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978-0-521-27289-6 - Algebra Through Practice: A Collection of Problems in Algebra with Solutions, Linear Algebra

T. S. Blyth and E. F. Robertson

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Algebra through practice

Book 4: Linear algebra

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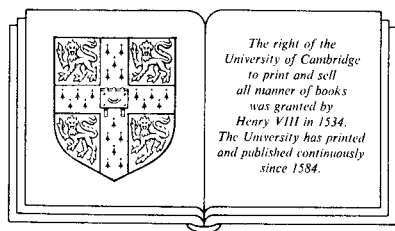
A collection of problems in algebra with solutions

Book 4

Linear algebra

T. S. BLYTH ◦ E. F. ROBERTSON

University of St Andrews



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Preface

The aim of this series of problem-solvers is to provide a selection of worked examples in algebra designed to supplement undergraduate algebra courses. We have attempted, mainly with the average student in mind, to produce a varied selection of exercises while incorporating a few of a more challenging nature. Although complete solutions are included, it is intended that these should be consulted by readers only after they have attempted the questions. In this way, it is hoped that the student will gain confidence in his or her approach to the art of problem-solving which, after all, is what mathematics is all about.

The problems, although arranged in chapters, have not been ‘graded’ within each chapter so that, if readers cannot do problem n this should not discourage them from attempting problem $n+1$. A great many of the ideas involved in these problems have been used in examination papers of one sort or another. Some test papers (without solutions) are included at the end of each book; these contain questions based on the topics covered.

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Background reference material

Courses on abstract algebra can be very different in style and content. Likewise, textbooks recommended for these courses can vary enormously, not only in notation and exposition but also in their level of sophistication. Here is a list of some major texts that are widely used and to which the reader may refer for background material. The subject matter of these texts covers all six of the present volumes, and in some cases a great deal more. For the convenience of the reader there is given overleaf an indication of which parts of which of these texts are most relevant to the appropriate sections of this volume.

- [1] I. T. Adamson, *Introduction to Field Theory*, Cambridge University Press, 1982.
- [2] F. Ayres, Jr, *Modern Algebra*, Schaum's Outline Series, McGraw-Hill, 1965.
- [3] D. Burton, *A first course in rings and ideals*, Addison-Wesley, 1970.
- [4] P. M. Cohn, *Algebra* Vol. I, Wiley, 1982.
- [5] D. T. Finkbeiner II, *Introduction to Matrices and Linear Transformations*, Freeman, 1978.
- [6] R. Godement, *Algebra*, Kershaw, 1983.
- [7] J. A. Green, *Sets and Groups*, Routledge and Kegan Paul, 1965.
- [8] I. N. Herstein, *Topics in Algebra*, Wiley, 1977.
- [9] K. Hoffman and R. Kunze, *Linear Algebra*, Prentice Hall, 1971.
- [10] S. Lang, *Introduction to Linear Algebra*, Addison-Wesley, 1970.
- [11] S. Lipschutz, *Linear Algebra*, Schaum's Outline Series, McGraw-Hill, 1974.

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- [12] I. D. Macdonald, *The Theory of Groups*, Oxford University Press, 1968.
- [13] S. MacLane and G. Birkhoff, *Algebra*, Macmillan, 1968.
- [14] N. H. McCoy, *Introduction to Modern Algebra*, Allyn and Bacon, 1975.
- [15] J. J. Rotman, *The Theory of Groups: An Introduction*, Allyn and Bacon, 1973.
- [16] I. Stewart, *Galois Theory*, Chapman and Hall, 1975.
- [17] I. Stewart and D. Tall, *The Foundations of Mathematics*, Oxford University Press, 1977.

References useful for Book 4

1: Direct sums and Jordan forms [4, Sections 11.1–11.4], [5, Chapter 7], [8, Sections 6.1–6.6], [9, Chapters 6, 7], [11, Chapter 10].

2: Duality and normal transformations [4, Chapter 8, Section 11.4], [5, Chapter 9], [8, Sections 4.3, 6.8, 6.10], [9, Chapters 8, 9], [11, Chapters 11, 12].

In [4] and [6] some ring theory is assumed, and some elementary results are proved for modules. In [5] the author uses ‘characteristic value’ where we use ‘eigenvalue’.