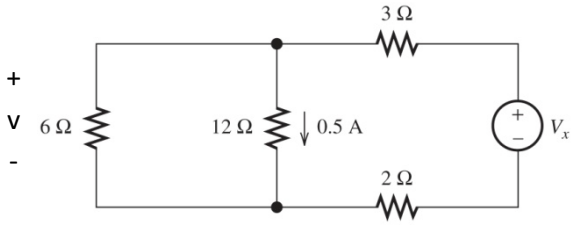
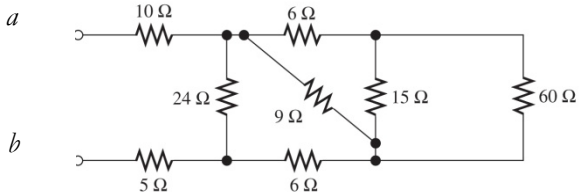
RBE 1001 Homework #7 **Name: _____**

1. Consider the circuit shown below.
   a) Find V_x. (ans ~ 12V)
   b) Find the total power absorbed by the resistors. (ans ~20W)

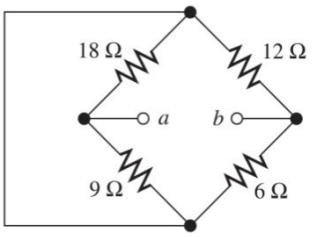


Ohm's Law: v = 0.5 x 12 = 6 V
Ohm's Law: Current through the 6 Ω = 6/1 = 1A
v_s = 3 Ω x 1.5 A + 6 V+ 2 Ω x 1.5 A = 13.5 V
Power = i v_s = 1.5 A x 13.5 V = 20.3 W

2. Find the equivalent resistance between terminals *a* and *b* in both of the following circuits: (ans ~20Ω; 10Ω)

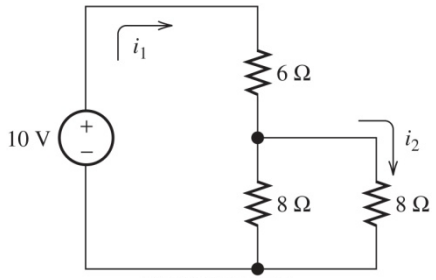


Working from right→left:
60 || 15 = 12 Ω
12 + 6 = 18 Ω
18 || 9 = 6 Ω
6 + 6 = 12 Ω
12 || 24 = 8 Ω
10 + 8 + 5 = 23 Ω



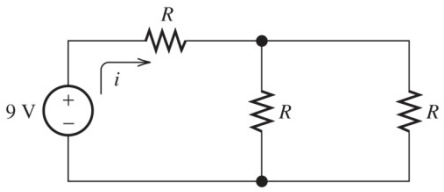
12 || 6 = 4 Ω
18 || 9 = 6 Ω
4 + 6 = 10 Ω

3. Find i_1 and i_2 in the circuit below. (ans $i_1 = \sim 1A$)



8 || 8 = 4 Ω
6 + 6 = 10 Ω
i_1 = 10 V / 10 Ω = 1 A
i_2 = 4 V / 8 Ω = 0.5 A

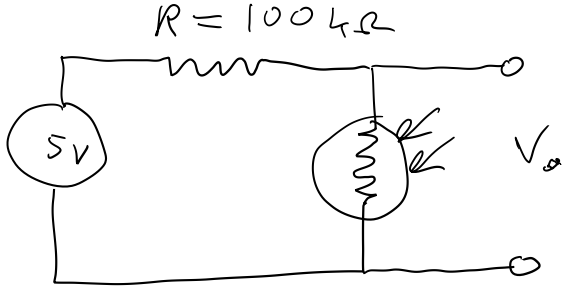
4. The 9-V battery in the circuit below is delivering 2.43 W of power to three robot sensors represented by the resistors. All the sensors are identical with resistance *R.* Find the value of *R*. (ans: ~20Ω)



R || R = R/2
R + R/2 = 1.5R
i = 9 V /1.5R
p = 9V i = 81 V^2 / 1.5R = 2.43W
R = 81V^2 / (1.5 x 2.43 W) = 22 Ω

5. *You may want to review the class notes to solve this problem.* A robot line-following sensor uses a photo resistor whose resistance changes from 10 kΩ (LIGHT) to 250 kΩ (DARK). Design an electronic circuit (with a 5 V source for all circuits) such that the output voltage is 0 V on WHITE and 5 V on BLACK. For purposes of limiting the current in the photo resistor loop, you decide to use a 100 kΩ resistor in series with it. For similar current considerations, you pick a 100 kΩ variable resistor ("potentiometer") for the reference circuit. Clearly draw your complete circuit diagram (to include the photo resistor, the op amp, the reference voltage loop with 100 kΩ potentiometer, and the 100 kΩ series resistor). Specify and explain the reference voltage selected. (ans ~2V)

First find the voltage variation of the photo resistor.

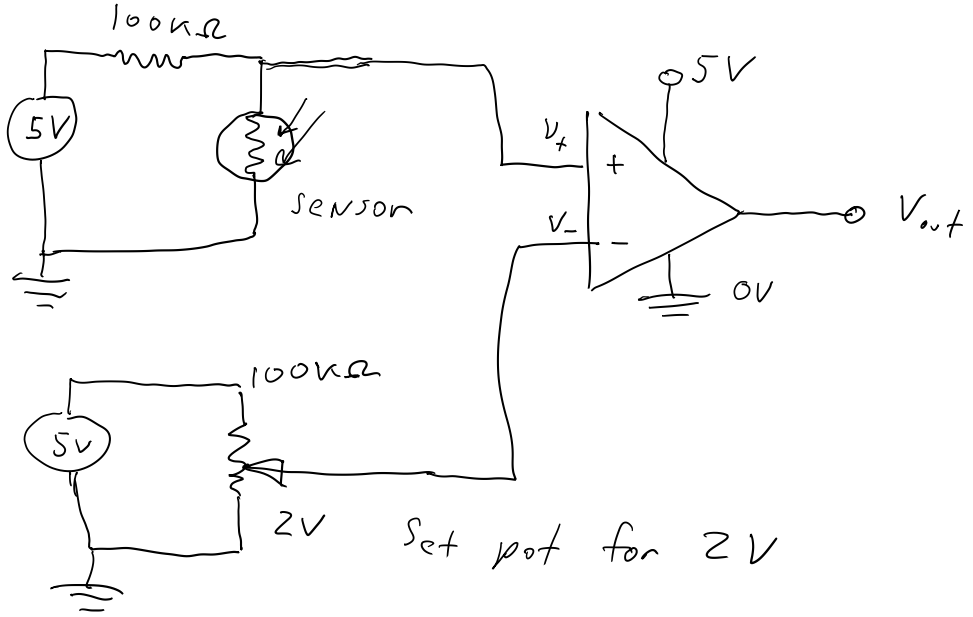


DK: $V_o = \left(\frac{250(k\Omega)}{250(k\Omega)+100(k\Omega)}\right) 5V = 3.6(V)$

LT: $V_o = \left(\frac{10(k\Omega)}{10(k\Omega)+100(k\Omega)}\right) 5V = 0.5(V)$

Note that the average is ≈ 2(V)

We want to choose a reference voltage that gives as much swing as possible between light and dark.


100kΩ
5V
sensor
5V
V_+
+
V_-
−
V_{out}
0V
100kΩ
5V
2V
Set pot for 2V