

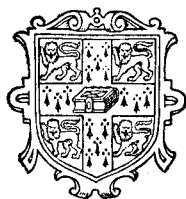
ALGEBRA  
FOR SCIENCE AND  
ENGINEERING STUDENTS

CAMBRIDGE

Cambridge University Press  
978-1-316-61273-6 — Algebra for Science and Engineering Students  
E. H. Lockwood  
Frontmatter  
[More Information](#)

ALGEBRA  
FOR SCIENCE AND  
ENGINEERING STUDENTS

BY  
E. H. LOCKWOOD  
*Senior Mathematics Master, Felsted School*



CAMBRIDGE  
AT THE UNIVERSITY PRESS  
1940

**CAMBRIDGE**  
UNIVERSITY PRESS

University Printing House, Cambridge CB2 8BS, United Kingdom

Cambridge University Press is part of the University of Cambridge.

It furthers the University's mission by disseminating knowledge in the pursuit of education, learning and research at the highest international levels of excellence.

[www.cambridge.org](http://www.cambridge.org)

Information on this title: [www.cambridge.org/9781316612736](http://www.cambridge.org/9781316612736)

© Cambridge University Press 1940

This publication is in copyright. Subject to statutory exception and to the provisions of relevant collective licensing agreements, no reproduction of any part may take place without the written permission of Cambridge University Press.

First published 1940

First paperback edition 2016

*A catalogue record for this publication is available from the British Library*

ISBN 978-1-316-61273-6 Paperback

Cambridge University Press has no responsibility for the persistence or accuracy of URLs for external or third-party internet websites referred to in this publication, and does not guarantee that any content on such websites is, or will remain, accurate or appropriate.

## PREFACE

*The essential feature of this book is its briefness. Boys studying science require some knowledge of 'Higher Algebra', but unless they are of unusual ability they have not time to work through one of the larger treatises. If their subject is biology, it is usually found that they have not time for mathematics at all, a state of affairs particularly regrettable at a time when biology is becoming every day more mathematical.*

*A second feature is that probability and statistics are brought within reach of the ordinary sixth form science boy. It is naturally impossible to include more than an introduction to these difficult subjects, but it is quite wrong that science students, particularly biology students, should go to their universities without having been made aware of even the existence of a side of mathematics whose importance is becoming more and more apparent.*

*Lastly, some attempt has been made to indicate by means of examples the usefulness to scientists of some of the ideas explained in the text. These isolated 'applications' do not of course represent completely the reason why the scientist must study mathematics—for he is dealing all the time in relations and dependences, and mathematics is the study of these in the abstract—but they are put in to help bridge the gap in the student's mind between two seemingly disconnected parts of his work.*

*I am greatly indebted to Mr D. McGregor, without whose help and encouragement the book would hardly have been completed; to Mr K. S. Snell, who has been kind enough to read the manuscript and proofs; to these and other critics for various suggestions; and to the Oxford and Cambridge Schools Examination Board for permission to reprint questions from examination papers.*

E. H. L.

December, 1939

## CONTENTS

	PAGE
<b>I. Indices, logarithms and surds</b>	
The index laws	1
Logarithmic form of the index laws	1
Change of base	2
Surds	3
Equations involving surds	3
<b>II. Variation</b>	
Direct proportion	8
The linear law	9
Inverse proportion	10
Variation as the square	11
The inverse square law	12
$y$ proportional to any power of $x$	13
Joint variation	14
<b>III. The Theory of quadratic equations</b>	
Real, equal and imaginary roots	18
Sum and product of the roots	18
Symmetrical functions of the roots	18
Forming equations	19
Maximum and minimum values of quadratic expressions	19
Maximum and minimum values of certain fractions	19
<b>IV. Factors and some developments</b>	
Test for factors	23
Remainder theorem	23
Cubic equations	23
Factors of $a^3 + b^3$ and $a^3 - b^3$	23
Symmetry	24
Cyclic symmetry	24
$\Sigma$ notation	24
Equating of coefficients	24
Partial fractions	25

	PAGE
<b>V. Permutations and combinations</b>	
Terminology	29
Notation	29
Evaluation of ${}_n P_r$	29
Permutations with repetitions	30
Permutations of $n$ things, $n$ at a time	30
Evaluation of ${}_n C_r$	30
Special cases of ${}_n C_r$	30
To divide $n$ things into groups of $p, q, r, \dots$	31
Total number of combinations of $n$ things	31
<b>VI. The binomial theorem (for a positive integral index)</b>	
Pascal's triangle	37
The binomial theorem for a positive integral index	38
Special cases	38
Sum of the coefficients	38
Expansion of $(1 - x)^n$	38
Expansion of $(a + x)^n$	39
Ratio of successive terms	39
<b>VII. Probability</b>	
Introduction	41
Assumptions	42
Definition	42
Addition of probabilities	43
Multiplication of probabilities	44
Representation of probabilities by algebraic expansions	44
Binomial probability-distributions	45
<b>VIII. Finite series</b>	
Arithmetic and geometric progressions	50
Sum of an arithmetic progression	51
Sum of a geometric progression	51
The method of differences	52
First differences and summation of some standard series	52
Methods of application	54
Arithmetic and geometric means	54
Inequality theorem	55

## CONTENTS

ix

**IX. Infinite series**

PAGE

Introduction	59
Infinite geometric series	60
‘Sum to infinity’ of a geometric series	60
Divergent geometric series	61
Definition of convergence	61
Divergence of $1 + \frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots$	61
D’Alembert’s test for convergence	61
Series of alternately positive and negative terms	62
Binomial series	62
Special cases	63
Expansion of $(a + x)^n$	63
Approximations	64
Error in approximations	64
The exponential series	64
Greatest term, etc.	65
Logarithmic series	65
Other series	66

**X. Statistics**

Introduction	73
Statistics	73
Frequency distributions	74
Normal curve of errors	75
Mode	75
Median and quartiles	76
Mean and standard deviation	76
Coefficient of variation	79
Probable error	80
Standard errors of mean and standard deviation	80
Linear regression	80
Correlation	83

Answers	95
---------	----

Index	101
-------	-----