RRB JE | SSE 2023

Foundation Batch

Analog Electronics

Day-11

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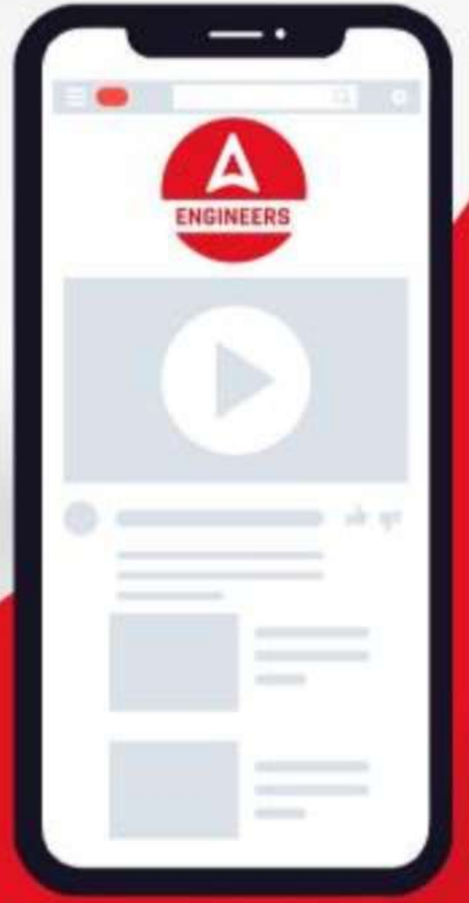

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Application of OP-Amp :

→ Summer :

→ Inverting Summer

→ Non-Inverting Summer

Voltage → $V_1 = 2V$ $V_2 = 5V$

Inverting Summer Output = -7

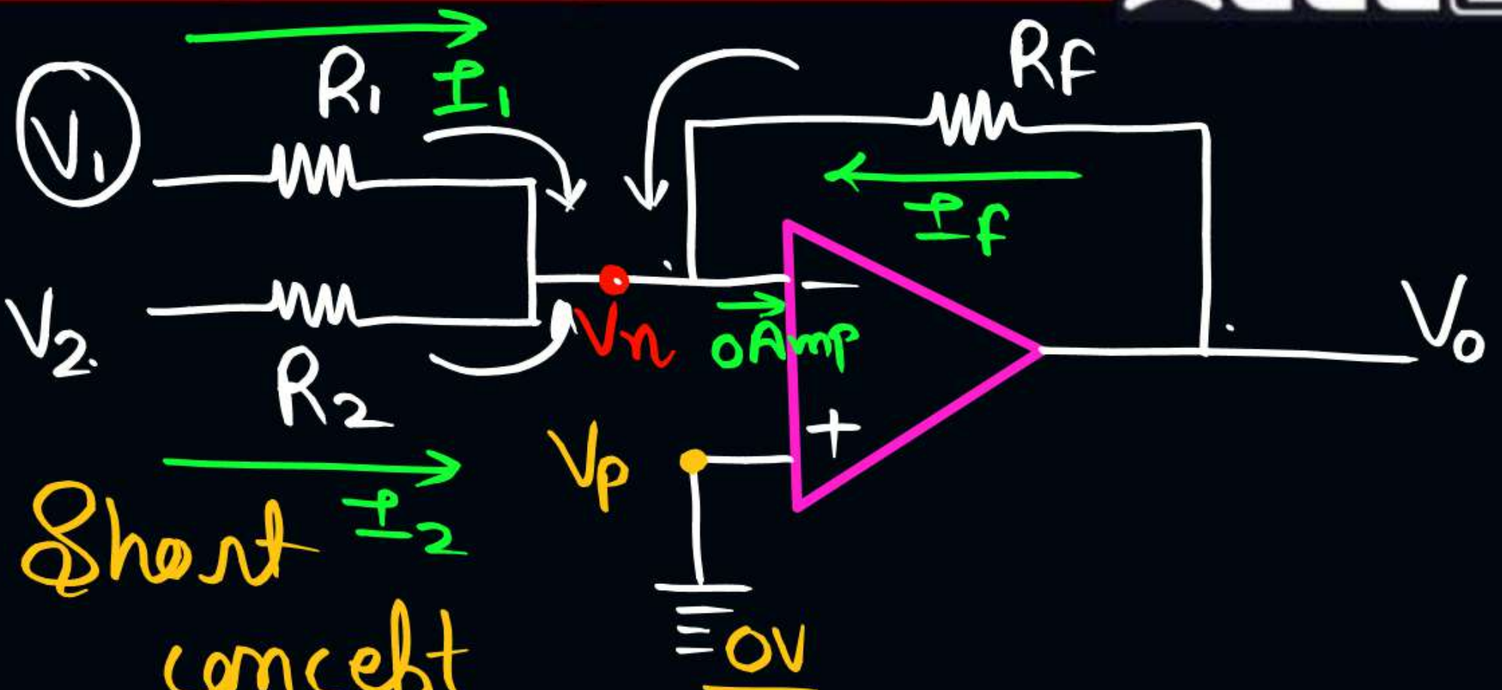
Non-Inverting Summer Output = 7

Inverting Summer:

2 Input Inverting Summer:

① V_1

② V_2



$V_p = 0 = V_n$

↳ Virtual Short concept

Apply KCL @ V_n:

$$I_1 + I_2 + I_f = 0$$

$$\frac{V_1 - V_n}{R_1} + \frac{V_2 - V_n}{R_2} + \frac{V_o - V_n}{R_f} = 0$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} + \frac{V_o}{R_f} = 0$$

$$\frac{V_o}{R_f} = -\frac{V_1}{R_1} - \frac{V_2}{R_2}$$

$$V_o = \left(-\frac{R_f}{R_1}\right) V_1 + \left(-\frac{R_f}{R_2}\right) V_2$$

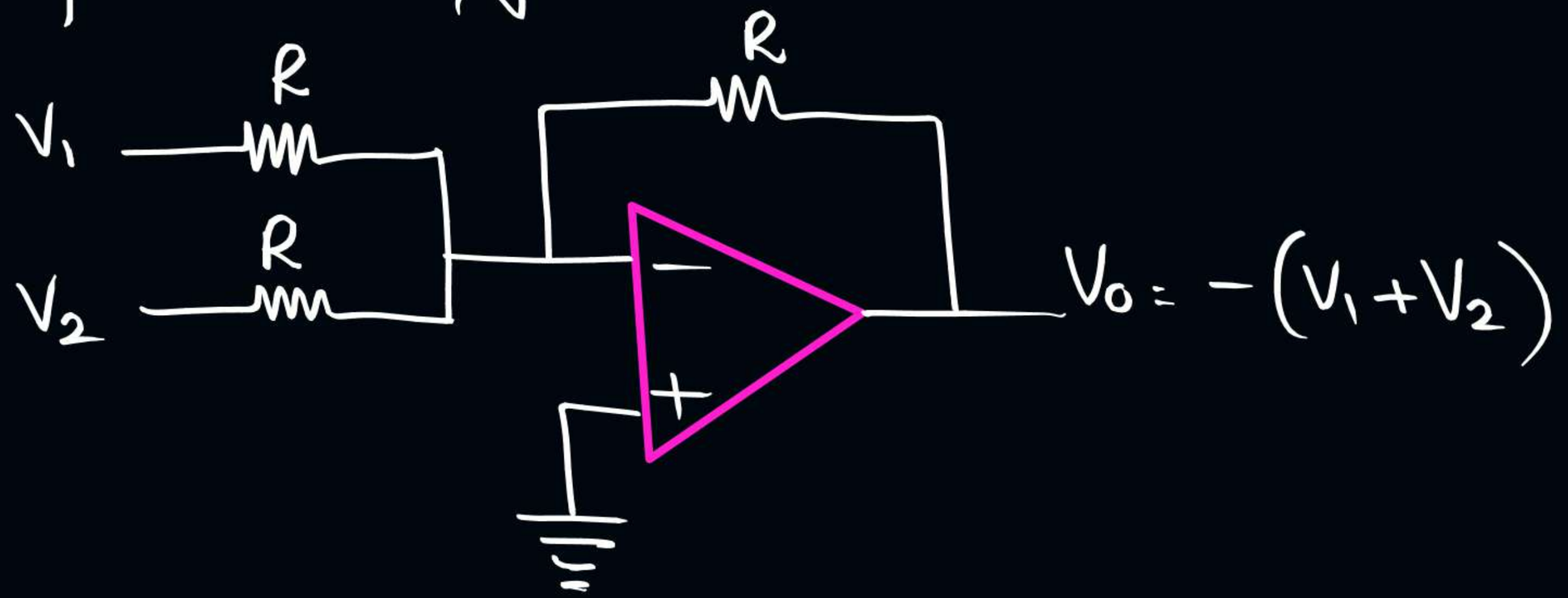
If $R_1 = R_2 = R_f = R$

$$V_0 = -\frac{R}{R} \cdot V_1 + \left(-\frac{R}{R}\right) \cdot V_2$$

$$\boxed{V_0 = -V_1 - V_2}$$

$$\boxed{V_0 = -(V_1 + V_2)} \rightarrow$$

2 Input Inverting Summer:

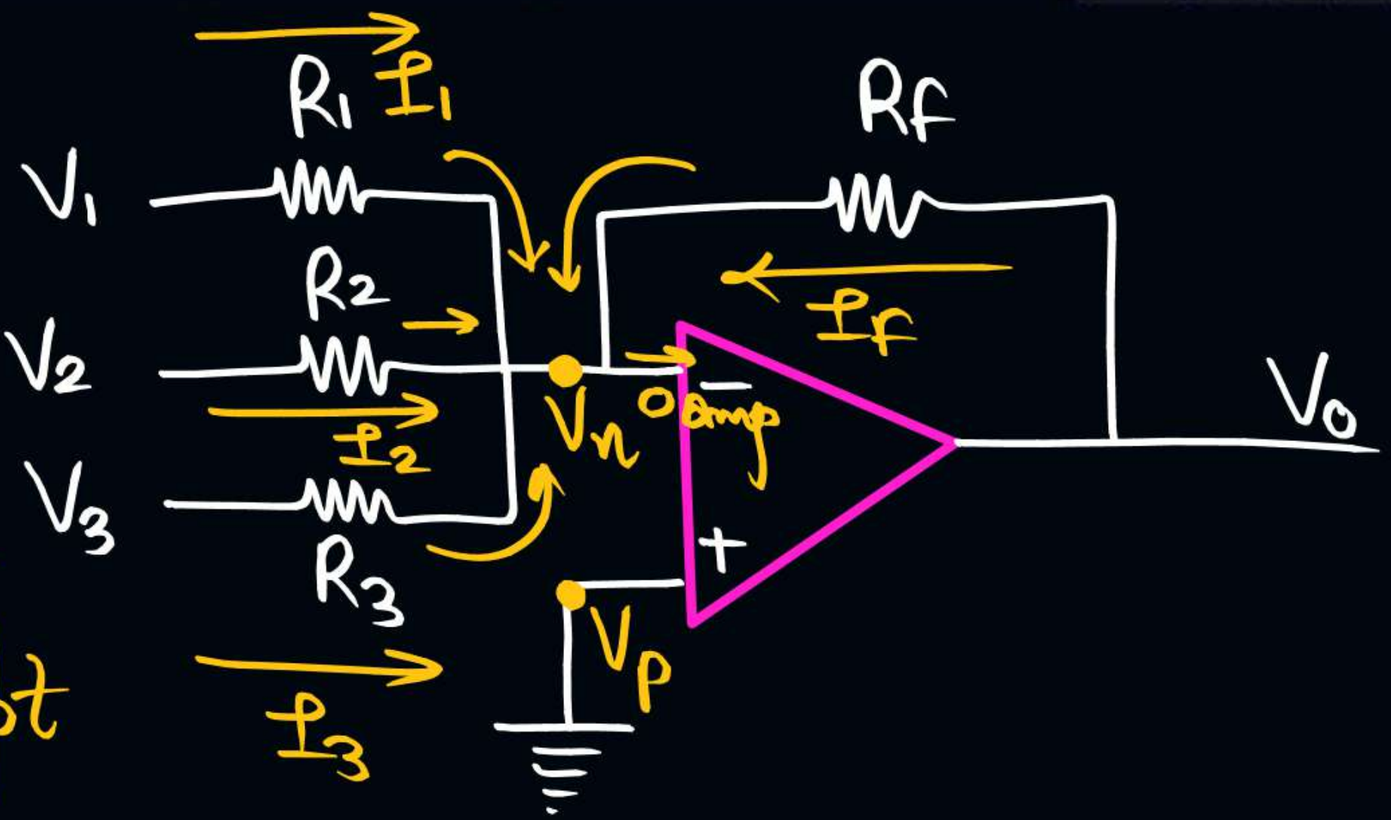


Ques: Design three input Inverting Summer and write the condition for R_1, R_2, R_3 and R_F for Inverting Summer?

$V_p = 0 = V_n$

↓

Virtual Short concept



Apply KCL @ V_n:

$$I_1 + I_2 + I_3 + I_f = 0$$

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

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

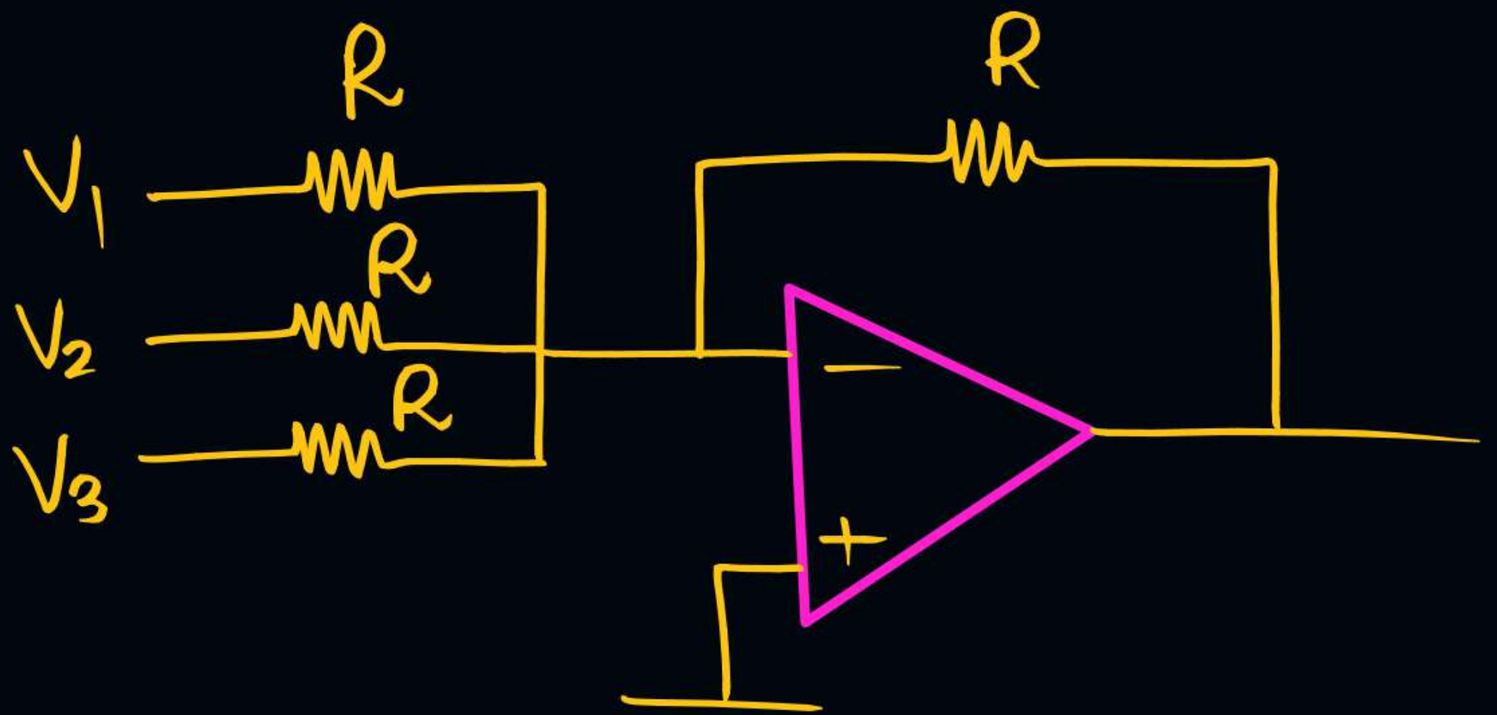
$$\frac{V_0}{R_f} = -\frac{V_1}{R_1} - \frac{V_2}{R_2} - \frac{V_3}{R_3}$$

$$\boxed{V_0 = \left(-\frac{R_f}{R_1}\right)V_1 + \left(-\frac{R_f}{R_2}\right)V_2 + \left(-\frac{R_f}{R_3}\right)\cdot V_3}$$

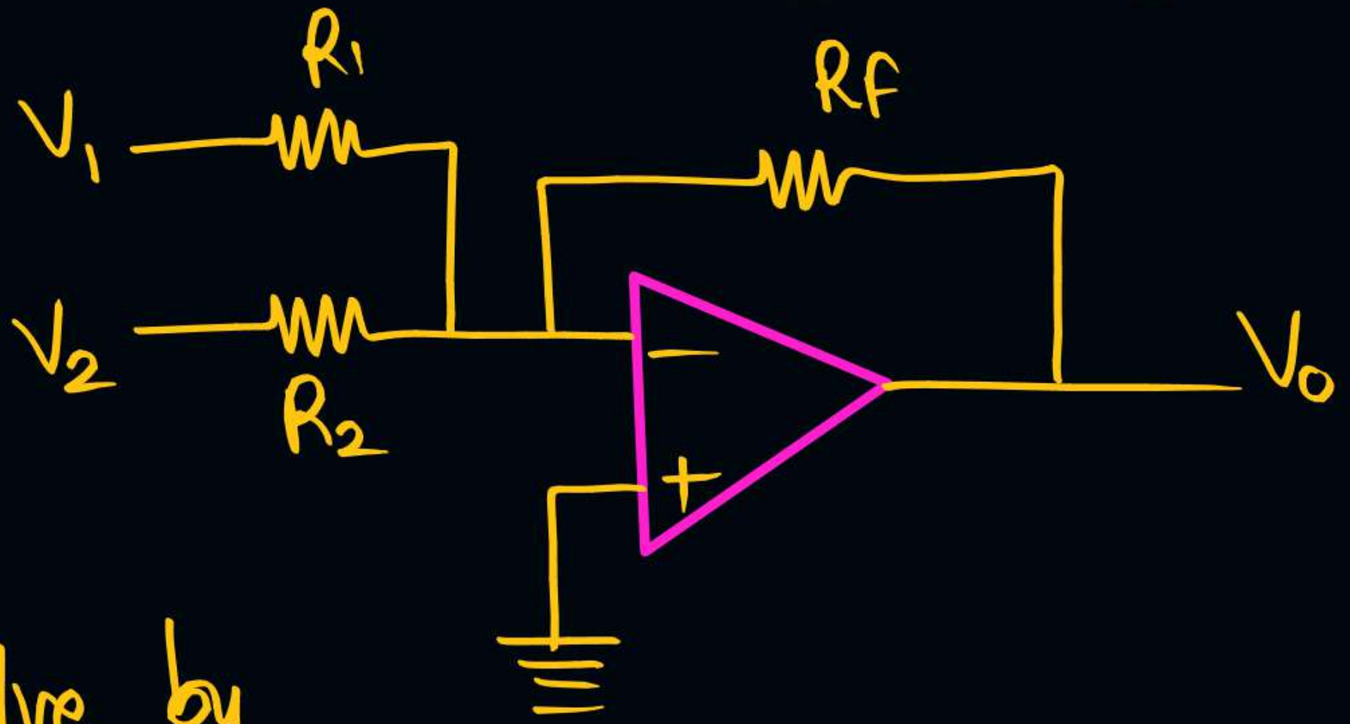
Condition for Summer:

$$R_f = R_1 = R_2 = R_3 = R$$

$$V_0 = -(V_1 + V_2 + V_3)$$



3 - Input Inverting Summer:

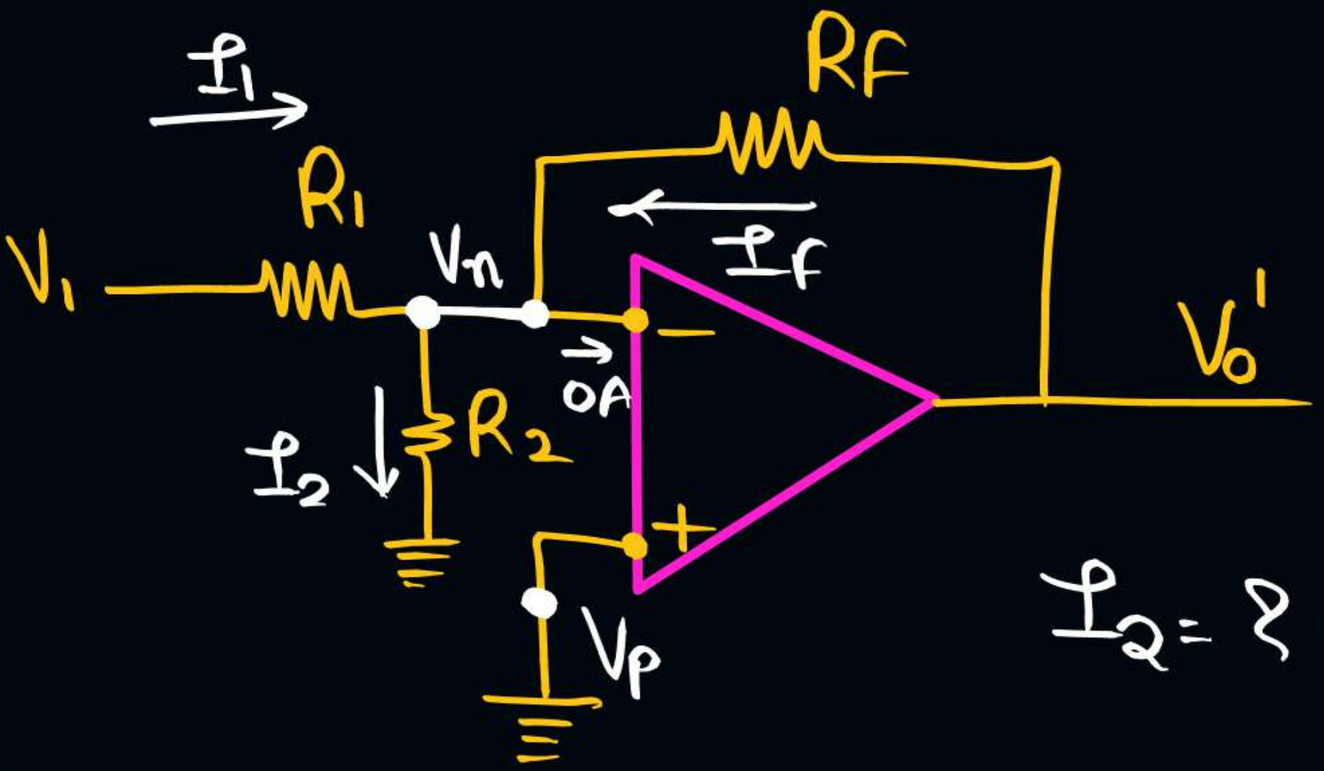


Solve by

Super-Position Theorem

$V_1 \rightarrow$ Active

$V_2 \rightarrow 0$



find $V_o' = ?$

$I_2 = ? = \frac{V_n - 0}{R_2}$

$= 0$ Amp

$V_p = 0 = V_n$

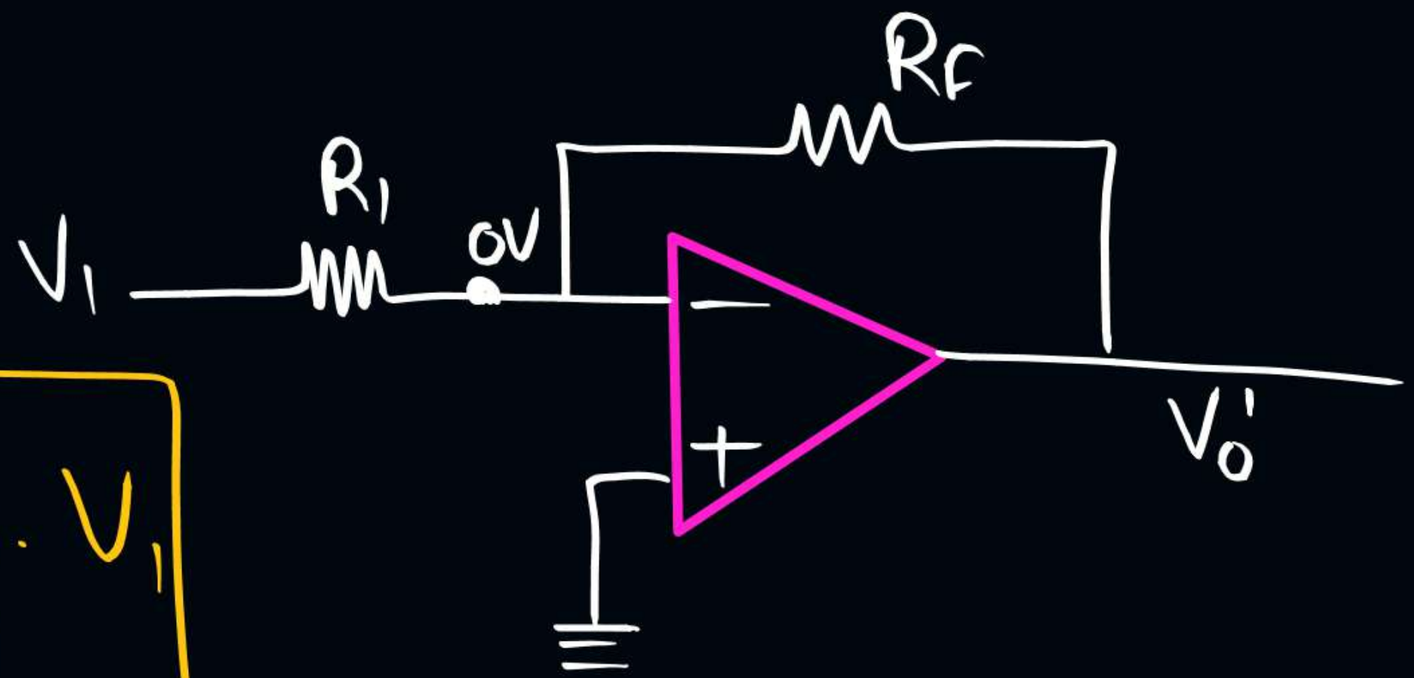
Virtual Short Concept

KCL @ V_n:

$$I_1 + I_f = 0$$

$$\frac{V_1 - V_n}{R_1} + \frac{V_0 - V_n}{R_f} = 0$$

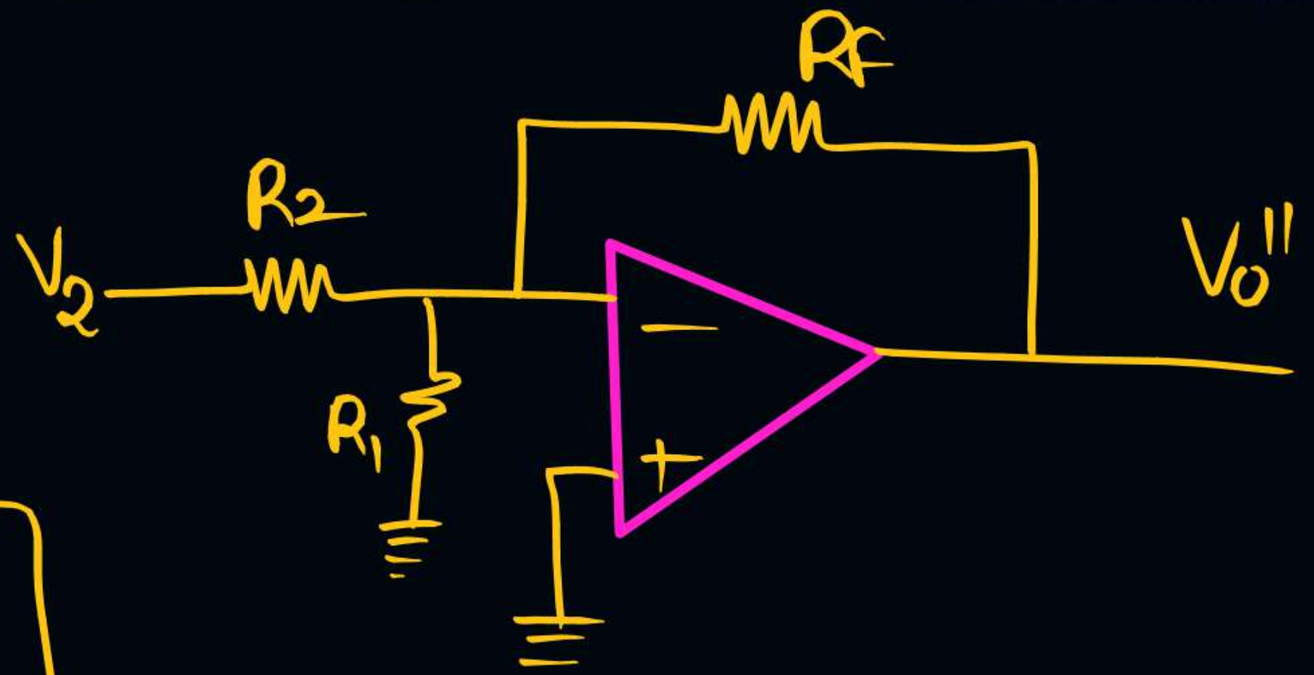
$$\boxed{V_0 = -\frac{R_f}{R_1} V_1}$$



$$V_0' = -\frac{R_f}{R_1} \cdot V_1$$

V_2 – Active

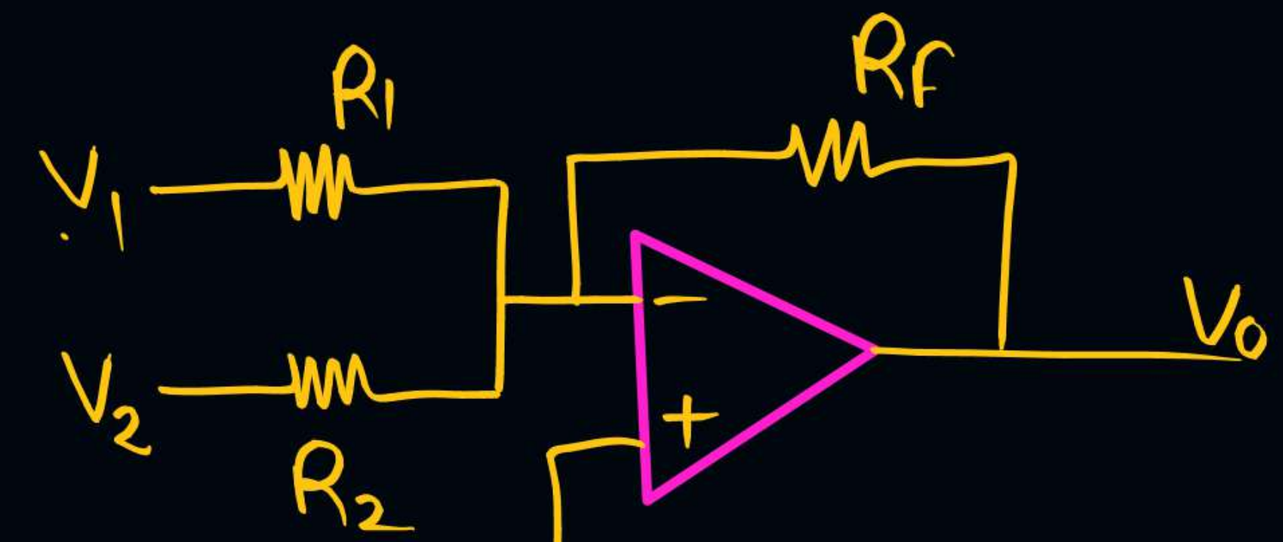
$V_1 \rightarrow$ Inactive



$$V_0'' = -\frac{R_f}{R_2} \cdot V_2$$

$$V_o = V_o' + V_o''$$

$$V_o = -\frac{R_f}{R_1} V_1 + \left(-\frac{R_f}{R_2}\right) V_2$$



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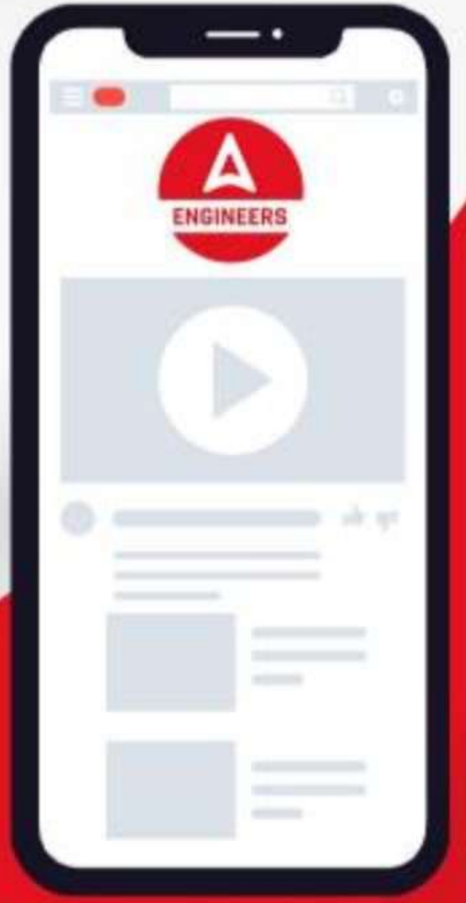

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