

Problem-Solving Exams

Preparing

Problem-solving exams come in a variety of forms, from multiple choice to short answer to long calculations. In all of these cases, prepare for the exam as you would prepare for any other exam, with particular emphasis on the following points:

- **Practise, practise, practise!** The most important tip in preparing for problem-solving exams is practice. The more problems and the more different types of problems you solve, the better prepared you'll be. Practice doing questions from old exams, the textbook and lab manual, and other texts on the same topic. If you can't find enough practice problems, create some with your study group or partner.
- **Review regularly, either on a daily or weekly basis.** Regular review is often critical to developing a thorough understanding of mathematics-based problems.
- **Study a section, then practise problems from that section.** Make sure you understand the information in each section before moving on to the next, particularly in courses that build on previous sections. Pay attention to problems emphasized in class, the text, and assignments. If a particular problem appears in more than one of these places, there's a good chance a similar problem will appear on the exam.
- **Study questions out of order.** Problems on exams rarely appear in the order taught and may include questions that combine information from a number of sections. To prepare for this, practise questions out of order. Pay attention to the possible links between questions and how the professor might combine questions on an exam, and seek out combination questions on old exams.
- **When studying a section, note the important formulae.** Although it's important to know how to use a formula, knowing when to use it is just as critical. Make connections between ideas and formulae and note how to distinguish between similar scenarios to choose the correct formula.
- **Use old exams when available.** Old exams often give you a good feel for the types of questions
- that are likely to be tested on the coming exam. While working on old exams, you should take some time to compare the exam questions with those presented in lecture, problem sets, and the text:
 - Where do the majority of exam questions come from? (Text, lecture, or assignments?)
 - How are the exam questions different from those in the text, lectures, and assignments?

- If equations are involved, which ones are needed and which ones are provided?

The answers to these questions offer excellent clues as to the probable content of the coming exam. Don't forget – some professors put old exams on course reserve for students to use as a study guide.

- **Go over your previous tests, quizzes, or exams.** Use your old tests as study tools by correcting all your answers and analyzing your errors. Sometimes similar questions will appear on the next exam, particularly if many students in the class got it wrong. Your previous errors will also indicate areas of the course that you may need to work on or study more, or types of questions that you may need more practice with. Refer to the 'Analyze Your Performance' section of this Study Skills Tip Sheet for more detail.
- **Use mock exams or make up your own.** When old exams are not available, make up your own questions, use a study group or partner to generate questions, or use mock exams if available from your professor.
Note: To get the most out of a practice exam, write it under exam conditions – in a quiet area, with a time limit equal to that of the exam you're writing. Unless it's an open book exam, close your books. Correct your answers and analyze errors. Seek assistance for any questions you don't understand.

Organizing Information

When you're studying for problem-solving exams, organizing all of the information from your notes, textbooks, labs, or other sources can help you understand course theories and concepts more deeply. Here are a few methods to help you organize your course information.

- Study methods depend on the particular individual. However, a simple technique you can use to organize information, facts, equations, theories, etc., is called **Concept Mapping**. Concept Mapping is used mainly to summarize and make connections between key concepts. Begin by writing the main idea in the center, and from there, place related ideas on branches radiating from the center. Mapping will allow you to see ways in which ideas fit together and can point out weak areas that you should focus on. For more information, please see our Study Skills Tip Sheet on Concept Mapping.
- A suggestion on how to take notes, either in class or from readings, is to use the **Cornell Method**. Designed to save time and be efficient, the method involves dividing the paper into two columns; however, the left column is only one quarter of the page width. The right column is used to write notes,

while the left column, called the cue column, is used after class to jot extra comments in relation to the notes taken. Leave around two inches at the bottom of the page to write a summary of the notes taken. The Cornell method allows for writing notes in an orderly fashion. For more information on the Cornell method, please see the resource section at the end of this Study Skills Tip Sheet.

- Another method for organizing your notes and course information is a technique called **SOAR**: select, organize, associate, and rehearse:
 - **Select**: Reduce the total amount of information to key ideas. Use key words as memory triggers for each concept.
 - **Organize**: Enter material into logical categories and make it meaningful to you. Use headings, numbers, diagrams, etc.
 - **Associate**: Link new information to previous knowledge and make connections with your own experiences.
 - **Rehearse**: Practise material as if it would be tested. Rehearse regularly in order to engage long-term memory.

Solving Problems

Here are a few general tips on how to solve problems. These can be useful while studying to increase comprehension and general problem-solving skills:

- Have a positive attitude. Take the time to fully work out the hard and lengthy questions. Don't give up! The more you work on a problem, the better you will understand it.
- Have an eye for details. Make an effort to fully understand every aspect of the problem you are working on. What is the question asking? Can it be broken into parts? How do the parts relate? Remember to check your answer for logic or calculation errors.
- **Break the problem into parts (if possible)**. Small parts are easier to work with and often lead to the information necessary for the next step in the equation. Start at a point that you understand best and work from there.
- **Draw diagrams or flow charts, or make summaries if needed**. In order to organize given information, arrange everything in a systematic way that you can easily see. It may help you to find the path you should take to solve a problem.
- **Try to link information together**. See what information is given and decide if it's important and how it can be related to equations and the answer you're trying to find.
- **Be aware of irrelevant information** – it may be given to throw you off!
- **Use memory techniques**. For some students, mnemonics are great tools for memorizing equations,

definitions, formulas, processes, etc. One mnemonic is the Journey Technique, where you associate information with landmarks on a journey that you know well. This allows you to retrace your steps to remember specific information. Another technique is the Roman Room Technique, which allows you to associate objects in a room with the image of the information that you need to remember.

- **Avoid guessing**. Work a problem through from beginning to end. Guessing can be dangerous and is not recommended.
Exception: Some Engineering professors allow assumptions to be made on exams – some professors even encourage it! In these cases, the professor will deliberately leave out pertinent or required information, which you must then assume. In these cases, assume carefully! Make your assumptions reasonable and within “typical” or “conventional” values, depending on the situation. If the assumption you're making can be anything under the sun (e.g. the length of a road to build), check the question again to make sure you really need the information, and if you do, try to assume a unit value (i.e. per metre or per kilometre of road, etc). Above all, **ask your professor if assumptions are allowed before you make any**.

Approaching Problems

There are a number of methods for solving problems that aim to make the process easier. Here are a few for you to consider. As with other study methods, there is no one method that works for everyone. Choose the method that works best for you.

- **The 3R Approach**: This is a simple, but often effective, method for approaching and solving many problems.
 - **Request**: What is the question asking for? Once you understand the question, formulate a response.
 - **Response**: This is the strategy you'll use to solve the problem. It's often broken into smaller steps that are easier to work through. Once you have decided how you'll respond to the question, follow the steps you've laid out to get to the result.
 - **Result**: This is your final answer. Remember to check your result and response to make sure they both accurately answer the request.
- **ABCDE Approach**: This method is effective because it prompts you to evaluate what you've learned.
 - **Analyze**: Read, understand, and create a mental image of the problem. Extract the given data and determine the nature of the unknown. Estimate an answer to the problem.
 - **Brainstorm**: Determine how to relate the unknown with the given information.
 - **Calculate**: Use the method determined in the previous step to solve the problem.

Problem-Solving Exams

- **Defend:** Check the solution given in the previous step. Is it acceptable? If you have not already done so, present the solution in a reasonable format.
- **Evaluate:** What have you learned by solving this problem?
- **ROPOSE Approach:** This approach is more lengthy than the above two examples; however, it can be a very effective study technique.
- **Read:** Read the problem carefully. What is it asking?
- **Organize:** Simplify the problem. Identify the given and unknown information and values.
- **Picture:** Visualize the problem. Use diagrams or write down chemical reactions, as appropriate.
- **Order:** Divide the problem into steps, and place these steps in order.
- **Solve:** Solve the problem.
- **Evaluate:** Check your calculations and your answer. Is the solution reasonable? What have you learned?

Writing the Exam

When the time comes to “show what you know,” here are a few tips and strategies to help you do your best.

- Dump the details. Find a blank page on your exam (the back of the instruction page, the back of the exam, etc.) and write down formulas, concepts, and constants that you have memorized before starting the exam.
- Look over the entire exam before beginning.
- Budget your time according to how much each question is worth.
- Do the easy questions first. Not only does this warm up your brain, but it also helps to calm exam nerves. The easier questions can provide helpful hints on how to solve harder problems later on.
- Read each question carefully and rephrase it in your own words. This may help you to understand what the question is asking and remind you how you went about solving similar problems in the past.
- Re-read the question, underlining units. Be aware of +/- signs. Keep track of all units. Convert values to keep the units consistent.
- Make an educated guess. Predict a reasonable answer that, given all the information, the real answer would be close to.
- Limit the rounding of numbers in intermediate steps until the final answer has been reached.
- Present numerical answers with the correct number of significant figures, and always write down the units.
- Clearly mark assumptions, if they are necessary, and place them at or near the beginning of the solution whenever possible.

- Look at your final answer. Does your answer sound reasonable, logical, and well-organized? If not, you probably made an error somewhere. Go back and check your work, but don't get hung up on a difficult problem, and remember to stick to your time limits.
- Review at the end. If possible, try to give yourself a couple of minutes at the end to check all the answers.

Difficult Problems

If you're having difficulties with a problem, here are a few hints to help you out.

- Don't panic! By staying calm, cool, and collected, you are more likely to recall something helpful.
- Be open to trying a different strategy to solve a problem if your usual method doesn't work.
- Sketch out an outline or diagram. This may help you to remember any missing details.
- Keep track of what you've done so far in order to save time. By noting your progress, you can see what you're doing and where you're going.
- Look for similar problems in the test that you have already answered that may give you a clue.
- Break problems into smaller parts in order to simplify. If you can do most of the parts, you're on your way to solving the whole problem. You may also receive partial marks for your work.
- Re-read and paraphrase the question in order to better understand it.
- Substitute simple numbers for a math problem in order to see what a logical answer may be.
- Work backwards from the solution. Make sure your answer is reasonable.
- Skip the problem and move on, but don't forget to go back to it! You don't want to lose marks somewhere else because you spent a lot of time trying to solve one question.

Ask for help from the professor if you don't understand what the question is asking.

Analyze Your Performance

After a midterm is returned, or after completing an old or mock exam, the following steps can help you determine how to improve your performance on the next exam.

- Read and consider comments and suggestions from the professor who marked the exam. These are usually intended to help you improve.
- How were the problems different from those given in the text, lecture, or homework?
- Determine the source of your errors.
- Careless errors: Double-check answers before handing in your papers.
- Misread the question: Re-read and process the question before answering it.

Problem-Solving Exams

- Many errors with a certain problem type: Practise that problem type until you understand it more fully. Also, try out some different studying approaches to develop a new way to approach the concept in the problem.
- Couldn't remember formulas correctly: Spend more time studying formulas before the next exam. Try developing mnemonics or placing formulas on cue cards.
- Ran out of time: Budget your time during the exam and spend more time studying in general – problem solving becomes faster and easier with practice. Take time at the beginning of each exam and read through the questions: which ones are worth the most marks? Which ones require the most time? Which can you answer right away?
- Practised the wrong problems: Follow the advice on determining which problems to study (See the "Preparing for the Exam" section).
- Brain went blank due to anxiety: Use stress-management techniques before the exam. Take a deep breath when you get into the exam, do a "dump the details" (above), and do the easier questions first to build confidence. For additional help, visit Counselling Services or talk to your professor for advice. Consider registering for Study Smarts, a four-session, non-credit course that combines effective study strategies with stress management techniques to students. Contact Student Services for dates and registration details.
- Could recall facts easily, but couldn't apply the knowledge to a new situation: Form a study group to brainstorm ideas for the types of questions that might be asked in order to apply the knowledge to new situations. Consider using concept maps to make links between concepts and material, or organizing your notes differently (e.g. Cornell method).

Want more information?

The Counselling Department and the Academic Success Centre are your best sources for advice and information on issues related to learning, studying, time management, and academic performance.

Workshops on learning, studying, etc., are offered regularly each semester by the Counselling Department. Please contact Student Services at Abbotsford - 604-854-4528 (B 214) or Chilliwack - 604-795-2808 (A 1318) to make an appointment.

Study Skills Tip Sheets providing information on many learning and time management topics, as well as writing and referencing, are available free to students. The complete range of Study Skills Tip Sheets is available on-line at www.ufv.ca/counselling/study/.

Link to Resources Elsewhere:

Whimbey, A., & Lochhead, J. (1986). Problem Solving & Comprehension, 4th Edition. London: Lawrence Erlbaum Associates.

McAllister, Howard C. (1997). Request-Response-Result. Retrieved March 24, 2006, from www.hawaii.edu/suremath/essentialRRR.html

Woodcock, D. (2000). The A Thru E Approach to Problem Solving in Chemistry. Retrieved March 31, 2006, from www.molecularmodels.ca/probsol/ps_A-E.html

Fogler, Scott H., & LeBlanc, Steven E. Strategies for Creative Problem Solving. Retrieved March 21, 2006, from www.engin.umich.edu/~cre/probsolv/ Student Learning Center. Retrieved March 31, 2006, from slc.berkeley.edu/general/index.htm

Other Relevant Study Skills Tips Sheets:

Concept Mapping

Making Time Management Work for You

Multiple Choice Exams

SQ4R: A Classic Method

Stress Management

Ways to Predict Test Questions

What to do Before the Test

What to do During the Test

With thanks to the University of Guelph
Learning Services
The Learning Commons