Electronic Circuit II

Amplifier

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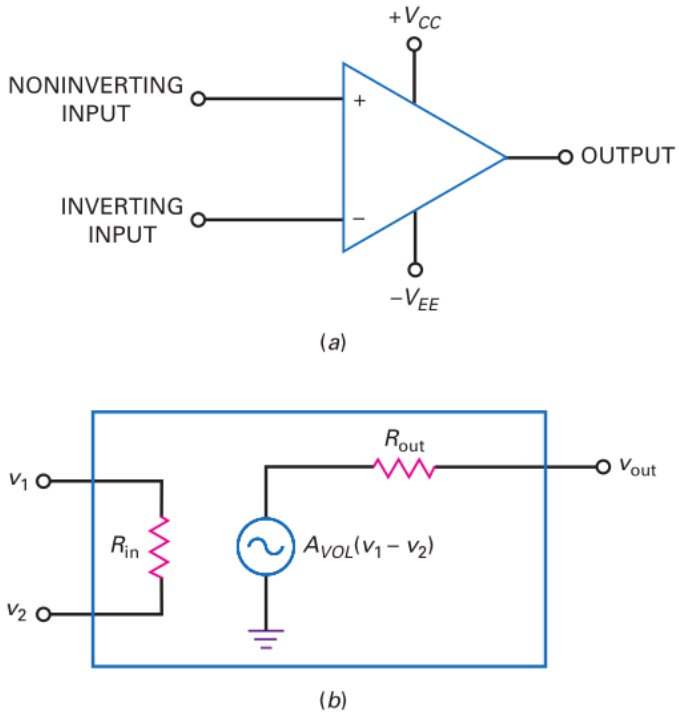
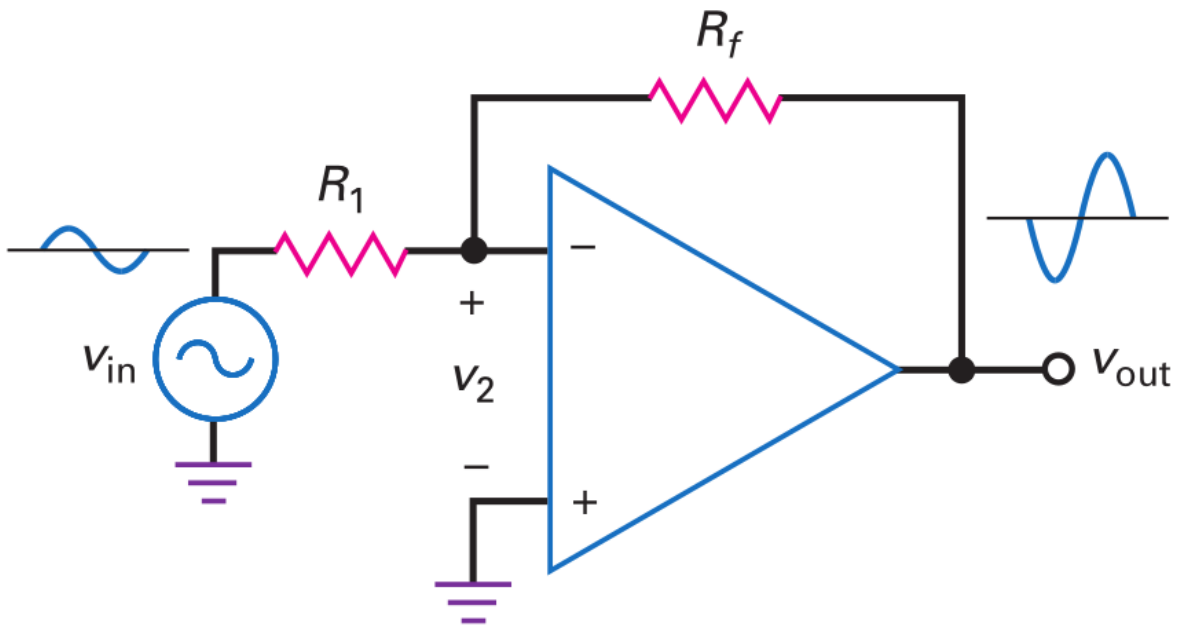
Operational Amplifier

(a) Schematic symbol for op amp; (b) equivalent circuit of op amp.



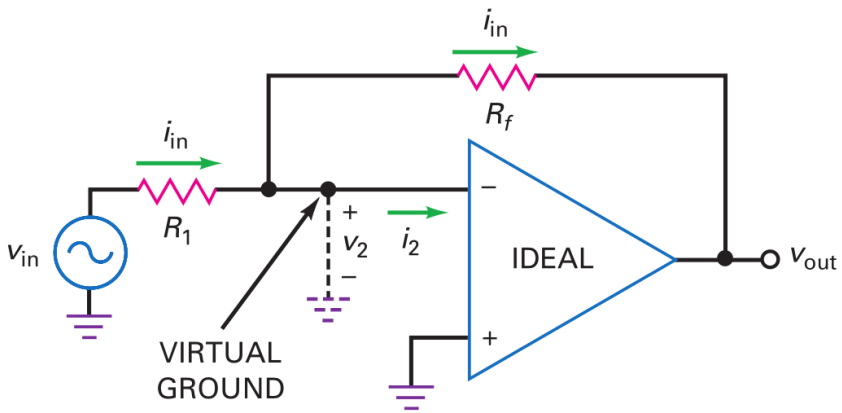
$R_{in} = \infty$, $R_{out} = 0$, $A_{VOL} = \infty$.

Inverting Amplifier



Inverting Amplifier - Virtual Ground

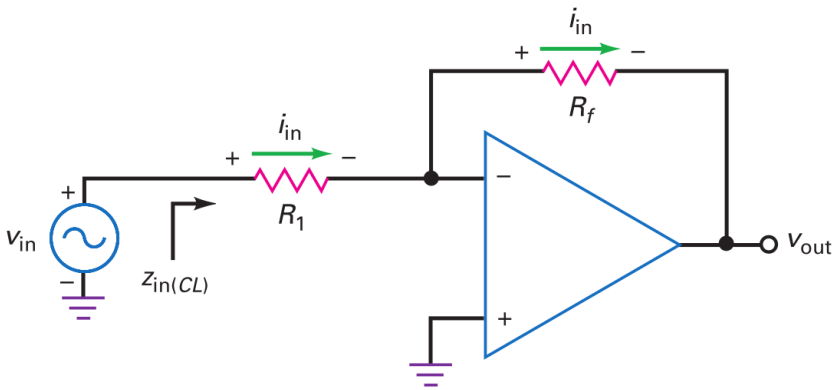
The concept of virtual ground: shorted to voltage and open to current.



- $R_{in} = \infty \rightarrow i_2 = 0$
- $A_{VOL} = \infty \rightarrow v_2 = 0$
- the inverting input acts like a ground for voltage but an open for current

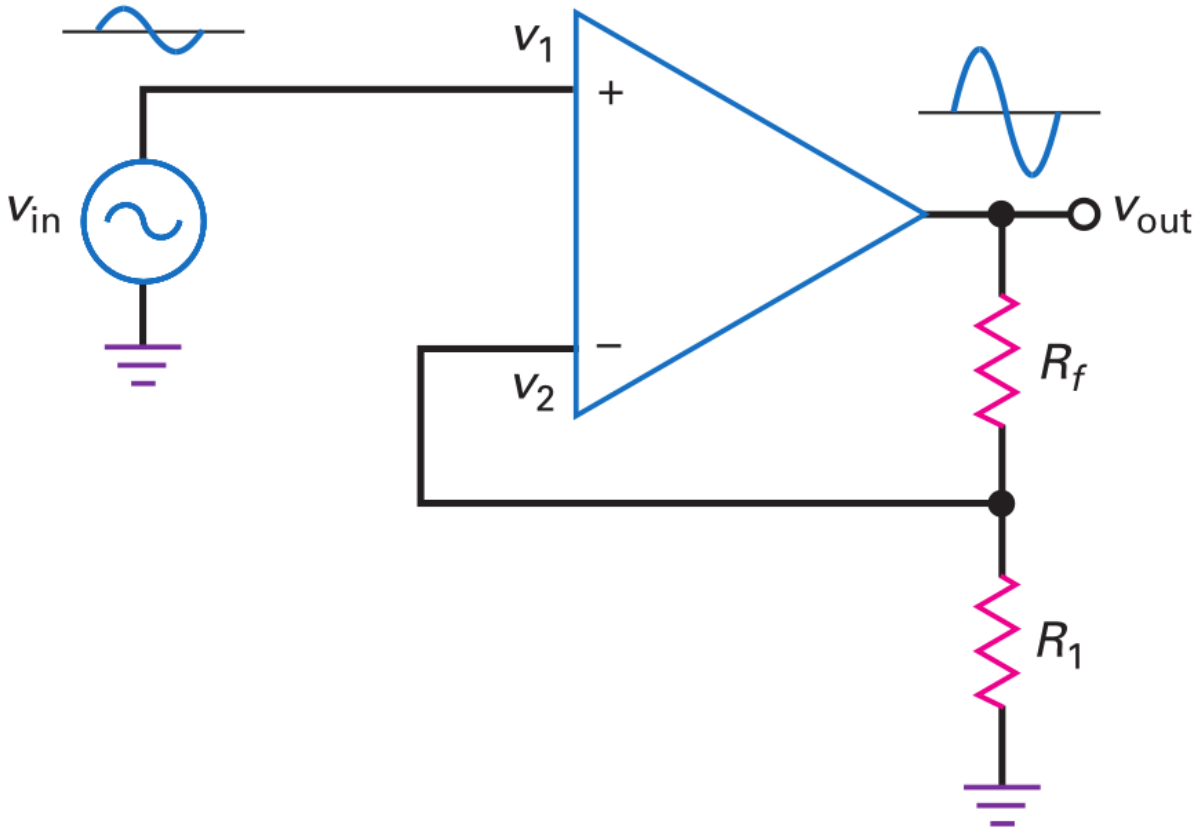
Inverting Amplifier - Voltage Gain

Inverting amplifier has same current through both resistors.



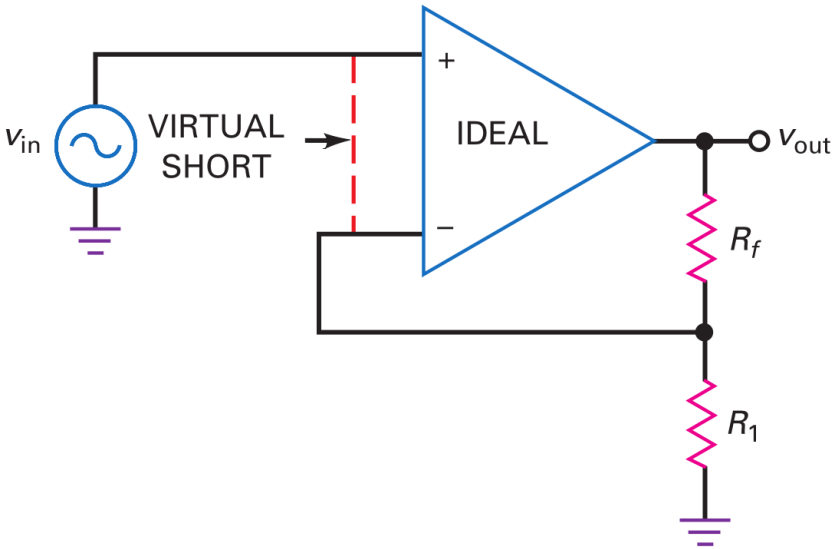
- $v_{in} = i_{in}R_1$
- $v_{out} = -i_{in}R_f$
- $A_V = v_{out}/v_{in} = -i_{in}R_f/i_{in}R_1$
- $A_{V(CL)} = \frac{-R_f}{R_1}$

Nonnverting Amplifier



Noninverting Amplifier - Virtual Short

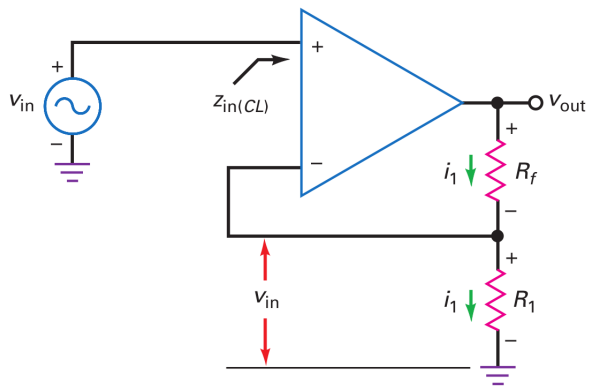
The virtual short is a short for voltage but an open for current.



- $R_{in} = \infty \rightarrow$ both $i_{in} = 0$
- $A_{VOL} = \infty \rightarrow v_1 - v_2 = 0$

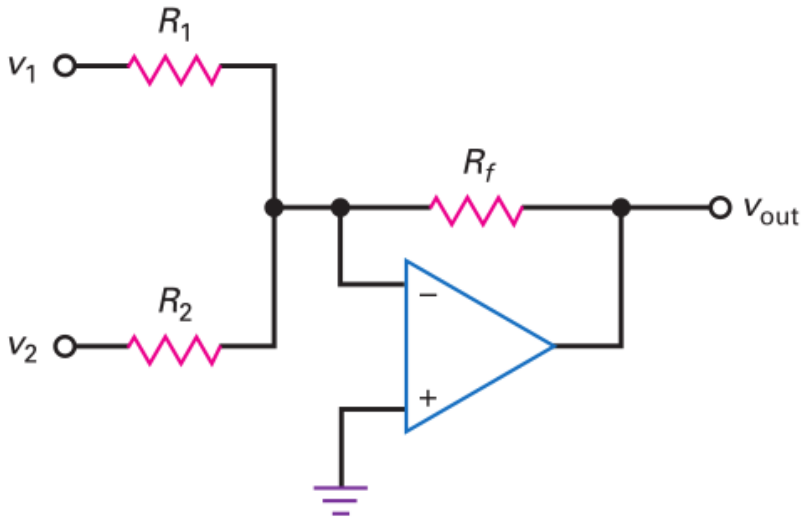
Noninverting Amplifier - Voltage Gain

Input voltage appears across R1 and same current flows through resistors.

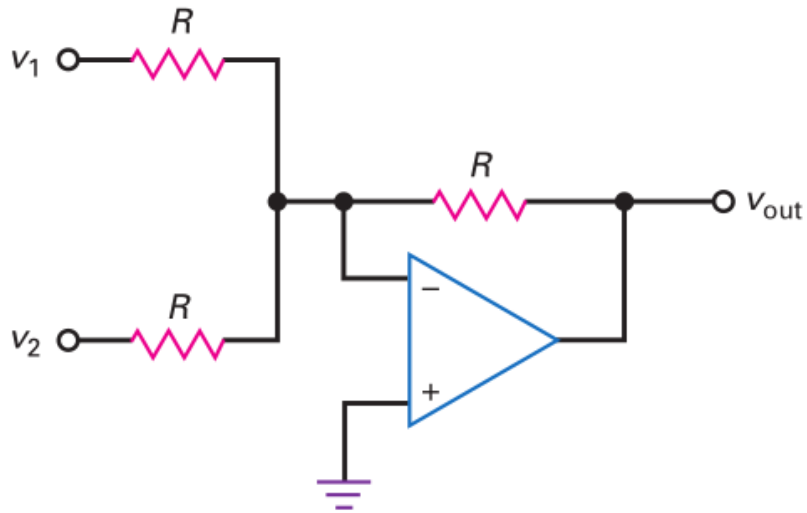


- $v_{in} = i_1 R_1$
- $v_{out} = i_1(R_f + R_1)$
- $A_{V(CL)} = \frac{R_f + R_1}{R_1} = \frac{R_f}{R_1} + 1$

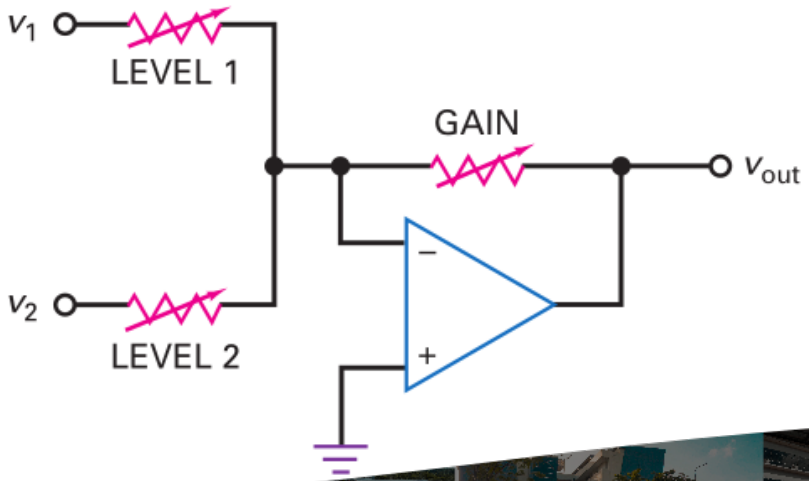
Summing Amplifier



(a)



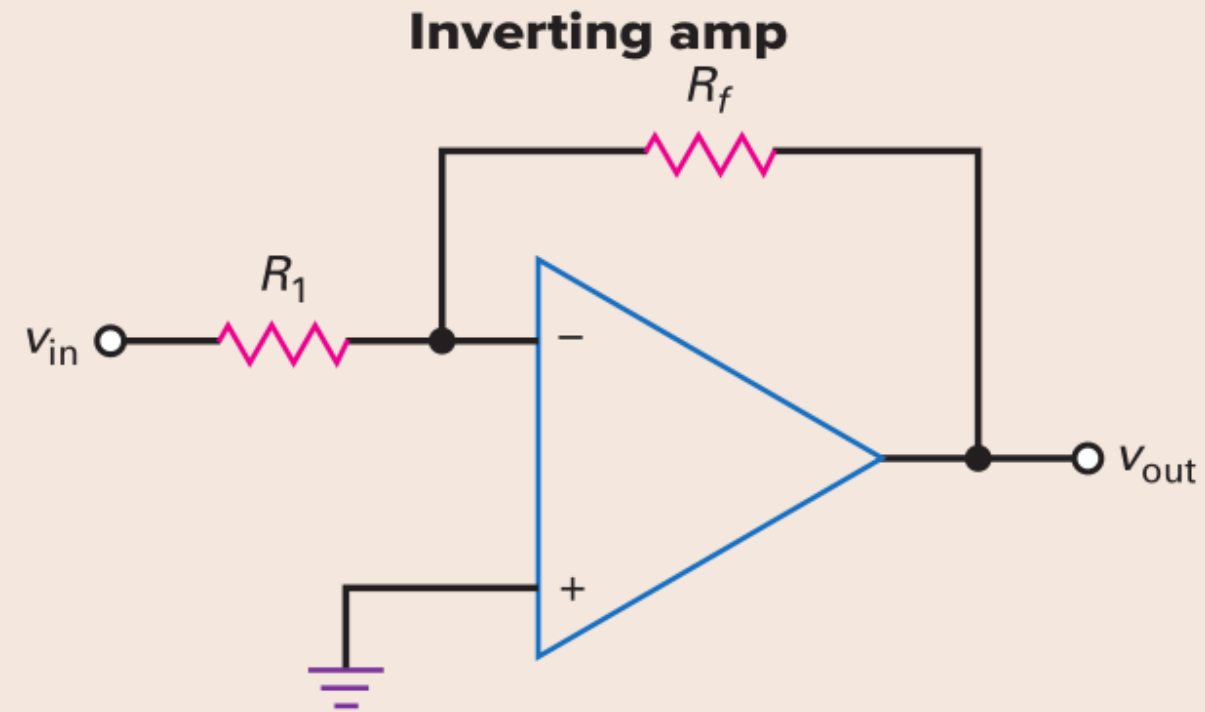
(b)



Summing Amplifier

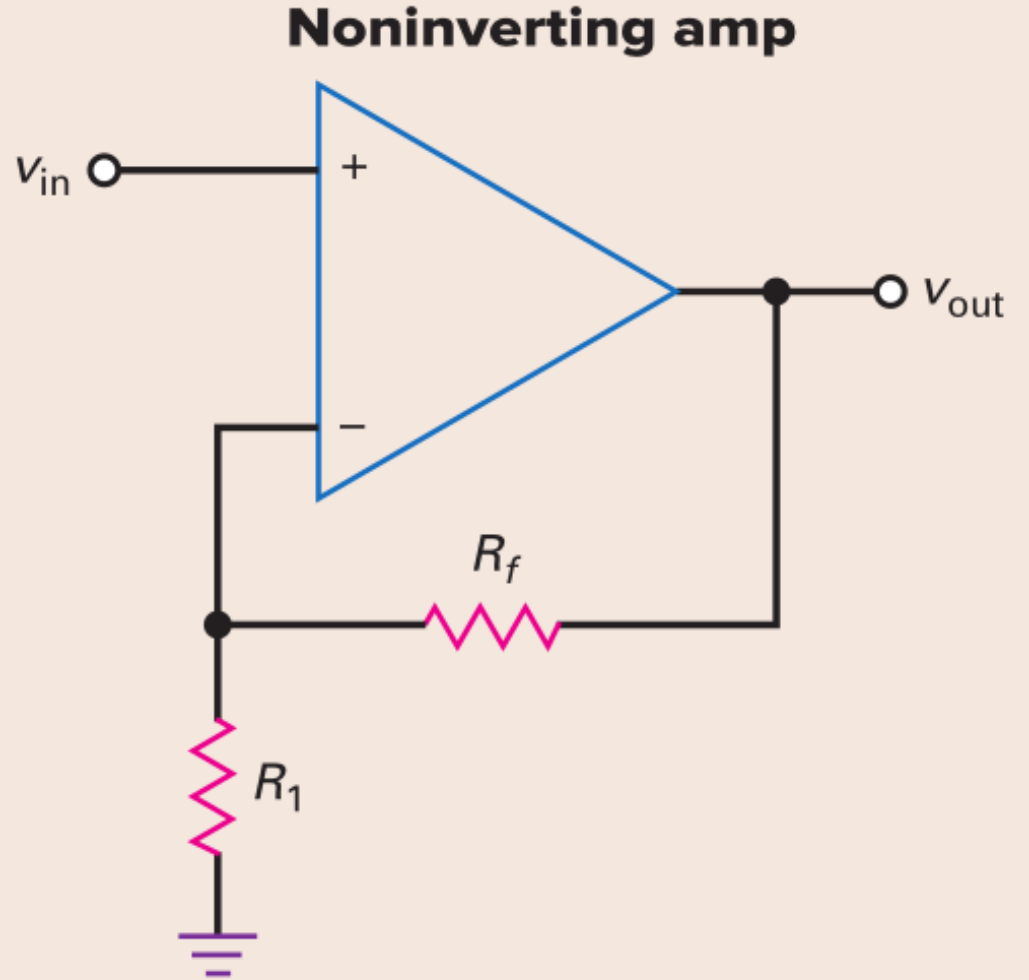
- $A_{V1(CL)} = \frac{-R_f}{R_1}$
- $A_{V2(CL)} = \frac{-R_f}{R_2}$
- $v_{out} = A_{V1(CL)}v_1 + A_{V2(CL)}v_2$

Summary

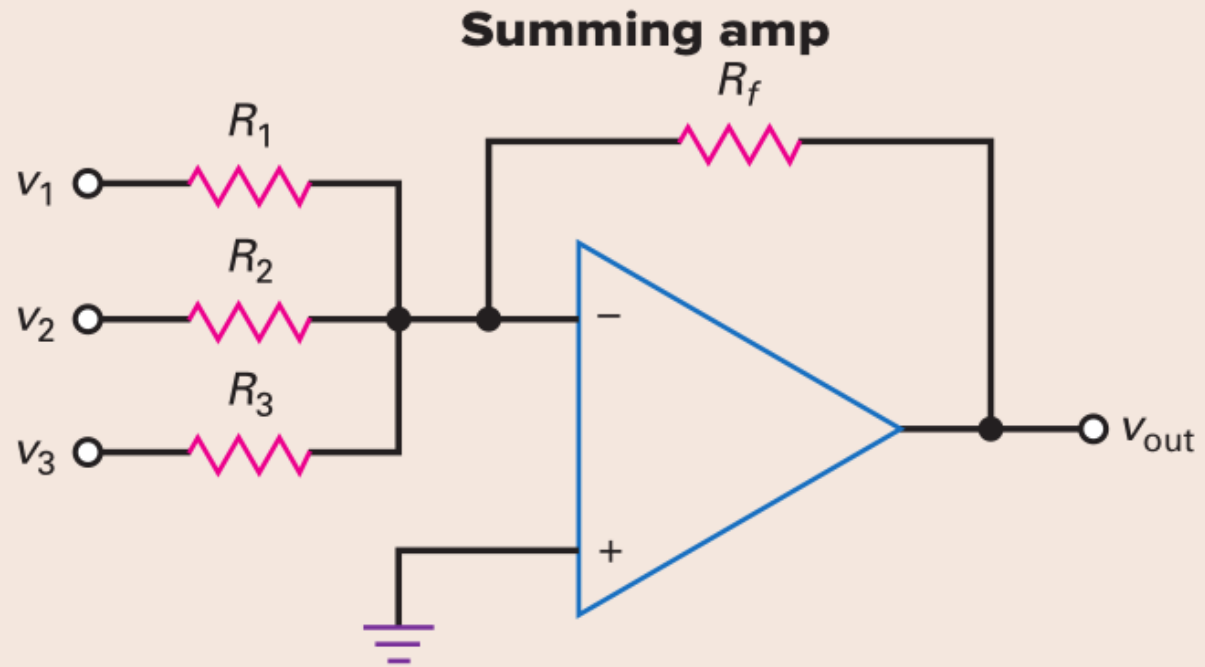


$$A_v = -\frac{R_f}{R_1}$$

Summary



Summary



$$v_{out} = -\left(\frac{R_f}{R_1}v_1 + \frac{R_f}{R_2}v_2 + \frac{R_f}{R_3}v_3\right)$$