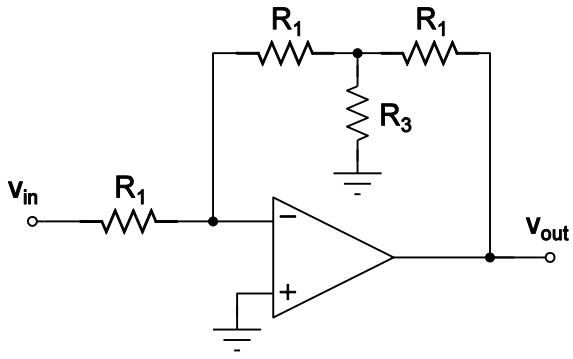
Q1: Assume the OpAmps in circuits shown below are ideal. If you are using an OpAmp property in your solution (e.g., virtual short, zero output impedance, etc), clearly state it where it is used.

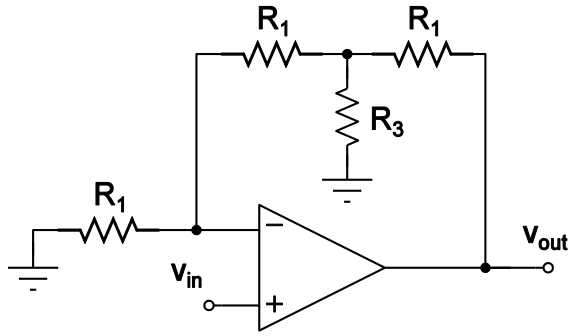
i. What are the voltage gains, $A_v = \frac{v_{out}}{v_{in}}$, of the circuits as a function of resistor values?

ii. What are the input resistances seen by the source, V_{in}?

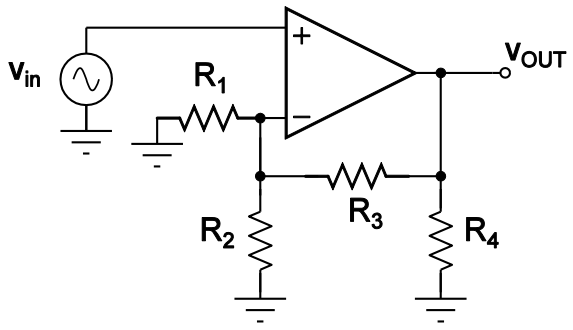
iii. Assuming $R_1 = R_2 = 10k\Omega$ and $R_3 = R_4 = 30k\Omega$, report numerical values for A_v and R_{in} for all circuits.



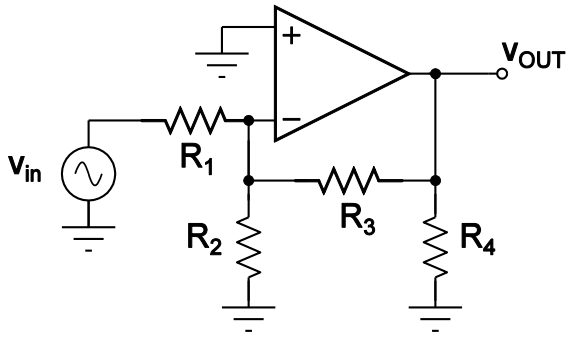
(a)



(b)

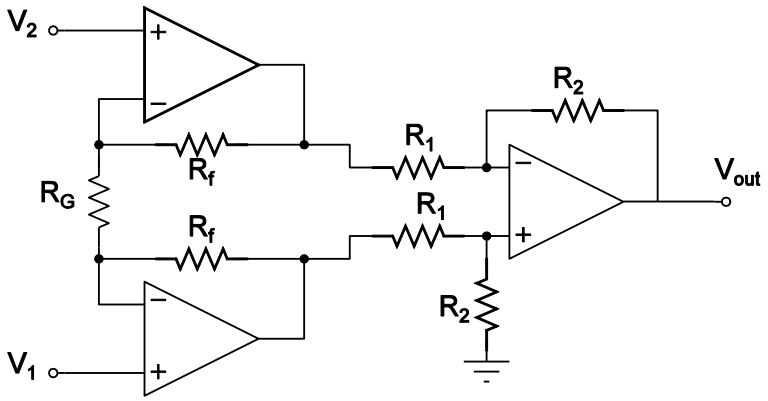


(c)



(d)

Q2: Using OpAmps with a gain-bandwidth product of $GBP = 1MHz$ and ideal otherwise, design the instrumentation amplifier shown below with a gain of $A_v = \frac{v_{out}}{V_1 - V_2} = 2000\frac{V}{V}$ over the entire audio band (i.e., $20Hz - 20kHz$).



Q3: What is the maximum gain that can be obtained if one needs to amplify a 15kHz sine wave with an amplitude of 1V without distortion using an OpAmp with a slew rate of $10^6 V/s$ which is otherwise ideal?