

Related Rates (3.10)

Expected Skills.

At the end of this section, students will be able to:

- build an appropriate mathematical model for word problems. This includes:
 - assign variables to appropriate quantities,
 - identify which numerical information is relevant and/or needed,
 - relate the variables using appropriate equations taking into account the numerical information provided,
- solve word problems using the differentiation techniques seen earlier in the term,
- for a given problem, clearly explain with words, mathematical symbols and equations their reasoning, in particular, what is known, what we are looking for and the steps of the procedure to solve the question.

Note

The hardest part for the students is the modeling part, not so much the computational part. It is therefore best to focus on that part.

This topic is well suited to have students actually solve problems in class.

It is probably best to do one or two worked-examples at the beginning of the lesson (or to have the students read them beforehand) and then have the students solve problems.

Pre-Class Activity (ch3-derivatives-7-relatedrates-1-pc). The goal of the pre-class activity is to have the students draw a proper diagram and start to solve a concrete related rate problem. This will be used directly in class.

Hopefully, working on a concrete example will motivate them!

Worksheet (ch3-derivatives-7-relatedrates-2-ws). For the activities, I would suggest the following format: for the first exercise, do it on the board while asking many questions to the students. Separate clearly the modeling part from the numerical application part. The idea is to give a worked example to the students. At the end of the exercise, we ask the students to reflect on it and identify the various steps of the resolution (if enough time, this can be done as a think-pair-share).

For the following two exercises, the idea is to have the students work by themselves on them.

I suggest the following: give the exercises without the numerical application part. Split the class in two (to make it easy for the following part, one can do one row is A, the next one is B, the next one is A, etc.). Then have each half of the class work on one question where they have to find the equation that relates the rates of change (they can work in group within their team). Make sure people in each team students understand the exercise and can explain it. After a few minutes, each student pairs up with someone from the other team. They have to explain to each other the exercise and how to solve it. Once this is done, one can give them the numerical application part. This would be also a good place to discuss what information is needed to solve

the exercise. This type of activity is often called a jigsaw

The last exercise can be used as a challenge exercise.

At the end of the section or as a review exercise before the prelim/final, have the students look at a number of exercises in the book and "classify" them.

Or have first the students write down the equation that relates the variables for these problems and then group the problems together.

For this exercise (in either variant we need the students to have done some exercises like these before. Thus it should come at the "end".