DESIGNING AND GRADING QUIZZES

We have already given some general advice on this topic; the purpose here is to discuss the substance of the quiz itself.

1. Students usually work more slowly than you think. *It should take you at most 4 minutes to write a complete solution to a 10 minute quiz.* As noted before, it is generally better to give the students a little more time than is needed rather than a little less, but if taken too far this will not prepare them for the pace of exams.
2. The quiz should be similar to homework problems; even slight variations on problems can seem completely different to students. Be aware that seemingly similar problems or slight modifications might require far more time than the original one.
3. Write the problems carefully. There should be no ambiguity or room for interpretation about the phrasing of the problem or the work required. Students rely heavily on the wording of problems to solve them; often they are not conscious of this. Slight variations in wording can be confusing; if you are not trying to see how well they can adjust to a change in wording, use the same style, notations and terminology as in the lectures and textbook.
4. Be aware of what you want to test the students on.
5. Do not test too much in one problem.

Preventing cheating

This will be discussed in more detail later, but a few comments in the meantime might be helpful. Some students are extremely resourceful at bringing things to class that will help them cheat; for example, notes on mirrored sunglasses, erasers, baseball cap visors, tape or CD players, pagers, cell phones, fake fingernails, and probably many more that have not yet been discovered by instructors or teaching assistants. It is appropriate to ask students to remove sunglasses and hats and also to put tape or CD players, pagers and cell phones away. Watch the class, and if you see suspicious behavior make general comments for students to keep their eyes on their own papers. If you suspect someone of cheating, make it clear that you are watching him/her closely, say by standing nearby and watching steadily. Some educators suggest that the instructor or proctor speak quietly to a student whose eyes seem to be wandering suspiciously, but there are also strong arguments against doing so; in particular, this can be disruptive to an honest student and affect his or her performance adversely. Report any instances to the appropriate faculty members, and make sure you know the course policy regarding cheating if there is one. Finally, remember that preventing cheating is always better than trying to catch students cheating.

Grading quizzes

Here are some suggestions:

1. Mark clearly where the students went wrong rather than just noting the number of points deducted, and write short comments about the nature of the mistake like *algebra error* or *use product rule, not chain rule.*
2. Never write comments that ***might*** be taken negatively by the student. These include things like *you should know better* or *you did not study.* In contrast a comment like incorrect *use of differentiation rules* tells the student where the problem might lie and does not criticize the student personally. To expand upon this, comments like *very good* or *you are improving* give feedback that the student's efforts are paying off.
3. Prevent the possibility of cheating ***after*** return of the quiz. The most frequent form of this is for students to change their answers after the papers are returned. Two precautionary measures are to write in and circle the right answer and to put lines around large empty spaces and mark ***blank*** inside them. If you really suspect cheating of this type be sure to copy the next quiz before returning it.
4. Write an answer key indicating partial credit. This saves time and promotes fairness. When deciding on partial credit, keep in mind what you wanted to test. Complaints about lost points often focus on the number of points and not the reasons for losing the points; if you think carefully on how to assign partial credit, such problems are easier to handle. Keep your grading key, and stick with your grading scheme.

Record keeping

If you are teaching a discussion section, follow the primary instructor's rules for recording grades. Here are some basic do's and don't''s that apply almost universally.

1. Record the maximum number of points possible; one way to do this is to use one line of the grade sheet to record such data.
2. Make sure that you put scores into the correct place on the grade sheet.

Writing a quiz – an example

Assume you are leading a Mathematics 9A discussion section and that the students have seen all the calculus tools involved in sketching functions (limits, derivatives, critical points, inflection points, first and second derivative tests, *etc*.). A typical question on a quiz might involve sketching the graph of $f(x) = (4x^3 - x^4)/5$. It would be too vague to ask simply for a sketch of the graph, because one is then faced with the issue of answers that have roughly the right shape but give inadequate reasons to support their response. One possible modification would be to add that the local extrema should be identified. This also leads to problems because some of the extrema might be identified, and perhaps their types also correctly identified, but the shape of the graph might be all wrong. Questions about partial credit arise naturally and can lead to considerable debate with students. Here is a more precise rephrasing of the question:

QUESTION. For the function

$$f(x) = (4x^3 - x^4)/5$$

we know that

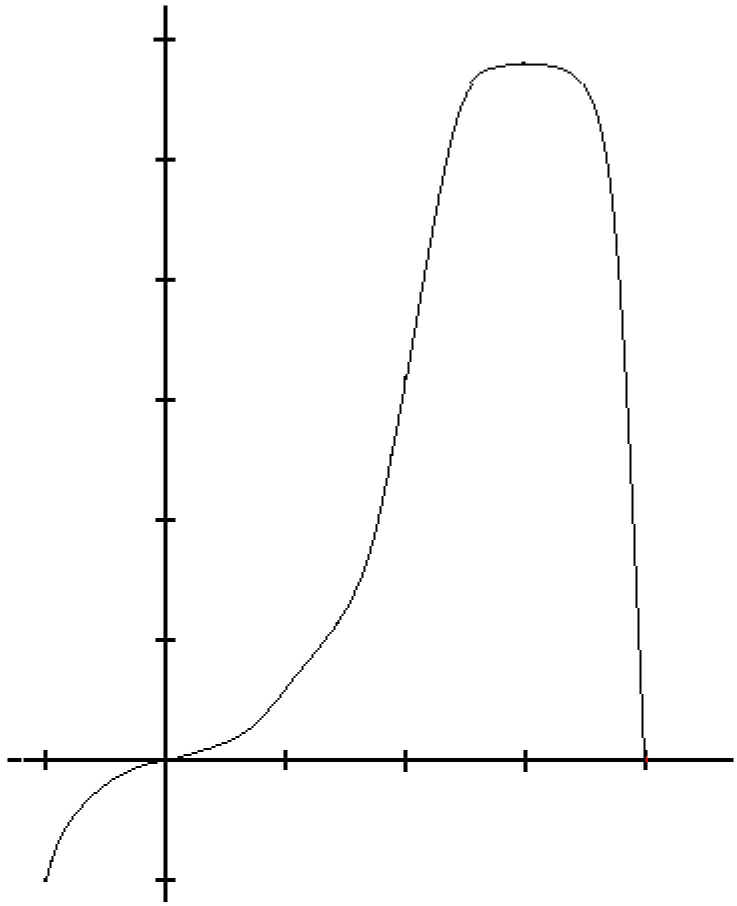
$$f'(x) = \big(4x^2(3 - \mathrm{x})\big)/5 \quad \text{and} \quad f''(x) = \big(12x(2 - x)\big)/5.$$

- Compute and label the local extrema and inflection points of f.
- Find the graph of f, showing the local extrema and inflection points that you located..

ANSWER.

- The x-intercepts are 0 (with multiplicity 3) and 4.
- The critical points are where $f'=0$, and therefore they are $x = 0$ with multiplicity 2 and $x = 3$.
- Since $f''(3) < 0$, the function is concave down and thus there is a **local maximum** at $x = 3$.
- Since $f'(x) > 0$ for x close to zero but not equal to zero, the function is increasing there and $x = 0$ is neither a maximum nor minimum.
- The inflection points are the roots of f'' ; namely, 0 and 2. Since they are simple roots, they are **inflection points** because the sign of the second derivative changes.

A rough sketch of the graph of the function appears on the next page:



PARTIAL CREDIT. Assume that the preceding quiz is worth 10 points. An orderly writeup of the correct answer allows you to assign partial credit in a reasonable fashion. Obviously two objectives are to use the first and second derivative tests to find the critical and inflection points. Another objective is to determine the nature of the critical points. Finally, there is the matter of sketching the graph.

There is no uniquely acceptable way to assign partial credit. Recognizing the roots of the first and second derivative as well as their role in the problem (as potential critical or inflection points) could be worth 3 points. Using further information about the first and second derivatives to determine the maxima and minima could be worth another 3 or 4 points, and sketching the graph could be worth 4 or 3 points.

This makes things easy to grade. One first looks to see if the roots of the first two derivatives and their potential significance were described correctly, then one looks to see if the precise roles of these roots were determined, and then one looks at the graph. Ease of grading effectively is important in carrying out your duties without draining your physical and emotional energy, so careful preparation for fast but good grading is very worthwhile.

It is probably a good idea to be generous in granting partial credit to students who know how to do a problem but make simple errors (say, in addition or multiplication) or miss a minor point. Carefulness is certainly important, but often the students are working at a very fast pace and under at least some pressure. Also, as suggested before it is likely that students will be more tolerant of the small mistakes you will inevitably make if you show some understanding for their minor errors.