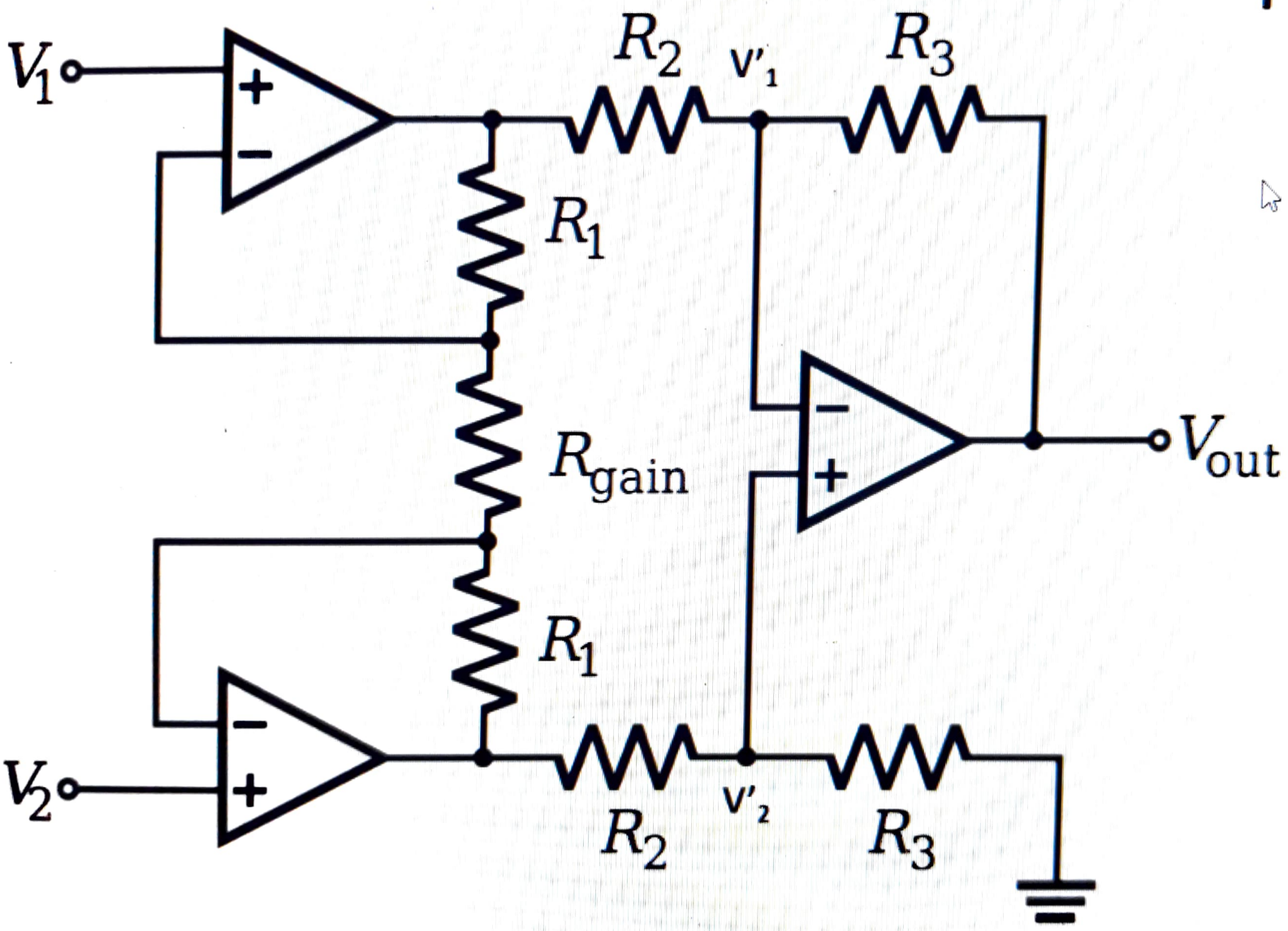
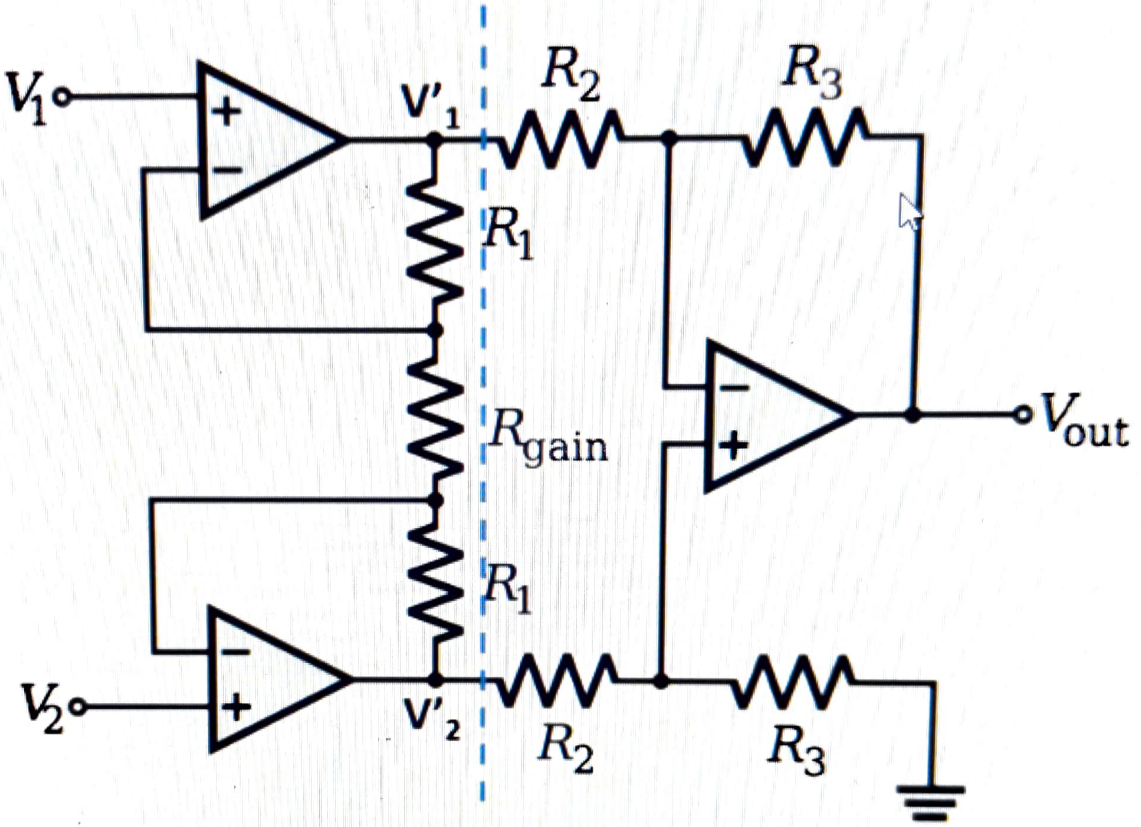
Instrumentation amplifier

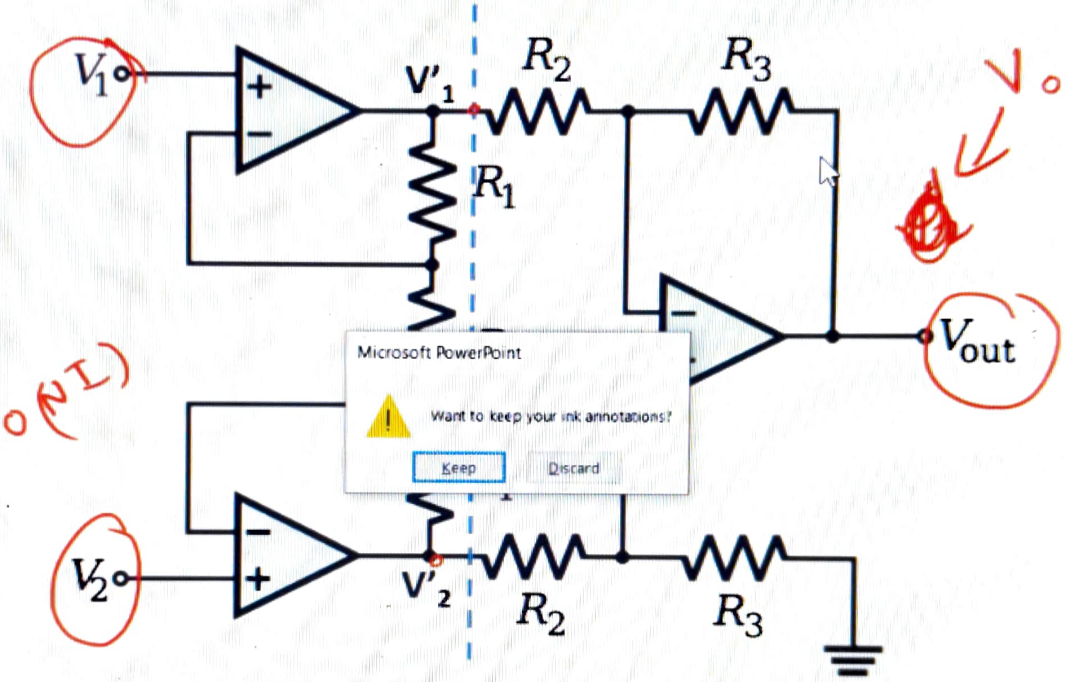


Instrumentation amplifier



$$V_{out} = \left(1 + \frac{2R_1}{R_{gain}}\right)\left(\frac{R_3}{R_2}\right)[V_2 - V_1]$$

Instrumentation amplifier

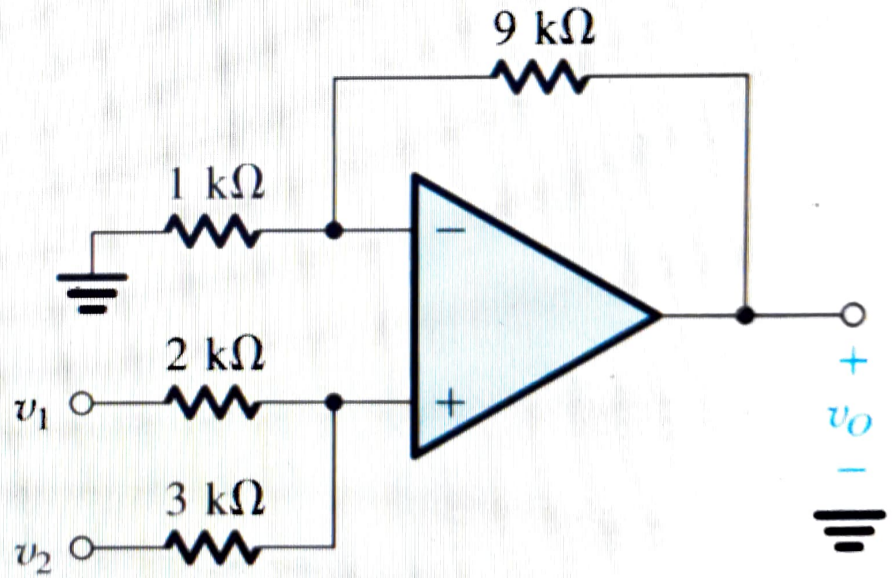


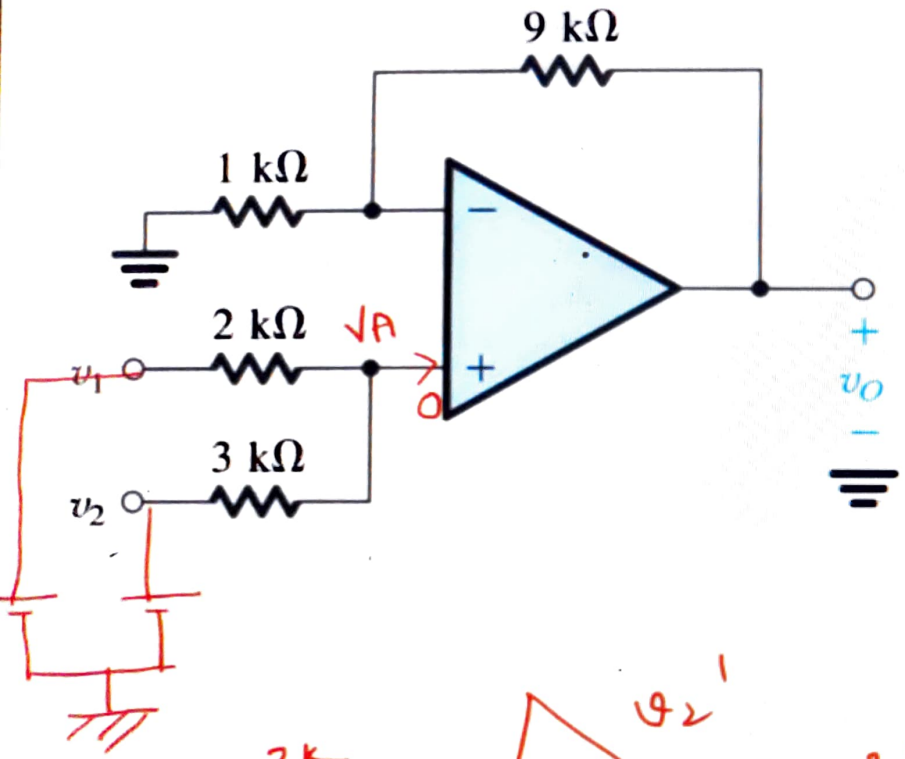
$$V_{out} = \left(1 + \frac{2R_1}{R_{gain}}\right)\left(\frac{R_3}{R_2}\right)[V_2 - V_1]$$

Problem: Superposition theorem

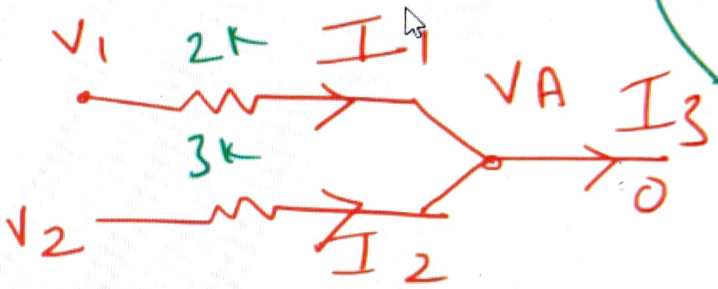
- Use the superposition principle to find the output voltage of the circuit shown in Fig.

$$v_o = 6v_1 + 4v_2$$



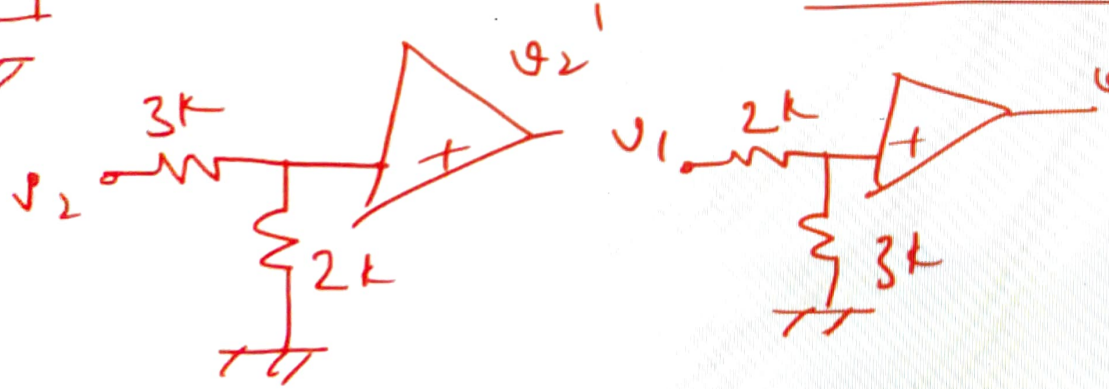


$$V_o = \left(1 + \frac{R_f}{R_1}\right) V_A = 10\, V_A$$



$I_1 + I_2 = 0$

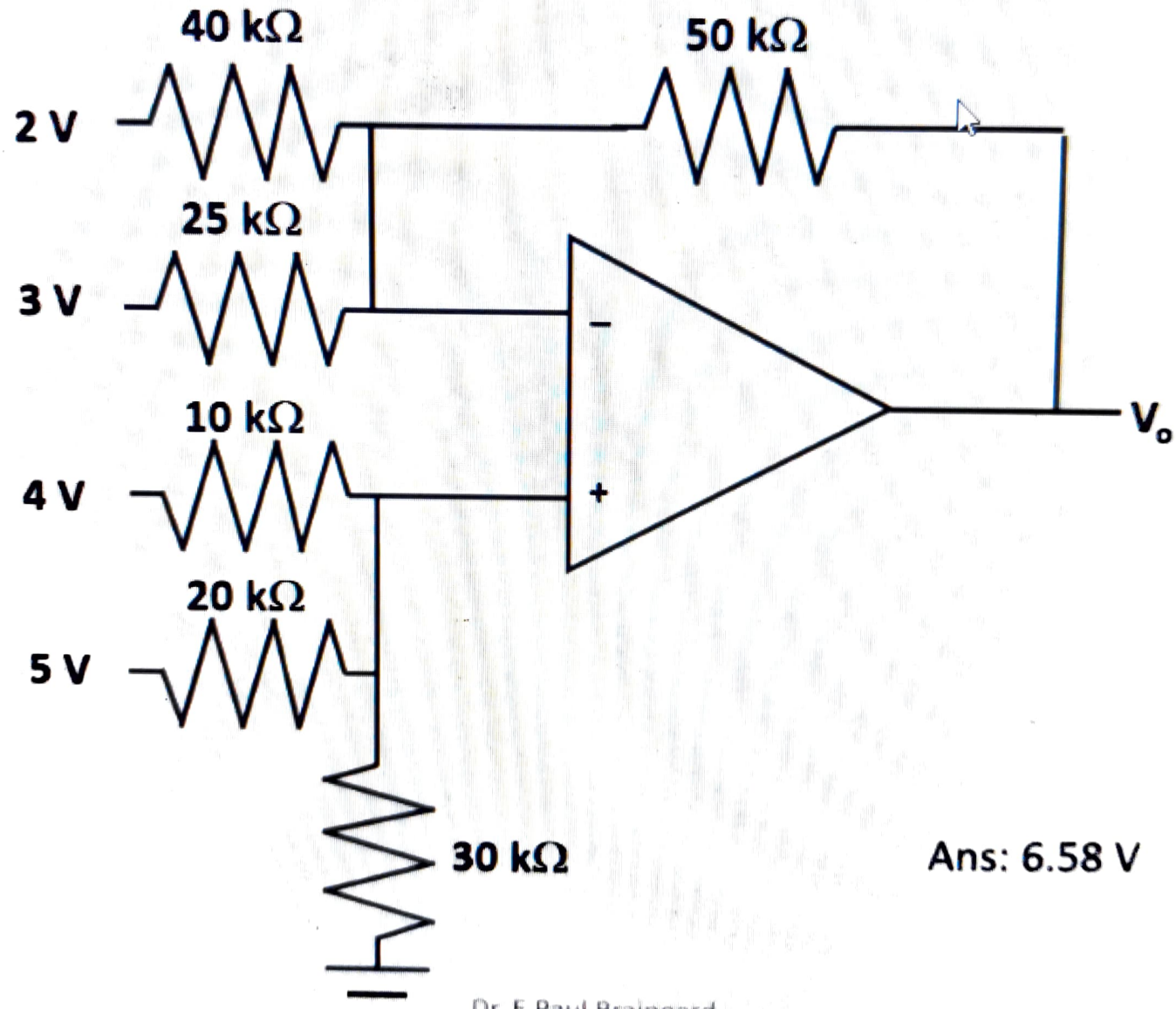
$$\frac{V_1 - VA}{2K} + \frac{V_2 - VA}{3K} = 0$$



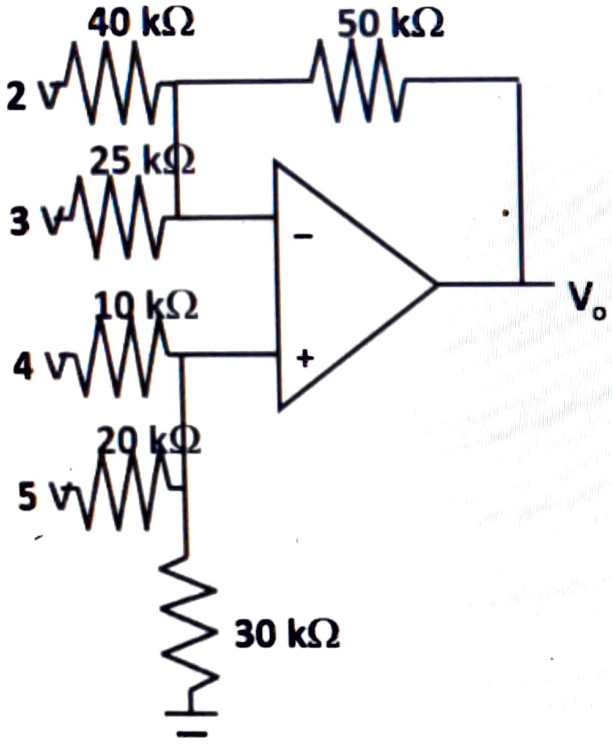
$$v_o = v_1' + v_2'$$

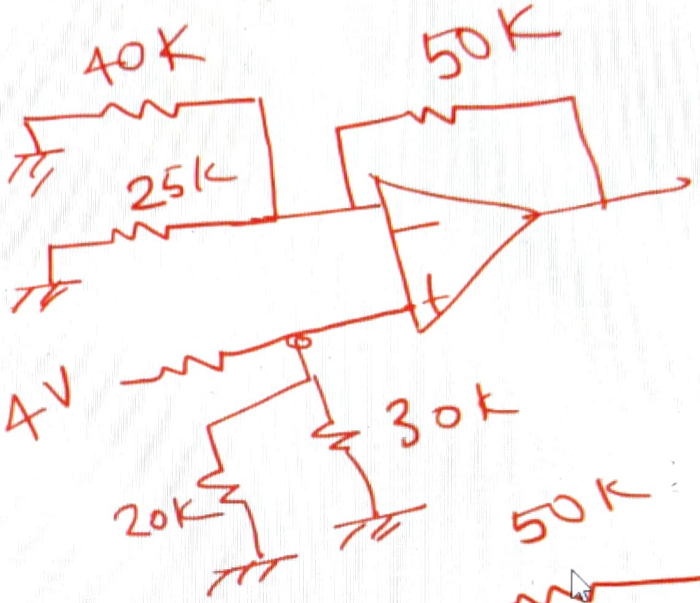
$$v_o = 6 v_1 + 4 v_2$$

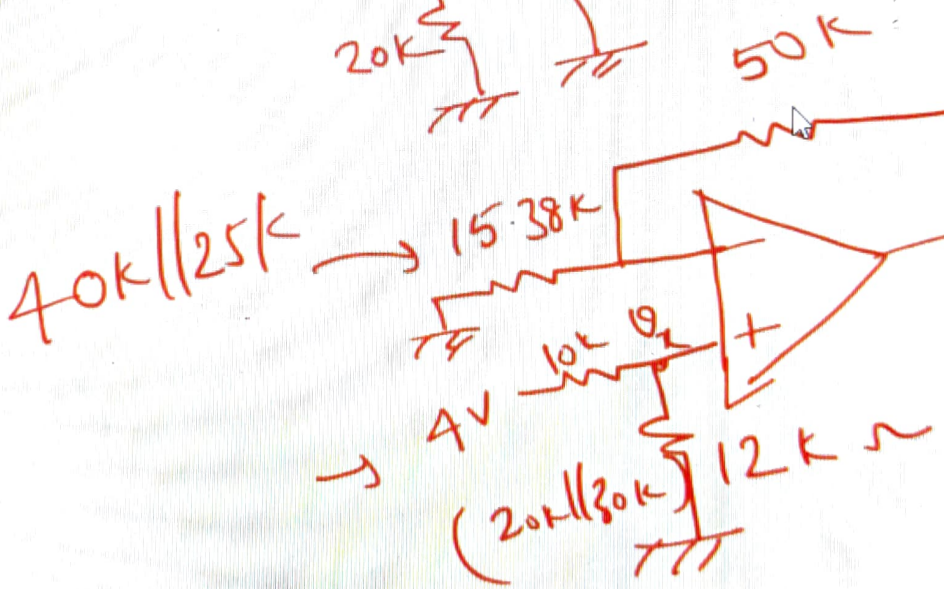
Problem: find V_o



Ans: 6.58 V

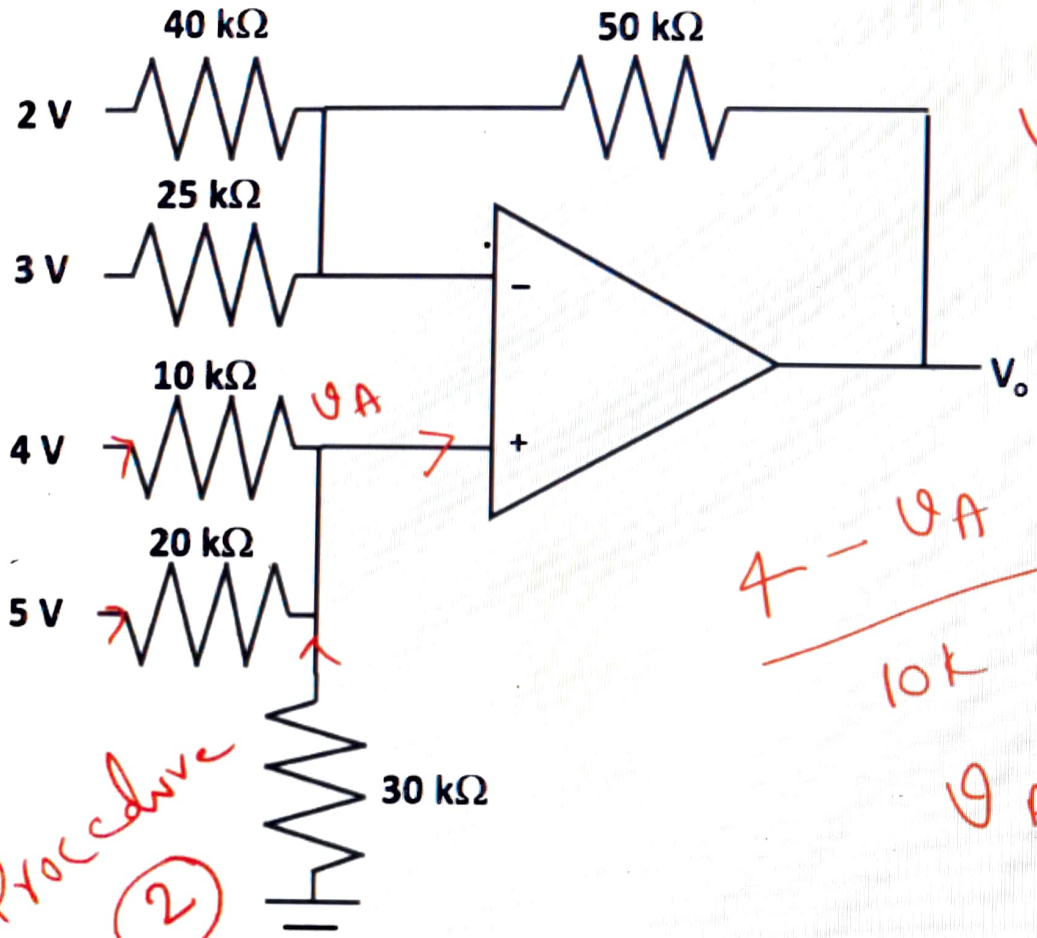






$V_{o1} = V_1\left(1+\frac{50}{15.38}\right)$

$\vartheta_1 = \frac{12K}{12K+10K}(4V)$



Procedure

(2)

$$v_o = \left(1 + \frac{50}{15.38}\right) 3.54\text{V}$$

$$\frac{4 - v_A}{10k} + \frac{5 - v_A}{20k} + \frac{0 - v_A}{30k} = 0$$

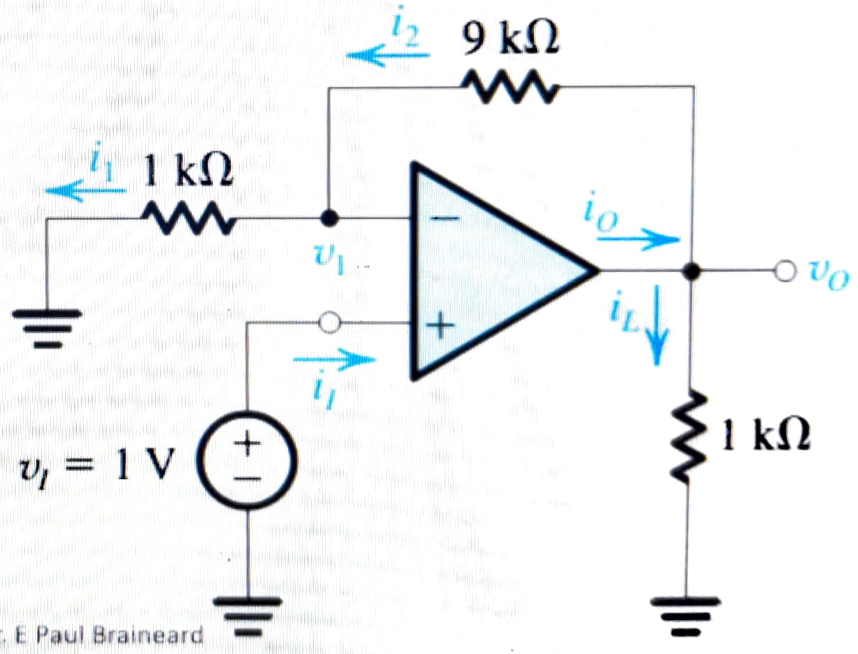
$v_A \rightarrow$

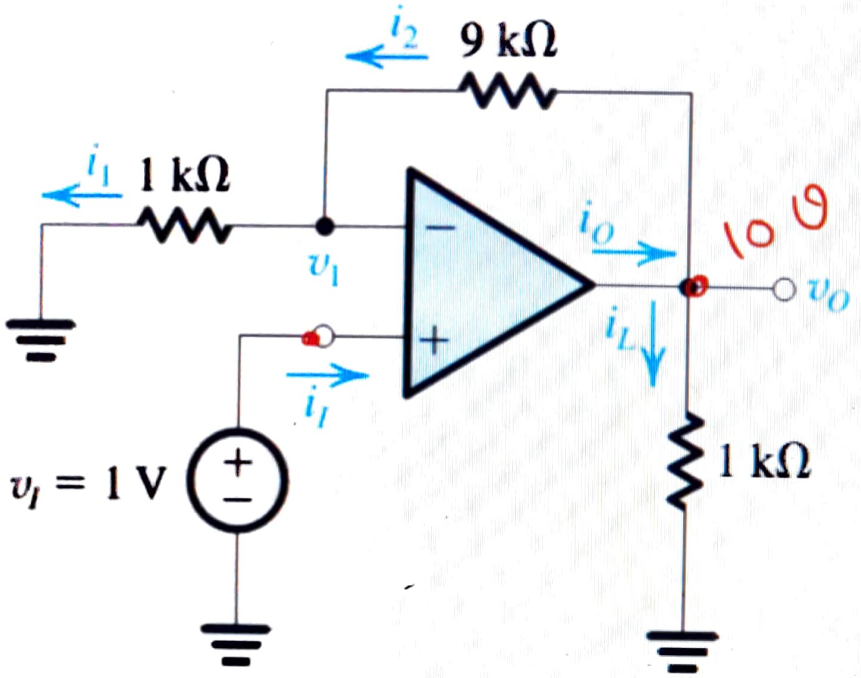
$$\frac{4}{10} + \frac{5}{20} = v_A\left(\frac{1}{10k} + \frac{1}{20k} + \frac{1}{30k}\right)$$

$$v_A = 3.54\text{V}$$

- For the circuit in Fig. find the values of i_I, v_1, i_1, i_2, v_o, i_L, and i_o. Also find the voltage gain v_o/v_I, the current gain i_L/i_I, and the power gain P_L/P_I

0; 1 V; 1 mA; 1 mA; 10 V; 10 mA; 11 mA; 10 V/V (20 dB);∞;∞





$$\vartheta_o = \left(1 + \frac{9K}{1K}\right) 1V$$

$$= 10\,V$$

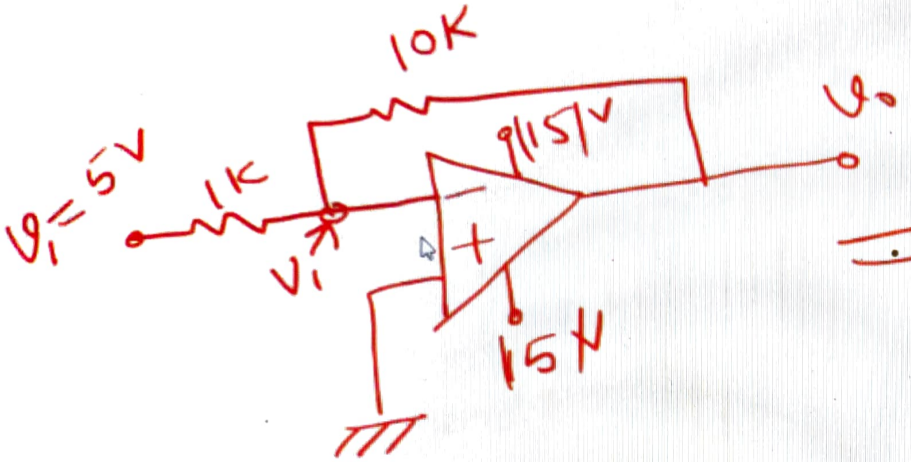
$$\vartheta_1 = 1\,V$$

$$\mathring{\imath}_1 = 1\,mA$$

$$\mathring{\imath}_2 = \frac{10-1}{9K} = 1\,mA$$

$$\mathring{\imath}_L = \frac{10-0}{1K} = 10\,mA$$

$$\mathring{\imath}_O = \mathring{\imath}_2 + \mathring{\imath}_L = 11\,mA$$



$\Rightarrow v_o = -50\ V$ ✗

$\simeq -15\ V$

if it is in linear range

$v^+ = v^-$

else $v^+ \neq v^-$