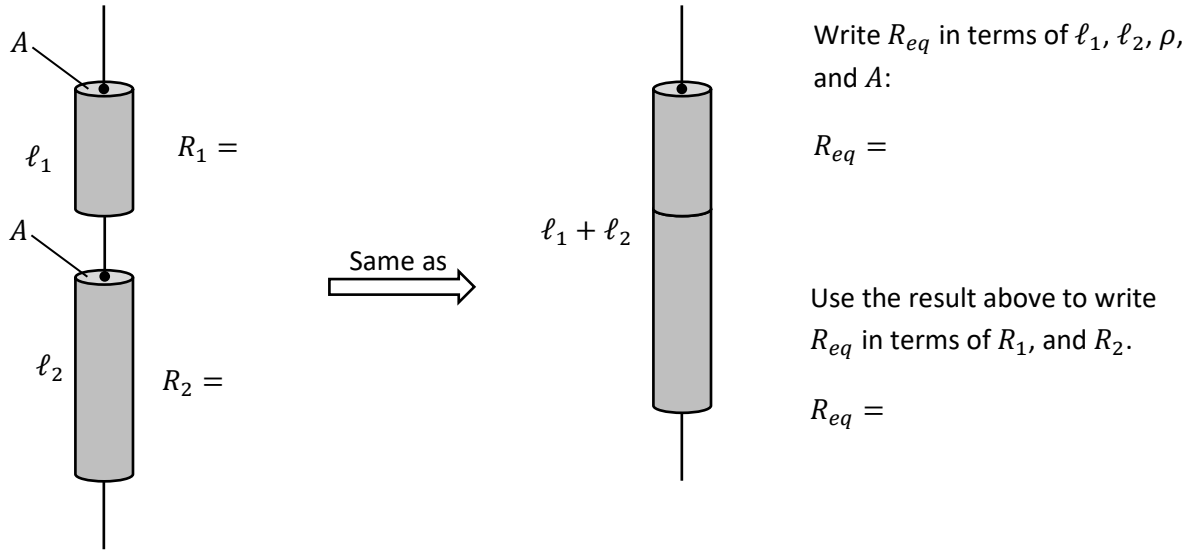


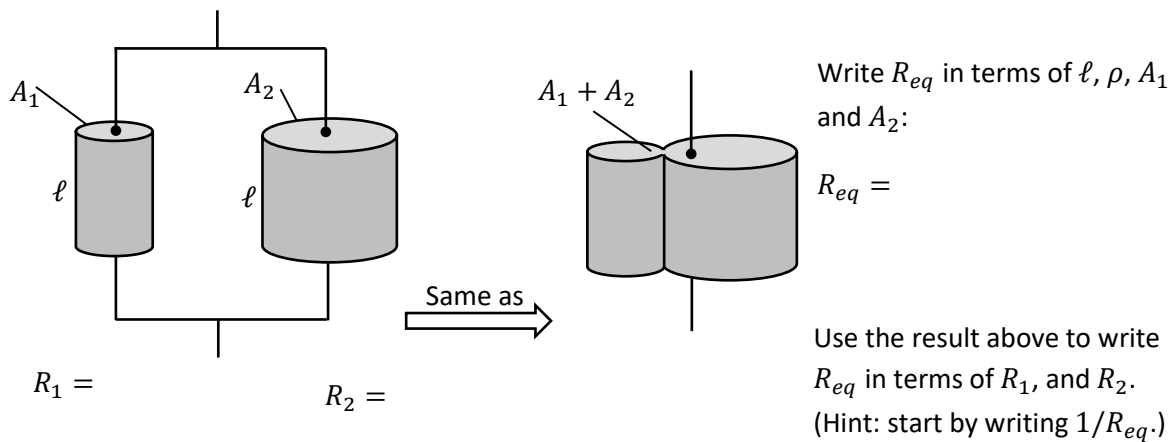
## Some random exercises with circuits, resistors, etc.

### Part 1.

Suppose you have two “resistors” in series, which are both cylinders of material with the same cross sectional area  $A$  and resistivity  $\rho$ , and different lengths  $\ell_1$  and  $\ell_2$ . Write their resistances below.

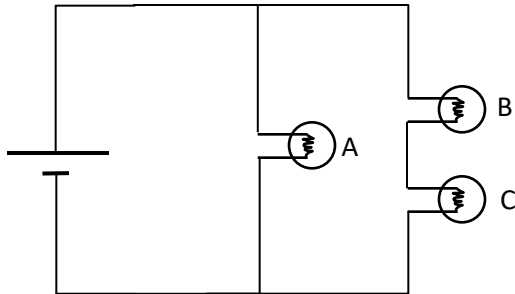


Suppose you have two “resistors” in parallel, which are both cylinders of material with the same cross sectional length  $\ell$  and resistivity  $\rho$ , and different Areas  $A_1$  and  $A_2$ . Write their resistances below.



## Part 2.

The circuit diagram below shows a battery connected to three light bulbs:



(a) In the space above, draw a diagram showing how to add a current meter and a voltmeter to measure the current through bulb A, and the voltage across bulb C.

(b) In general, you hope that when you connect current and voltage meters, they don't actually change any currents or voltages in your circuit. Ideally, would you want the resistance of your current meter to be very small, very large, or somewhere in the middle?

(c) Ideally, would you want the resistance of your voltmeter to be very small, very large, or somewhere in the middle?

(d) You have two DMMs at your station. Use one of them as a resistance meter (on " $\Omega$ ") to measure the resistance of the other meter when it is used as a current meter (on all four ranges) and as a voltmeter. Write your results below.

Did your measurements agree with your predictions in parts (b) and (c)?

### Part 3.

An ideal battery would always produce a constant EMF  $\mathcal{E}$  across the “load” resistance. (The “load” might be a motor or a light bulb, for instance.) What would be the current through a load resistance of  $10\ \Omega$ , if  $\mathcal{E} = 1.5$  Volts?

A typical 1.5 volt alkaline battery might have an additional “internal” resistance  $R_{int} = \Omega$ . What would be the current through a  $10\ \Omega$  load resistance in that case?

For the non-ideal battery above, with  $\mathcal{E} = 1.5$  Volts and  $R_{int} = 1\ \Omega$ , what would be the voltage across a  $10\ \Omega$  load resistance?

What current would the non-ideal battery above produce if you short circuited the two terminals together with a wire? What would be the short-circuit current of an “ideal” battery?