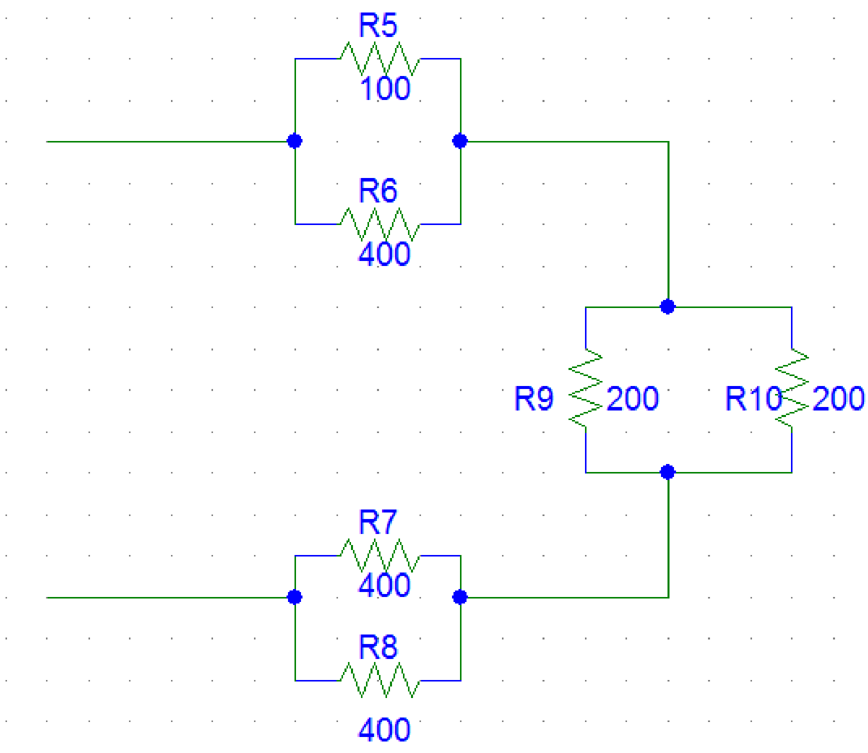
Shock Value Practice Test Key

1. Electromagnet A has 10 coils with a current of 2 A. Electromagnet B has 100 coils and a current of 1.5 A. Both are the same length, and they have identical iron nails in the center of the coils. Which one do you think can exert a greater magnetic force, and why?

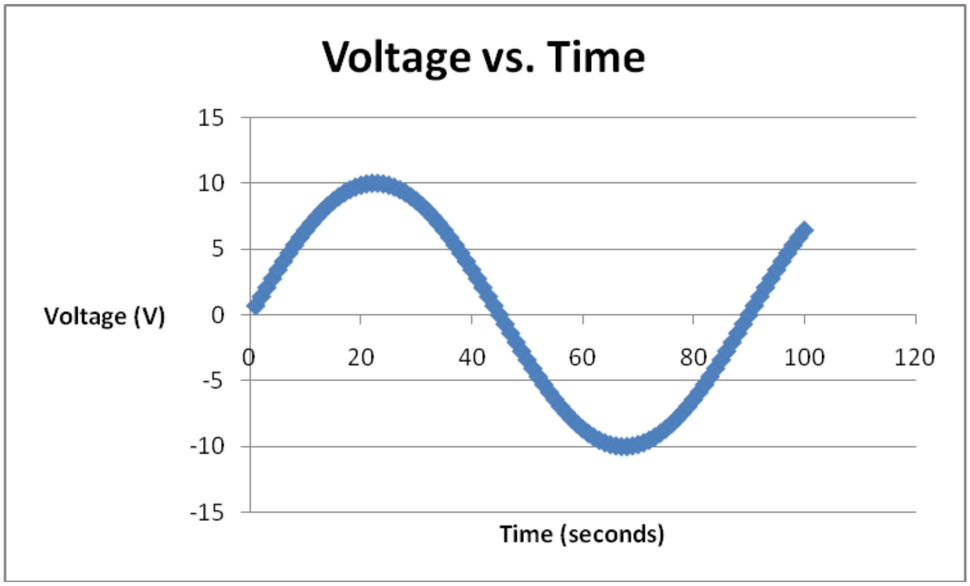
   Electromagnet B. Electromagnet strength depends on current and the number of turns. While the current through Electromagnet A is greater, the much greater number of turns in Electromagnet B will make it the stronger magnet.

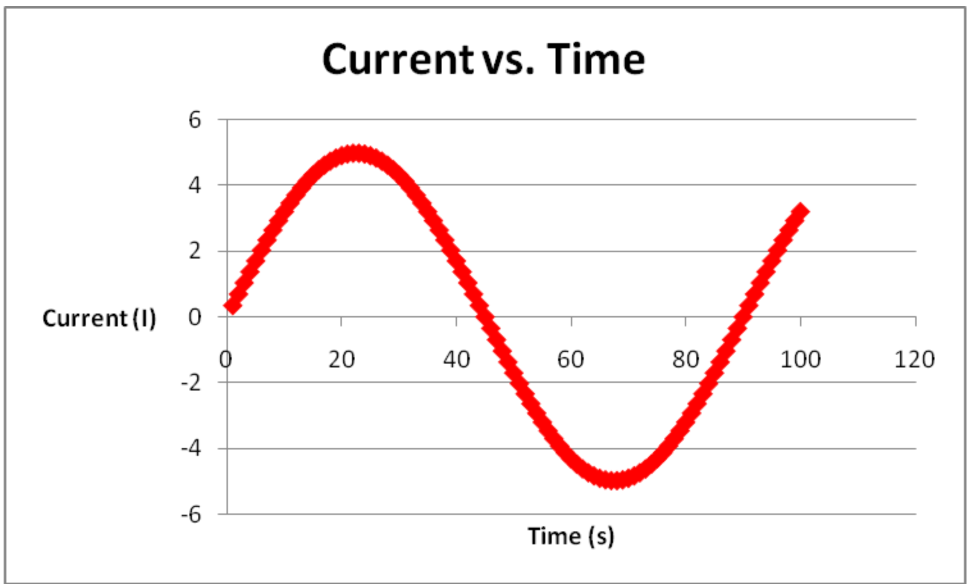
2. Determine the equivalent resistance of the following circuit. All numbers are in ohms.



380 ohms

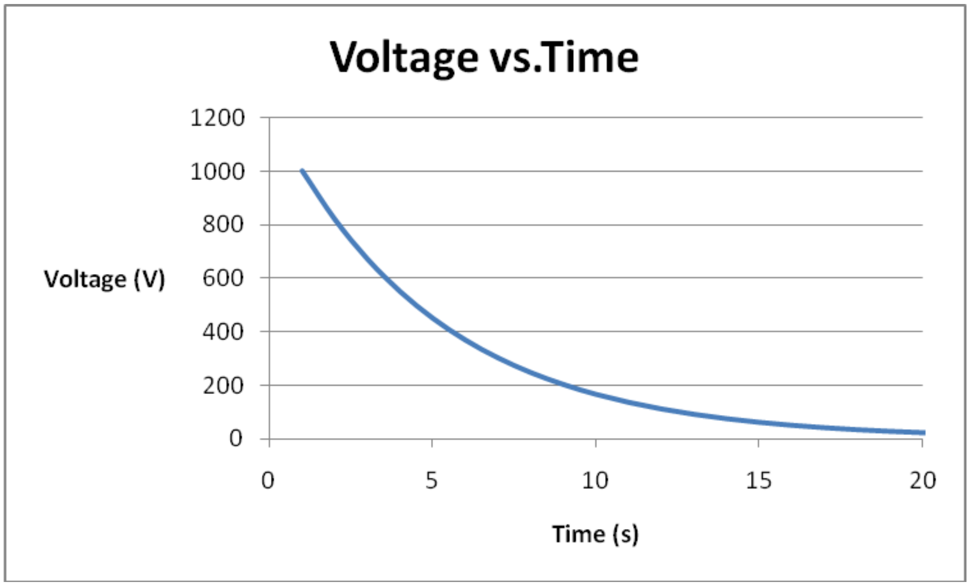
3. What is the resistance of the circuit that generated the following graphs?


Voltage vs. Time
15
10
5
0
-5
-10
-15
Voltage (V)
0
20
40
60
80
100
120
Time (seconds)


Current vs. Time
6
4
2
0
-2
-4
-6
Current (I)
0
20
40
60
80
100
120
Time (s)

2 ohms

4. What is the current through a resistor that has a resistance of 10 ohms and the voltage at time t = 5 seconds on the following graph?



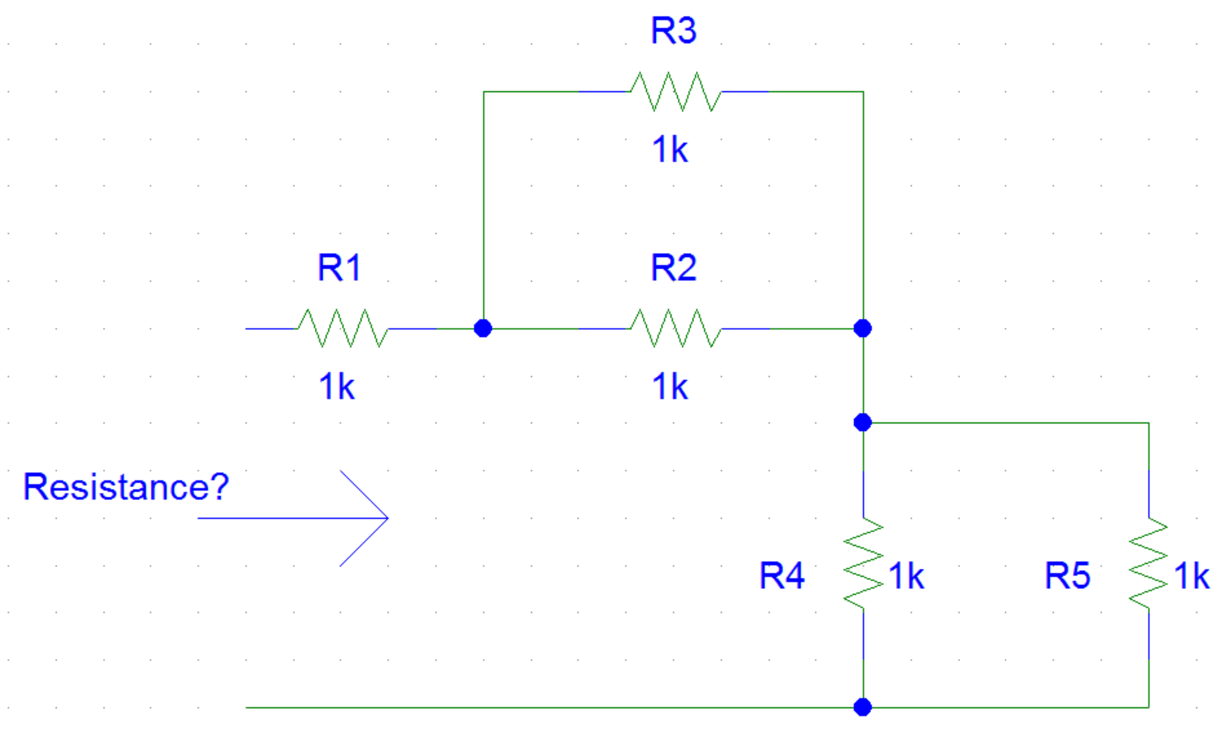
At time t = 5 seconds, the voltage is about 450 V. Therefore, the current is 45 A (anything between 40 and 50 would be accepted).

5. Which of the following materials will be attracted to a magnet?
   a. Carbon steel Yes—carbon steels are magnetic
   b. Plastic No
   c. An iron bar Yes
   d. Ceramic No
   e. Pure water No—impurities give water magnetic properties, but water itself is not magnetic
   f. A plugged-in electrical cord Yes—a current generates a magnetic field (consider an electromagnet)
   g. An unplugged electrical cord No—there's nothing about a copper conductor that is inherently magnetic.

6. Santa Claus, polar bears, and the Arctic sea are all located near which MAGNETIC pole?

South (remember, they are backwards)

7. Find the equivalent resistance of the following circuit. All numbers are in ohms.



2000 ohms

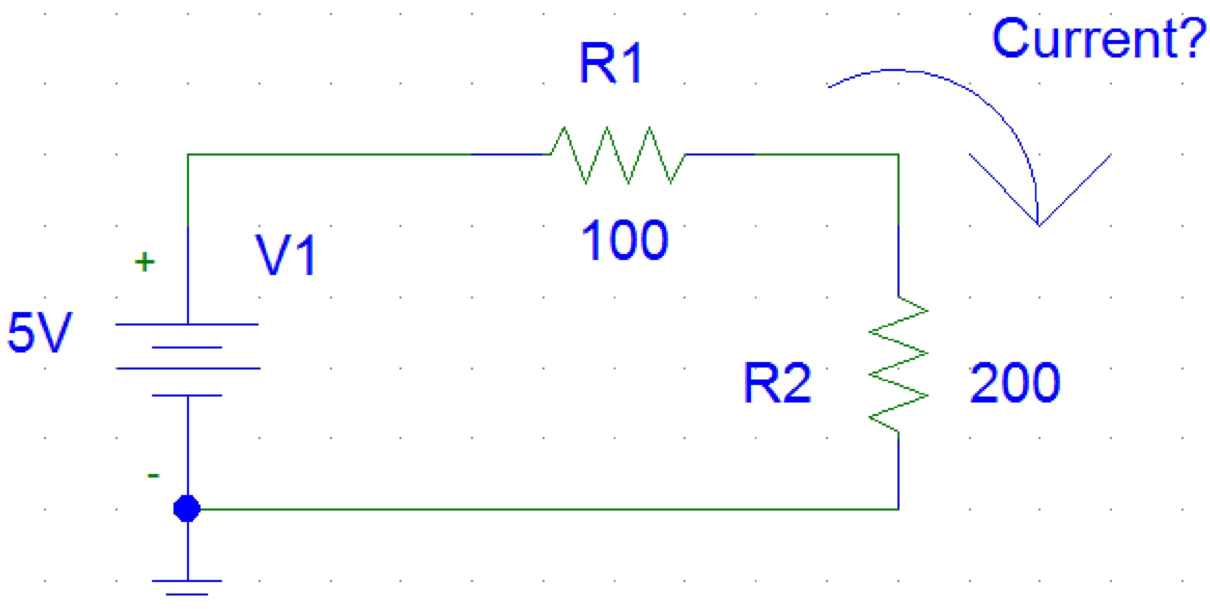
8. What determines if a material will be a good conductor?

Electrons can move freely in the material

9. Match the following with their definitions:

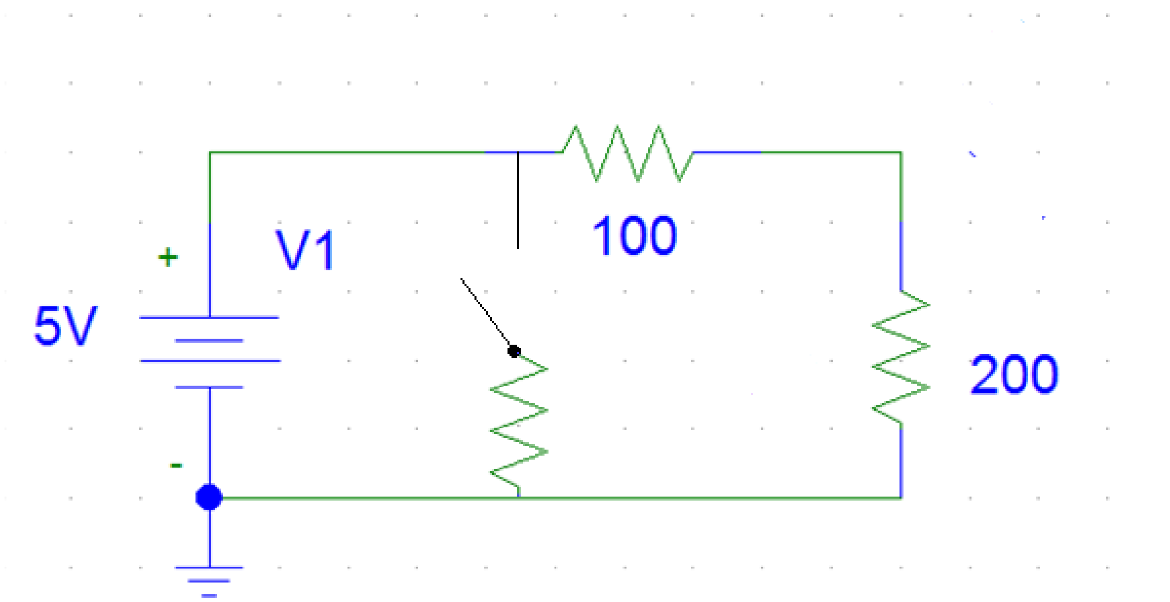
A.	Ohm	4	1.	The amount of charge moving in a circuit
B.	Resistor	9	2.	The unit of current
C.	Voltage	10	3.	The unit of voltage
D.	Potential	5	4.	The unit of resistance
E.	Current	1	5.	A device that maintains a set voltage across its terminals
F.	Volt	3	6.	Also called "voltage level"; it is the voltage at a certain point in a circuit
G.	Amp	2	7.	Determines how difficult it is to cause current to flow
H.	Battery	5	8.	Equals voltage divided by current; usually equal to resistance in simple circuits.
I.	Resistance	7	9.	A device that opposes the free movement of current.
J.	Impedance	8	10.	A quantity that describes how hard a circuit tries to push current through it; equals current times resistance

10. What is the current in the following circuit?



0.0167 A = 1.67 mA

11. Which of the following statements are true about this picture:



A. If the switch is closed, the current will go up.
B. If the switch is closed, the current may go up, or it may go down.
C. Closing the switch will always lower the equivalent resistance.
D. Closing the switch will always raise the equivalent resistance.
E. Closing the switch might raise or lower the equivalent resistance, depending on the value of the resistor near the switch.
F. If the resistor near the switch has a very low resistance, the current through the battery will be very large.

A, C, and F are true.

Lab Section

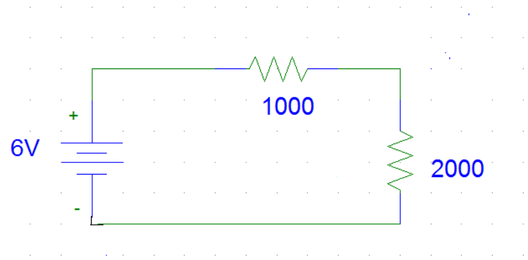
Show all work in the space provided below each question.

Note to coaches: I was able to find all necessary components for the circuits at the electronics section in Radio Shack. At this level, event writers have been encouraged to use gator clips or similar connectors over breadboards, as circuit construction on a breadboard is a difficult concept to teach to middle schoolers.

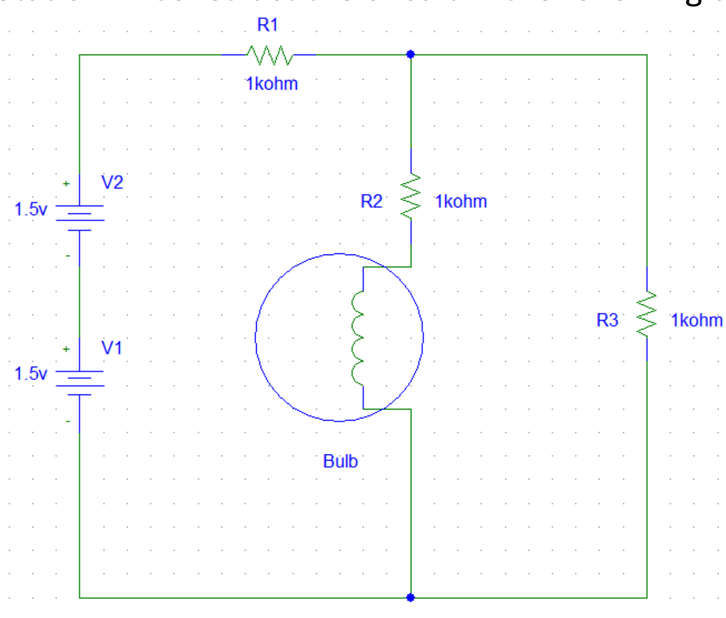
Station 1: Determine the resistance of the mystery resistor in the circuit.

The way I set this up was to have a 6 V battery pack (4 double A batteries) connected to a 1 kilohm resistor and a 2 kilohm resistor in series. Just in case any students had memorized the color band system, I blacked out the color bands on the 2 kilohm resistor with a sharpie. The students were told the value of the 1 kilohm resistor and the voltage and given a voltmeter (I taped over the dial so they couldn't use the ohmmeter setting).
The solution procedure is to measure the potential drop across each resistor. The voltage across the 1 kilohm resistor is about 2 V, and the voltage across the mystery resistor is about 4 V. While in this case some students deduce immediately that the mystery resistor has twice the resistance of the 1 kilohm resistor (and I would give them full credit for doing so), the more general procedure is to calculate the current through the 1 kilohm resistor using ohm's law (2 mA). Since the current is the same everywhere in a series circuit, the resistance of the mystery resistor can also be found using ohms law (where the voltage used is the 4 V drop across the resistor and the current used is the 2 mA calculated from the known resistor).

Draw a diagram of this circuit below.



Station 2: Construct the circuit in the following diagram.



Station 3: Determine the equivalent resistance of the constructed circuit.

The circuit used for a question like this will be similar in complexity to question 2 or question 7. All resistor values will be clearly labeled, and if any components such as light bulbs or motors are used, their resistance will be given.

Station 4: Use the voltmeter, current meter, and battery provided to determine the reisistance of the resistor.

This is a more straightforward application of Station 1. The students should connect the battery, resistor, and current meter in series, and the voltmeter should be measuring across the resistor only. From the values on the two meters, the resistance is calculated using V = IR.