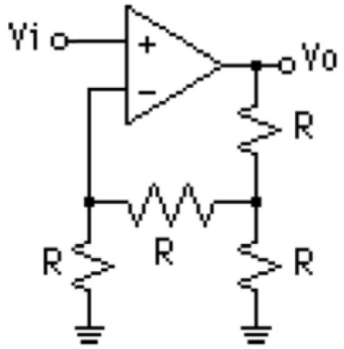
# Tutorial 9 - Operational Amplifier Abstraction

**Q1.** We have the following Op-amp circuit. Determine the circuit gain $A_v=v_o/v_i$.

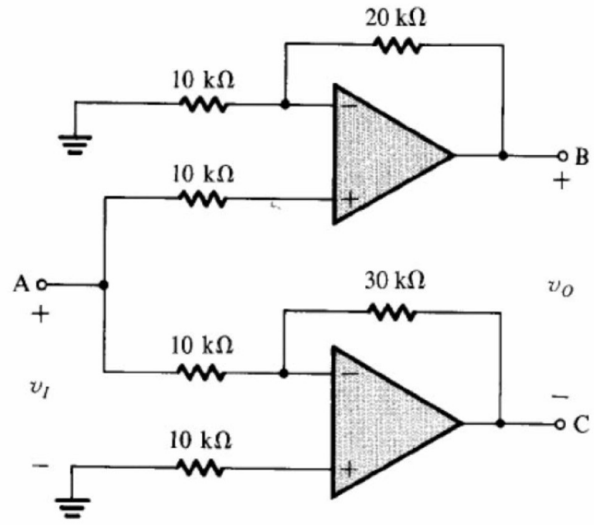



**Q2.** The circuit shown below is intended to supply a voltage to floating loads (those for which both terminals are ungrounded) while making greatest possible use of the available power supply.

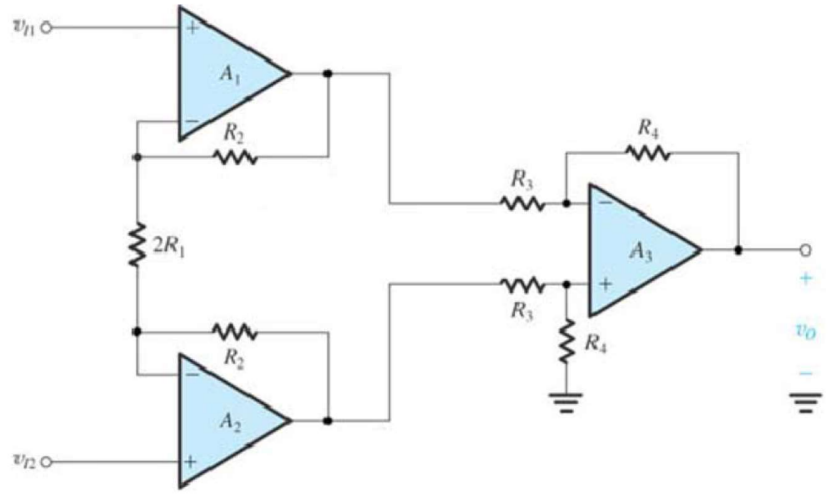
a) Assuming ideal op amps, sketch the voltage waveforms at nodes B and C for a 1-V peak-to-peak sine wave applied at A. Also sketch $v_0$.

b) What is the voltage gain $v_0/v_i$?

c) Assuming the op amps operate from ±15-V power supplies and their output saturates at ±14V, what is the largest sine wave output wave output that can be accommodated? Specify its peak-to-peak value.



**Q3.** Determine the expression of the output $v_o$ as a function of inputs $v_{I1}$ and $v_{I2}$




**Q4.** Consider the difference amplifier shown below. Calculate the differential gain $A_d=v_o/v_{id}$. Assume that $R_5$ and $R_6$ are much smaller than R so that the current through R is much lower than the current in the voltage divider, with the result that $\beta=R_6/(R_5+R_6)$.