Solving physics problems: a detailed solution style

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Procedure

- Copy down the assigned problem
- Draw a picture of the problem, labeling useful quantities
- Make a list of relevant formulas
- Apply the formulas to the particular cases in the problem
- Solve for the unknown quantities
- Are your answers reasonable?

Copy down the assigned problem

This step ensures you read the problem carefully

17.24)
A 10.0 m length of wire consists of 5.0 m of copper followed by 5.0 m of aluminum, both of diameter 1.0 mm. A voltage difference of 85 mV is placed across the composite wire. (a) What is the total resistance (sum) of the two wires? (b) What is the currnent through the wire? (c) What are the voltages across the aluminum part and across the copper part?

Draw a picture of the problem

This step doublechecks your understanding of the problem, helps you translate it into your own terms, and makes it clear what quantities your various symbols refer to.

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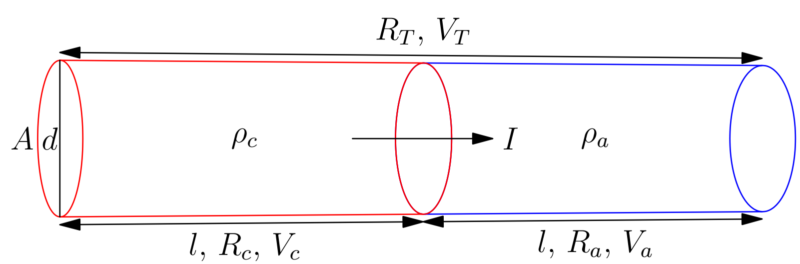

Make a list of relevant formulas

This is the key step, digging deep into your physics knowledge to dredge up any appropriate formulas.

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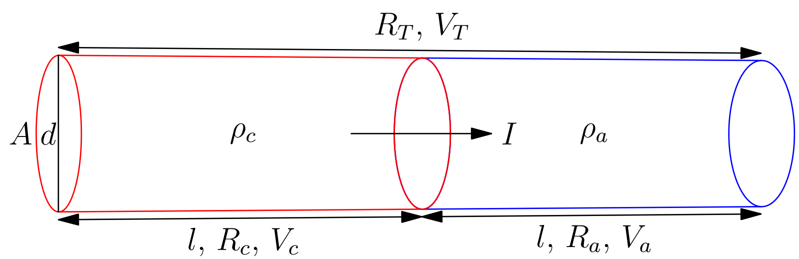
$$R = \rho \frac{L}{A}$$

$$V = IR$$

$$R_{1,2} = R_1 + R_2$$

$$A = \pi r^2 = \pi (d/2)^2$$



Apply formulas to patricular cases

Here we simply apply the general equations to the problem at hand, and look up any constants we don't know.

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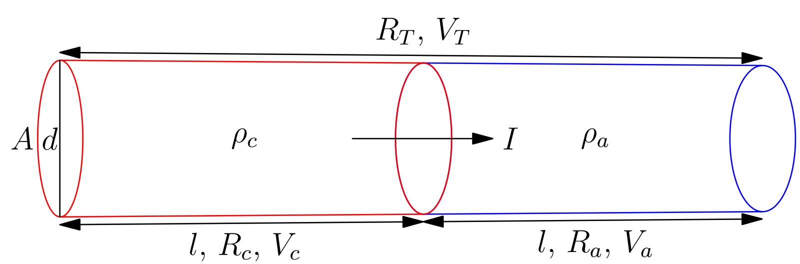

$$R_T = R_c + R_a \qquad R_c = \rho_c \frac{l}{A} \quad R_a = \rho_a \frac{l}{A}$$
$$V_T = IR_T \qquad V_c = IR_c \quad V_a = IR_a$$
$$\rho_c = 1.68 \cdot 10^{-8}\ \Omega\text{m}$$
$$\rho_a = 2.65 \cdot 10^{-8}\ \Omega\text{m}$$

Solve for the unknown quantities

From this point out it's just math.

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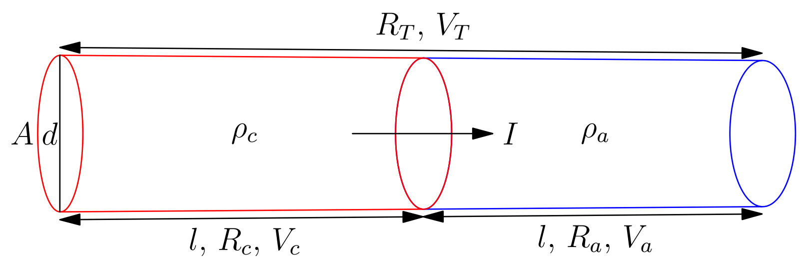

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$$R_c = \rho_c \frac{l}{A} = \rho_c \frac{4l}{\pi d^2} = 0.10654\ \Omega$$
$$R_a = \rho_a \frac{l}{A} = \rho_a \frac{4l}{\pi d^2} = 0.16870\ \Omega$$
$$R_T = R_c + R_a = 0.28\ \Omega$$
$$V_T = IR_T \qquad I = V_T/R_T = 0.31\ \text{A}$$
$$V_c = IR_c = 33\ \text{mV} \qquad V_a = IR_a = 52\ \text{mV}$$

Are your answers reasonable?

Yes. The wire is made out of copper and aluminum, both good conductors, and has a reasonable length and diameter, so we expect low resistance. We also expect the more resistive aluminum to have a higher resistance and a greater voltage drop.

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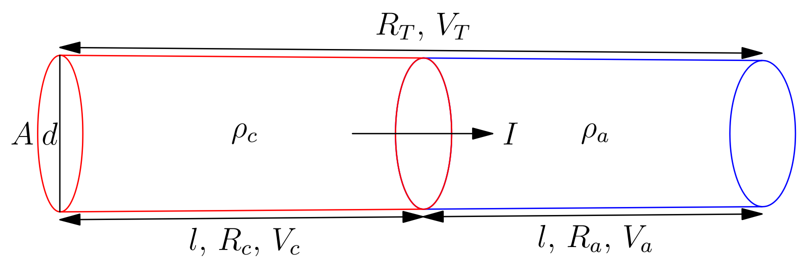

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Some thoughts

Obviously this formal approach is not neccessary for simple problems that you can almost do in your head. However, for more complicated problems, the extra work of drawing a labeled figure and explicitly writing out the general equations you use will help you solve the problem faster by making it very easy to remember what each symbol means and see where you have information that you haven't used in your solution yet.

Finally, physics isn't just about getting the "right answer", but also about demonstrating to others why your answer is right and how you came to that conclusion. This solution framework makes your argument clearer, which will help you as you develop the argument, and others when you try and teach/convince them.

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