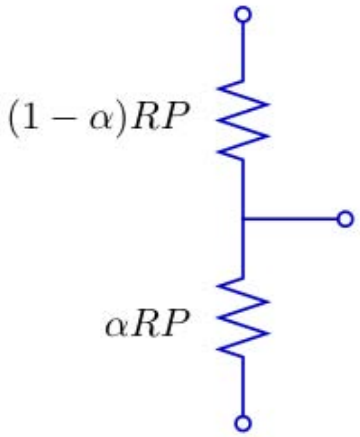
Problem Wk.7.1.2: Potentiometer

A potentiometer is a three terminal device, with a knob on it that you can physically turn. The resistance between the middle and bottom terminals increases in proportion to the angle of the input shaft (θ) and the resistance between the middle and top terminals decreases, so that the sum of the top and bottom resistors is constant (here it is some value R_P).

Potentiometers have a limited range of rotation, say 1.5π. To avoid having to deal wih the actual angles, we parameterize the angle using α, which goes between 0 (corresponding to the minimum θ) and 1 (corresponding to the maximum θ). So, our model for a potentiometer is:

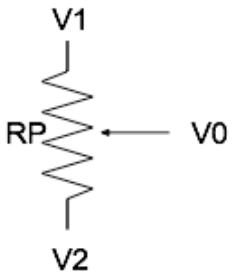


By connecting a potentiometer as shown below we can create a device that converts α into a voltage Vo. **All voltages are measured relative to ground.**

Your answers below will involve variables such as V_1, V_2, R and R_P, you should enter a valid infix expression as you would in Python, e.g. `3*V_1+R_P/2`. The asterisks are optional.

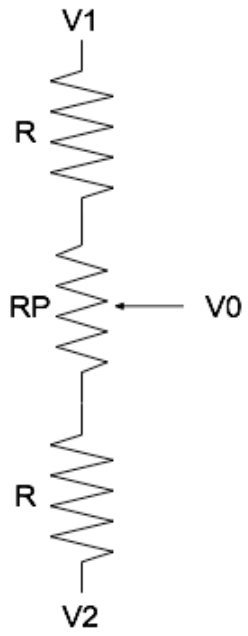
You must capitalize the variable names exactly as shown and include underscores where indicated.

1. For the circuit in the figure below, which depicts a potentiometer with total resistance R_P and with V_0 signifying the voltage on the middle terminal.:



Give an expression (in terms of V_1, V_2, and R_P) for the value of V_0 when α = 0:

2. In the same circuit, give an expression (in terms of V_1, V_2, and R_P) for the value of V_0 when α = 1:
3. In the same circuit, give an expression (in terms of V_1, V_2, and R_P) for the value of V_0 when α = 0.5:
4. Now, consider the circuit in the figure below:



   Given an expression (in terms of V_1, V_2, R, and R_P) for the value of V_0 when α = 0 :

5. In the same circuit, give an expression (in terms of V_1, V_2, R, and R_P) for the value of V_0 when α = 1:
6. In the same circuit, give an expression (in terms of V_1, V_2, R, and R_P) for the value of V_0 when α = 0.5. This has a very simple answer, please make sure that you look for that.

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