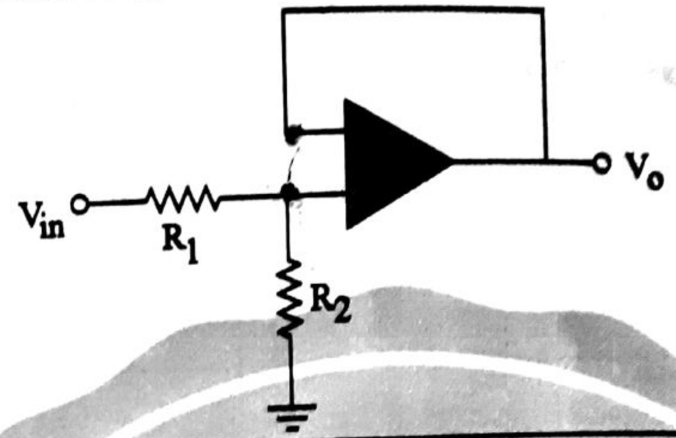
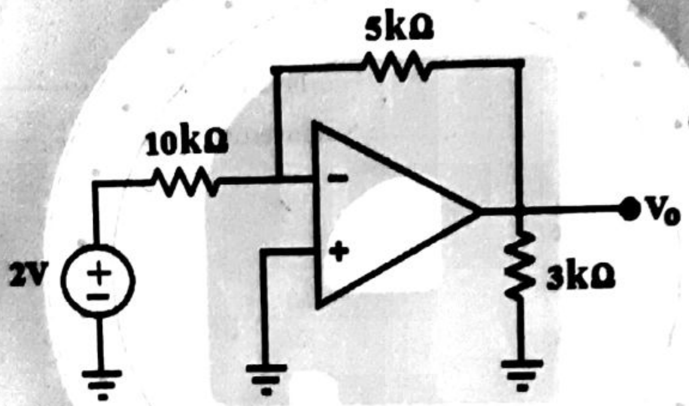
Find the output of the following circuits:



on:

$$V_O = \frac{R_2}{R_1 + R_2} \times V_{in}$$

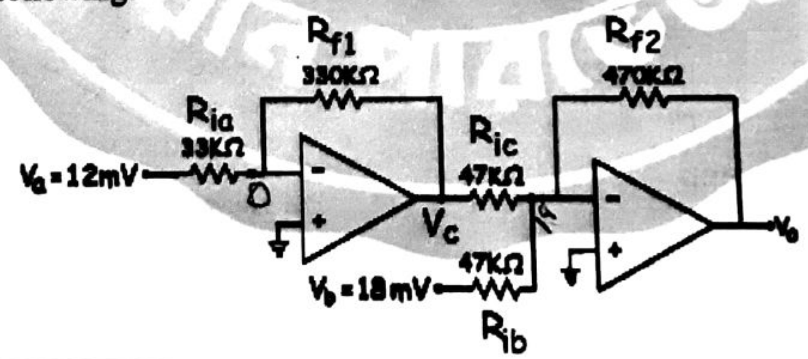
Find the gain in the following op-amp circuit.



ution:

$$gain = \frac{V_0}{V_i} = -\frac{R_f}{R_i} = -\frac{5}{10} = -\frac{1}{2}$$

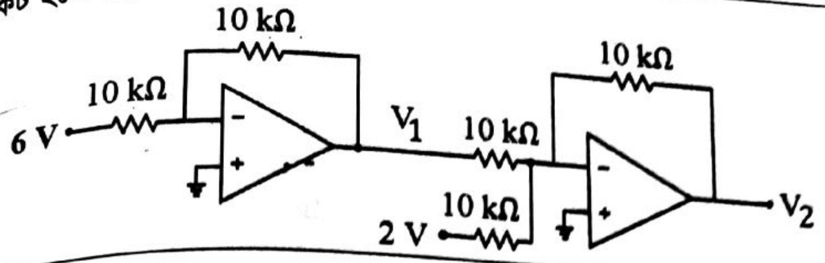
Find V_O in the following:



$$V_c = -\frac{R_{f1}}{R_{ia}} \times V_a = -\frac{330}{33} \times 12 = -120 \text{ mV}$$

$$V_O = -\frac{R_{f2}}{R_{ic}} \times V_C - \frac{R_{f2}}{R_{ib}} \times V_b = -\frac{470}{47} \times (-120) - \frac{470}{47} \times 18 = 1020 \text{ m}$$

নিম্নের সার্কিট হতে V_1 ও V_2 বের কর।

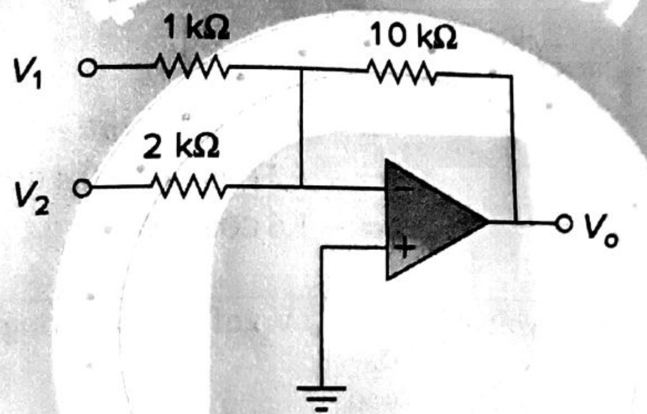


Solution:

$$V_1 = -\frac{10}{10} \times 6 = -6\,V$$

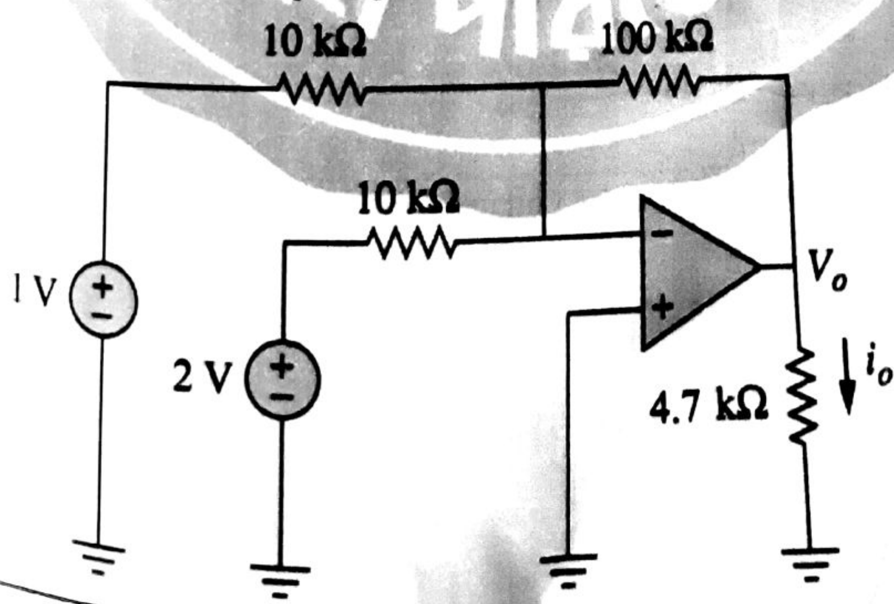
$$V_2 = -\frac{10}{10} \times V_1 - \frac{10}{10} \times 2 = -V_1 - 2 = -(-6) - 2 = 4\ V \quad \textbf{\textit{Ans.}}$$

Find V_o



$$-\frac{R_f}{R_1} \times V_1 - \frac{R_f}{R_2} \times V_2 = -\frac{10}{1} \times V_1 - \frac{10}{2} \times V_2 = -10\,V_1 - 5V_2 \quad \textbf{\textit{Ans.}}$$

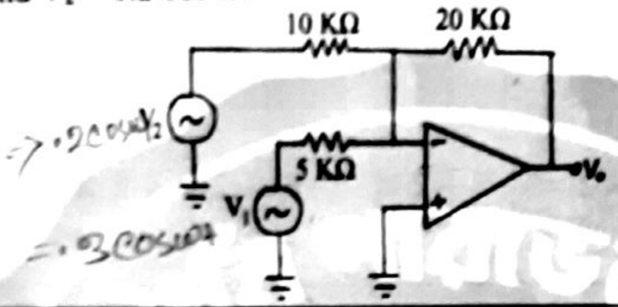
...nd i_o in the following ideal op-amp.



Solution:

$$V_0 = -\frac{R_f}{R_1}\times V_1 - \frac{R_f}{R_2}\times V_2 = -\frac{100}{10}\times 1 - \frac{100}{10}\times 2 = -10 - 20 = \ldots$$

$$i_0 = \frac{V_0}{4.7} = -\frac{30}{4.7} = -6.383\ mA \quad \textbf{Ans.}$$

7	Calculate the output voltage of the following amplifier. Input signals are $V_1 = 0.3\cos\omega t$ and $V_2 = 0.2\cos\omega t$ 

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

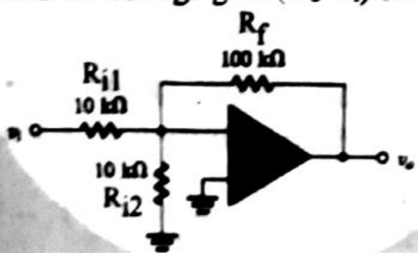
Solution:

$$V_0 = -R_f\left(\frac{V_1}{R_1}+\frac{V_2}{R_2}\right) = -20\times\left(\frac{V_1}{5}+\frac{V_2}{10}\right) = -4V_1 - 2V_2$$

$$= -4\times 0.3\cos\omega t - 2\times 0.2\cos\omega t$$

$$= -1.2\cos\omega t - 0.4\cos\omega t$$

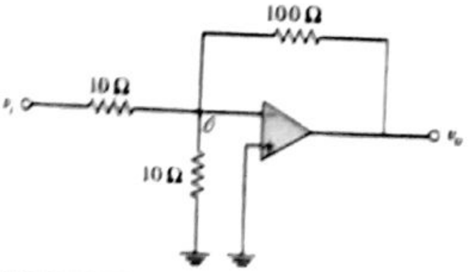
$$= -1.6\cos\omega t$$

8	Assuming ideal op amp find the voltage gain (V_o/V_i) of the following circuit. 

Solution:

$$V_o = -\frac{R_{f2}}{R_{i1}}\times V_i - \frac{R_f}{R_{i2}}\times 0 = -\frac{100}{10}\times V_i - 0 = -10V_i$$

$$\therefore \frac{V_o}{V_i} = -10 \quad \textbf{Ans.}$$

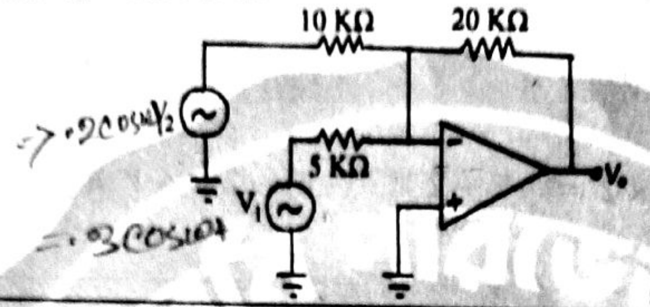
9	For the following op amp circuit, find the voltage gain v_o/v_i. [Similar to Exercise 6.23, Sadiku] 

olution:

$$V_0 = -\frac{R_f}{R_1}\times V_1 - \frac{R_f}{R_2}\times V_2 = -\frac{100}{10}\times 1 - \frac{100}{10}\times 2 = -10 -$$

$$i_0 = \frac{V_0}{4.7} = -\frac{30}{4.7} = -6.383\ mA \quad \textit{Ans.}$$

7 Calculate the output voltage of the following amplifier. Input signals are V
0.3 cos ώt and V_2 = 0.2 cos ώt



$-\frac{R}{R_1}V_1 - \frac{R}{R_2}$

olution:

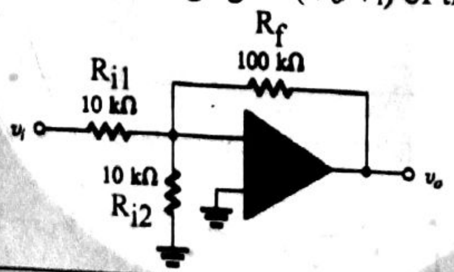
$$V_0 = -R_f\left(\frac{V_1}{R_1}+\frac{V_2}{R_2}\right) = -20\times\left(\frac{V_1}{5}+\frac{V_2}{10}\right) = -4\,V_1 - 2\,V_2$$

$$= -4\times 0.3\cos\omega t - 2\times 0.2$$

$$= -1.2\cos\omega t - 0.4\cos\omega t$$

$$= -1.6\cos\omega t$$

8 Assuming ideal op amp find the voltage gain (V_o/V_i) of the following circuit

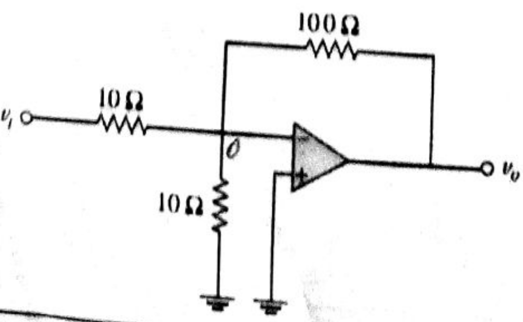


olution:

$$V_o = -\frac{R_{f2}}{R_{i1}}\times V_i - \frac{R_f}{R_{i2}}\times 0 = -\frac{100}{10}\times V_i - 0 = -10\,V_i$$

$$\therefore\ \frac{V_o}{V_i} = -10 \quad \underline{\textbf{Ans.}}$$

9 For the following op amp circuit, find the voltage gain v_o/v_i. [Similar to Exercise 5.23, Sadiku]



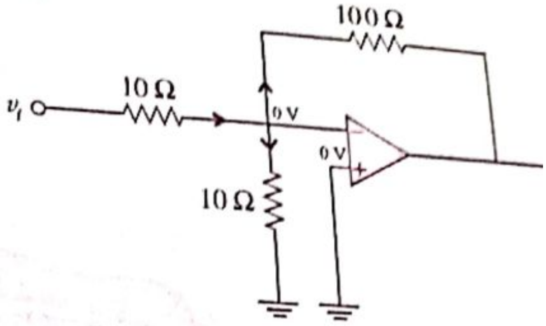
tion:

lying nodal analysis at non-inverting terminal,

$$\frac{v_i - 0}{10} = \frac{0-0}{10} + \frac{0-v_0}{100}$$

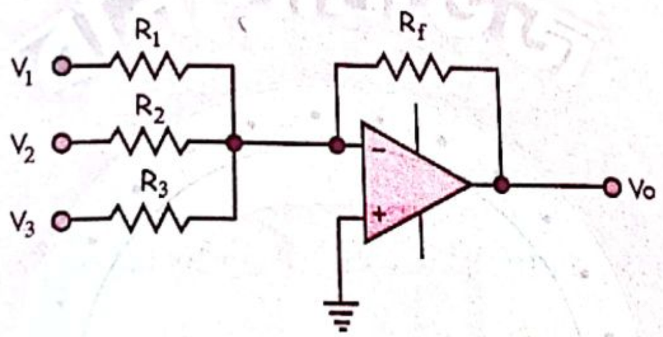
$$\frac{v_i}{10} = \frac{-v_0}{100}$$

$$\frac{v_0}{v_i} = \frac{-100}{10} = -10 \quad \textbf{Ans.}$$

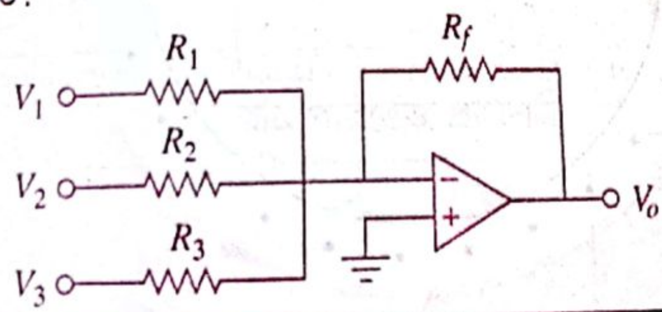


Draw a 3 input summing amplifier using Op-Amp. | BT

n:

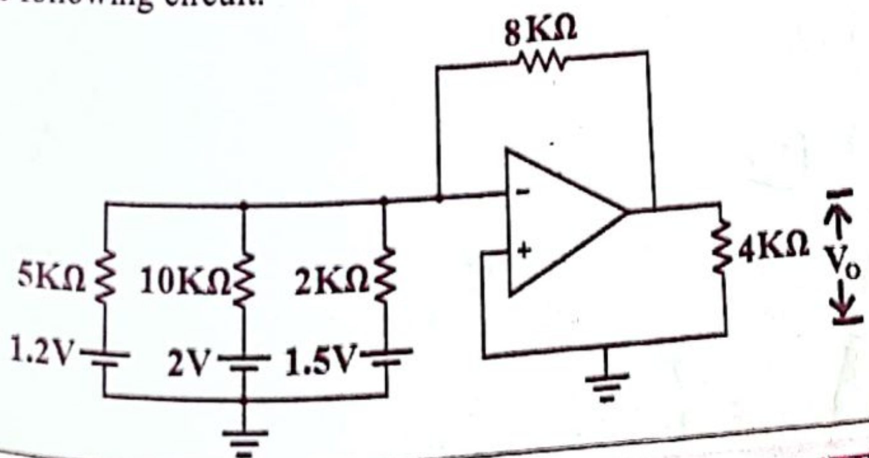


চের সার্কিটে, $V_1 = 1$ V, $V_2 = 2$ V, $V_3 = 3$ V, $R_1 = 500$ kΩ, $R_2 = R_3 = R_f = 1$ MΩ
ল V_0 এর মান কত?



$$V_0 = -\frac{R_f}{R_1} \times V_1 - \frac{R_f}{R_2} \times V_2 - \frac{R_f}{R_3} \times V_3$$
$$= -\frac{1}{0.5} \times 1 - \frac{1}{1} \times 2 - \frac{1}{1} \times 3 = -2 - 2 - 3 = -7\,V \quad \textbf{Ans.}$$

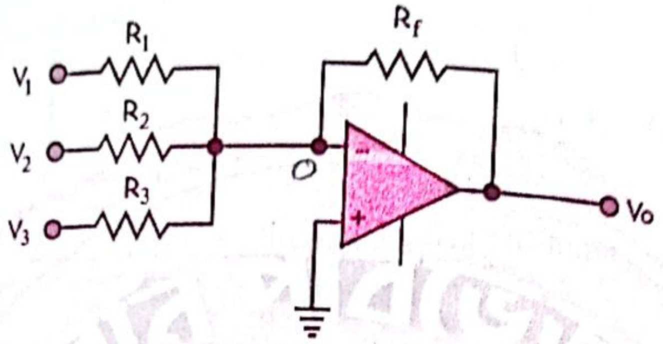
nd V_o of the following circuit.



Solution:

$$V_0 = -R_f\left(\frac{V_1}{R_1}+\frac{V_2}{R_2}+\frac{V_3}{R_3}\right) = -8\times\left(\frac{1.2}{5}+\frac{2}{10}+\frac{1.5}{2}\right) = -9.52\ V$$

13	In the following op-amp, $V_1 = 50\sin(1000t)$ mV, $V_2 = 10\sin(3000t)$ mV, $V_3 = 0$ and $R_1 = 33$ kΩ, $R_2 = 10$ kΩ, $R_3 = 10$ kΩ and $R_f = 330$ kΩ. Find V_O.



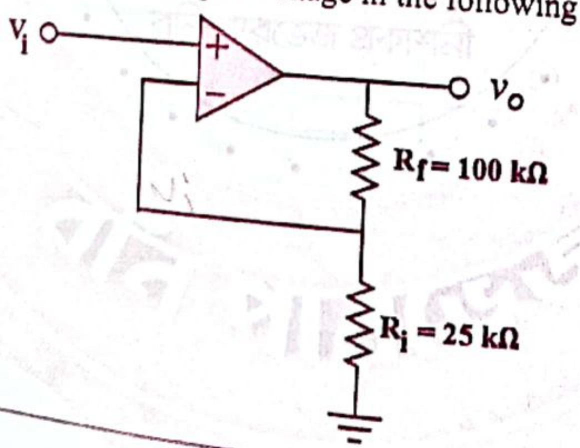
Solution:

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

$$= -\frac{330}{33}\times(50\sin 1000t) - \frac{330}{10}\times(10\sin 3000t) - \frac{330}{10}\times 0$$

$$= -500\sin 1000t - 330\sin 3000t$$ **Ans.**

14	Find the ratio of Input voltage and Output Voltage in the following operational amplifier



Solution:

$$V_0 = \left(1+\frac{R_f}{R_i}\right)\times V_i$$

$$\Rightarrow \frac{V_0}{V_i} = \left(1+\frac{R_f}{R_i}\right) = \left(1+\frac{100}{25}\right) = 5$$

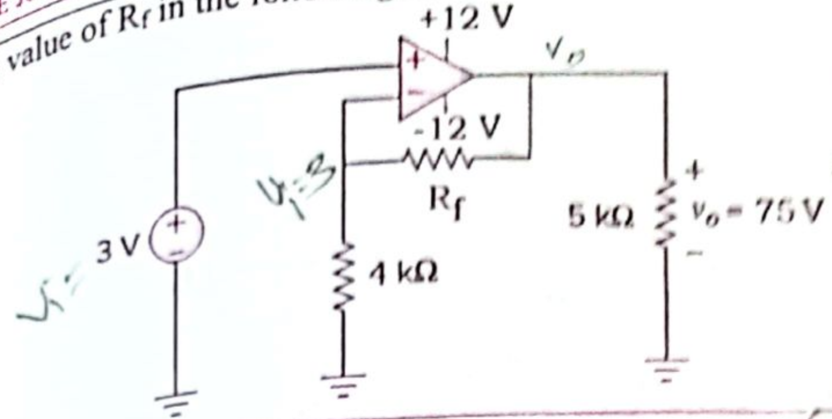
$$\Rightarrow \frac{V_i}{V_0} = \frac{1}{5}$$

$V_{in} = V_0 \times \frac{R_i}{R_i+R_f}$

$V_0 =$ $\frac{R_i+R_f}{R_i}$

Ans.

Find the value of R_f in the following circuit.



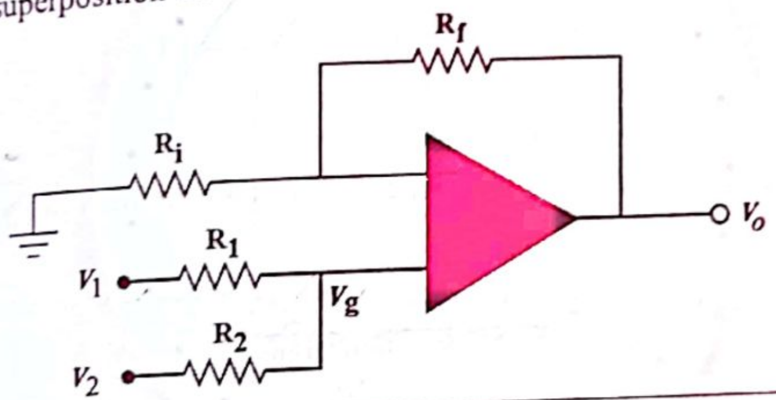
$V_0 \times 4000$
$4000 + R_f$

Solution:

$$V_o = \left(1 + \frac{R_f}{R_i}\right) V_i$$

$$R_f = \left(\frac{V_0}{V_i} - 1\right) R_i = \left(\frac{75}{3} - 1\right) \times 4000 = 96000\ \Omega = 96\ k\Omega$$ **Ans.**

Find Vo using superposition theorem



Solution:

When only V_1 is active and $V_2 = 0$, then applying voltage divider rule:

$$V_g = V_{g1} = \frac{R_2}{R_1 + R_2} \times V_1$$

$$\therefore V_0 = V_{01} = \left(1 + \frac{R_f}{R_i}\right) \times V_{g1} = \left(1 + \frac{R_f}{R_i}\right) \times \frac{R_2}{R_1 + R_2} \times V_1$$

When only V_2 is active and $V_1 = 0$, then applying voltage divider rule:

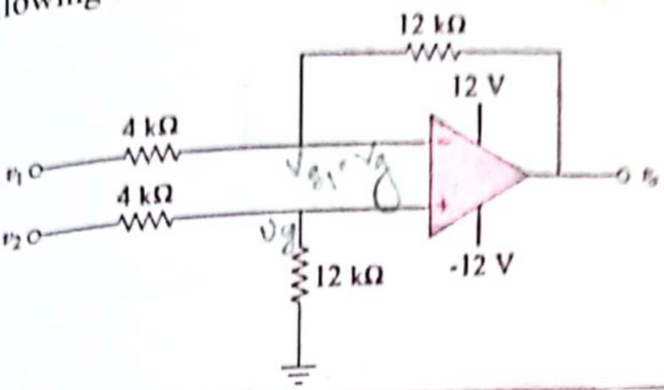
$$V_g = V_{g2} = \frac{R_1}{R_1 + R_2} \times V_2$$

$$\therefore V_0 = V_{02} = \left(1 + \frac{R_f}{R_i}\right) \times V_{g2} = \left(1 + \frac{R_f}{R_i}\right) \times \frac{R_1}{R_1 + R_2} \times V_2$$

Applying superposition theorem (both V_1 and V_2 is active)

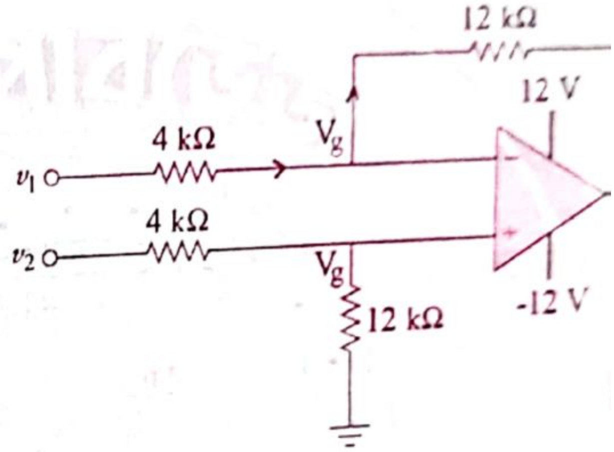
$$V_0 = V_{01} + V_{02} = \left(1 + \frac{R_f}{R_i}\right) \times \frac{R_2}{R_1+R_2} \times V_1 + \left(1 + \frac{R_f}{R_i}\right) \times \frac{R_1}{R_1+R_2} \times V_2$$ **Ans.**

18 Find V_0 in the following circuit when $V_1 = V_2 = 0.5$ V.



Solution:

$$V_g = \frac{12}{4+12} \times 0.5 = 0.375\ V$$



At V_g node,

$$\frac{V_1 - V_g}{4} = \frac{V_g - V_0}{12}$$

$$\Rightarrow 3(V_1 - V_g) = V_g - V_0$$

$$\Rightarrow V_0 = V_g - 3V_1 + 3V_g$$

$$= 4V_g - 3V_1$$

$$= 4 \times 0.375 - 3 \times 0.5$$

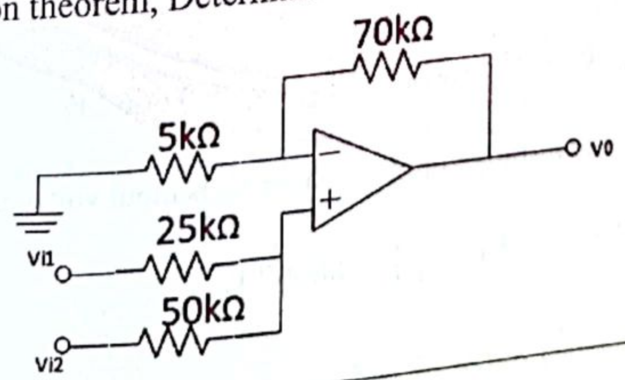
$$= 4 \times 0.375 - 3 \times 0.5$$

$$= 0\ V \quad Ans.$$

Alternate Solution:

$$V_0 = \left(1 + \frac{R_f}{R_i}\right) V_g - \frac{R_f}{R_i} V_1 = \left(1 + \frac{12}{4}\right) \times 0.375 - \frac{12}{4} \times 0.5 = 1.5 - 1.5 = 0\ V$$

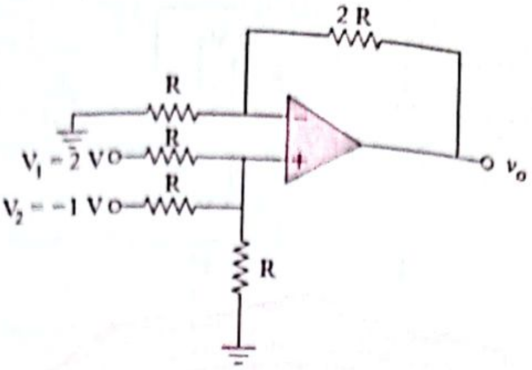
19 Using superposition theorem, Determine the V_0 of the Op-Amp:



Solution:

$$V_0 = \left\{\left(1 + \frac{70}{5}\right) \times \frac{50}{\quad} \times V_{i1}\right\} + \left\{\left(1 + \frac{70}{5}\right) \times \frac{25}{25+50} \times V_{i2}\right\} = 10\,V_{i1} + 5\,V_{i2}$$

20. Find V_0 in the following circuit:



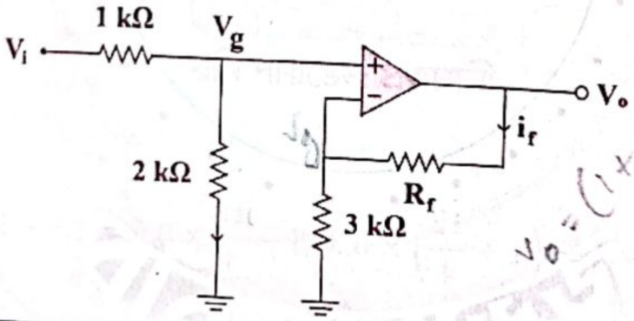
Solution:

$$V_{01} = \left(1 + \frac{2R}{R}\right) \times V_1' = \left(1 + \frac{2R}{R}\right) \times \frac{R\,||\,R}{R + R\,||\,R} \times V_1 = (1+2) \times \frac{\frac{R}{2}}{\frac{3R}{2}} \times 2$$

$$V_{02} = \left(1 + \frac{2R}{R}\right) \times V_2' = \left(1 + \frac{2R}{R}\right) \times \frac{R\,||\,R}{R + R\,||\,R} \times V_2 = (1+2) \times \frac{\frac{R}{2}}{\frac{3R}{2}} \times (-1)$$

$V_0 = V_{01} + V_{02} = 2 + (-1) = 1$ V **Ans.**

21. Find R_f for having gain 5.



Solution:

Using voltage divider rule, $V_g = \frac{2}{2+1} \times V_i = 0.6667\,V_i$

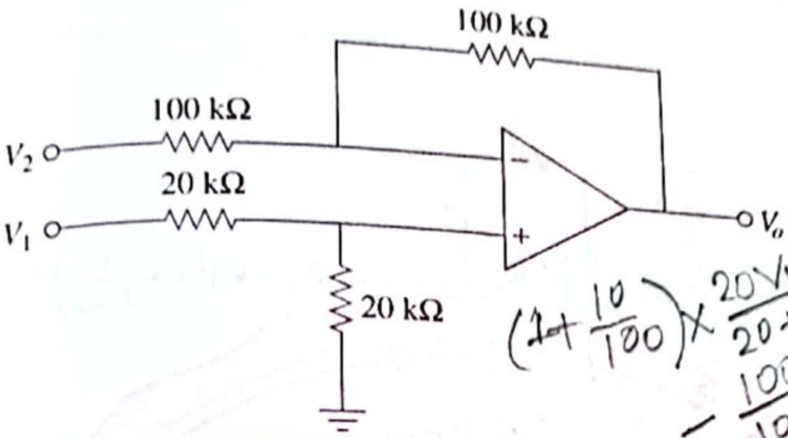
The circuit is like non-inverting amplifier where V_g is input voltage.

$$\therefore V_O = \left(1 + \frac{R_f}{R_1}\right) \times V_g = \left(1 + \frac{R_f}{3}\right) \times 0.6667\,V_i$$

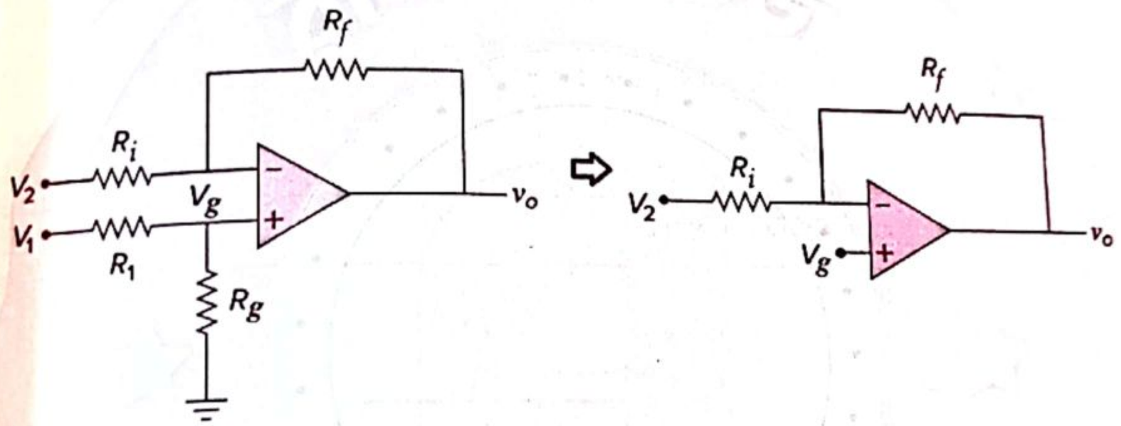
$$\Rightarrow \frac{V_O}{V_i} = \left(1 + \frac{R_f}{3}\right) \times 0.6667 = 5 \qquad [\text{Given, gain } \tfrac{V_O}{V_i}$$

$$\Rightarrow R_f = \left(\frac{5}{0.6667} - 1\right) \times 3 = 19.5\,k\Omega$$

Ans.

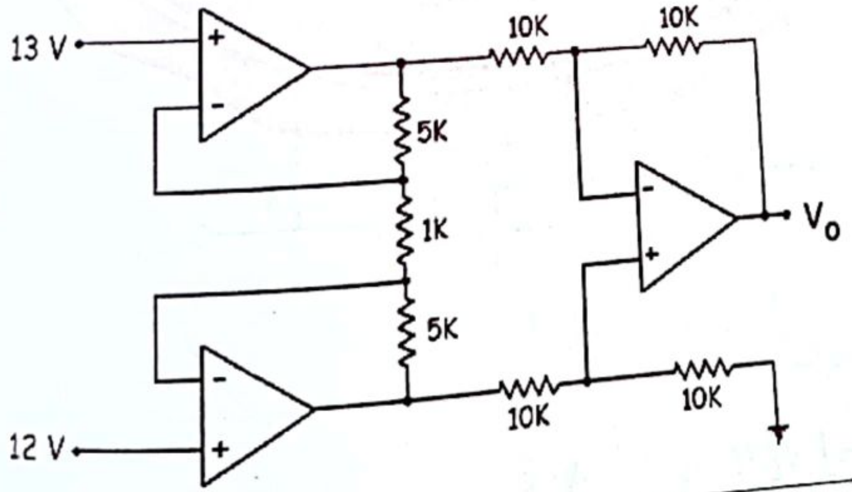
25	নীচের সার্কিটে V_0 এর মান কত?  $\left(1+\frac{10}{100}\right)\times\frac{20V_1}{20+20} - \frac{100}{100}\times V_2$	TGTDCL-18 (SAE)

Solution:



Applying voltage divider rule: $V_g = \frac{R_g}{R_1 + R_g} \times V_1 = \frac{20}{20+20} \times V_1 = 0.5\,V_1$

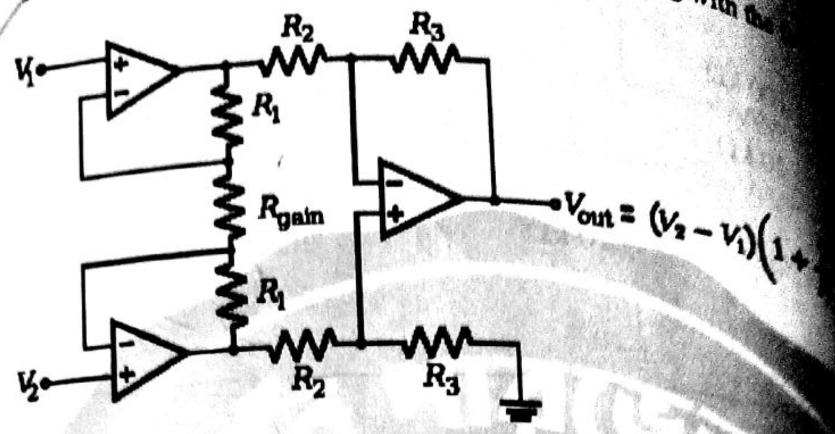
$$V_o = \left(1+\frac{R_f}{R_i}\right)\times V_g - \frac{R_f}{R_i}\times V_2 = \left(1+\frac{100}{100}\right)\times 0.5\,V_1 - \frac{100}{100}\times V_2 = V_1 - V_2 \quad \underline{\textbf{Ans.}}$$

6	Calculate the Output V_O of the following circuit: 	DPDC-14

Solution:

The given circuit is a circuit diagram of instrument amplifier. Comparing with the amplifier,

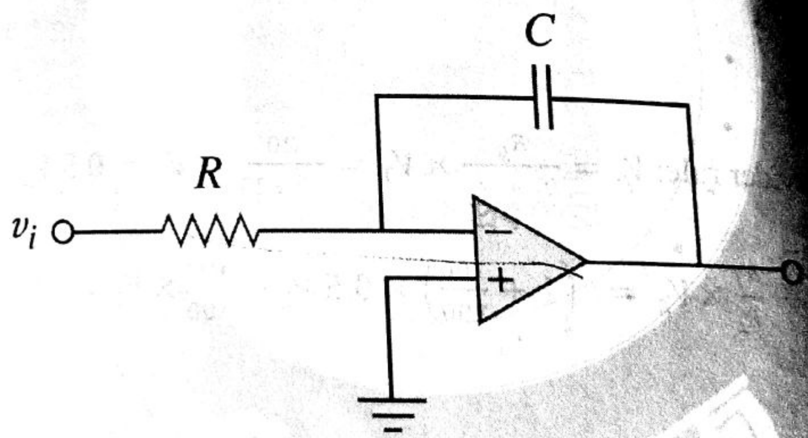
Instrument amplifier

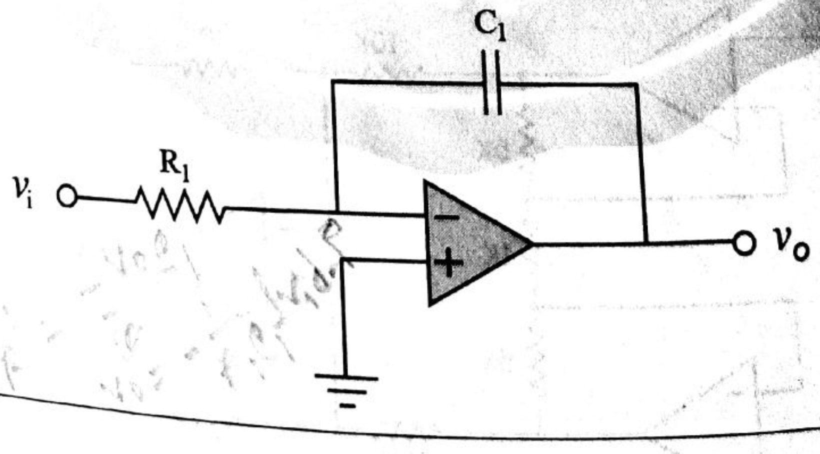


$\therefore \quad V_0 = (V_2 - V_1)\left(1 + \frac{2R_1}{R_{gain}}\right)\frac{R_3}{R_2} = (12 - 13)\left(1 + 2 \times \frac{5}{1}\right) \times \frac{10}{10} = -11V$

27	একটি Op-Amp Integrator এর চিত্র আঁকুন।

Solution:

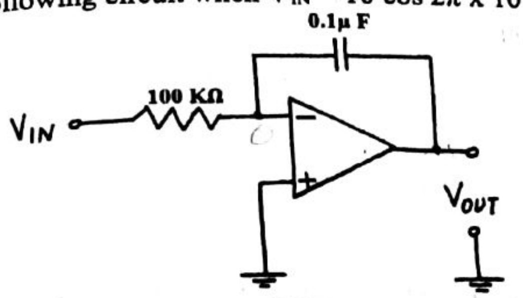


28	Find the output of the following circuits: 

Solution:

$$V_0 = -\frac{1}{R_1 C_1}\int v_i dt$$

Ans.

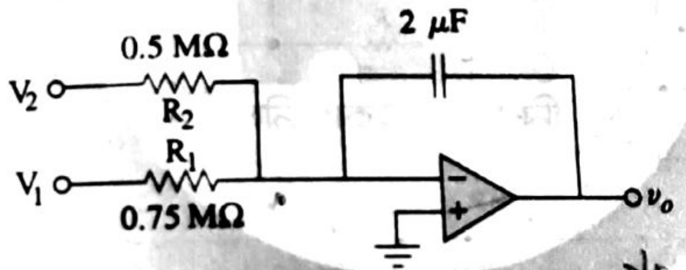
…e output of the following circuit when $V_{IN} = 10 \cos 2\pi \times 10^3$ t.  $\frac{V_{in}}{100} + \frac{-V_{out}}{}$	EGCB-14

$$V_0 = -\frac{1}{RC}\int v_{in} dt$$

$$= -\frac{1}{100 \times 10^3 \times 0.1 \times 10^{-6}} \int_0^t 10 \cos\,(2\pi \times 10^3)t\, dt$$

$$= -\frac{1}{100 \times 10^3 \times 0.1 \times 10^{-6}} \times \frac{1}{2\pi \times 10^3}[10 \sin\,(2\pi \times 10^3)t]_0^t$$

$$= -\frac{1}{2\pi} \sin\,(2\pi \times 10^3)t \qquad \textbf{Ans.}$$

…দত্ত সার্কিটের জন্য $V_1 = 10 \sin(200t)$ এবং $V_2 = 15 \sin(200t)$ হলে V_0 এর মান …এখানে অপ-এম্পটি অসীম গেইনসহ আদর্শ বৈশিষ্ট্যসম্পন্ন। 	DPDC-20 (SAE)

$\frac{V_2}{R_2} + \frac{V_1}{R_1} - \frac{V_0}{RC} = 0$

$$\ldots \int v_1\, dt - \frac{1}{R_2 C}\int v_2\, dt$$

$$\ldots\frac{1}{\ldots 75 \times 10^6) \times (2 \times 10^{-6})} \times \int 10 \sin(200t)\, dt - \frac{1}{(0.5 \times 10^3) \times (2 \times 10^{-6})} \times \int 15 \sin(200t)\, dt$$

$$\ldots \times \left\{10 \times \frac{1}{200} \times \cos(200t)\right\} - 1 \times \left\{15 \times \frac{1}{200} \times \cos(200t)\right\}$$

…33 cos (200t) − 0.075 cos (200t)

…108 cos (200t) ***Ans.***