Practice Problems Section 7 Solutions

1. A cylindrical metal wire has resistance . What will be the resistance of this wire, in terms of , if you stretch the wire to three times its original length. Assume that the density of the wire remains constant. (*Hint: Stretching the wire will not only affect the length, but also the cross-sectional area of the wire*).

The resistance of a wire involves three factors: the resistivity, the length, and the cross-sectional area.

In this example, the resistivity will remain the same, since it is only dependent on the wire material (i.e. it is intrinsic to the type of wire), which has not changed.

However, the length and cross-sectional area have both changed. To figure out the new resistance, we must figure out how the length has changed and how the cross-sectional area has changed.

First, for the length. Clearly, from the statement in the problem, the length has increased by a factor of three. If the old length was , then

Now to figure out the cross-sectional area. Assume the original cross-sectional area was . Since we know the volume of the cylinder has remained the same, we know that

This yields

Thus, because the length of the wire has tripled, the cross-sectional area has been reduced by a factor of three. Finally, we can compute the resistance of the wire.

**The resistance of the wire has increased by a factor of 9.**

1. When a resistor is connected to a 1.50 V battery, the resistor dissipates 0.0625 W of power.
2. Solve for the resistance of the resistor.

We know that for any circuit element, the power dissipated is

Using Ohm’s law, we can express in terms of and . This yields, for the resistor,

Solving for yields

1. Now assume that the same resistor is connected to a 12.6 V car battery. How much current will flow through the resistor, and how much power will the resistor dissipate?

The same resistor is now connected to a different battery, however the resistor has not changed, so its resistance will remain the same. Thus, using Ohm’s law

The power dissipated is, as always,

We can use Ohm’s law to express this as