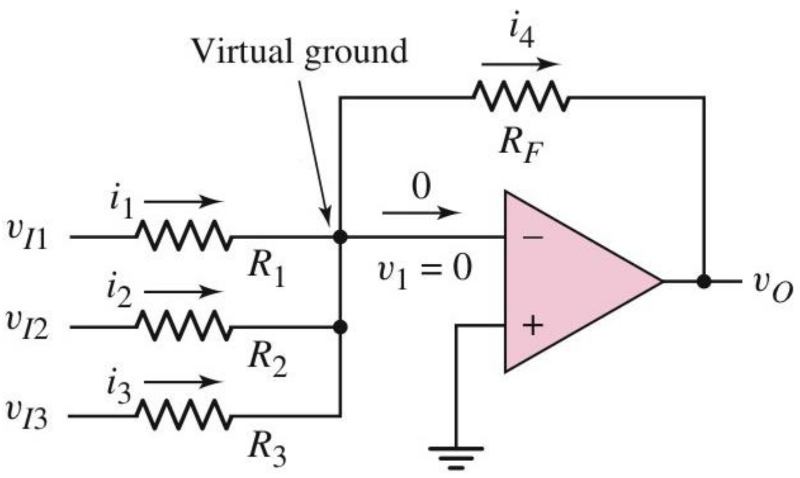
SUMMING AMPLIFIER



Similarly,

Using KCL at the input node

$$i_1 + i_2 + i_3 - i_4 - 0 = 0$$

Output voltage

$$V_0 = -R_F\left(\frac{V_{i1}}{R_1} + \frac{V_{i2}}{R_2} + \frac{V_{i3}}{R_3}\right)$$

$$V_0 = -R_F\left(\frac{V_{i1}}{R_1} + \frac{V_{i2}}{R_2}\right)$$

Example 8.2

Design a summing amplifier as shown in figure to produce a specific output signal, such that **$v_o = 1.25 - 2.5 \cos \omega t$** volt. Assume the input signals are **$v_{I1} = -1.0$ V, $v_{I2} = 0.5 \cos \omega t$** volt. Assume the feedback resistance $R_F = 10\ k\Omega$

Solution: output voltage

$$V_0 = -R_F\left(\frac{V_{i1}}{R_1}+\frac{V_{i2}}{R_2}\right) = -R_F\left[\frac{(-1)}{R_1}+\frac{0.5\cos\omega t}{R_2}\right]$$

Or, $$1.25 - 2.5\cos\omega t = R_F\left[\frac{1}{R_1}-\frac{0.5\cos\omega t}{R_2}\right]$$

Or, $$\boxed{1.25} - \boxed{2.5}\cos\omega t = \boxed{\frac{R_F}{R_1}} - \boxed{\left(\frac{R_F}{R_2}\right)(0.5}\cos\omega t)$$

$$\frac{R_F}{R_1} = 1.25 \qquad \text{Or,} \qquad R_1 = \frac{R_F}{2.5} = \frac{10}{1.25} = 8\ \text{k}\Omega$$

$$\left(\frac{R_F}{R_2}\right)(0.5\cos\omega t) = 2.5\cos\omega t \qquad \text{Or,} \qquad R_2 = R_F\times\frac{0.5\cos\omega t}{2.5\cos\omega t} = 10\times\frac{0.5}{2.5} = 2\ \text{k}\Omega$$

Calculating Gain and Design Questions

INVERTING

Voltage gain, $A_v = \frac{V_0}{V_i} = -\frac{R_2}{R_1}$

NON - INVERTING

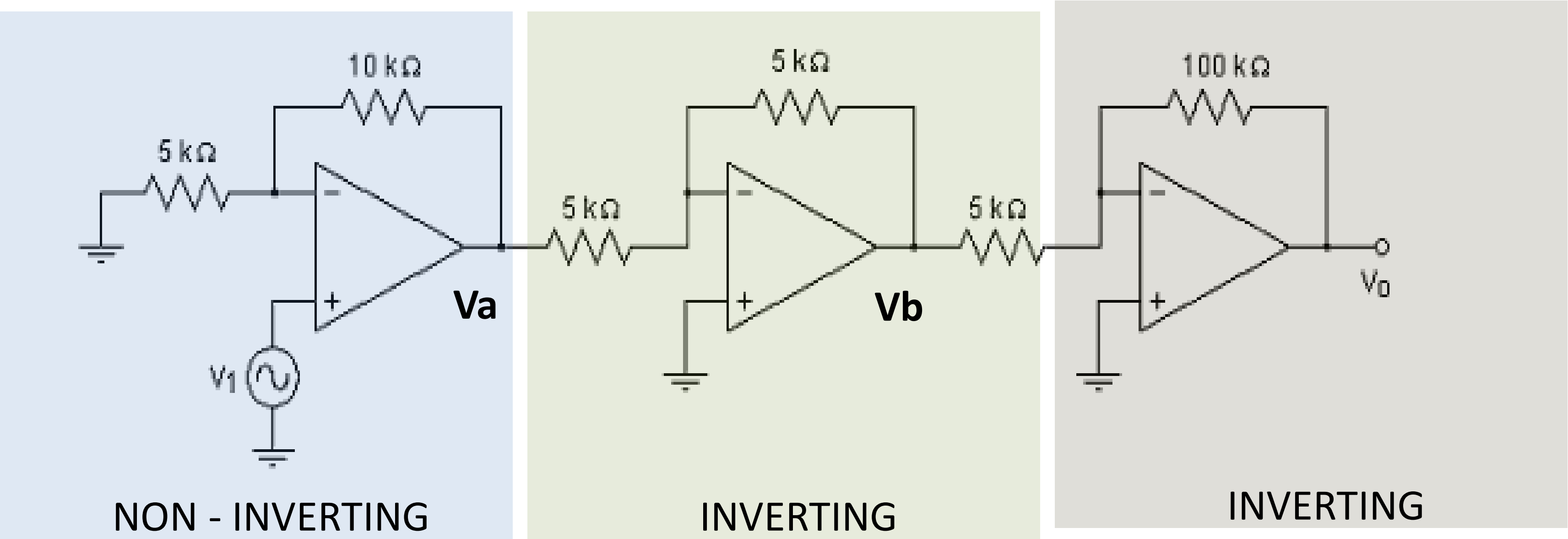
Voltage gain, $A_v = \frac{V_0}{V_i} = 1 + \frac{R_2}{R_1}$

Calculating Output and Design Questions

SUMMING AMPLIFIER

Output voltage

$$V_0 = -R_F\left(\frac{V_{i1}}{R_1} + \frac{V_{i2}}{R_2} + \frac{V_{i3}}{R_3}\right)$$



Calculate the input voltage if the final output, V_O is 10.08 V.

Have to work backwards:

Vo = -(100/5) Vb

10.08 = -20 Vb

Vb = -0.504 V

Then:

Vb = -(5/5) Va

-0.504 = - Va

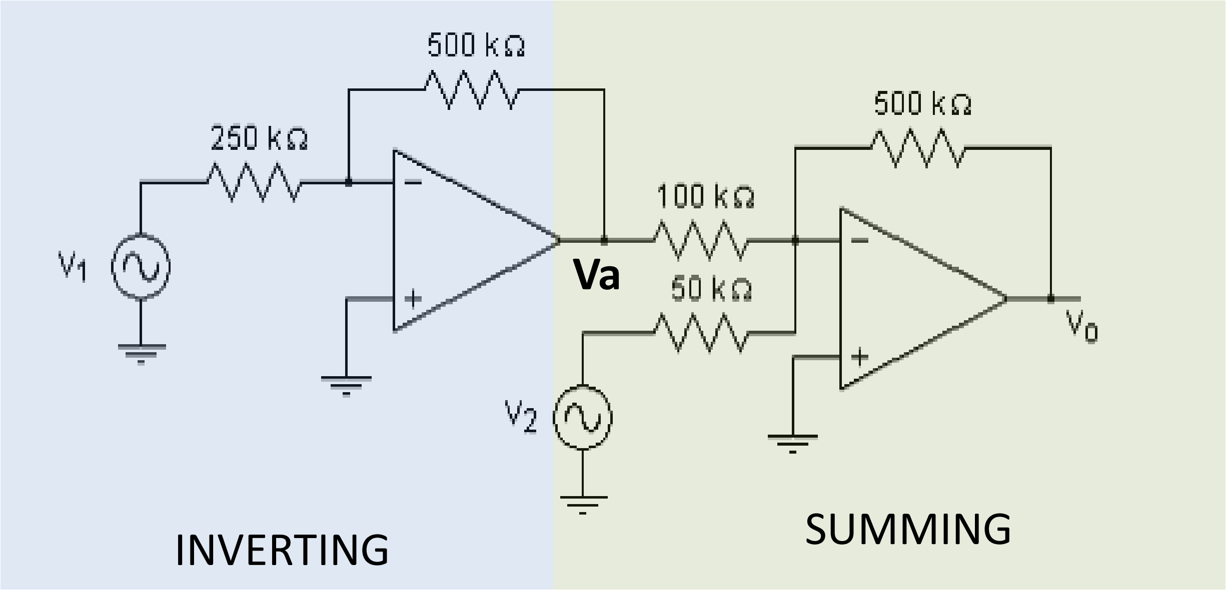
Va = 0.504 V

Finally:

Va = (1 + 10/5) V_1

0.504 = $3V_1$

$\underline{V_1 = 0.168\ V}$



Calculate the output voltage, V_O if $V_1 = V_2 = 700$ mV

Va = -(500/250) 0.7
Va = -1.4 V

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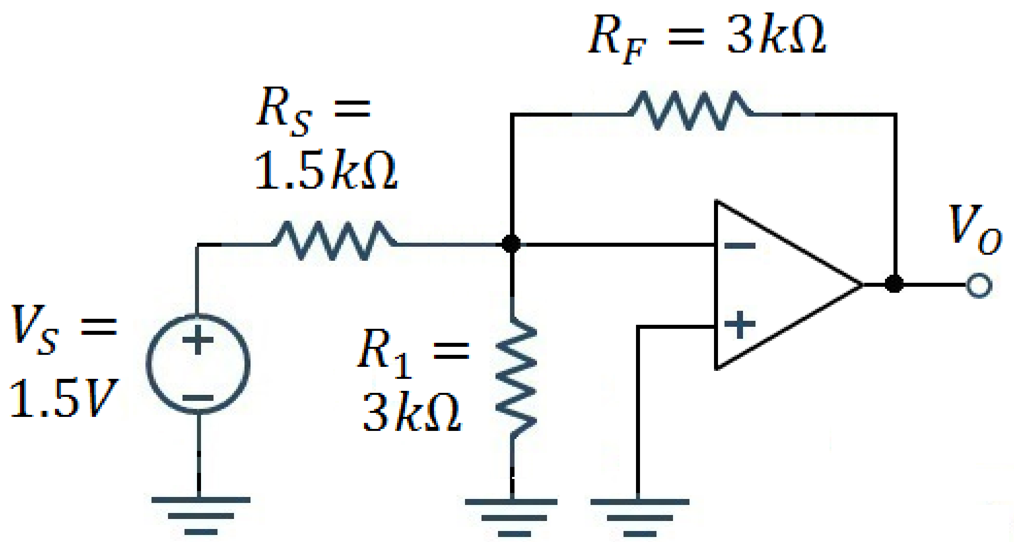
Then:

Vo = - 500 [V_a / 100 + V_2 / 50]
Vo = - 500 [-1.4 / 100 + 0.7 / 50]
Vo = 0 V



Calculate the output voltage V_O of the operational amplifier circuit as shown in the figure.

Answer: -3 V

$i_1 - i_2 - i_3 - 0 = 0$

$(Vs - 0) / R_s - [(0 - 0) / R_1] - [(0 - Vo) / R_F] = 0$

$1.5 / 1.5 - [(- Vo) / 3] = 0$

$1 + [Vo / 3] = 0$

$Vo / 3 = -1$

$Vo = -3\ V$