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## Preface

*Abstract Algebra: An Inquiry-Based Approach, Second Edition* is a textbook that covers material in ring theory and group theory. To keep the size (and cost) of the text manageable, some additional and reference material is offered in this document.

### Supplemental Investigations

- **Investigation 34: RSA Encryption.** This investigation describes the RSA algorithm and assumes familiarity with modular congruence and prime numbers from Investigation 1. This investigation is referred to in Exercise 20 of Investigation 23 concerning Fermat's Little Theorem.
- **Investigation 35: Check Digits.** This investigation introduces the idea of check digits in several contexts and assumes familiarity with modular congruence (Investigation 1) and the dihedral groups (Investigation 21).
- **Investigation 36: Games: NIM and the 15 Puzzle.** This investigation applies group theory to develop a winning strategy in the game of NIM and to determine which 15 Puzzles are solvable. It assumes knowledge of groups (Investigation 17) and subgroups (Investigation 19), along with the symmetric groups (Investigation 22).
- **Investigation 37: Groups of Order 8 and 12: Semidirect Products of Groups.** In this investigation, we classify all groups of order 8, introduce semidirect products of groups, and then classify all groups of order 12. We assume familiarity with the earlier classification of groups of various orders (Investigation 26) and with products of groups (Investigation 25).

### Appendices

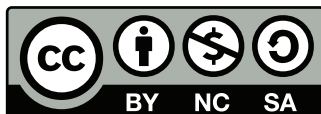
- **Appendix A: Functions.** This appendix appeared in the first edition and provides background information for students on properties of functions. This material is a helpful reference for the study of homomorphisms and isomorphisms in Investigations 7, 13, 26, symmetries in Investigation 17, as well as permutations in Investigation 22 in the text.
- **Appendix B: Mathematical Induction and the Well-Ordering Principle.** Mathematical induction and the Well-Ordering Principle are used throughout *Abstract Algebra: An Inquiry-Based Approach, Second Edition*. This appendix can be used as a review of these important items, and also provides proofs of the equivalencies of the Well-Ordering Principle and the different flavors of mathematical induction for those who are interested.
- **Appendix C: Methods of Proof.** This is a new appendix that provides review material on different methods of proof other than induction, including direct proofs, proofs using logical equivalencies, proof by contradiction, and proofs using cases.
- **Appendix D: Proof that  $R[x]$  is a Ring.** The formal proof that  $R[x]$  is a ring when  $R$  is a ring is long and notationally complex. The details in the general case are omitted in Investigation 8 in the text, but are included in this appendix for those who want to see a complete proof.

- **Appendix E: The Cubic Formula.** This material was in the first edition as a supplement to the investigation on irreducible polynomials. A complete derivation of the cubic formula is presented here. This formula is useful for Exercise 11 in Investigation 11 and is also referenced in Investigation 33 related to solvability by radicals in the text.
- **Appendix F: The Fundamental Theorem of Algebra.** The Fundamental Theorem of Algebra is an important result regarding irreducible polynomials in Investigation 11. Since proofs of this theorem are not algebraic in nature, they don't usually appear in modern algebra texts. In this appendix we present what we believe is an accessible proof for the interested reader.
- **Appendix G: Complex Roots of Unity.** Complex roots of unity appear throughout Investigations 32 and 33 related to field extensions and Galois theory. Many students may already have a firm background in this topic. In this appendix we present a review of complex roots of unity for those who may benefit from one.

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