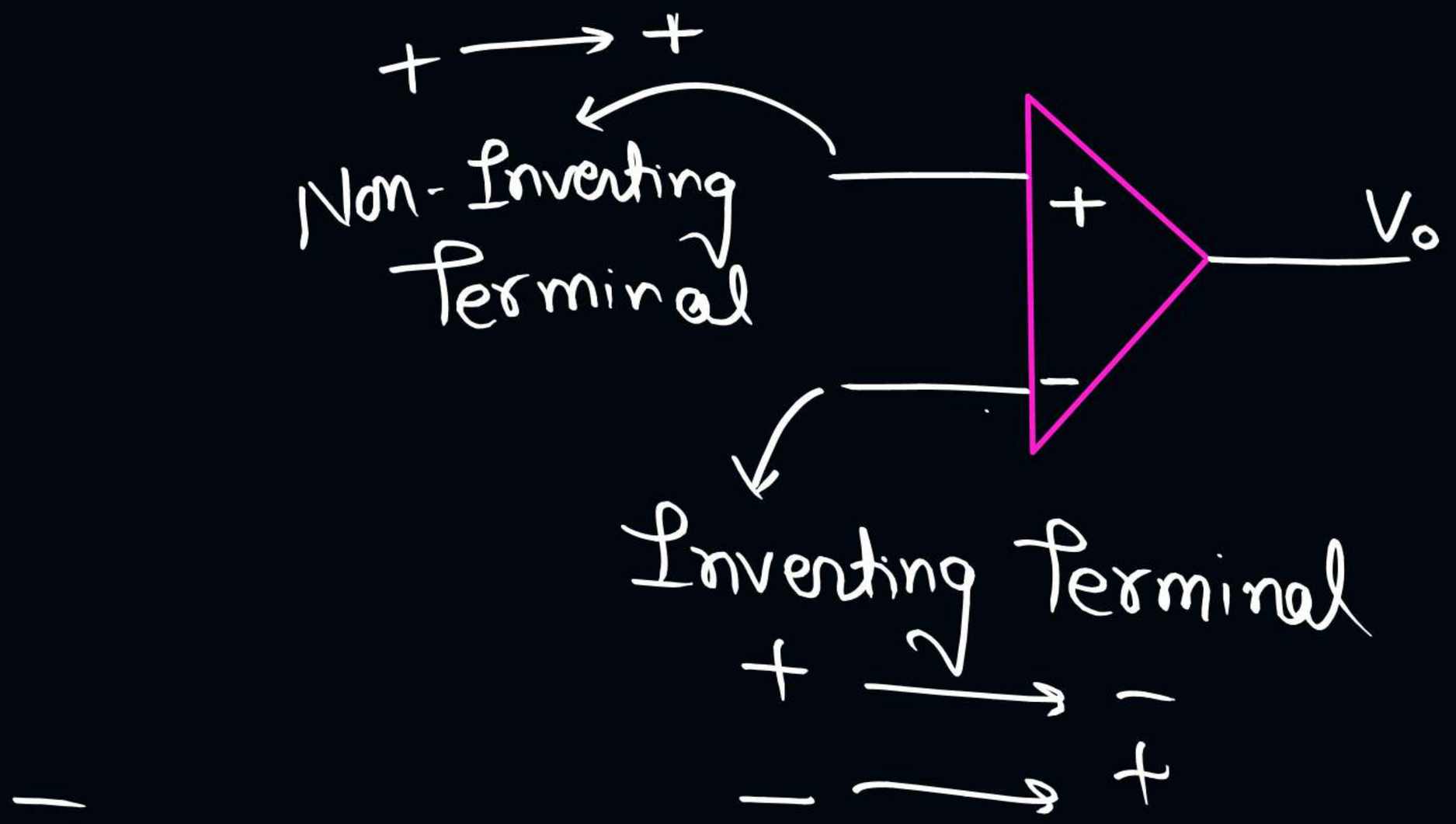
Non-Inverting Mode:

① Op-Amp is Ideal:

$A_V \to \infty$

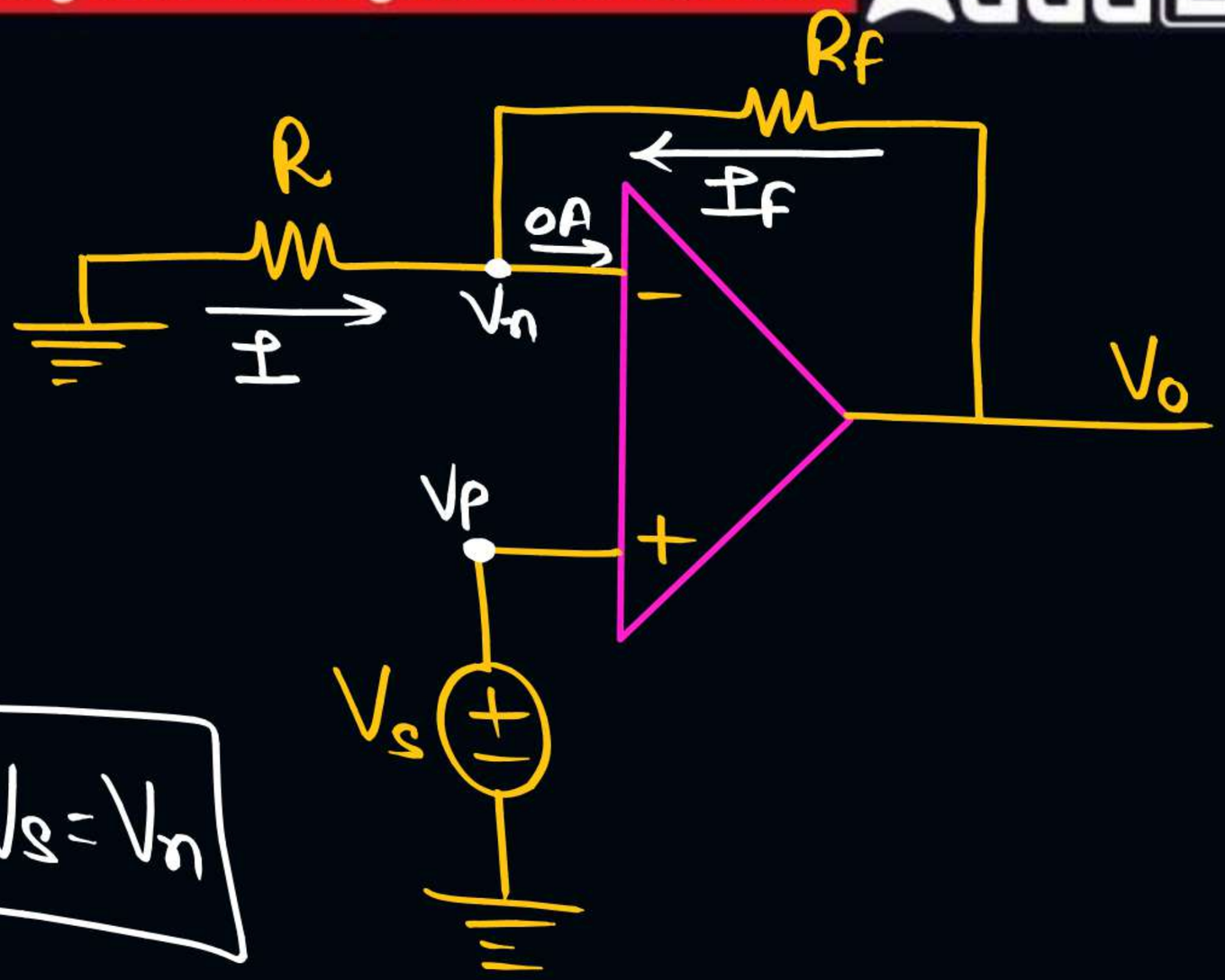




Virtual Short Concept:

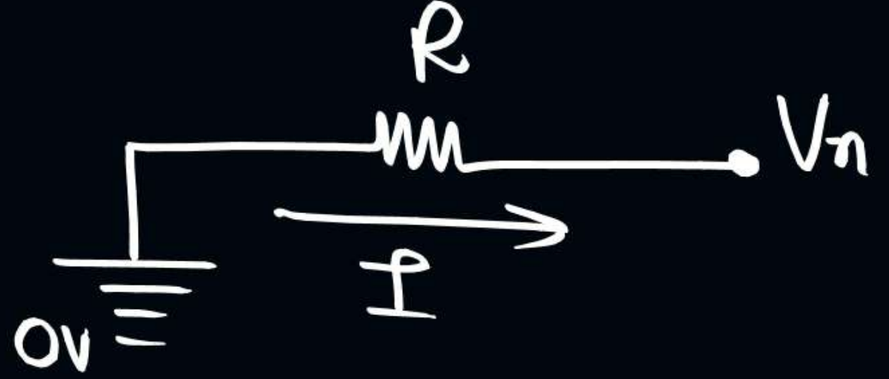
$$V_p = V_n$$

$$\longleftrightarrow \quad V_p = V_s = V_n$$



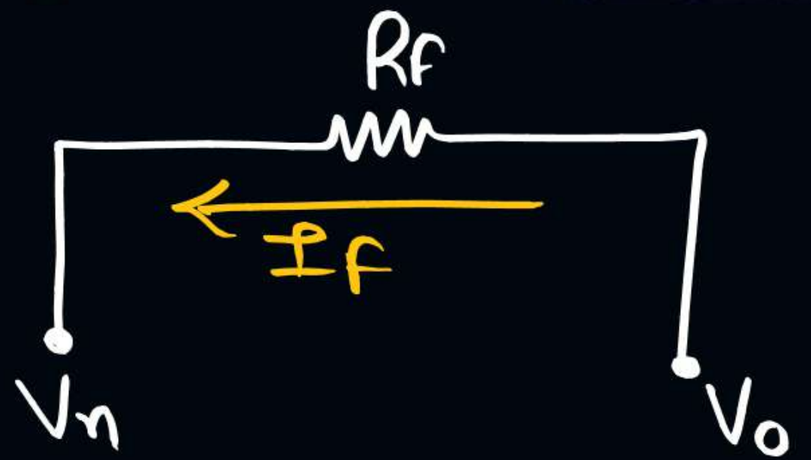
Apply KCL @ V_n:

$$I + I_f = 0$$



$$I = \frac{0 - V_n}{R} = -\frac{V_n}{R}$$

$$I_f = \frac{V_o - V_n}{R_f}$$



$$I + I_f = 0$$

$$\frac{-V_n}{R} + \frac{V_o - V_n}{R_f} = 0$$

Put $V_n = V_s$ (Virtual Short concept)

$$\frac{-V_s}{R} + \frac{V_o - V_s}{R_f} = 0$$

$$\frac{V_o}{R_f} - \frac{V_s}{R_f} = \frac{V_s}{R}$$

$$\frac{V_o}{R_f} = \frac{V_s}{R} + \frac{V_s}{R_f}$$

Multiply 'R_f' both Side

$$V_o = V_s \cdot \frac{R_f}{R} + V_s = V_s\left(1 + \frac{R_f}{R}\right)$$

$$\frac{V_o}{V_s} = 1 + \frac{R_f}{R}$$

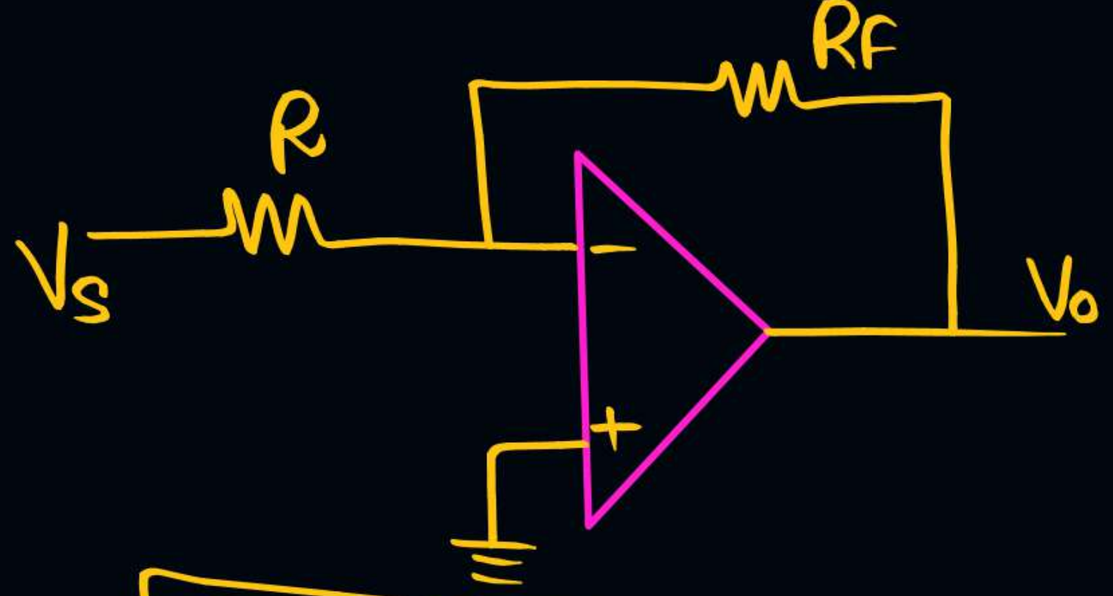
$$V_o = \left(1 + \frac{R_f}{R}\right) V_s$$

If $V_s = 1v$, $R_f = R = 1K\Omega$

$$V_o = \left(1 + \frac{1K}{1K}\right) 1 \text{ volt}$$

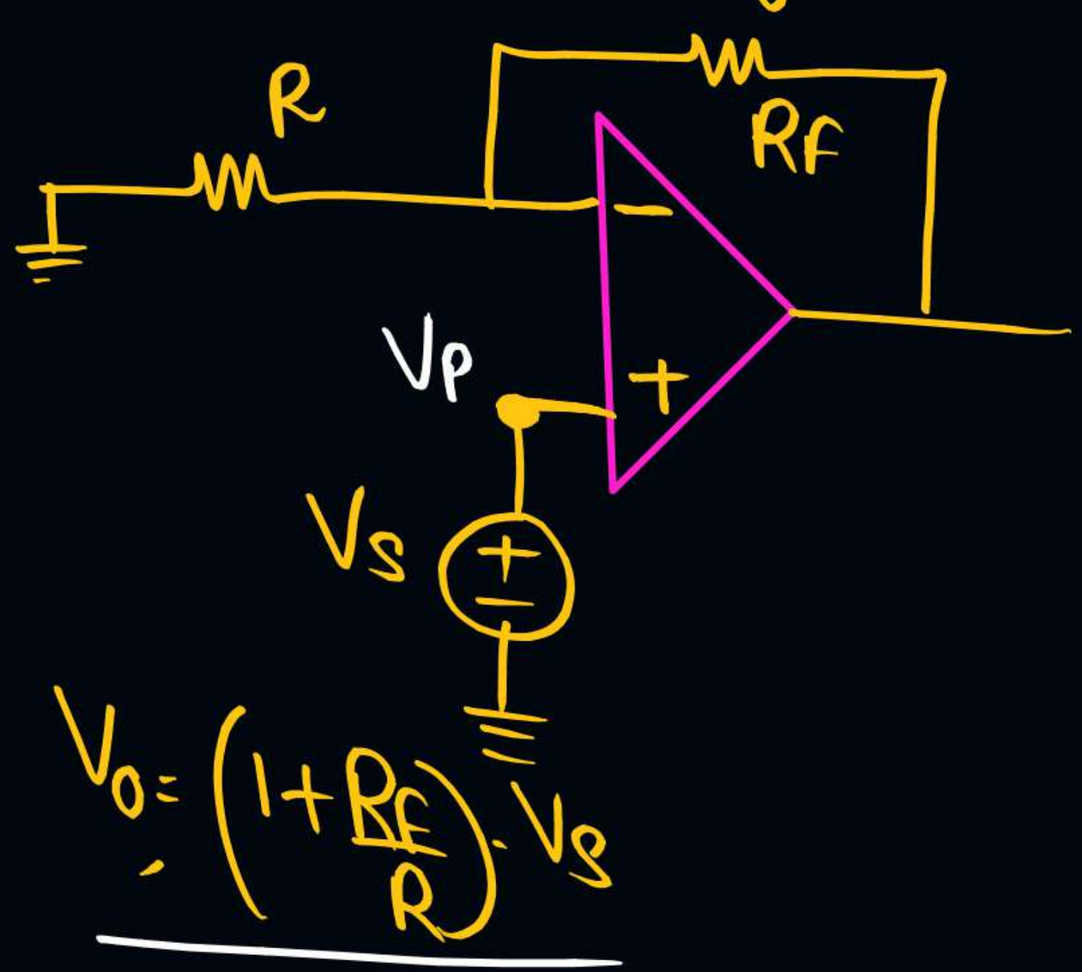
$$V_o = 2 \text{ volt}$$

Inverting Mode



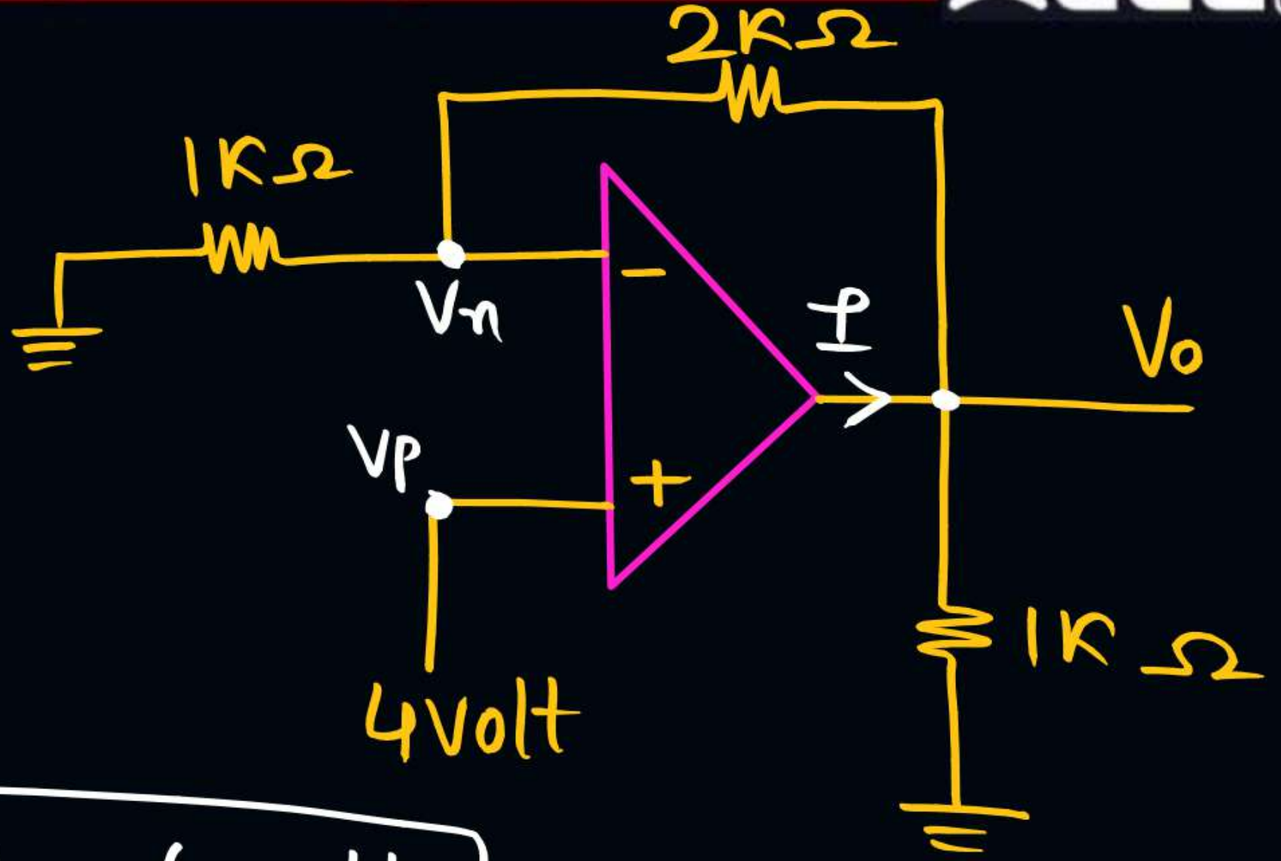
$$V_0 = -\frac{R_f}{R} \cdot V_s$$

Non-Inverting Mode



$$V_0 = \left(1 + \frac{R_f}{R}\right) \cdot V_s$$

Find the value of V_o and I = ?



Solution:

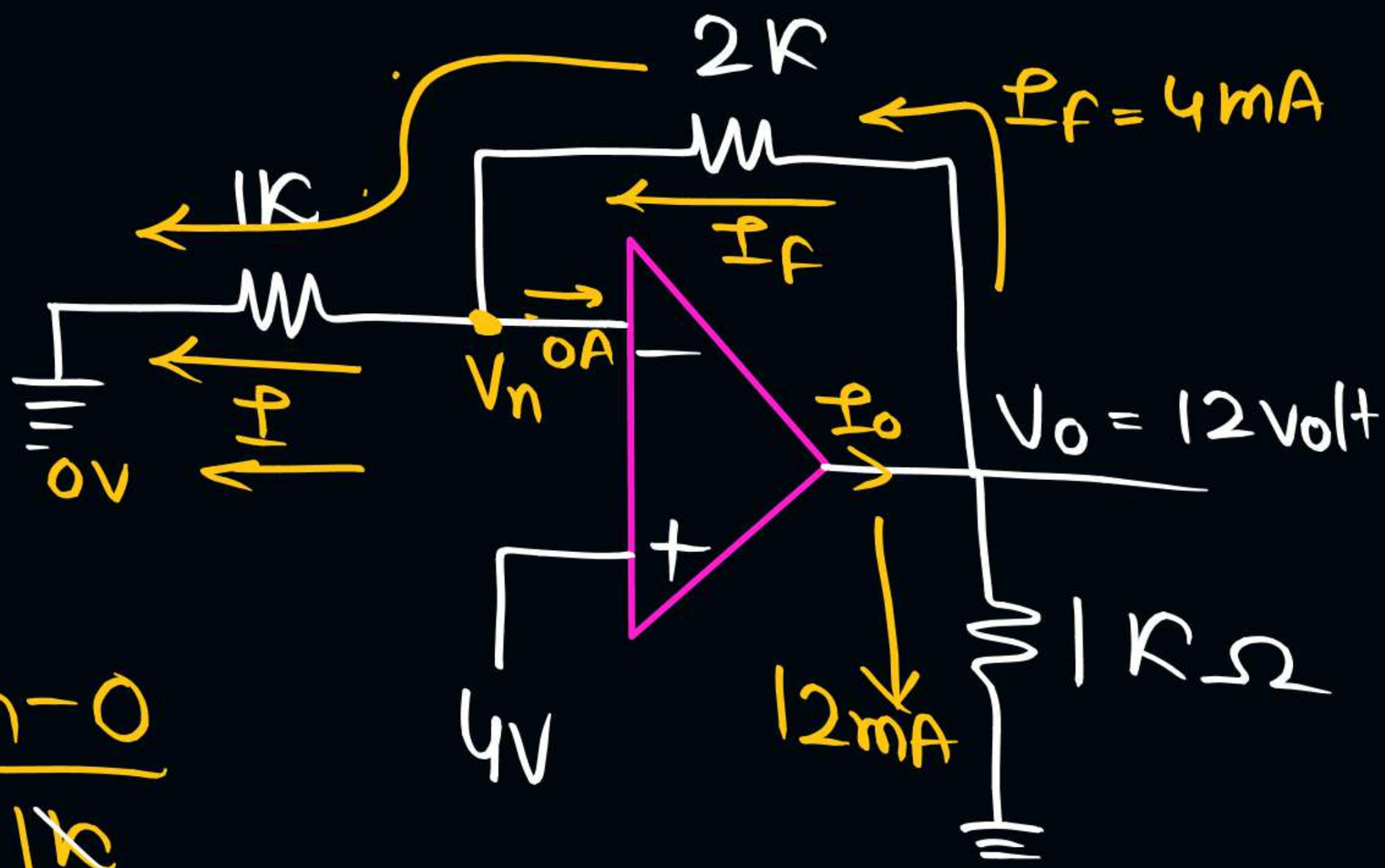
$$V_p = V_n = 4\text{volt}$$

$V_n = 4V$

KCL @ V_n :

$I_f = I + 0$

$$\frac{V_0 - V_n}{2K} = \frac{V_n - 0}{1K}$$



$$\frac{V_0 - 4}{2} = \frac{4}{1}$$

$$V_0 - 4 = 8$$

$$\boxed{V_0 = 12 \text{ volt}}$$

$$V_0 = \left(1 + \frac{R_f}{R}\right) \cdot V_s$$

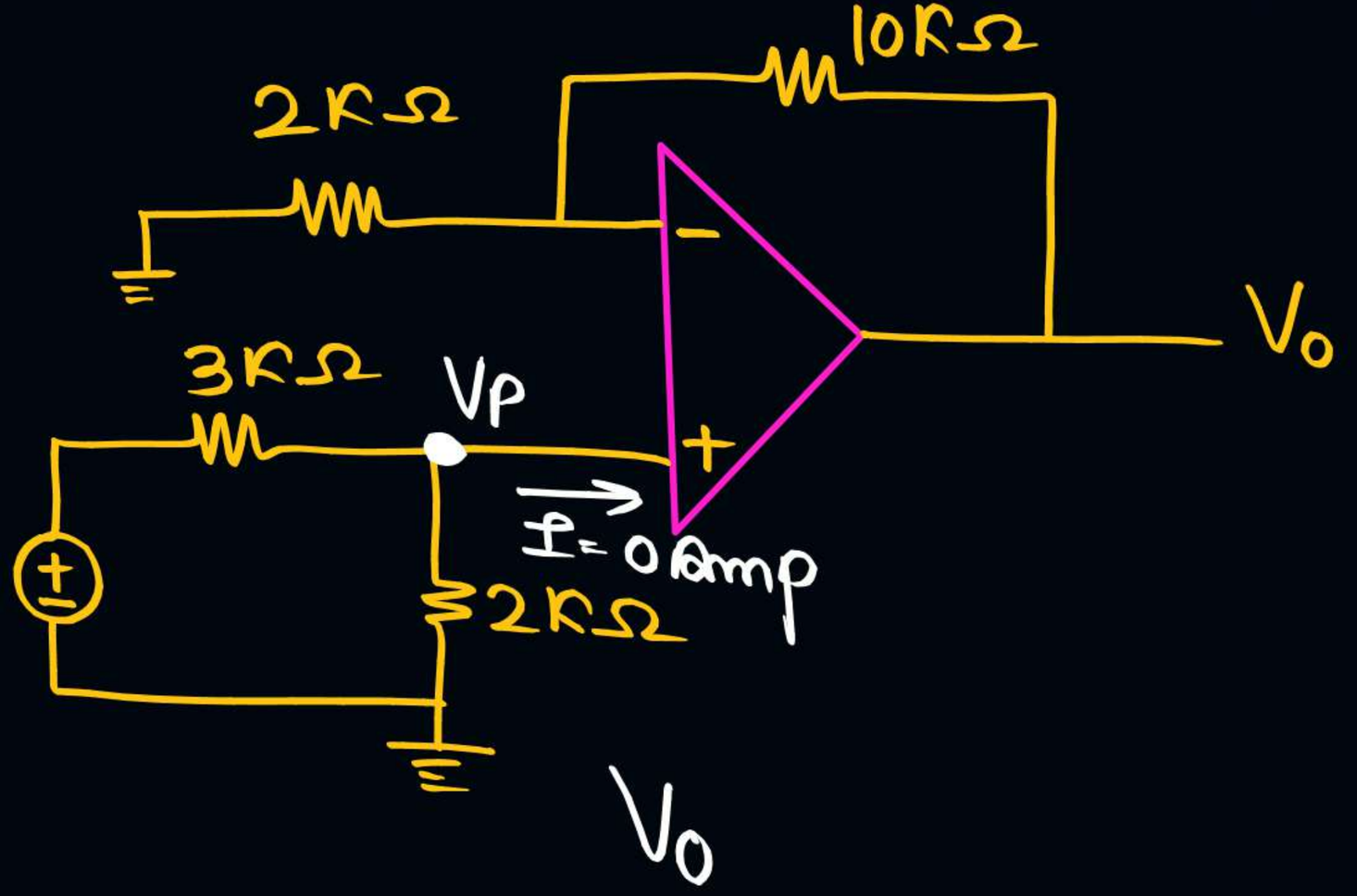
$$= \left(1 + \frac{2K}{1K}\right) \cdot 4$$

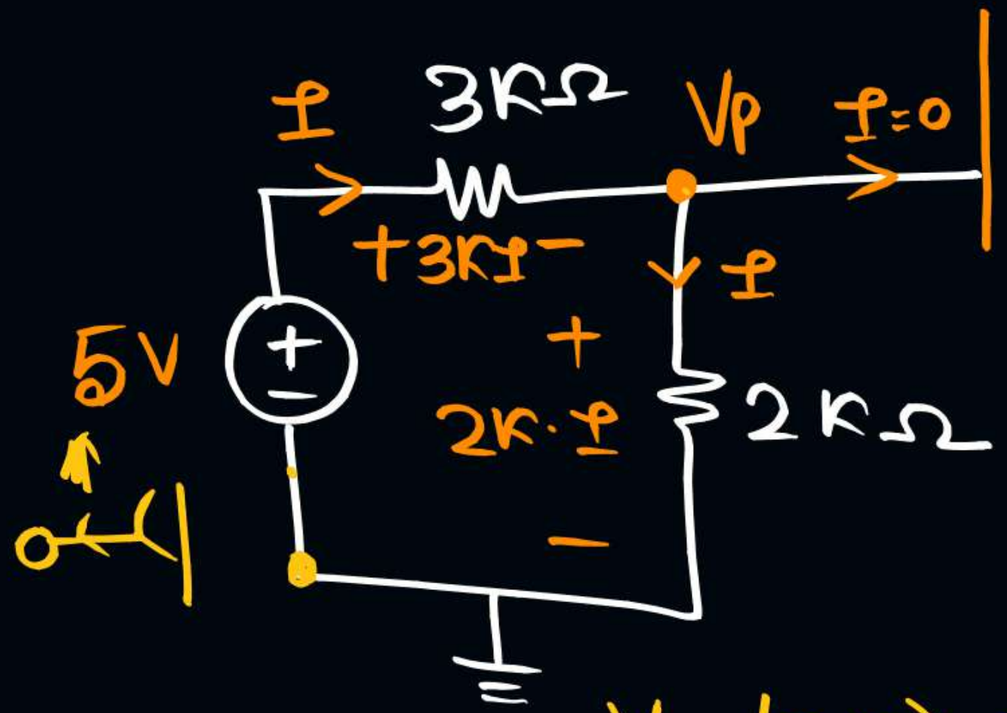
$$\boxed{V_0 = 12 \text{ volt}}$$

$$I = \frac{V_n - 0}{1K} = \frac{4}{1K} = 4mA$$

Find $V_0 = ?$

$$V_0 = \left(1 + \frac{R_f}{R}\right) V_p$$





KVL

$$-5 + 3K \cdot I + 2K \cdot I = 0$$

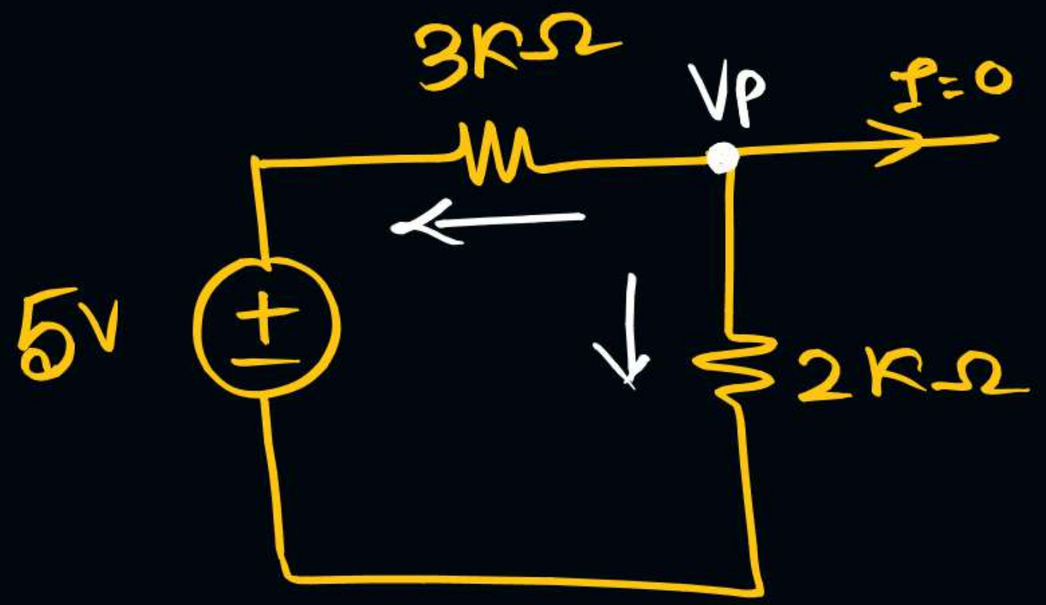
$$5K \cdot I = 5$$

$$I = \frac{5}{5K}$$

$$I = 1mA$$

$$V_p = (2K) \cdot I$$

$$V_p = 2 \text{ Volt}$$



Nodal @ V_p :

$$\frac{V_p - 5}{3K} + \frac{V_p}{2K} + 0 = 0$$

$V_p = 2$ Volt

$$V_0 = \left(1 + \frac{10K}{2K}\right) \cdot V_P$$

$$V_0 = (1 + 5)\, 2 = 12 \text{ Volt}$$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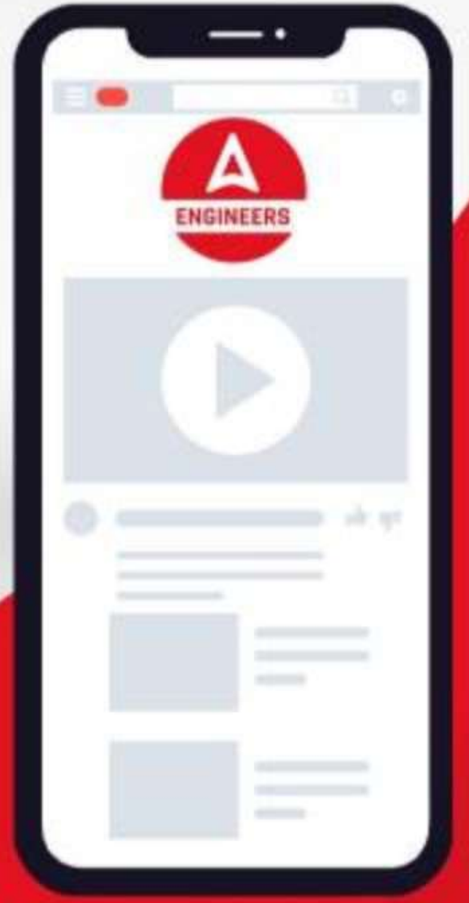

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