Lecture S3 Muddiest Points

General Comments

The were many general questions about the node method. That's not too surprising — I didn't finish explaining the method. We will spend much of Monday's lecture on this, where I hope this will be cleared up.

Also, there's still some latent confusion about the sign conventions.

Responses to Muddiest-Part-of-the-Lecture Cards

(41 cards)

1. ***General confusion about the node method — how it works, where it comes from, why it's easier, need mor practice, etc. (12)*** I will say much more about this at the next lecture. It's *easier* because the equations are much more organized, and many of the intermediate steps can be eliminated. It *works* because it embodies Kirchhoff's laws, and the constitutive laws for the circuit elements. And you will definitely get more practice. This is a non-answer answer, but I haven't finished the lecturing on this topic yet.

2. ***Can you explain the node method in more detail. I've never used it before. (1)*** Yes, I will do that in lecture Monday. I don't expect that you've seen it before.

3. ***What is e? (3 students)*** Any symbol e (e_1, e_2, etc.) is a node potential. The potential is always measured relative to an arbitrary reference potential (ground) which, by definition, has a potential of zero volts. Potential always has units of volts.

4. ***I was under the impression that a node was any new branch of a circuit, instead of the connection of several elements. (1)*** No, a node (or junction) is the common connection of two or more circuit elements (or branches). Some nodes connect to very many elements. That may not have been clear in 8.02, since the circuits there are small.

5. ***How do you come up with the "easy" equation without intermediate steps? (1)*** I hope that that will become clear in the next lecture. There is a pattern that we take advantage of.

6. ***I don't understand the convention for assigning node potentials. (1)*** There are three steps: (1) Pick one node to be "ground," and assign it a potential of zero. (2) Label all the known nodes. These are the nodes connection to ground through a voltage source. Since their potential is known, label them that way. (3) Label all the other nodes with unknown potentials e_1, e_2, e_3, etc.

7. ***Why do we do the node method? It sounds as if we are doing the same stuff as in 8.02. (1)*** In 8.02, you never saw a circuit complicated enough to need the node method. There is no new physics in the node method, but it is an easier way to organize the equations.

8. ***Does "Kirchhoff" have one "h" or two? (1)*** Two. "Kirchhoff" is the correct spelling, according to dictionary.com

9. ***In the example [with two resistors in series], all the elements have the same current. Why define 3 currents, instead of using the one that's actually there? (1)*** There are circuits where no two elements have the same current. It's true that 3-element circuits (series or parallel) are simple, and shortcuts can be taken. I'm showing you a general method that will always work. So for the example, I could have done as you suggest, but that would not have helped you understand the more complicated example.

10. ***Why do voltage drops around the loop [when using KVL] instead of voltage rises? Why go against physics convention? (1)*** Three answers: (1) You can use either drop or rise, so long as you use only one or the other around any single loop. (2) Using *drop* will turn out to be easier than using *rise* — it will simplify signs enormously. (3) My unscientific survey (using google.com) shows that *drop* is favored over *rise* by at least five to one.

11. ***Could you define "near" and "far" potentials? (1)*** When applying KCL at a node, we are summing all the currents flowing *out* of a node. The current flowing out of a node through a resistor is $i = v/R$, where v must be measured with the + sign nearest the node we are considering, if the current is to be flowing out. Then v is given by the potential of the node we are at (the *near* node), minus the potential of the node to which the resistor is connected (the *far* node).

12. ***What was the element [drawn as a circle with an arrow in the middle]? (2)*** That's a *current source*. It always produces the same current, no matter what the voltage across its terminals. The current flows in the direction of the arrow, of course.

13. ***The node and loop methods aren't part of Kirchhoff's laws? (1)*** No. The node and loop methods are ways to organize the solution of a circuit, using Kirchhoff's laws and the constitutive laws of the components.

14. ***In the node method, should the sign convention matter if you know where the higher and lower potentials are? (1)*** But how can you know that before you solve the circuit? However, we will see that the sign conventions are a lot less difficult when we use the node method.

15. ***Didn't you write down the last equation incorrectly? (3)*** Yes. The correct equation should be

$$\left(\frac{1}{R_2} + \frac{1}{R_3} + \frac{1}{R_4}\right) e_1 - \left(\frac{1}{R_4}\right) e_2 = \frac{1}{R_2} V \tag{4}$$

16. ***What does the above equation tell us? (1)*** The equation expresses Kirchhoff's current law at the e_1 node, using the constitutive laws of the components that connect to that node. One more node equation (at e_2), and we can solve for the node voltages.

17. ***How do you make a rectifier? (1)*** Rectifiers are nonlinear, and therefore generally beyond the scope of this subject. If you like, talk to me at office hours, and I will be happy to show you how it's done.

18. ***I don't understand why you choose to make the current down through the voltage sources. I know that it's arbitrary, and the sign will ultimately tell you the direction, but doesn't it make sense to label it correctly from the start and change it if your intuition ends up wrong? (1)*** No; that's my answer, and I'm sticking to it. Seriously, only for the simplest circuits will your intuition be good enough to tell you the direction of the current. So why not pick a convention, and stick to it?

19. ***Confused about sign convention for resistors. (1)*** Please see me at office hours.

20. ***No mud (4)*** Some nice comments: ***"Thanks for showing us a less algebra intensive method! This is making a lot more sense than last year."*** Great! Glad to hear it. ***"Faster method for solution was extremely cool to listen to."*** Thanks! It's a little hard to see with the small examples we are doing, but the node method really is much faster than more *ad hoc* approaches.