PHYSICS WORKSHEET - RESISTIVITY /30 Name: ______________

Various factors affect the resistance of a material:

1. Temperature. The resistance of all substances changes to some degree with temperature. In the case of pure metals, the resistance increases rapidly with a rise in temperature.
2. Length. Resistance of a uniform conductor is directly proportional to its length. When length increases, resistance increases.
3. Cross-Sectional Area. The resistance of a uniform conductor is inversely proportional to its cross-sectional area. When cross-sectional area increases, resistance decreases.
4. Material Properties. The resistance of a given conductor depends on the material from which it is made. A numerical value called the *resistivity* is assigned to materials based on how well they conduct electricity.

To remember trends in electrical resistance, it is helpful to think of water flowing in a pipe. If the length of the pipe increases, the resistance increases. Think of drinking through a very long straw -- It would take a lot of effort! On the other hand, increasing the diameter (and so the cross-sectional area) decreases the resistance. A straw with a bigger diameter is easier to use, especially when drinking those thick fast-food store milkshakes.

Bringing all of these trends together results in this formula: $R = \frac{\rho l}{A}$

R is the resistance, ρ is the resistivity of the material, l is length, and A is cross-sectional area. Below are the resistivities of some common conductors at 20°C, in units of ohm-meters, and some related problems.

Material	**Resistivity (ohm-meters)**
aluminum	2.82×10^{-8}
copper	1.72×10^{-8}
iron	9.68×10^{-8}
nichrome	100×10^{-8}
platinum	10.0×10^{-8}
silver	1.63×10^{-8}

Problems

1. Compute the resistance of a hardened copper rod 2 meters long and 8 mm (8×10^{-3} meters) in diameter if the resistivity of the material is 1.756×10^{-8} ohm-meters. (6.99×10^{-4} Ω)
2. What is the resistance of a copper wire 20 meters long and 0.81 mm in diameter at 20°? (0.668 Ω)
3. The resistance of a uniform copper wire 50.0 meters long and 1.15 mm in diameter is 0.830 ohms at 20° C. What is the resistivity of the copper at this temperature? (1.726×10^{-8} Ω m)
4. Find the resistance of a length of wire 50 meters long and 8 mm in diameter if it is made of
   (a) alumimum (2.8×10^{-2} Ω),
   (b) copper (1.71×10^{-2} Ω),
   (c) iron (9.63×10^{-2} Ω),
   (d) platinum (9.95×10^{-2} Ω), and
   (e) silver (1.62×10^{-2} Ω).
5. At 20° C, 33 meters of copper wire has a resistance of 0.639 ohms. What is the resistance of 165 meters? (3.195 Ω)
6. A square aluminum rod is 1.0 meters long and 5.0 mm on each side. What is the resistance between is ends? What must be the length of one side of a square copper rod if its resistance is to be the same? (1.128×10^{-3} Ω)
7. A rectangular block of iron is 15 cm long and 1.2 cm on each edge.
   a) What is the resistance of the block measured between the two square ends? (1.008×10^{-4} Ω)
   b. What is the resistance of the block measured between two opposite rectangular faces? (6.44×10^{-7} Ω)
8. Which conductor in the chart above is most likely to be used in heating elements for electric stoves and ovens? Explain. (Nichrome, most resistive)