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Writing an Exam for IR, NMR, and GC-MS.
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Instrumental Methods of Analysis
Exam III

ATTENTION:

1. Pages 1-2.5 contain background information necessary to write an exam.
2. Page 2.5-3 gives the grading scheme I will use to "grade" your exam.

How you write an exam depends upon what you intend to accomplish both in the course and in the exam. The goal I have set for this class is to facilitate your ability to function as an analytical chemist. This requires you to have 1) a skills set in concepts and background of the basis for measurements 2) a skills set in operating some standard instruments to be found in an analytical lab; 3) a skills set in manipulating chemistry to prepare samples for analysis; 4) a skills set in designing a method of analysis (how to test yourself within the process for LOD, reliability, and unknowns); and 5) an ability to problem solve "on your feet" when presented with a new sample.

The quotes in the next section that are highlighted in italics express the heart and guts of the matter

HOW STUDENTS LEARN

http://books.nap.edu/openbook.php?record_id=10126&page=1

1. Students come to the classroom with preconceptions about how the world works. If their initial understanding is not engaged, they may fail to grasp the new concepts and information, or they may learn them for purposes of a test but revert to their preconceptions outside the classroom.

2. ***To develop competence in an area of inquiry, students must (a) have a deep foundation of factual knowledge, (b) understand facts and ideas in the context of a conceptual framework, and (c) organize knowledge in ways that facilitate retrieval and application.***

3. A "metacognitive" approach to instruction can help students learn to take control of their own learning by defining learning goals and monitoring their progress in achieving them

To explore just a little further point 2 quoted above we can think of learning as a range of activities starting at relatively trivial and progressing to relatively complex as shown in the quoted material below:

LEARNING

http://www.infed.org/biblio/b-learn.htm

1. Learning as a quantitative increase in knowledge. Learning is acquiring information or 'knowing a lot'.
2. Learning as memorizing. Learning is storing information that can be reproduced.
3. Learning as acquiring facts, skills, and methods that can be retained and used as necessary.
4. ***Learning as making sense or abstracting meaning. Learning involves relating parts of the subject matter to each other and to the real world.***
5. ***Learning as interpreting and understanding reality in a different way. Learning involves comprehending the world by reinterpreting knowledge. (quoted in Ramsden 1992: 26)***

At one extreme lie those unintentional and usually accidental learning events which occur continuously as we walk through life. Next comes incidental learning - unconscious learning through acquisition methods which occurs in the course of some other activity... Then there are various activities in which we are somewhat more more conscious of learning, experiential activities arising from immediate life-related concerns, though even here the focus is still on the task... Then come more purposeful activities - occasions where we set out to learn something in a more systematic way, using whatever comes to hand for that purpose, but often deliberately disregarding engagement with teachers and formal institutions of learning... Further along the continuum lie the self-directed learning projects on which there is so much literature... More formalized and generalized (and consequently less contextualized) forms of learning are the distance and open education programmes, where some elements of acquisition learning are often built into the designed learning programme. Towards the further extreme lie more formalized learning programmes of highly decontextualized learning, using material common to all the learners without paying any regard to their individual preferences, agendas or needs. There are of course no clear boundaries between each of these categories. (Rogers 2003: 41-2)

The five types of learning that are listed required different types of assessment. The first 3 types of learning are most easily assessed with a boring scantron type of exam. (Which is why I suppose we instructors tend to like focusing on these types of learning.). To write an exam for the first three types of learning there are some "tips" which you can access from the box to the right.

The last two types of learning are much harder to assess in an exam. When I write an exam the questions that I hope are assessing learning skills 4&5 generally result

EXAM WRITING TIPS FOR LEARNING 1-3

Go to

http://www.heacademy.ac.uk/assets/ps/documents/practice_guides/practice_guides/ps0069_desiging_assessment_to_improve_physical_sciences_learning_sept_2003.pdf

Read pages 16 through 24

in the most complaints. The goal is to write some question that is, indeed, not transparent. BUT the lack of transparency should be due to the fact that you are giving the student an "unknown" and asking them to stretch and organize the skills that they have learned to approach to the "unknown" problem. What often happens, because these are the most difficult questions to write, is that the lack of transparency is due to poor writing of the question. I like, when I am able, to delegate these questions to take home and essay. That, of course, raises issues related to cheating and plagiarism which most of us instructors like to avoid. These types of questions are similarly much more difficult to grade which raises issues of fairness.

When I write an exam for the Gen Chem sequence I attempt to write about 50-70% of the problems to address learning skills 1-3 (straight out of homework, for example, with numbers changed). I then attempt to write about 15 to 35% of the problems to be "unknowns" that are recognizable as permutations on the homework (inside out and backwards). The last set of questions attempt to assess the last two skill sets directly and are my gauge of whether or not a student is truly a "master" of the material.

How I will assess the Exam you write:

1. **(10%)** You should begin with a one-two page learning goals statement of what skills you think the student should demonstrate related to IR, NMR and GC-MS. In this section you should state whether or not you are including for assessment content/experiences in the associated labs.
2. **(10%)** You should state if the exam you are giving is for a 1 hour 15 minute period; an open period of time, and if you will be allowing "cheat" sheets etc. You should also state if you are allowing partial credit in your exams and the rationale for allowing partial credit in your assessment scheme. Give reason for each of your choices.
3. **30%** Your choices in 1&2 above will drive the design of your exam. **30%** of the grade for your exam will be based on how well your exam assesses the goals you have for the students and how well it will fit your exam format.
4. **25%** of your grade will be for factual accuracy in the exam content (10%), numerical consistency in any problems that you write (7.5%) , clarity of how you word any essay questions (including spell check) (7.5%).
5. **25%** of your grade will be for the answers or key that you provide for the exam. If you are allowing for partial credit in your exam structure greater points will be awarded for keys in which the entire problem is worked out and for which grade guides are given for different branching points in the problem. For example, if you ask a student to calculate the density of a compound in g/cm^3 based on a weight, a total volume of water and the mass of displaced water in the key you should indicate "x points" to arrive at the at the displaced volume. "Y points subtracted for math errors".