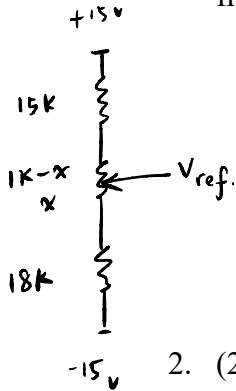


Keep your pre-lab with you during this week's lab! Turn it in to your TA with your handout, making sure your TA checks it off on the check-sheet.

1. (2 points) Calculate the maximum and minimum possible reference voltages from our pot circuit that we're going to build in the lab.



$$V_{ref} = -15 + \frac{x + 18k}{18k + 15k + 1k} \cdot 30 = -15 + \frac{x + 18k}{34k} \cdot 30$$

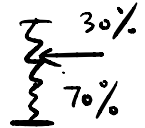
$$V_{ref \min} \big|_{x=0} = -15 + \frac{18k}{34k} \cdot 30 = 0.8823V$$

$$V_{ref \max} \big|_{x=1k} = -15 + \frac{19k}{34k} \cdot 30 = 1.7647V$$

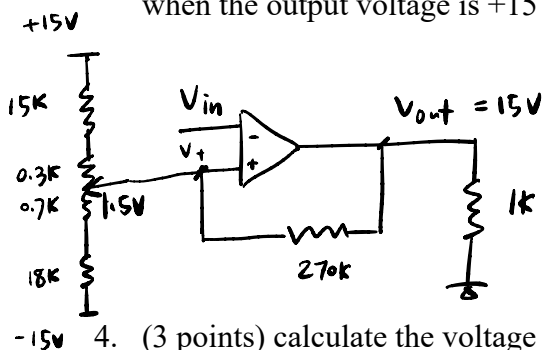
2. (2 points) Calculate the potentiometer setting, as a percentage, to produce a 1.5V reference signal.

$$V_{ref} = 1.5 = -15 + \frac{x + 18k}{34k} \cdot 30 \Rightarrow \frac{x + 18k}{34k} = \frac{16.5}{30} \Rightarrow x = 0.7k$$

So as percentage. It should be $\frac{1k - 0.7k}{1k} = 30\%$



3. (3 points) Now, suppose you keep the potentiometer setting as in question 2. After adding hysteresis in the lab, calculate the voltage at the non-inverting input when the output voltage is +15V.



$$Upper: 15.3k\Omega$$

$$Lower: 18.7k\Omega \quad V_{th} = 1.5V$$

$$R_{th} = (15.3) \parallel (18.7) = 8.38k\Omega$$

$$V_+ = \left(\frac{V_{th}}{R_{th}} + \frac{15V}{270k} \right) \cdot \left(\frac{1}{\frac{1}{R_{th}} + \frac{1}{270k}} \right) = 1.91V$$

4. (3 points) calculate the voltage at the non-inverting input when the output voltage is -15V.

$$Same \quad V_+ = \left(\frac{V_{th}}{R_{th}} + \frac{-15V}{270k} \right) \cdot \left(\frac{1}{\frac{1}{R_{th}} + \frac{1}{270k}} \right) = 1.0V$$