Measuring potential differences

Recorder_____ Manager_____
Skeptic_____ Energizer_____

1 Setting up the voltmeter

You will use a digital multimeter to measure potential differences. Since the meter can measure different things, you need to set it to measure DC voltages. Since we have autoranging meters, it is not difficult.

Plug the red probe lead into the middle socket, labeled VΩmA.

Plug the black lead into the rightmost socket, labeled COM.

Set the dial to Volts DC (the symbol with the line and dots shown in the diagram).
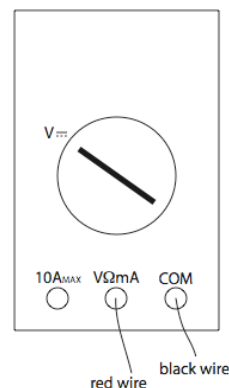
You may have expectations about the outcomes of the following measurements. Record your actual measurements, not your expectations!

2 Measuring ΔV

Record the voltmeter readings you see when you do the following:
a) Touch the voltmeter leads together:

b) Get a connecting wire (with alligator clips on the ends). Clip one end of the wire to the red lead, and the other end to the black lead:

c) Take a single batter out of the battery holder. Touch the red lead to the end of the battery marked +, and the black lead to the other end:

d) Reverse the leads of the voltmeter, so the black lead is touched to the positive end of the battery:

e) To get a positive reading, which voltmeter lead should touch the negative end of the battery?

f) Use a ruler to measure the length of the battery. What is the magnitude of the average electric field inside the batter? Show your calculation:

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g) Take the other battery out of the holder. Put the batteries end to end, so the negative end of one touches the positive end of the other. Measure the potential difference across the two batteries:

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h) Turn one of the batteries around and repeat the measurement:

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i) You have two kinds of light bulbs: short round light bulbs, and long light bulbs.

Use only ONE battery, ONE ROUND light bulb, and ONE connecting wire from the kit. (Do not use a socket or a battery holder). Make the light bulb light. Draw a diagram showing your circuit:

CHECK WITH ANOTHER GROUP TO SEE HOW THEY DID THIS.

Now put the battery back into the battery holder. Using two connecting wires (with alligator clips), one battery, one socket, and a round bulb, connect the circuit shown at the right, so that the bulb is lit. Measure and record the following potential differences and the length of each object, and calculate the magnitude of the electric field inside each object.
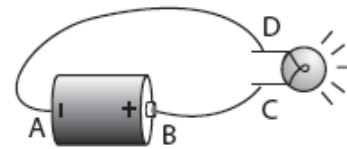
Be careful about signs. Keep the leads in the same relative position for all measurements. Some values should be positive, others negative.

j) From A to B across battery

$\Delta V =$	$L =$	$\left| \vec{E} \right| =$

k) From B to C

$\Delta V =$	$L =$	$\left| \vec{E} \right| =$

l) From C to D (the length of the actual filament, uncoiled, is 1 cm)

$\Delta V =$	$L =$	$\left|\vec{E}\right| =$

m) From D to A

$\Delta V =$	$L =$	$\left|\vec{E}\right| =$

n) What is the round trip potential difference from A to B to C to D back to A? Show your calculation, using your measurements from parts j) to m):

o) Take the bulb out of the circuit. Measure the potential difference across the bulb.

$\Delta V =$

Is the bulb filament in equilibrium?

Repeat this round-trip potential difference measurement for a circuit with two batteries placed in the battery holder, two sockets containing round bulbs, and four connecting wires as shown. Record the individual potential differences across each circuit element (battery, connecting wire, bulb), including the correct sign, and calculate the round-trip potential difference.

$V_B - V_A =$

$V_C - V_B =$

$V_D - V_C =$

$V_E - V_D =$

$V_F - V_E =$

$V_G - V_F =$

$V_H - V_G =$

$V_A - V_H =$

Round trip $\Delta V =$

Make sure that everyone in the group agrees with the results.
Check with another group, then give to instructor to grade.