ECT150
Homework #4 Key
Sr. Professor Wheeler

Chapter 5 problems 1-9
Total Points: 27 (3 points per problem)

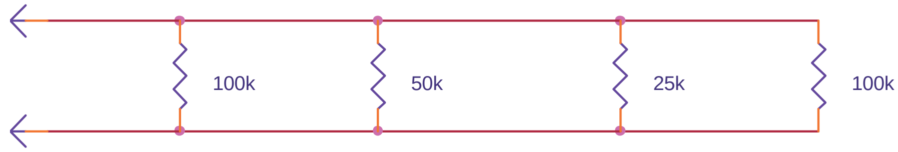
All work must be shown, and final answers boxed or underlined. No credit if work is not shown.

1. The total resistance of the circuit can be calculated using product over sum as follows:

$$R_T = \frac{R1R2}{R1+R2} = \frac{(27k)(47k)}{(27k+47k)} = \underline{\underline{17.15k\Omega}}$$

(Student may also calculate using reciprocals, Ohm's law, or "assumed voltage" methods.

2. The network of Figure 5-31 looks like this simplified:



Note to students: Components are normally drawn at right-angles in electronic circuit diagrams, except in certain "bridge" circuits (such as a Wheatstone bridge).

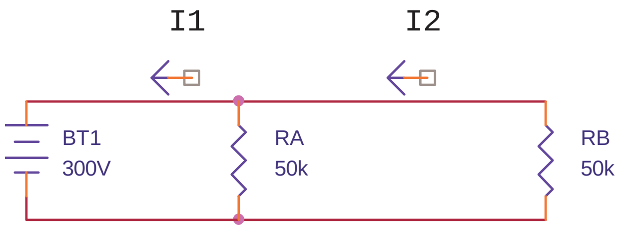
Since this is just four parallel resistors, the reciprocals method can be used:

$$R_T = \frac{1}{1/R1+1/R2+1/R3+1/R4} = \frac{1}{1/100k+1/50k+1/25k+1/100k} = \underline{\underline{12.5k\Omega}}$$

3. In Figure 5-32 the total current (I1+I2) is 40 mA, and I1 is given as 10 mA. Therefore, we can use KCL to solve for I1:

$$I_T = I1 + I2$$
$$40mA = 10mA + I2$$
$$\therefore I2 = 40mA - 10mA = \underline{\underline{30mA}}$$

4. The circuit configuration shown has six (6) 150 k resistors, in two groups of three. Therefore it really looks like this:



I1 and I2 can be solved by using Ohm's law and KCL:

$$I_2 = I_{M2} = \frac{V}{RA} = \frac{300V}{50k} = \underline{\underline{6mA}}$$

By inspection, the current I_{RA} is equal to I_{RB} since they see the same voltage and have the same total resistance (50k). Therefore the total current can be found by:

$$I_1 = I_T = I_{RA} + I_{RB} = 6mA + 6mA = \underline{\underline{12mA}}$$

The total power can be found by Ohm's law:

$$P_T = V_T I_T = (300V)(12mA) = \underline{\underline{3.6W}}$$

5. In Figure 5-34, if R2 opens, then:

I1 will remain the same
I2 will decrease (to zero)
I3 will remain the same
I_T will decrease
P_T will decrease
V_1 invalid voltage designator (au: No test point "1" found in Figure 5-34)

If R3 shorts (before fuse or power supply failure), then:

I1 will become zero (no voltage drop across R1 due to shorted R3)
I2 will become zero (due to shorted R3)
I3 will become infinity (or very high)
Total circuit current becomes infinity (or very high)

6. In Figure 5-35, find the value of R1. (Figure shows two parallel resistors, R1 and R2, with a total parallel resistance of 4k. R2 is known to be 12k.)

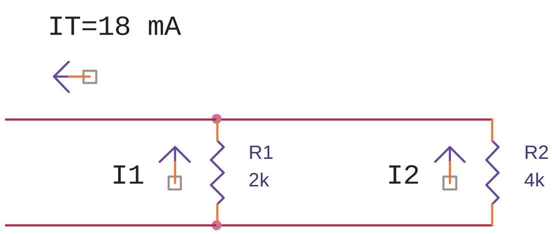
One way to solve this would be to use one of the formulas for parallel resistance, and solve for the unknown resistor. For example, we might write:

$R_T = \dfrac{1}{1/R1 + 1/12k} = 4k\Omega$ and solve for R1. Doing so, we'll get:

$$R1 = \frac{1}{1/4k - 1/12k} = \underline{\underline{6k\Omega}}$$

This isn't the *only* way to solve the problem; the assumed voltage method (see text) also works quite well.

7. Given Figure 5-36 and a total current I_T of 18 mA, find the currents I1 and I2.



One way to deal with this problem is to find the total voltage V_T across the resistors, then find the voltage across each one:

$$R_T = \frac{R1R2}{R1 + R2} = \frac{(2k)(4k)}{(2k + 4k)} = 1.33\bar{3}k\Omega$$

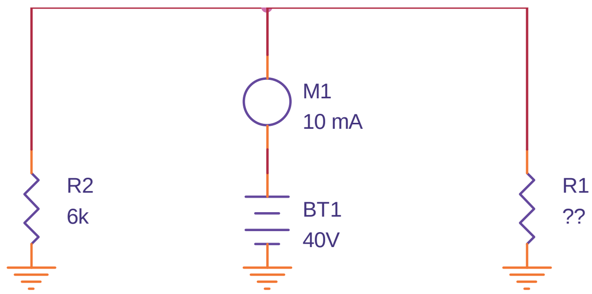
$$V_T = I_T R_T = (18mA)(1.33\bar{3}k) = 24V$$

Now I1 and I2 and be directly solved by Ohm's law, since V_T appears across both resistors:

$$I_1 = \frac{V_T}{R1} = \frac{24V}{2k} = \underline{\underline{12mA}}$$

$I_2 = \dfrac{V_T}{R2} = \dfrac{24V}{4k} = \underline{\underline{6mA}}$ (You could also use KCL to find this current, since IT=I1+I2)

8. Referring to Figure 5-37, what is the value of R1?



The total current in the circuit is 10 mA. We just need to find the current in R1, then we can solve for R1 by Ohm's law. First, we need to find out how much flows in R2:

$$I_{R2} = \frac{V_T}{R2} = \frac{40V}{6k} = 6.6\overline{6}mA$$

Therefore, the current in R1 is the total (10 mA) minus the current in R2 (6.66 mA):

$$I_{R1} = I_T - I_{R2} = 10mA - 6.6\overline{6}mA = 3.3\overline{3}mA$$

Now R1 can be found by Ohm's law:

$$R_1 = \frac{V_{R1}}{R_1} = \frac{40V}{3.3\overline{3}mA} = \underline{\underline{12k\Omega}}$$

9. In Figure 5-38, what is the value of P_{R1}?

To solve for P_{R1}, we need to know V_{R1} and I_{R1}. (We could also find I_{R1} and R_1, but that takes more steps.)

R1 and R2 are in parallel, therefore V_{R1} and V_{R2} are equal and can be expressed as:

$$V_{R1} = V_{R2} = I_{R2}R_2 = (2A)(25\Omega) = 50V$$

The current in R1 can be found by KCL:

$$I_T = 2.5A = I_{R1} + I_{R2} = I_{R1} + 2A$$
$$\therefore I_{R1} = I_T - 2A = 2.5A - 2A = 0.5A$$

Knowing these two pieces of information, we can now write:

$$P_{R1} = I_{R1}V_{R1} = (0.5A)(50V) = \underline{\underline{25W}}$$