THE UNIVERSITY OF MELBOURNE

# Problem-solving exams

## Succeeding at problem-based exams

Problem-solving exams are common in a range of disciplines from Physics, Engineering and Mathematics, to Architecture, Law and Linguistics. Sometimes there will be exact or correct answers to problems – as in answering maths problems – or sometimes you may be asked to propose and justify a course of action to address a specified situation, or to develop a well-reasoned explanation or response based on data analysis, models or precedent.

***Whatever the problem you are required to solve, the secret of exam success is in preparation and practice.***

This flyer discusses the revision and response techniques best suited to problem-solving exams, and offers advice on what to do if you get stuck on a problem-solving task.

## Problem-solving basics

Problem-solving requires a range of critical thinking skills from identification, description and analysis, to synthesis and evaluation. Consequently, if you want to do well in a problem-solving exam, attending lectures, reading examples and memorising formulae won't be enough.

To do well, you need to be able to apply the appropriate solution methods accurately and quickly. This takes practice. It also requires understanding of the theoretical principles and governing frameworks behind the problem and application of the solution method. In other words, you need to understand and be able to explain what it is that you are doing as you proceed to solve the problem. Problem-solving frequently has common stages which apply to most disciplines. Be aware of these as you work through examples and old exams. Typically, these stages are as follows:

***Identification:*** *At this stage you are asking: What information has been supplied? What is its significance or use? What else might I need to know? What information is required?*

***Classification:*** *This stage may be concurrent with identification. You are asking: Given the type of information provided or required, what kind of problem is this? (e.g. 'negligence' or 'breach of contract'?) Which area/s of the course does it relate to? Which solution method will apply?*

***Transformation****: To achieve the required result or outcome, problems generally require you to manipulate the given information, drawing on your additional knowledge. You must bring something to the problem which enables you to transform the given data into another form.*

***Substitution:*** *Transformation frequently requires the given information to be 'substituted' or 'slotted into' the appropriate formula or flow-chart, or evaluated according to the applicable rules or criteria.*

***Comparison:*** *Here you are asking: How can I know if my result looks reasonable? Is it in the right range or order of magnitude? How does it compare with solutions or results previously recorded for problems of the same kind with similar data/facts?*

## Revision techniques for problem-solving exams

**Use active learning strategies**

Because *understanding* – not just familiarity or memorisation – of the concepts and procedures is required, you will need to keep your mind actively engaged with the material you are studying. In order to do this, try some of the following:

**Develop a glossary** for the topic by jotting down key terms and writing your own definitions as you read over notes.

**Change the format of information** – for example, convert an explanation into a diagram or a graph into a table.

**Create information gaps** by writing each element of a formula or process on post-it notes and then taking away some of the bits. Can you remember the missing link(s)?

(Also see our Academic Skills flyer on **Active learning** for more tips and strategies in this area.)

**Develop a range of strategies**

Working through a textbook and the examples it supplies won't be enough to turn you into an expert problem-solver. You need to develop flexibility, speed and accuracy for the exam, so try to think laterally and creatively as you revise. For example:

- compare textbook explanations with notes from lectures and tutes
- identify similarities and differences between problem types and solution methods
- ask yourself how the principles and procedures you are examining would apply to alternative situations or data
- try to solve the problem as far as you can before referring back to worked examples

**Practise problem solving – without your notes**

There is a vast difference between working through the examples or problems in a particular section of a textbook in your own time and trying to solve unidentified problems under exam conditions.

Generally, you won't be able to refer to notes and worked examples in the exam, so make sure you do plenty of practice-solving problems under exam conditions (applying exam time limits). It's also important that you review your mistakes – figure out where and why you went wrong. This will help build your accuracy as well as speed.

**Work in a study group**

Working with other students gives you the opportunity to compare and discuss your understanding, methods and solutions. Using the time to explain to others how you went about solving a particular problem and your reasons for adopting the approach you did can reinforce *your* learning and understanding. In addition, listening to others' explanations and comparing techniques, reasons and outcomes, may provide alternative approaches or solutions for you. Seeing problems from a different point of view is extremely useful. You may also find it a good motivating factor if you schedule some revision time working with others.

**Ensure you work with problems 'out of context'**

One of the most important problem-solving tasks in exams is to correctly identify the type of problem. To gain practice in classification you need to work on problems other than those under specific headings in notes or textbooks. Old exam papers are a great source of 'unclassified' problems. You could also try writing a few problems on separate sheets of paper as you finish each topic throughout the course. Then, when it comes time to revise for the exam, go to your pile of problems.

## Sitting problem-solving exams

**1.** As with all exams, you need to calculate how much time you can spend on a question according to how many marks it's worth. Keep to that time.

**2.** Read **all** the questions during reading time and identify the ones you must attempt and/or the ones you might attempt if there are options.

**3.** At the start of reading time, brainstorm all the formulae, procedures or principles you are holding in your short-term memory.

**4.** As soon as possible, write some brief notes next to all of the problems you will attempt. Note the kind of problem or subject area/s the question covers, what formulae, approach or principles you will apply, and any other brief, initial thoughts. This will give you something to work with when you return to answer the question in full later in the exam.

**5.** Do the easiest problems first. This will help you settle into the exam and help develop confidence.

**6.** Write clearly, describing each step to your solution.

**7.** State assumptions or principles you are relying on.

**8.** Check that your notation is consistent and carefully check calculations.

**9.** Re-read the question and check that you have answered it (and not gone off the topic or problem). Is your solution in the right range, unit of measurement or order of magnitude? Are your reasons clearly stated?

**10.** Leave time at the end of the exam to go back to check answers and/or calculations.

## If you have problems with any parts of the exam

If you get stuck trying to solve the problem go back to basics:

**Re-read the question**. Make sure you understand it correctly.

**Review the information given**. Have you overlooked something? What exactly are you missing?

**Consider your classification**. Quickly review all the topics you have covered in the course. Could this problem be of a different kind than you first assumed? Also, review the whole exam paper. Have all the topics been covered by the questions? The problem you are having trouble with may relate to your 'missing' topic.

**Check your steps**. When you have gone as far as you can without finding a solution, look back over what you have done. Have you proceeded in the right order? Have you omitted a step? Consider another problem of this type that you are familiar with. What is the next step in solving that problem? Can it be applied to this one?

**Check your calculations.** One of the most common errors and costly in terms of time as well as marks.

**Try to use a different method**. For example, if you relied on your calculator the first time, try mental arithmetic and vice versa.

**Break the question down**. If the question has several parts and you are stuck on one part, move on and attempt the next section – don't abandon the entire problem. You may still be able to earn marks for later work on the problem, despite any early 'gaps', miscalculations or 'false steps'.

**Most *importantly,* write what you *do* know.** If you can't supply a definitive answer or don't have time to complete your calculations you can still earn marks on a problem. Marks are usually allocated for your understanding of the topic, correct use of technical language, classification of the problem and identification of relevant information.

Therefore, if you are unable to finish, write down what solution method or framework you *would* apply, what assumptions you *can* make, and/or what order of magnitude or range you *expect* the solution to be in. At least you may get some marks for trying!