RRB JE | SSE 2023

Foundation Batch

Analog Electronics

Day-5

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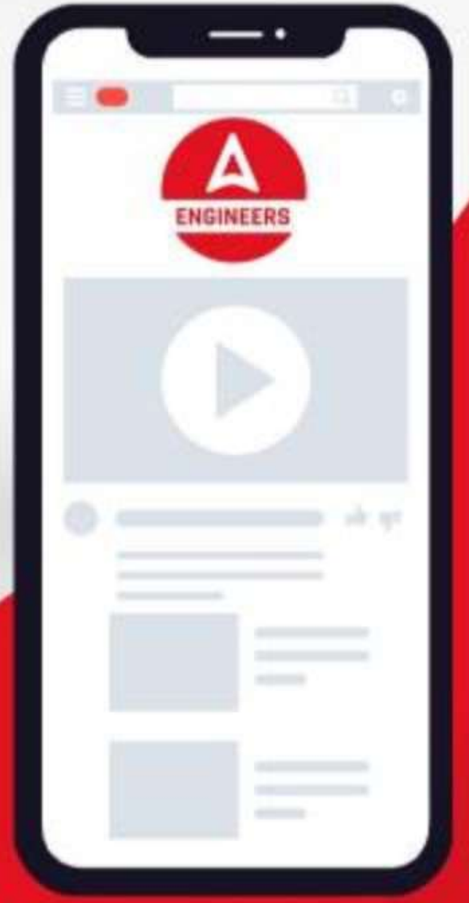

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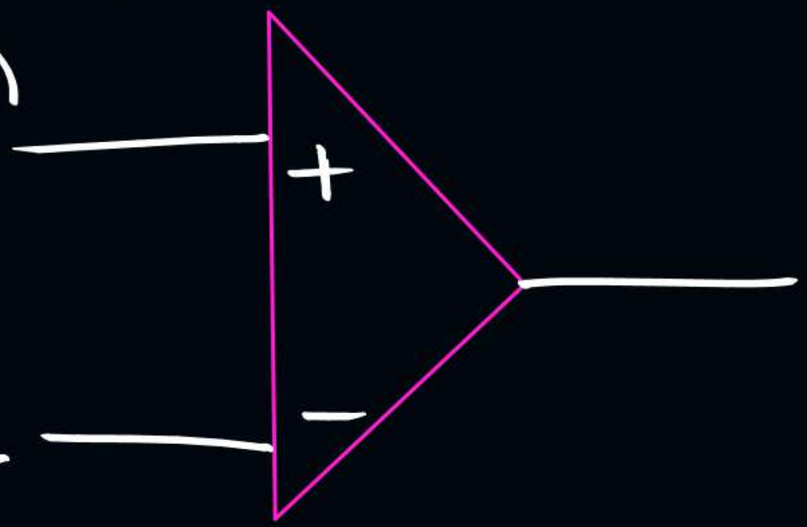
Mode of operation:

- → Inverting Mode
- → Non Inverting Mode
- → Differential Mode

Non-Inverting Terminal



Inverting Terminal

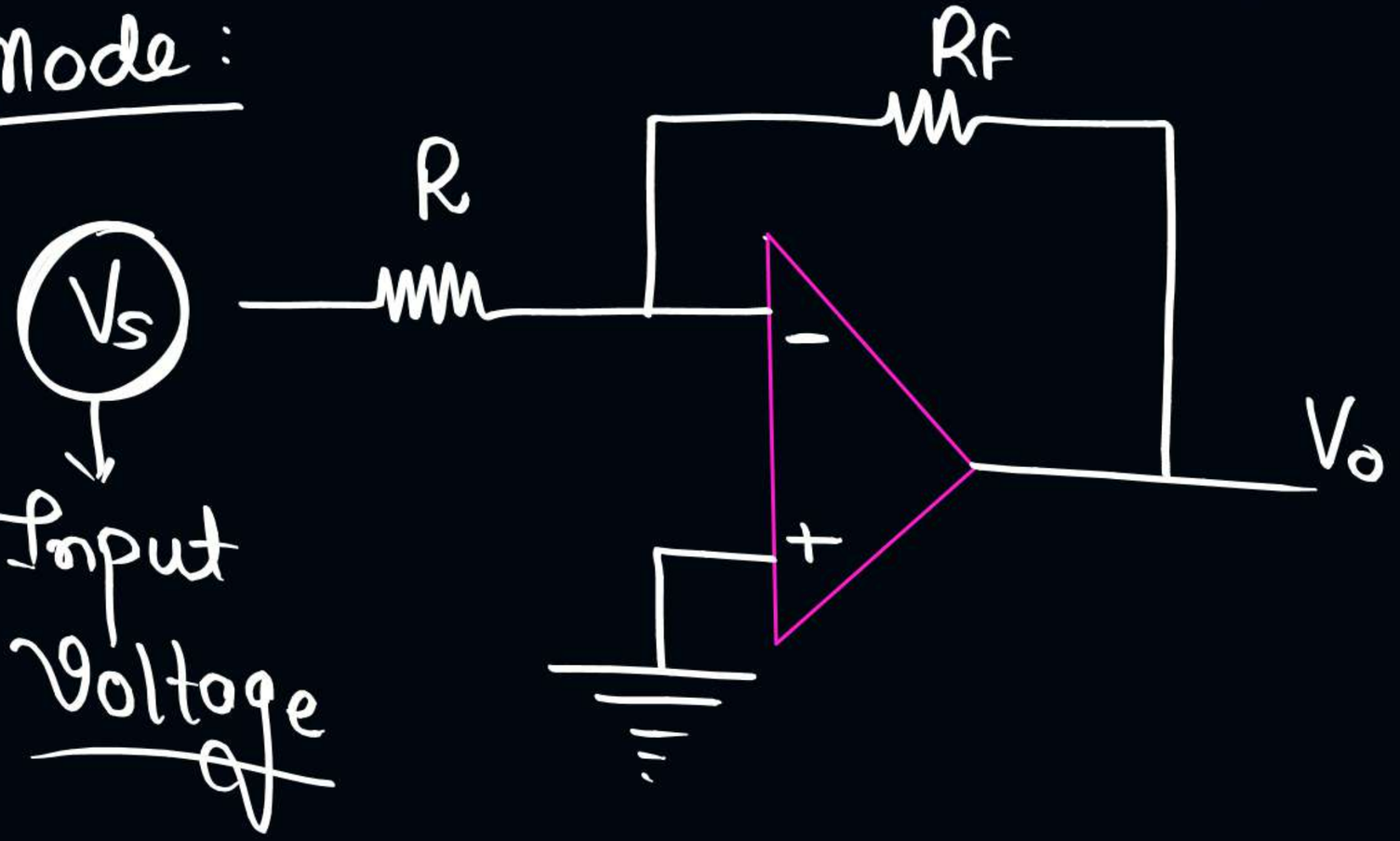
Voltage

Invert:

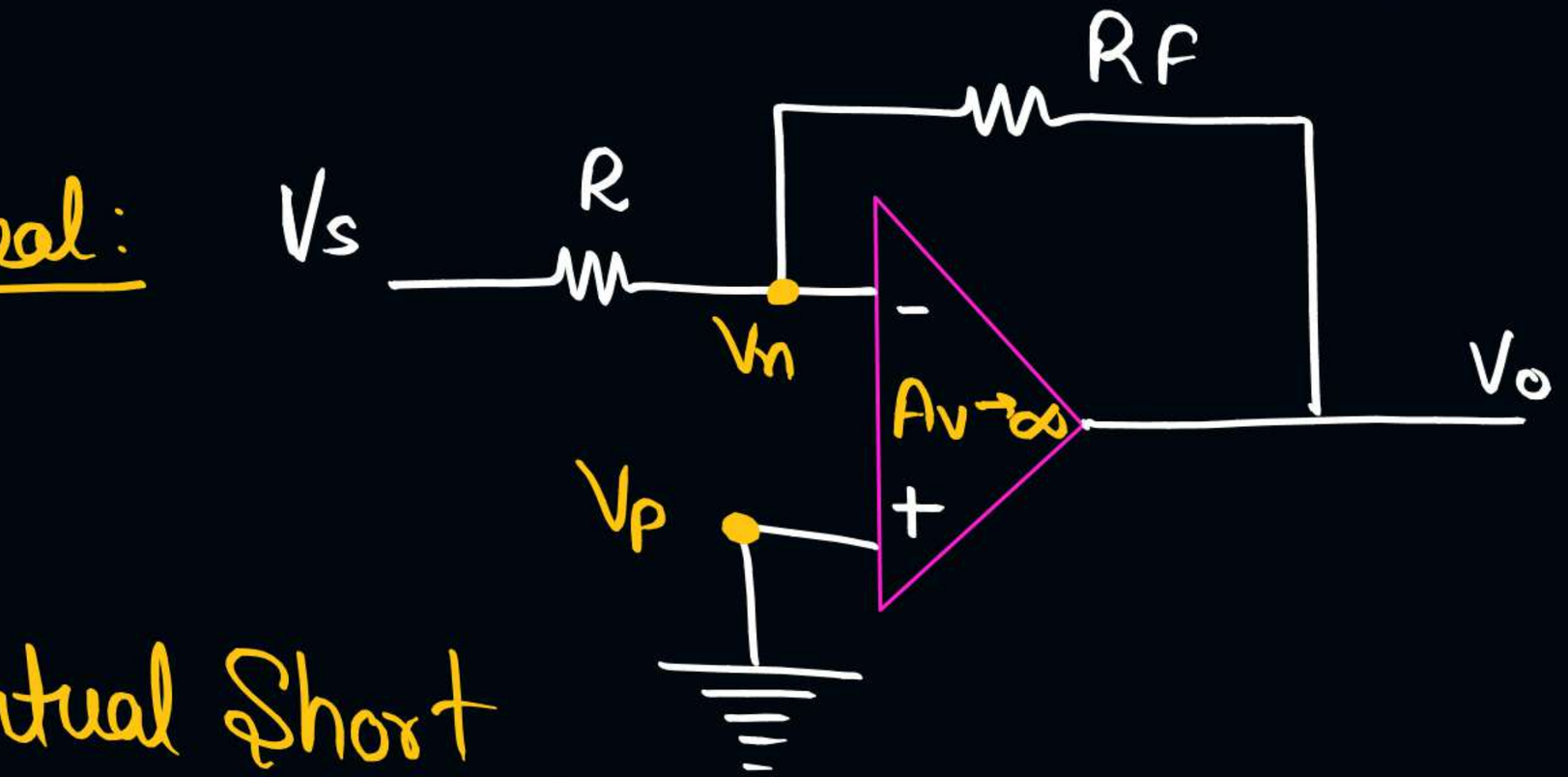
+ → −

− → +

Inverting Mode:



Op: Amp is Ideal:

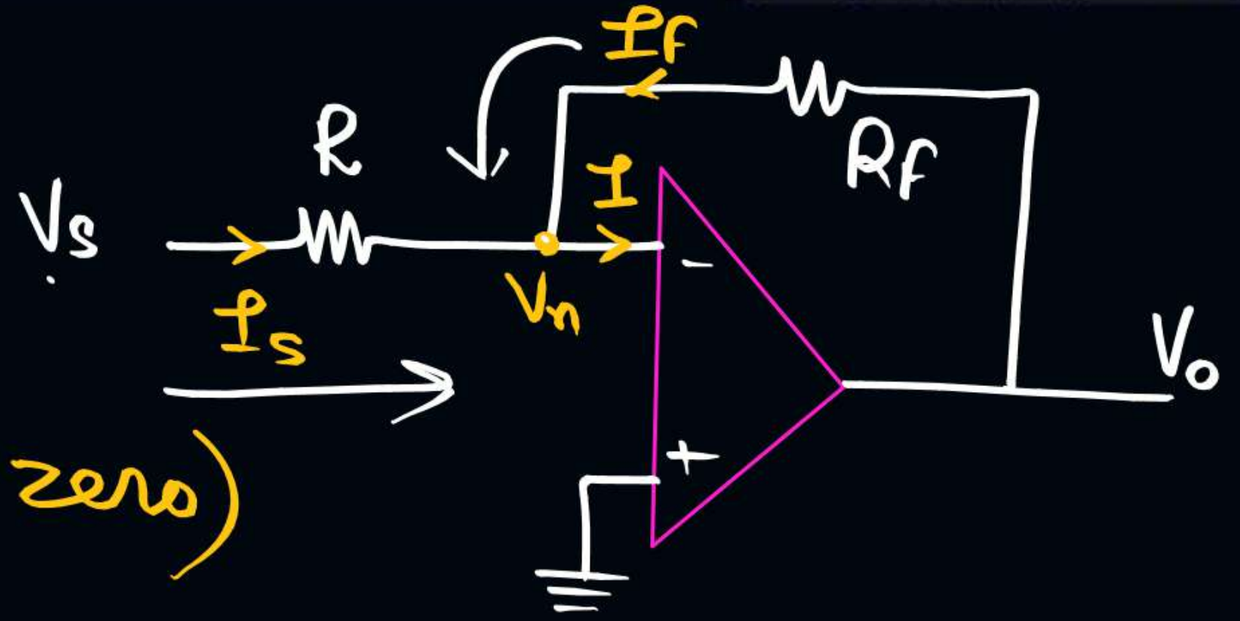


$V_p = V_n$

↳ Virtual Short Concept

$\therefore V_p = 0 = V_n$

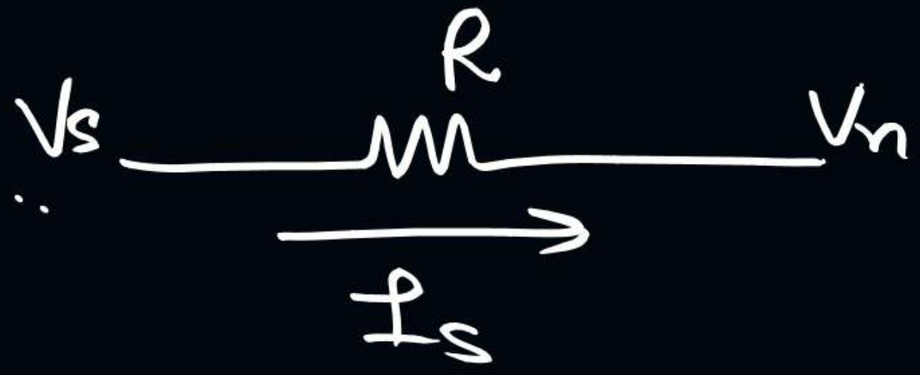
∵ $I = 0$ (current enters at OP-Amp is zero)



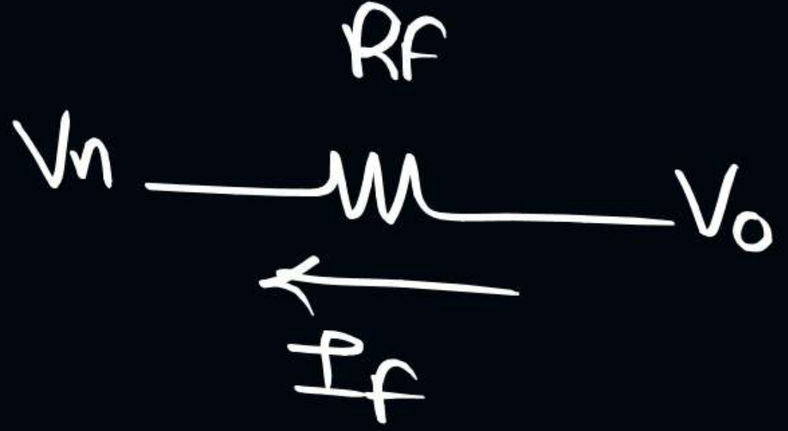
Apply KCL @ V_n:

$$I_f + I_s = I = 0$$

$$I_f + I_s = 0$$



$$I_s = \frac{V_s - V_n}{R}$$



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

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

$\because V_n = 0 = V_p$ (Virtual Short Concept)

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

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

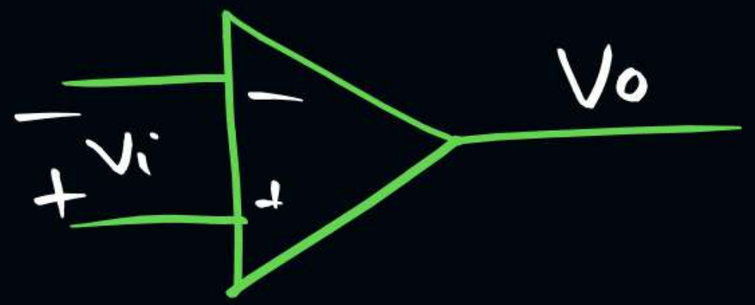
$$V_o = \left(-\frac{R_f}{R}\right) \cdot V_s$$ → Output of Inverting Mode OP-Amp

$$\frac{V_o}{V_s} = -\frac{R_f}{R}$$ → Gain of Inverting Mode

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

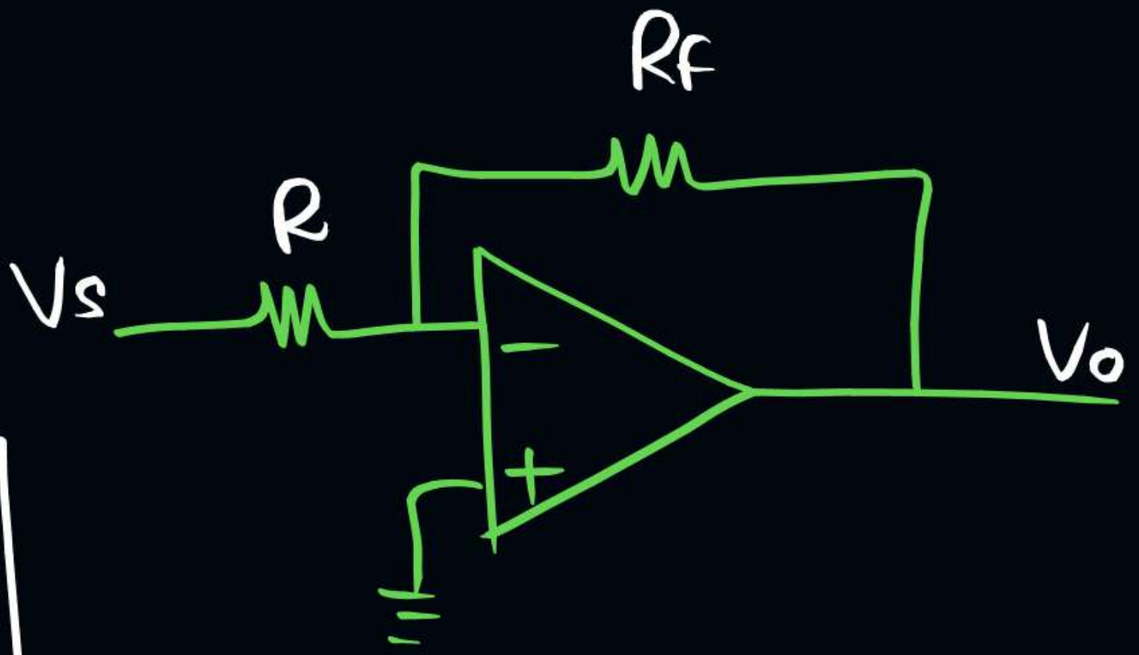
$$\because R_f = 2K\Omega \,,\; R = 1K\Omega \,,\; \underline{V_s = 1\,Volt}$$

$$V_0 = \frac{-2}{1} \cdot 1 = \underline{-2\,volt}$$ (Inverting Mode)



$A_V = \infty$ (Ideal)

$\frac{V_o}{V_i} = \infty$



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

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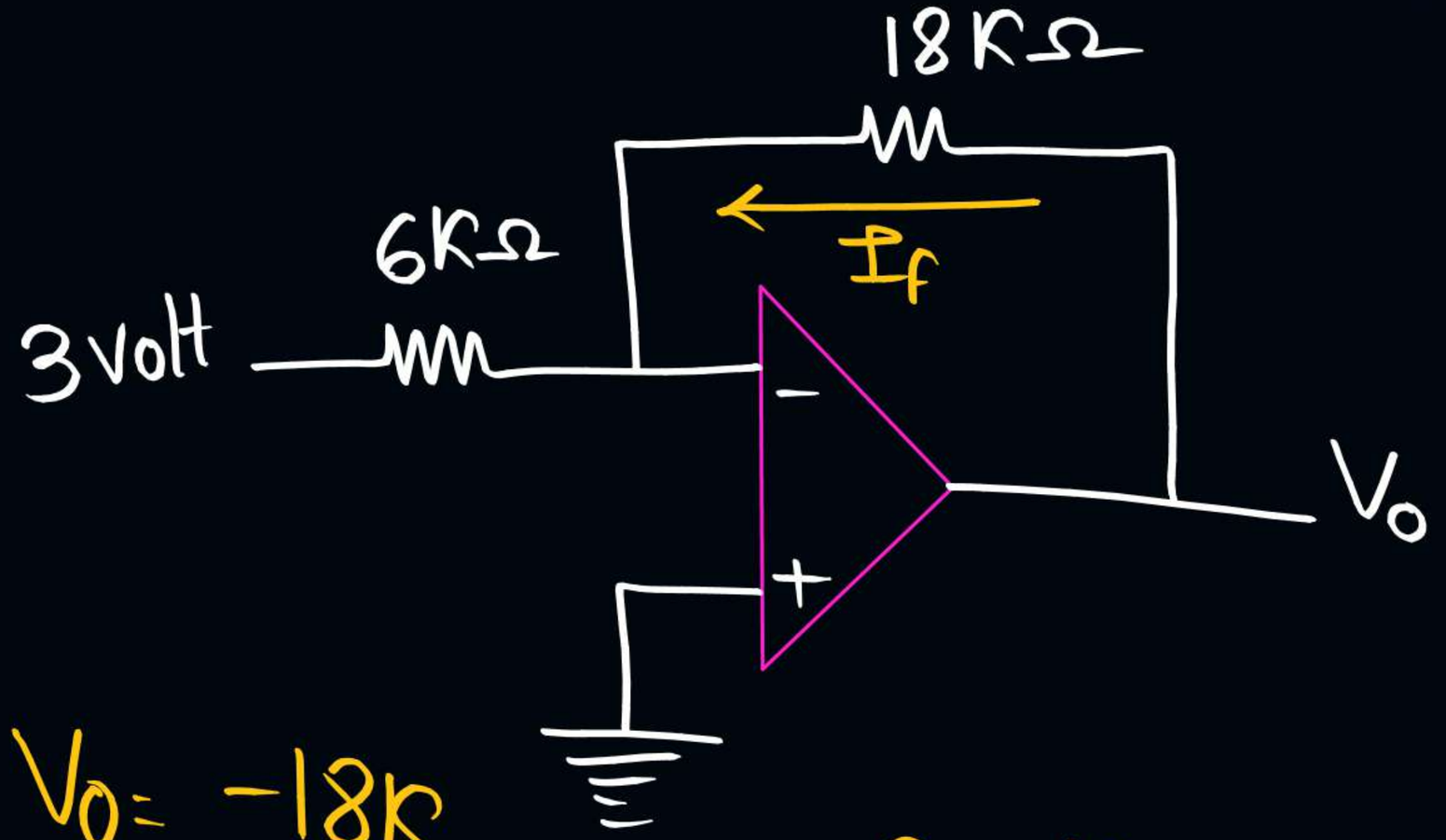
Ques:

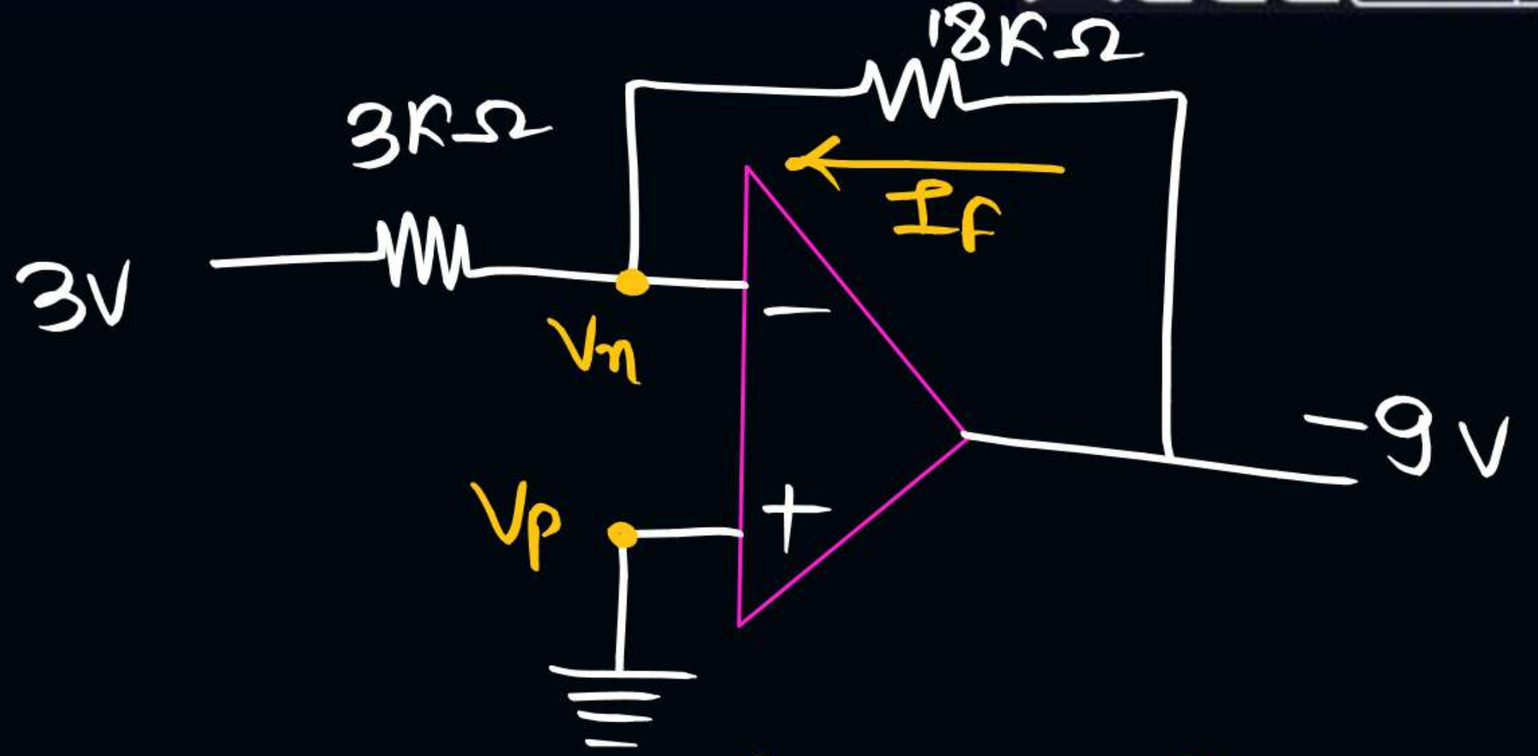


Find

$V_o = ?$

$I_f = ?$

$$V_o = -\frac{18k}{6k} \times 3v = -9 \text{ volt}$$



$$I_f = \frac{V_o - V_n}{18K}$$

$$I_f = \frac{-9 - 0}{18K}$$

$V_p = 0 = V_n$ (Virtual Short Concept)

$$I_f = \frac{-9}{18\,K}$$

$$= -\frac{1}{2}\,mA = -0.5\,mA$$

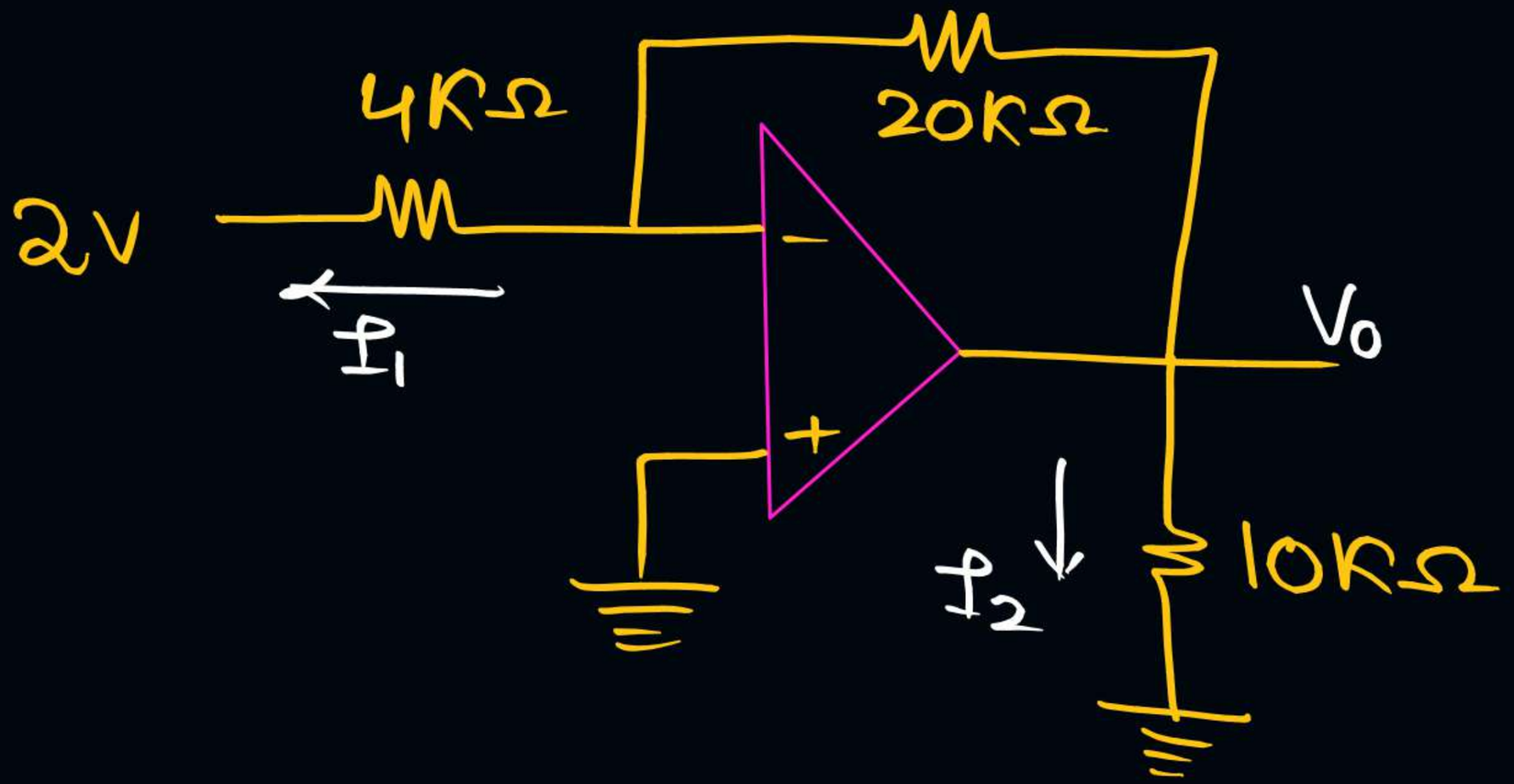
Q:

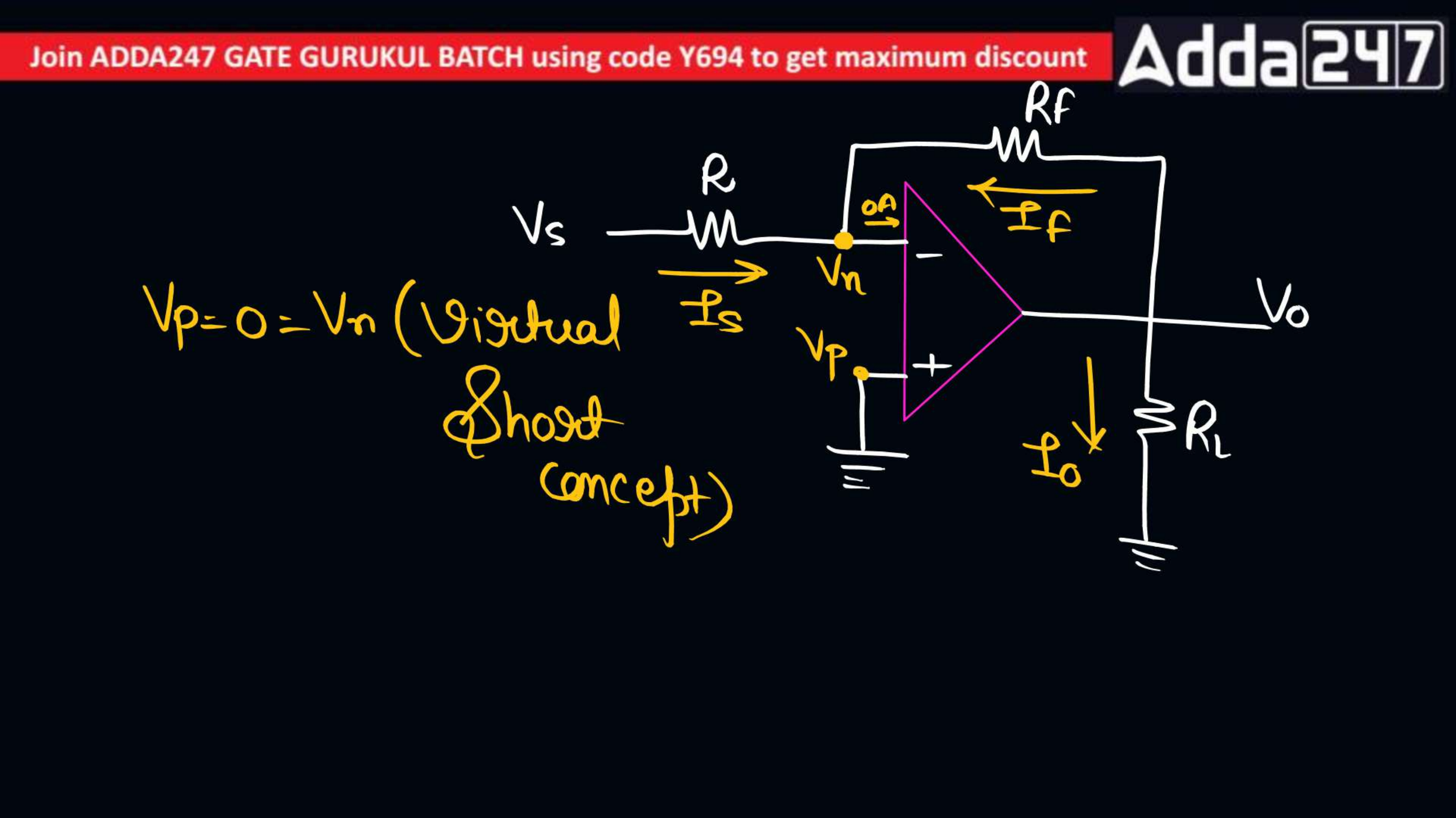
Find

$I_1 = ?$

$I_2 = ?$

$V_0 = ?$





$V_p = 0 = V_n$ (Virtual & short concept)

Apply KCL @ v_n:

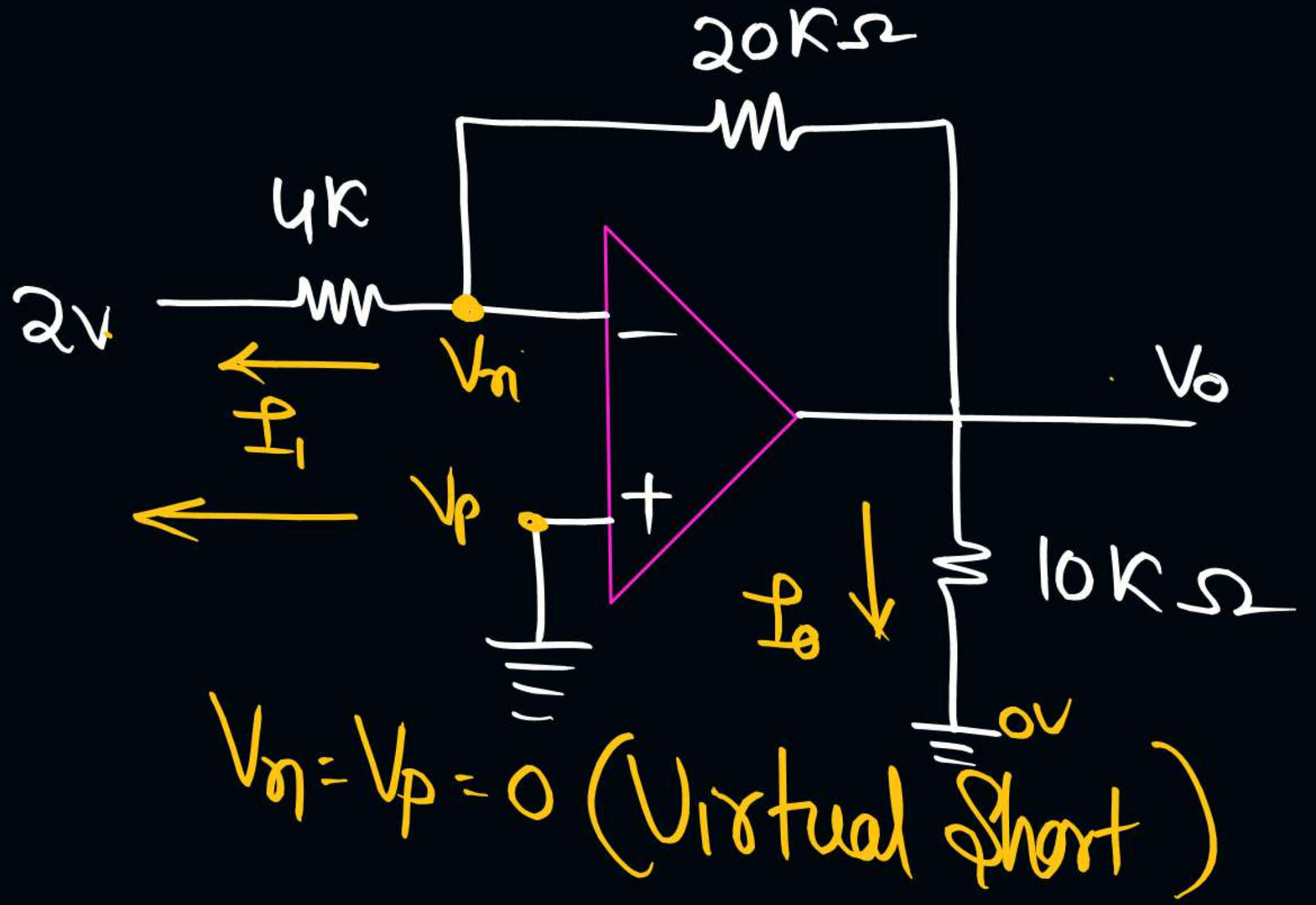
$$I_s + I_f = 0$$

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

$$\boxed{V_n = 0}$$

$$V_0 = -\frac{20K}{4K}(2V) = -5(2V)$$

$$V_0 = -10 \text{ Volt}$$



$$V_n = V_p = 0 \text{ (Virtual Short)}$$

$$I_1 = \frac{V_n - 2}{4K}$$

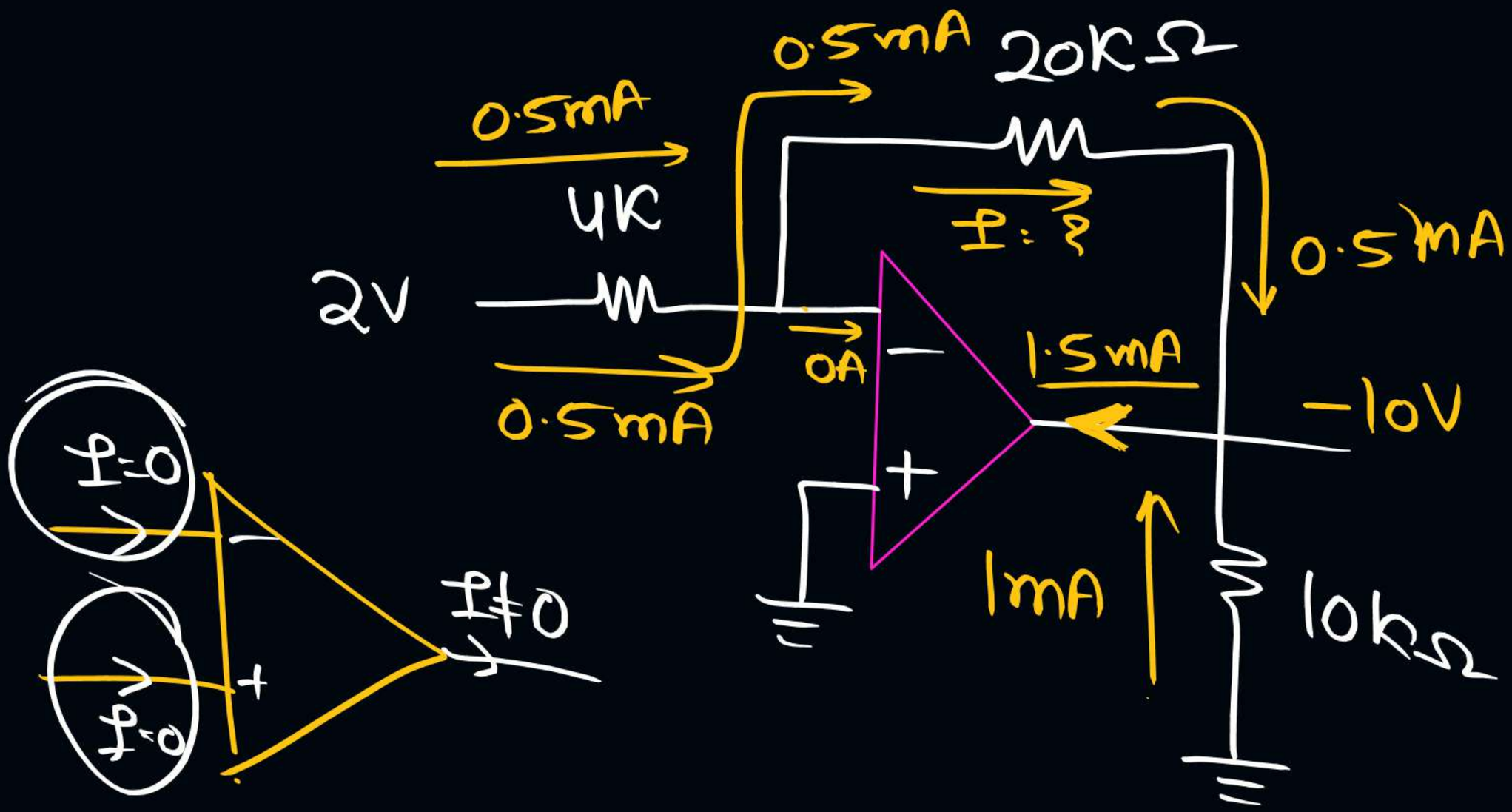
$$I_1 = \frac{0 - 2}{4K}$$

$$I_1 = -\frac{2}{4}\,mA = -0.5\,mA$$

$$I_0 = \frac{V_0 - 0}{10K\Omega}$$

$$I_0 = \frac{-10V}{10K\Omega}$$

$$\boxed{I_0 = -1mA}$$



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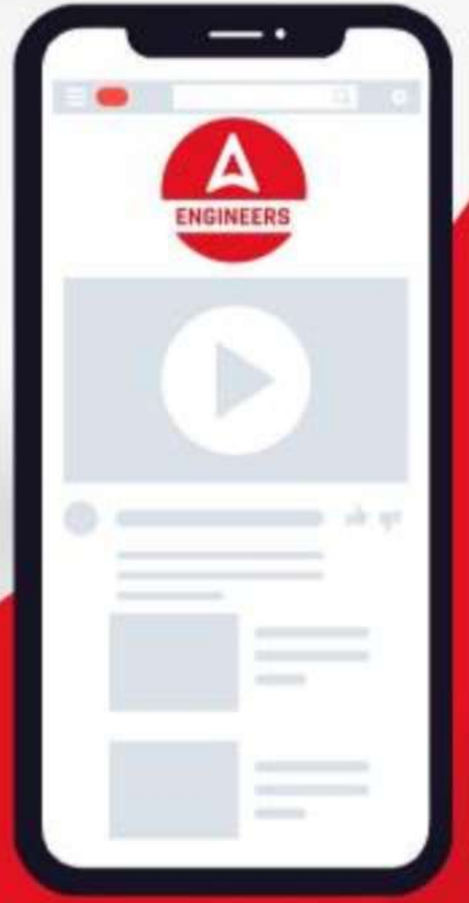

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