

Exam Format for Topics in Ring and Representation Theory

- As is the standard format for upper-level 10 credit courses, the exam will be closed book and have four questions, where your best three answers count (so you only need to answer three!). Each question will be out of 25.
- Since this is the first year the course has run, there are no past papers. The mock exam is on the course webpage [here](#), and the solutions are also on the course webpage [here](#).

Examinable Material and Advice

- The exam will have the same look and feel as the mock exam. You should expect to see questions that are very similar to those in both the mock exam and the exercise sheets.
- Everything in the lecture notes, exercise sheets, workshops and book is examinable, **except**
 1. Things we obviously did not cover (e.g. Section 1.6, Section 1.7, Chapter 3, connections with Lie groups,...).
 2. Any linear algebra statement that was presented as a fact (e.g. commuting linear maps can be simultaneously diagonalised, Jordan canonical form, the linear algebra lemma before Cartan's 1st criterion,...).
 3. (a) Weyl's Theorem, (b) The proof that L is semisimple if and only if it is the sum of simple Lie algebras, (c) The existence of Cartan subalgebras and the fact that $H = C_L(H)$, (d) The axiomatics of root systems, (e) Anything in Week 10 onwards.
- That said, the exam will **not** ask you to prove very long theorems; there is little to be gained from memorising proofs. It will however ask you short proofs and manipulations, which are testing your experience in manipulating and understanding the course material. In the mock, such questions are e.g. Q1(a)(ii), Q1(b)(iii), Q2(a), Q3(a)(b), Q4(b)(i), and there are many similar questions on the exercise sheets.
- The exam will ask for definitions, and also for statements of main results. Examples of this in the mock are Q1(a)(i) Q1(b)(i)(ii), Q2(a)(b)(d), Q3(a)(b)(c), and Q4(a).
- The exam will also ask you properties of, and to calculate with, small examples. In the mock, see Q1(c), Q2(e), Q3(d) (and to a lesser extent, Q4(e)). You can be assured that the exam will only ask about **small dimensional** Lie algebras, and there are not so many small Lie algebras that we studied in the course. Any such exam question will be the small special case of something in the lectures or exercise sheets (e.g. in the mock Q2(e) is a special case of Ex3.2, Q3(d) is Ex6.1 and Ex7.2, and Q4(c) is really just Ex8.3).
- If a question asks you to "Give a specific example of..." (e.g. Q2(c) in the mock) you need to be specific. For example, if you are asked to "give a specific example of a Lie algebra of dimension 8", the answer " \mathfrak{sl}_3 " is good, but the answer "take any Lie algebra of dimension 8" is not.

- If there is a true or false question asking for a 'short proof', or 'brief justification', you can be brief, but make sure the logic of your answer is clear. In the solutions to the mock, the answers are longer than you need to write; I've only written them in full so that hopefully they are easier to follow.

As an example, in the mock Q4(c)(ii), answering "FALSE, by a result in lectures" is not good (it looks like you are guessing), whereas "FALSE. In lectures we showed that if α is a root then so is $-\alpha$, so roots come in pairs. As a result, there is always an even number of roots" is much better, as the logic is completely clear.