RRB JE | SSE 2023

Foundation Batch

Analog Electronics

Day-12

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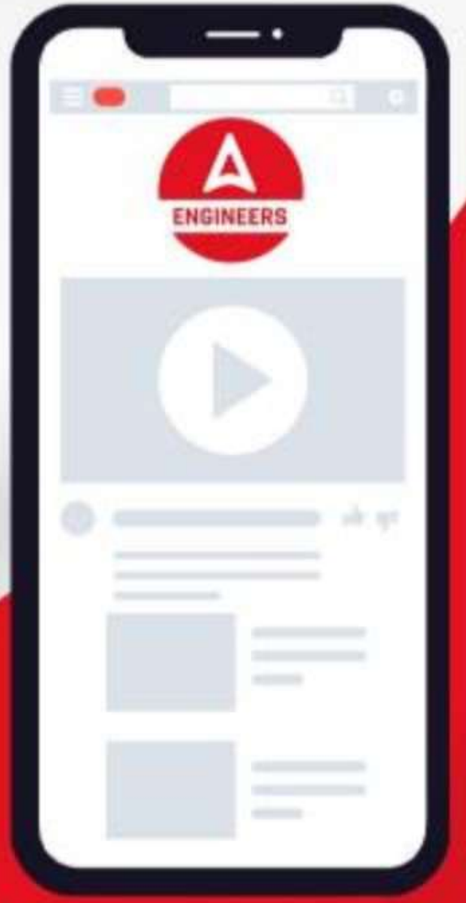

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Non Inverting Summer:

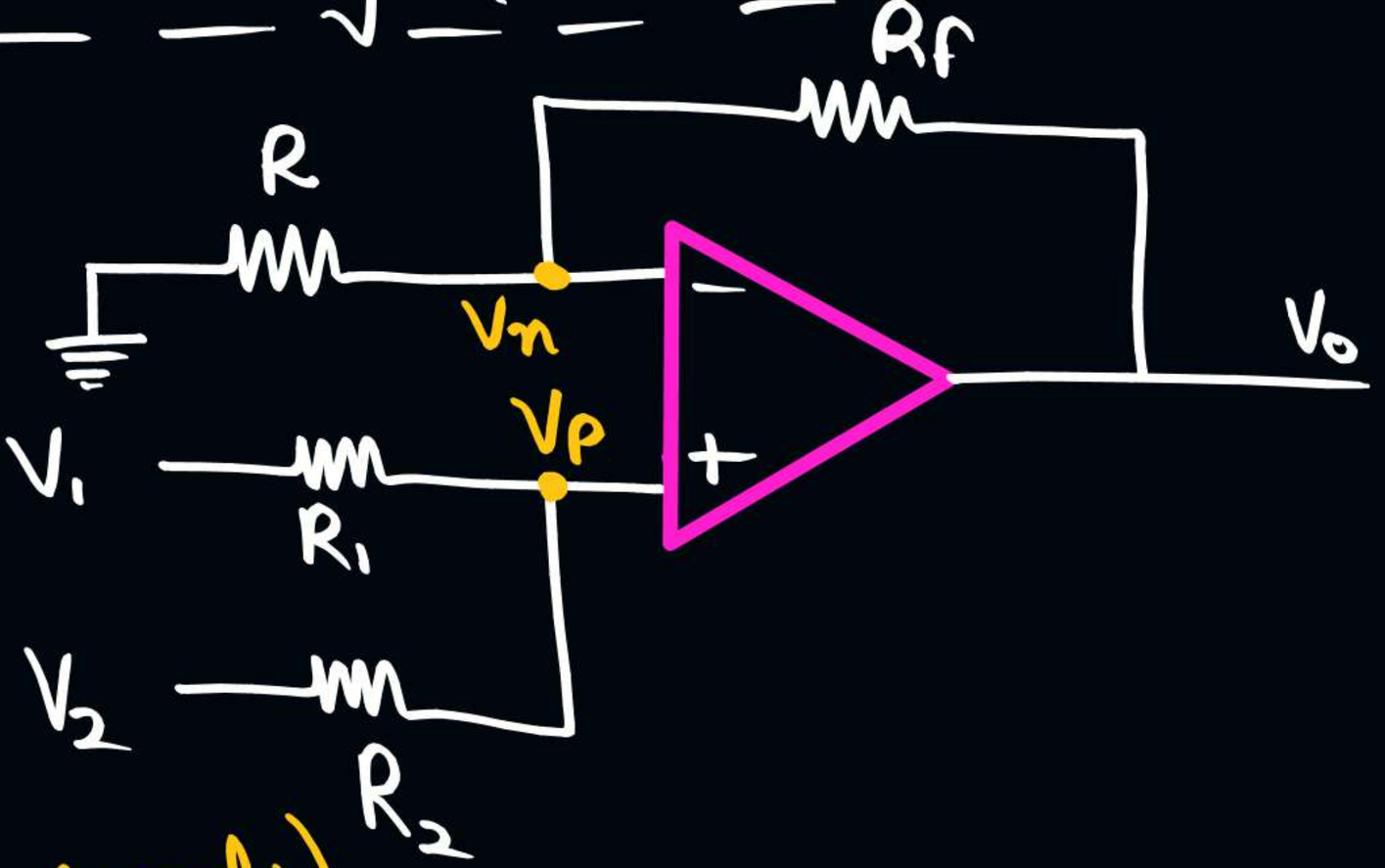
$V_1 = 4V$ & $V_2 = 3$ volt

Non-Inverting Summer o/p = 4+3

= 7 volt

Two Input Non-Inverting Summer:

Find $V_0 = ?$

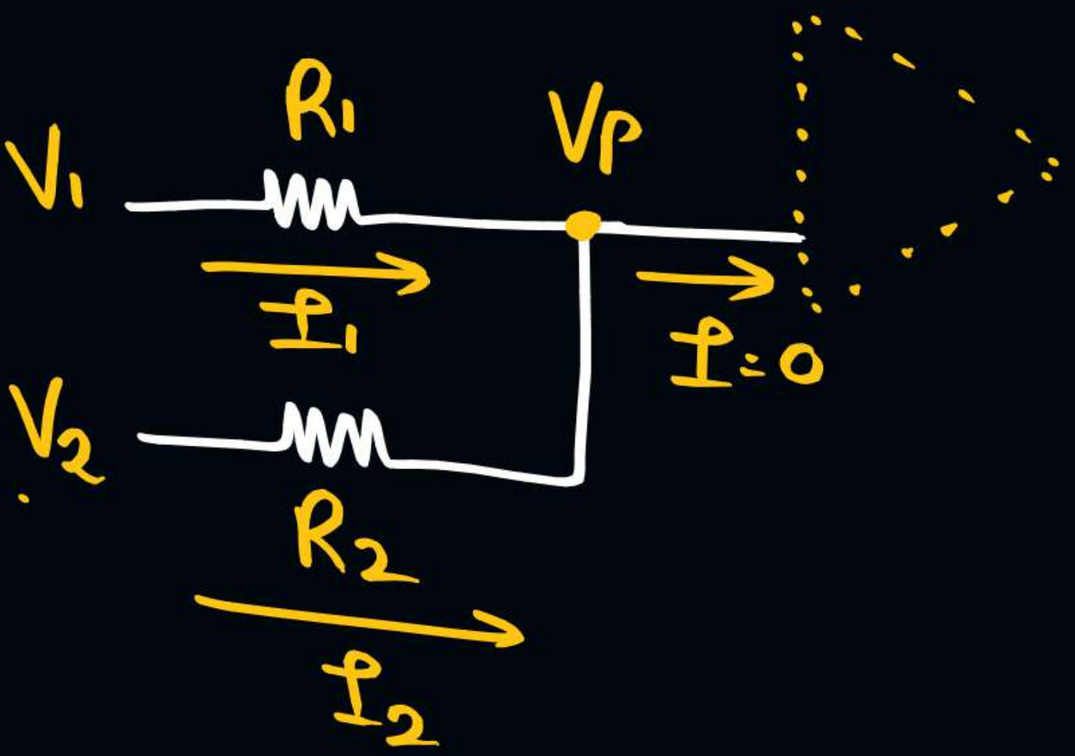


$V_n = V_p$ (Virtual Short concept)

KCL @ V_P :

$$I_1 + I_2 = 0$$

$$\frac{V_1 - V_P}{R_1} + \frac{V_2 - V_P}{R_2} = 0$$



$$\frac{V_1 - V_P}{R_1} + \frac{V_2 - V_P}{R_2} = 0$$

$$\frac{V_1}{R_1} + \frac{V_2}{R_2} - \frac{V_P}{R_1} - \frac{V_P}{R_2} = 0$$

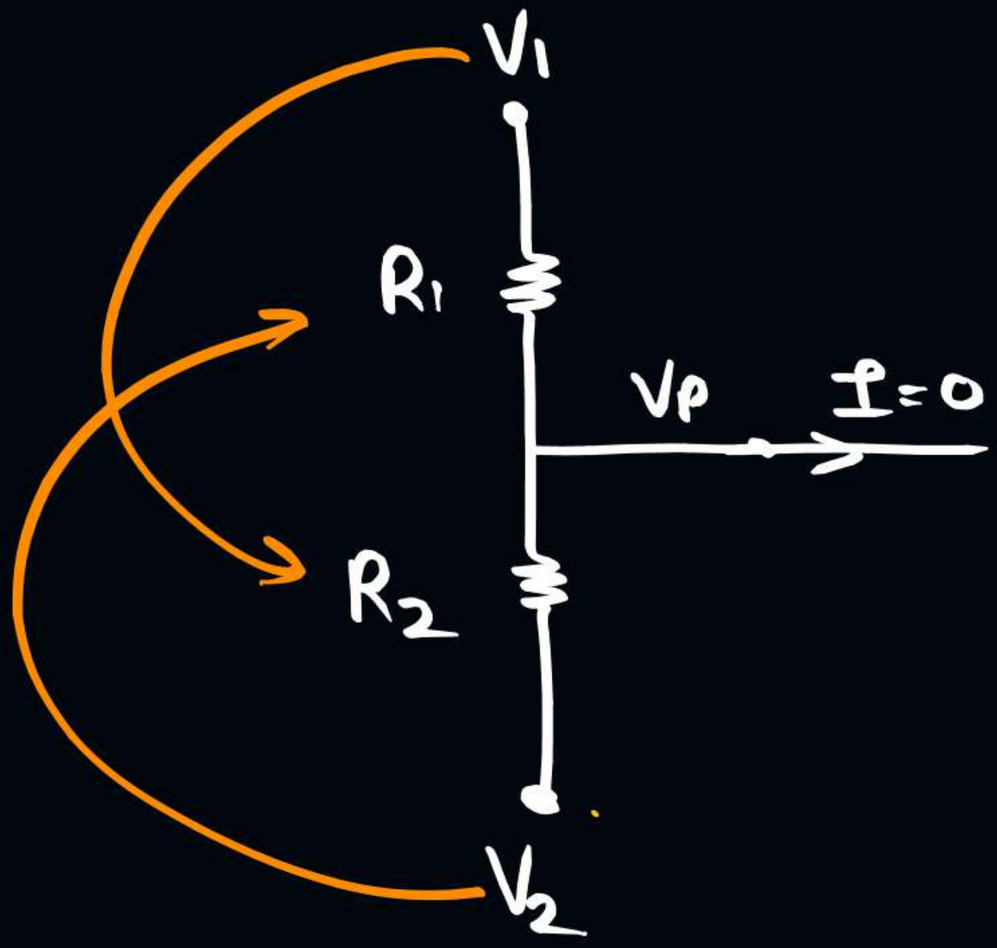
$$\frac{V_1}{R_1} + \frac{V_2}{R_2} = \frac{V_P}{R_1} + \frac{V_P}{R_2}$$

$$\frac{V_1 \cdot R_2 + V_2 R_1}{\cancel{R_1 R_2}} = \frac{V_p R_2 + V_p \cdot R_1}{\cancel{R_1 R_2}}$$

$$V_p (R_1 + R_2) = V_1 R_2 + V_2 \cdot R_1$$

$$\star \quad \boxed{V_p = \frac{V_1 \cdot R_1}{R_1 + R_2} + \frac{V_2 \cdot R_1}{R_1 + R_2}}$$

$$V_p = \frac{V_1 \cdot R_2 + V_2 \cdot R_1}{R_1 + R_2}$$

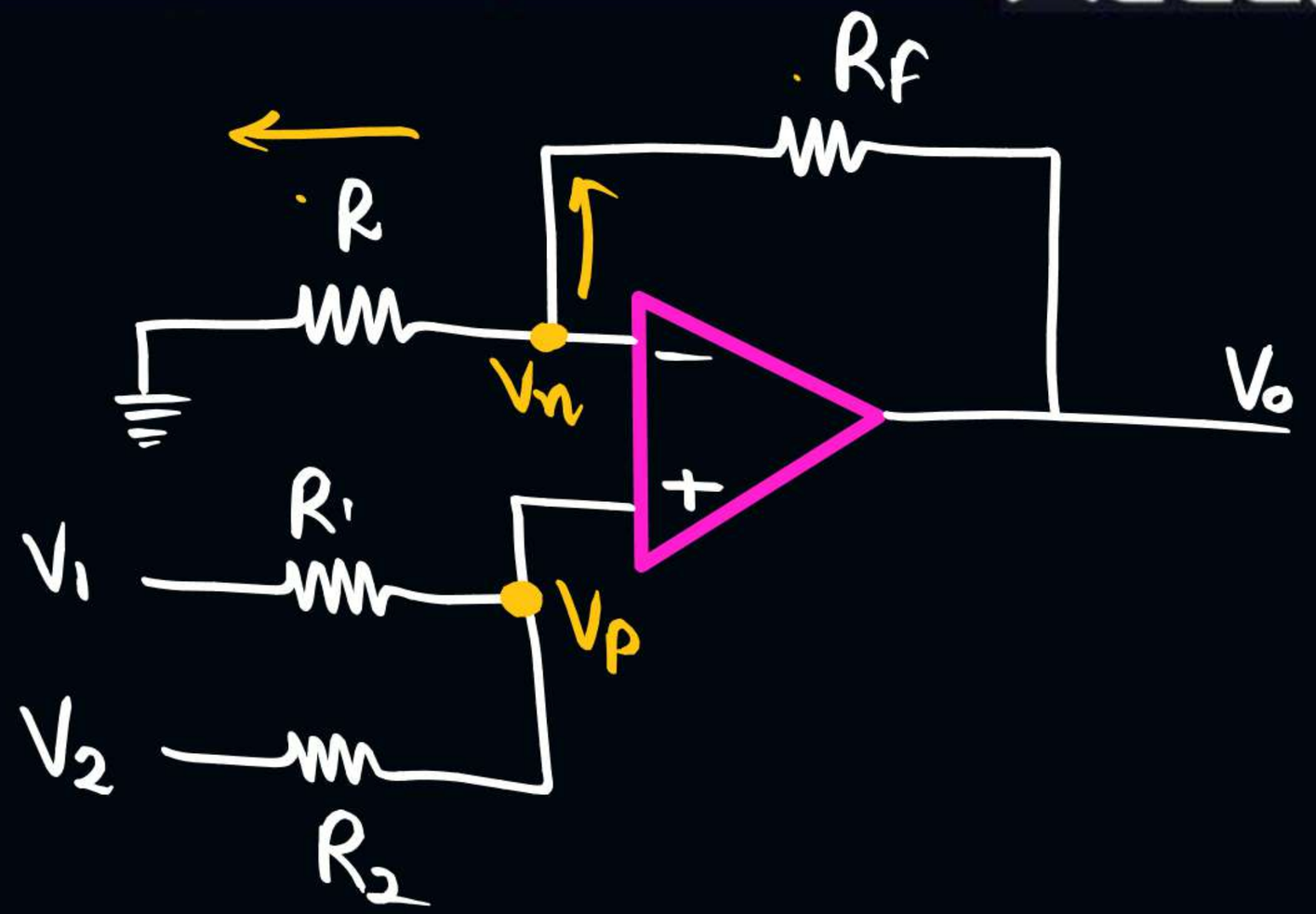


If: $R_1 = R_2 = R'$

$$V_p = \frac{V_1 \cdot R' + V_2 \cdot R'}{2R'}$$

$$V_p = \frac{V_1 + V_2}{2}$$

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



Nodal @ V_n:

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

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

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

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

$\because V_n = V_p$

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

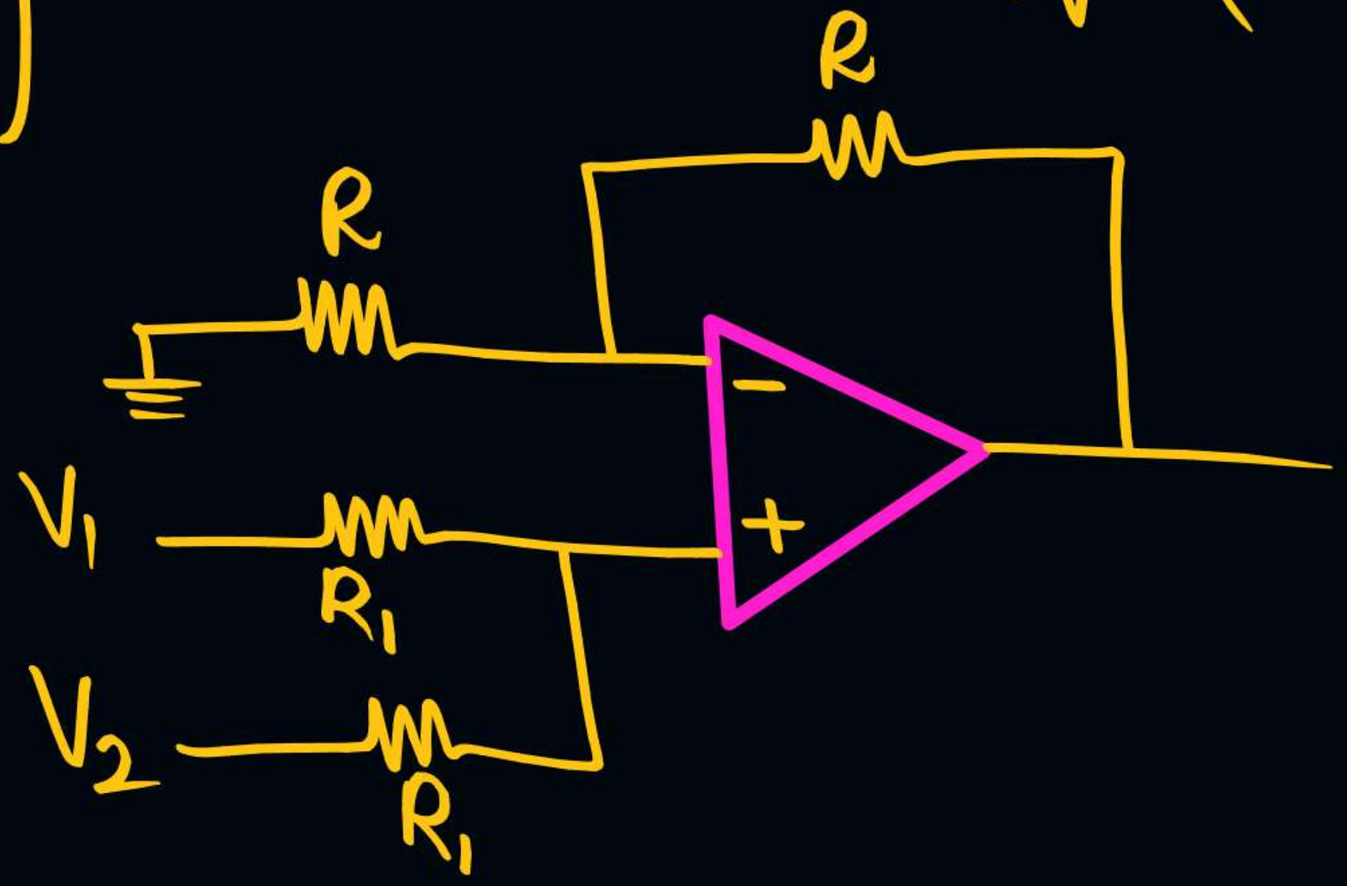
$$V_0 = \frac{V_1 + V_2}{2}\left(1 + \frac{R_f}{R}\right)$$

If $R_f = R = R''$

$$V_0 = \frac{V_1 + V_2}{2}\left(1 + \frac{R''}{R''}\right) = V_1 + V_2$$

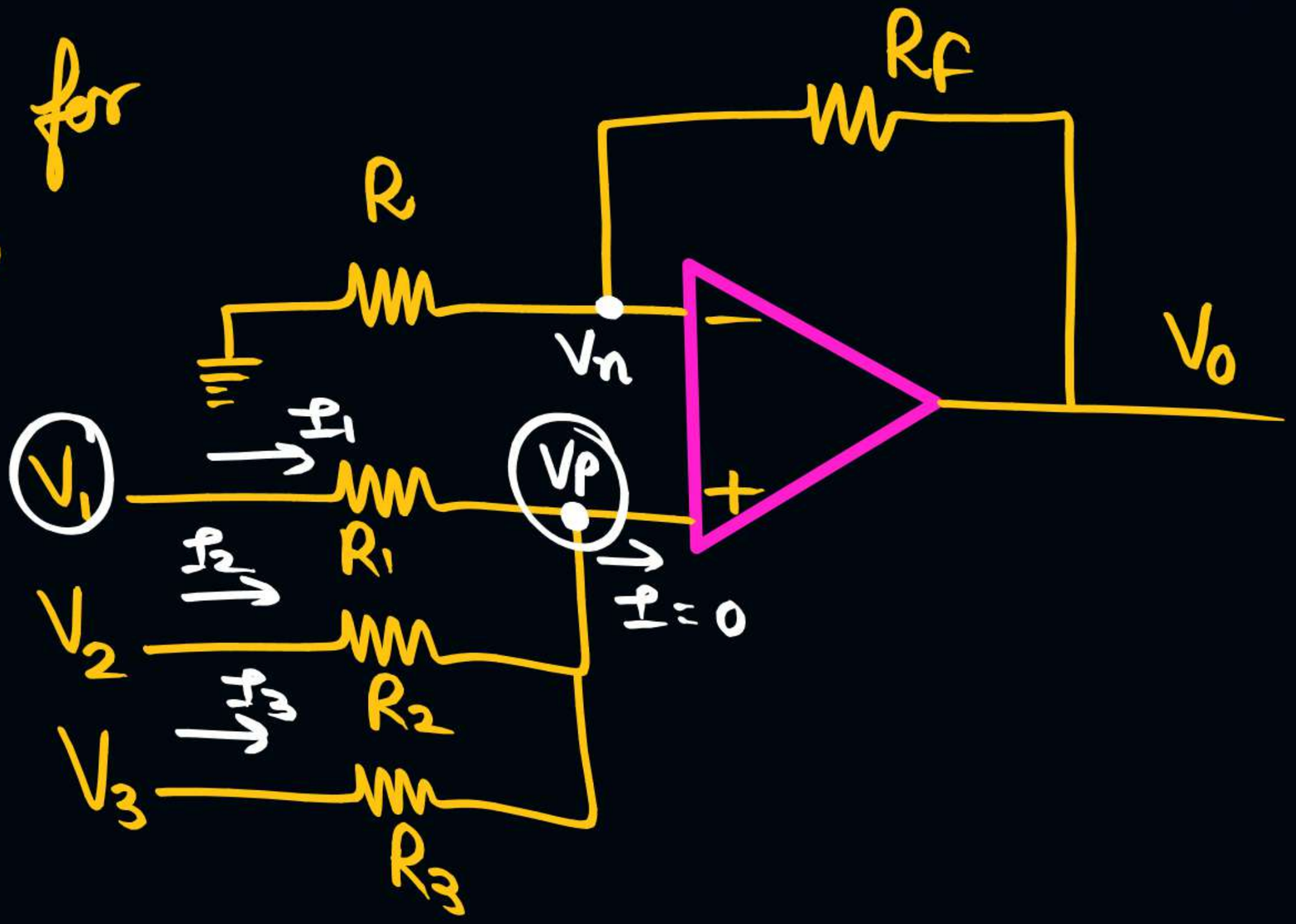
Two Input Non-Inverting Summer:

$$V_0 = V_1 + V_2$$



Find condition for Resistance to get output Voltage

$V_0 = V_1 + V_2 + V_3$



KCL @ V_P:

$$I_1 + I_2 + I_3 = 0$$

$$\frac{V_1 - V_P}{R_1} + \frac{V_2 - V_P}{R_2} + \frac{V_3 - V_P}{R_3} = 0$$

If $R_1 = R_2 = R_3 = R'$

$$\frac{V_1 - V_p}{R'} + \frac{V_2 - V_p}{R'} + \frac{V_3 - V_p}{R'} = 0$$

$$\frac{V_1 - V_p + V_2 - V_p + V_3 - V_p}{R'} = 0$$

$$V_1 + V_2 + V_3 - 3V_p = 0$$

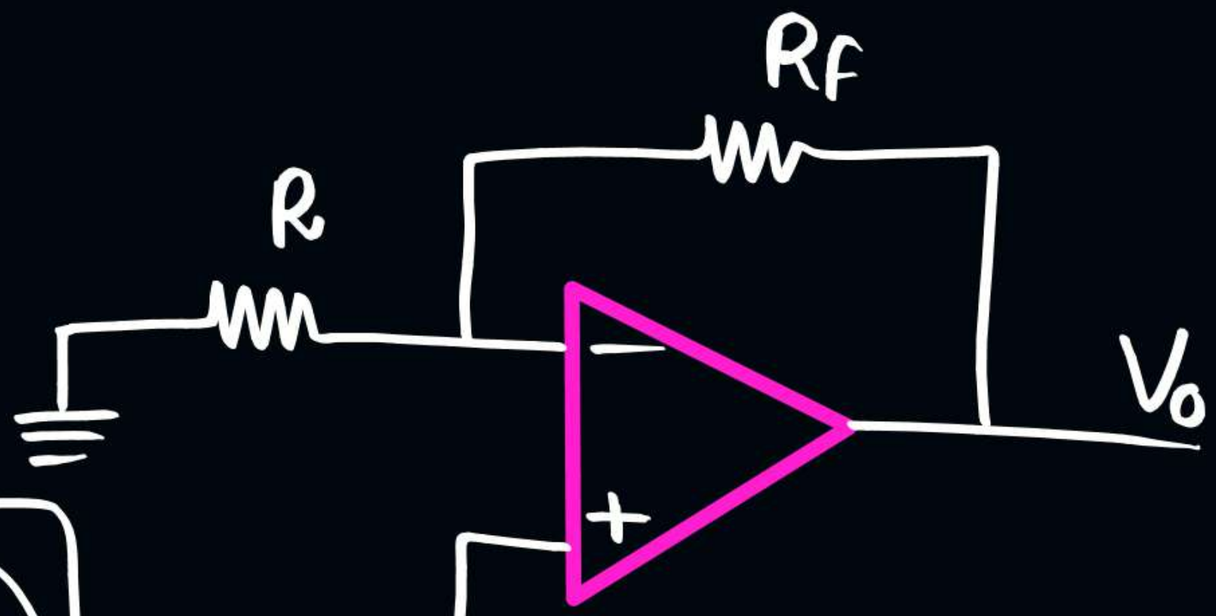
$$3V_p = V_1 + V_2 + V_3$$

$$\boxed{V_p = \frac{V_1 + V_2 + V_3}{3}}$$

***

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

$$\boxed{V_o = \frac{V_1 + V_2 + V_3}{3}\left(1 + \frac{R_f}{R}\right)}$$



$$V_p = \frac{V_1 + V_2 + V_3}{3}$$

for Summer: $R_f = 2R$

$$V_0 = \frac{V_1+V_2+V_3}{3}\left(1+\frac{2R}{R}\right)$$

$$\boxed{V_0 = V_1+V_2+V_3} \rightarrow$$

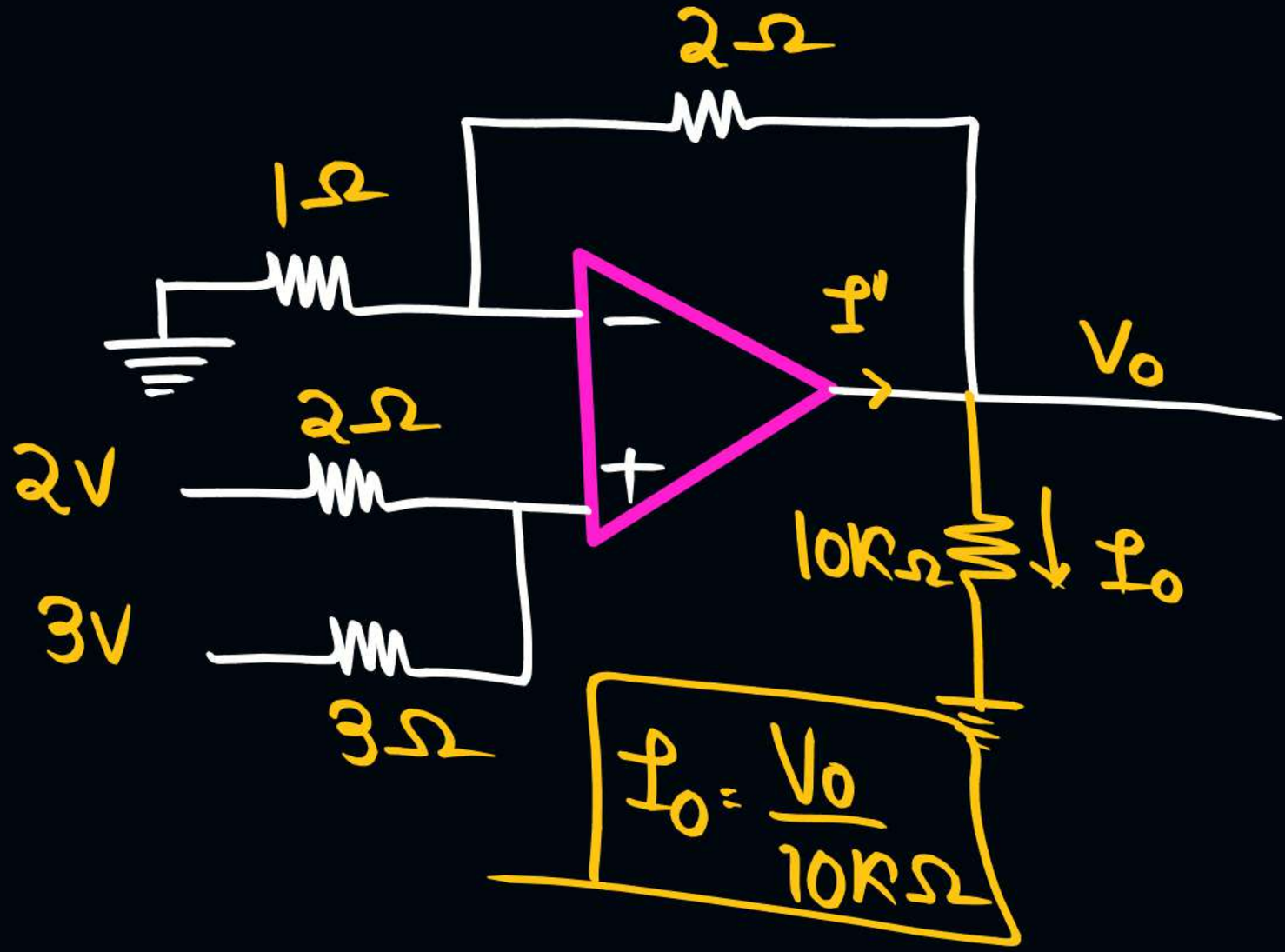
Ques:

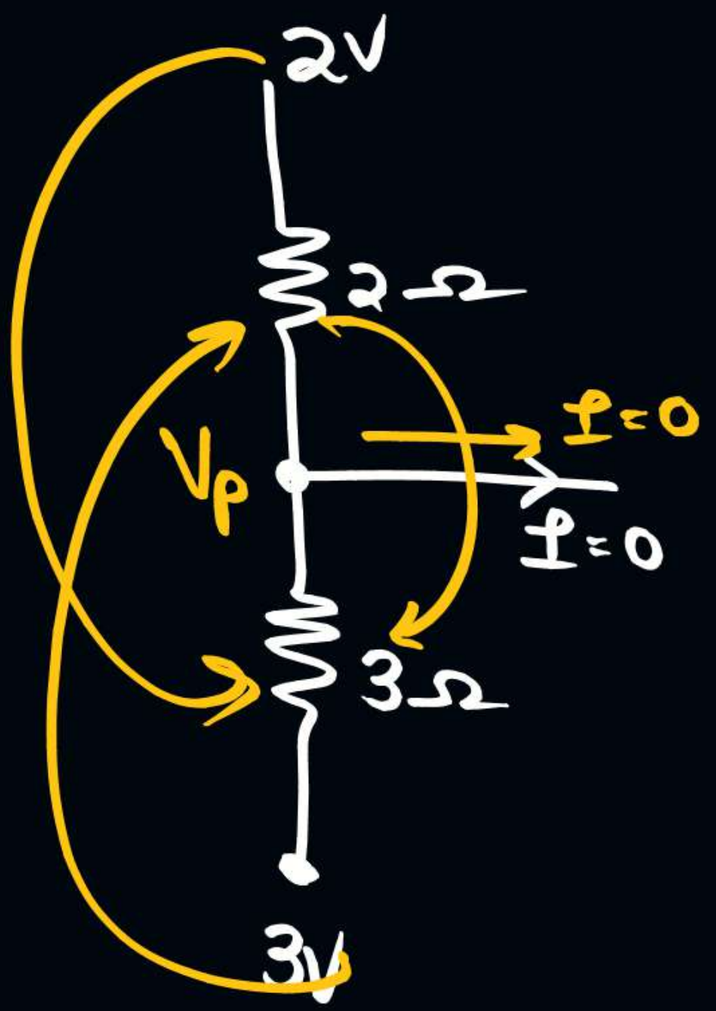
Find

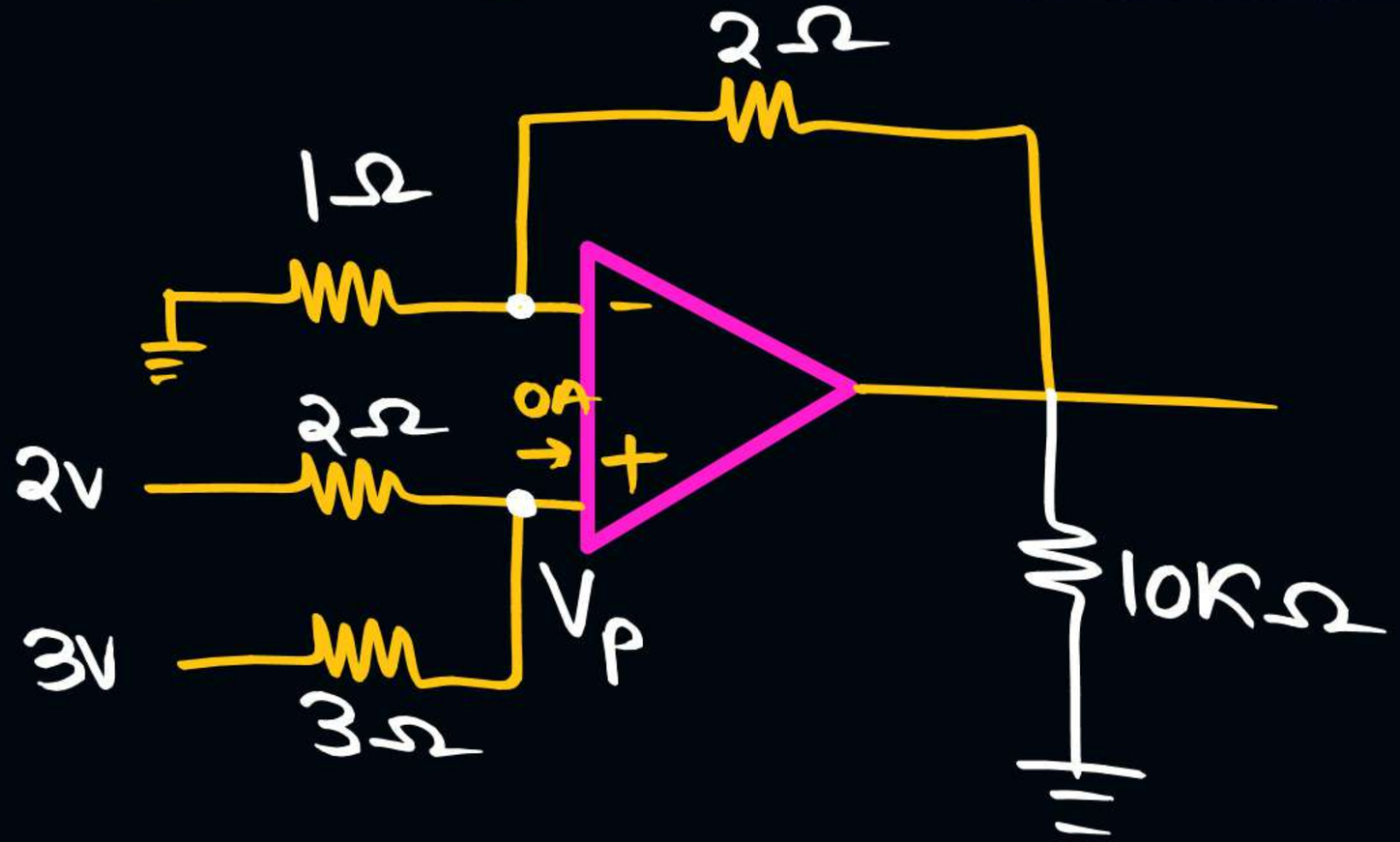
$V_o = ?$

$I_o = ?$

$I' = ?$







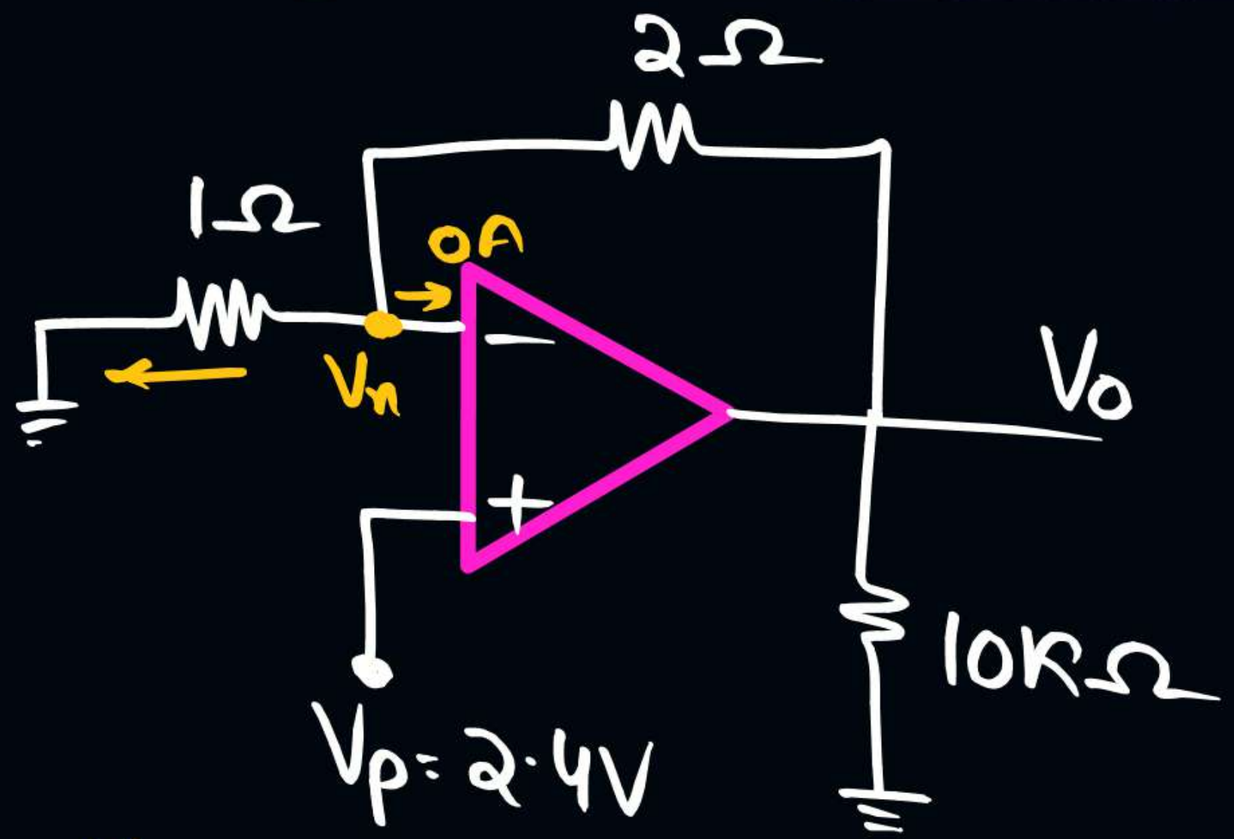
$$V_p = \frac{2 \times 3 + 3 \times 2}{2 + 3}$$

$$V_p = \frac{6+6}{5} = \frac{12}{5} = 2.4 \text{ volt}$$

$V_n = V_p = 2.4$

↓

Virtual Short concept :



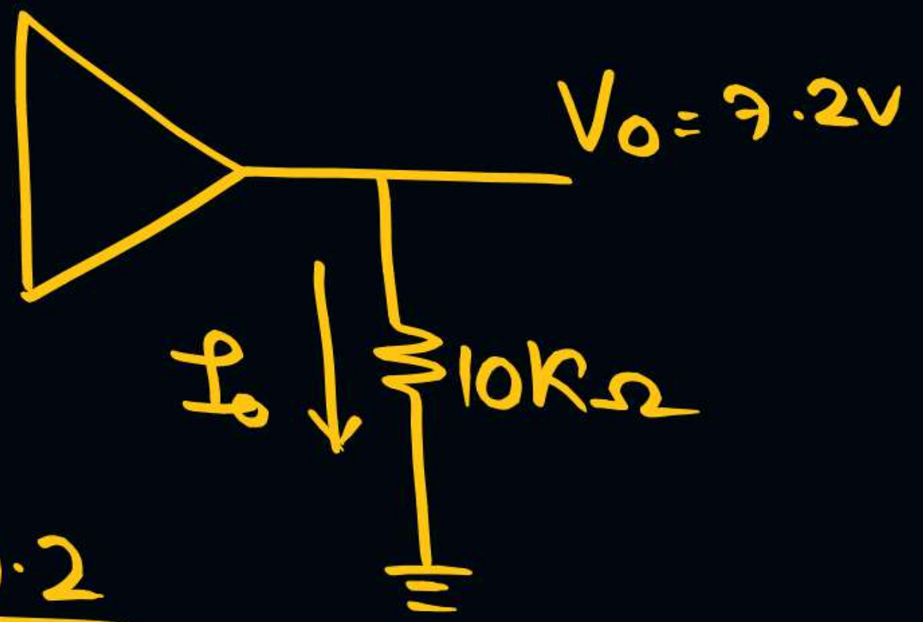
Nodal @ V_n :

$$\frac{V_n - 0}{1} + \frac{V_n - V_o}{2} = 0$$

$$\frac{2.4}{1} + \frac{2.4 - V_0}{2} = 0$$

$$\frac{4.8 + 2.4 - V_0}{2} = 0$$

$V_0 = 7.2$ Volt



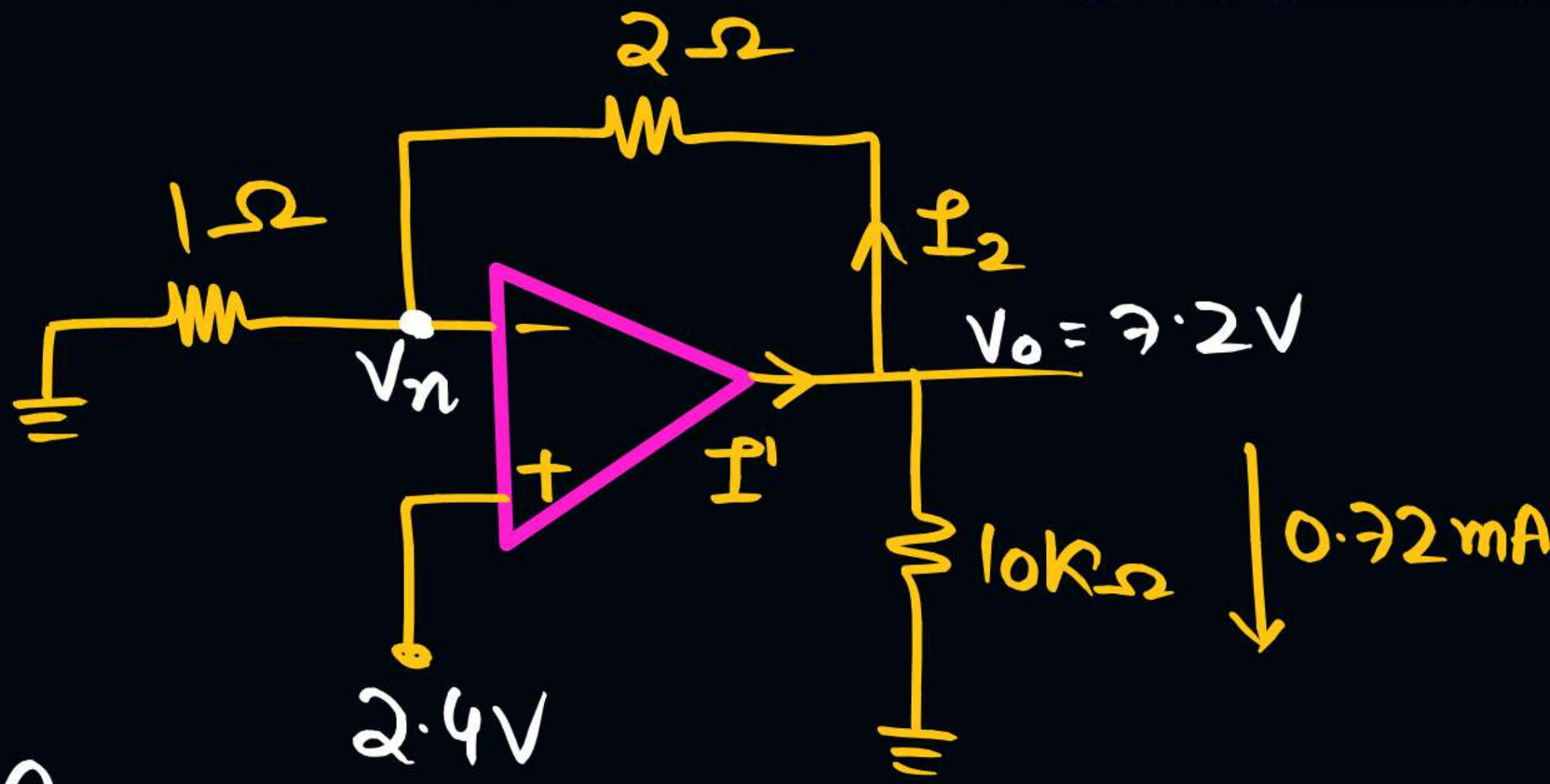
$$I_0 = \frac{7.2}{10K}$$

$I_0 = 0.72$ mA

$$I_2 = \frac{V_0 - V_n}{2\Omega}$$

$$= \frac{7.2 - 2.4}{2}$$

$$= \frac{4.8}{2} = 2.4 \text{ Amp}$$



$$I' = I_2 + I_0$$

$$= 2.4 + 0.72\ mA$$

$$= 2.4 + 0.00072\ Amp$$

$$I' = 2.40072\ Amp$$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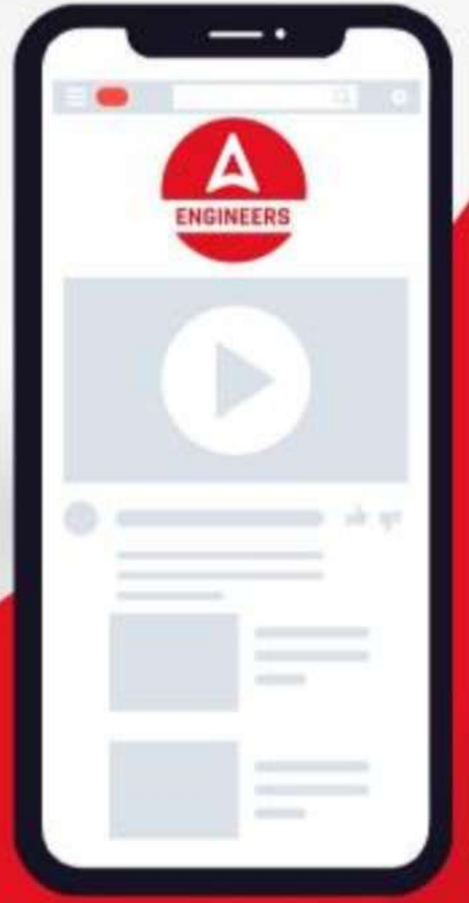

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