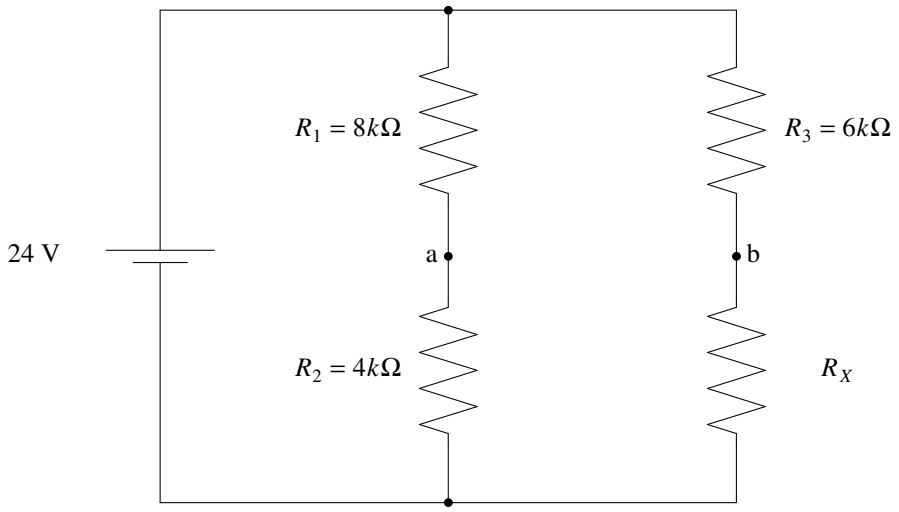
Problem 2: (30 pts.) Consider the circuit below, known as a Wheatstone Bridge.



a. (15 pts.) If the voltage difference V_{ab} is measured to be 0 V, what is the unknown resistance R_X?

b. (15 pts.) Next, resistor R_X is replaced by a new unknown resistor R_Y. The voltage $V_{ab} = V_a - V_b$ is now measured to be 2.00 V. What is R_Y? (In this type of circuit, measurements of V_{ab} can be used to monitor changes in resistance of R_Y.)

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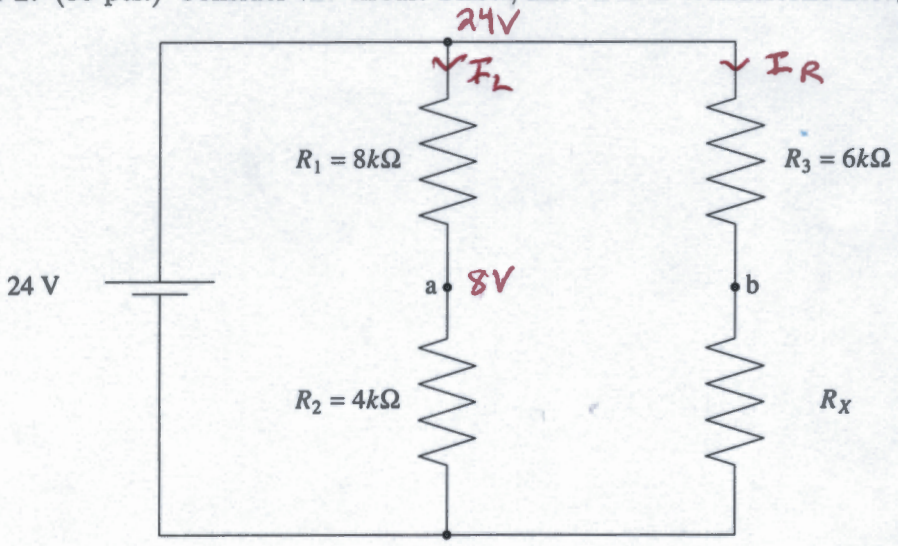

a. (15 pts.) If the voltage difference V_{ab} is measured to be 0 V, what is the unknown resistance R_X? $I_L = \frac{24V}{8k\Omega + 4k\Omega} = 2mA$

$V_a = I_L R_2 = 8V$.

V_1 = voltage across resistor 1 $= I_L R_1 = 16V$

$\therefore$ Requir $V_b = 8V$, $V_a = 16V$, so $I_R = \frac{16V}{6k\Omega}$.

Lastly, Requir $V_b = 8V = I_R R_x \Rightarrow R_x = \frac{8V}{16V/6k\Omega} = \boxed{3k\Omega}$

b. (15 pts.) Next, resistor R_X is replaced by a new unknown resistor R_Y. The voltage $V_{ab} = V_a - V_b$ is now measured to be 2.00 V. What is R_Y? (In this type of circuit, measurements of V_{ab} can be used to monitor changes in resistance of R_Y.)

Now, requir $V_b = 6V$, so $I_R = \frac{24-6}{6k\Omega} = 3mA$

Then, since $V_b = 6V = I_R R_Y$, $R_Y = \frac{6V}{3mA} = \boxed{2k\Omega}$