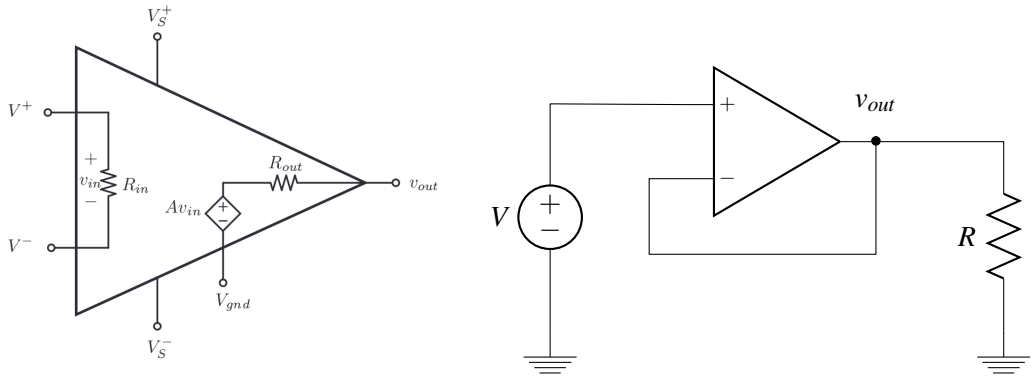
EECS 16A Designing Information Devices and Systems I
Fall 2015 Anant Sahai, Ali Niknejad **Discussion 9A**

1. Op-Amp Golden Rules

On the left is a picture of the equivalent circuit of an op-amp.



(a) Write down the current flowing through R_{in} in terms of V^+ and V^-. What is this current in the limit of $R_{\text{in}} \to \infty$?

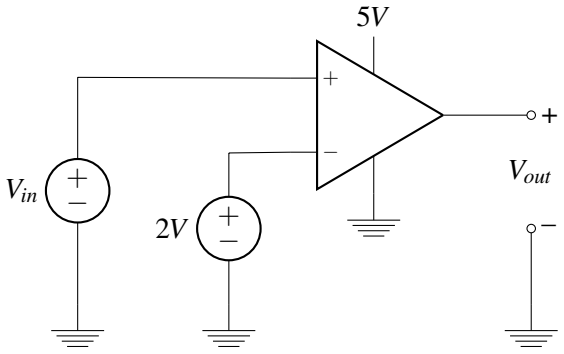
(b) Suppose we add a resistor of value R between v_{out} and ground. What is the value of v_{out} in terms of R, R_{out} and Av_{in}? What is v_{out} in the limit of $R_{\text{out}} \to 0$?

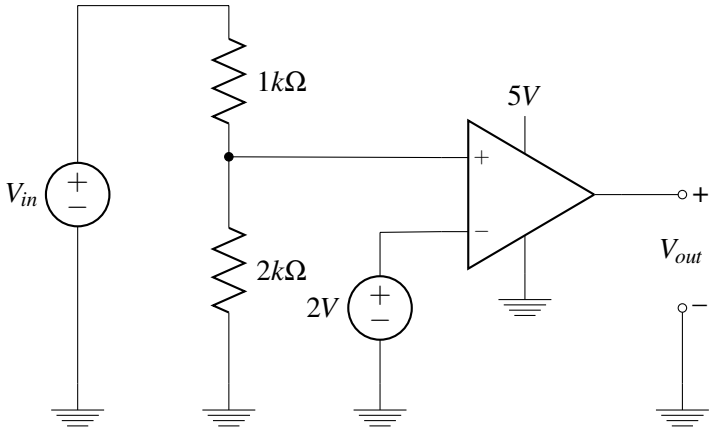
(c) Now consider the circuit on the right. Assume for the op-amp that $R_{\text{in}} \to \infty$ and $R_{\text{out}} \to 0$. Draw the equivalent circuit for this op-amp and calculate v_{out} in terms of A, V and R. Does v_{out} depend on R? What is v_{out} in the limit as $A \to \infty$?

2. Op-amps as Comparators

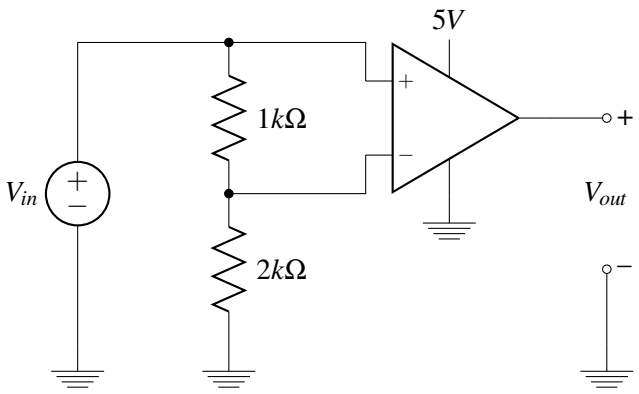
For each of the circuits shown below, plot V_{out} for V_{in} ranging from 0V to 10V.

(a)





(b)



(c)

3. Wine Barrel Filler

You own a wine tasting place in Berkeley! You have a very elegant dispenser set up for each kind of wine. To minimize the number of bottles you use, you dispense the wine directly from refillable rectangular barrels. To make sure that the barrels never run out, you want to design a level "detector" which will send the appropiate signal to the tank of wine to pour wine into a barrel until a certain level. Two lateral faces of the barrel (opposite to each other) are coated inside with a perfectly conducting material and you have wires coming out of the barrel at the two faces. You are given that the resistivity of wine is ρ. The dimensions of the barrels (other than height) are l and w. Design a circuit to control the level of the wine. You don't want it to go below a threshold $h_{\min}$ and above a threshold $h_{\max}$. The only commands the circuit needs to output are "Fill" and "Stop Fill". Recall the formula $R = \frac{\rho l}{A}$.