

Foundations of Mathematics (Math 131)

Department of Mathematics - College of Science - King Saud University

First Semester: 1448 (August, 2026 – December, 2026)

List of Recommended Exercises

Recommended book: Mathematical Proofs: A Transition to Advanced Mathematics, Fourth Edition, Chartrand/Polimeni/Zhang

Recommended Exercises from the above book: Working through exercise problems is essential to mastering this course. While completing every suggested problem is not expected, consistent practice is key to your success. You are strongly encouraged to collaborate and discuss solutions with your classmates!

1) Sets

- **Section 1.1 – Describing a Set:** 1.1, 1.2, 1.3, 1.4, 1.8
- **Section 1.2 – Subsets:** 1.10, 1.11, 1.12, 1.13, 1.14, 1.17, 1.20
- **Section 1.3 – Set Operations:** 1.22, 1.23, 1.26, 1.28, 1.29
- **Section 1.4 – Indexed Collections of Sets:** 1.36, 1.40, 1.45
- **Section 1.5 – Partitions of Sets:** 1.48, 1.50, 1.52, 1.55
- **Section 1.6 – Cartesian Products of Sets:** 1.59, 1.63, 1.64, 1.66

2) Logic

- **Section 2.1 – Statements:** 2.1, 2.2, 2.3, 2.4, 2.6, 2.8
- **Section 2.2 – Negations:** 2.11, 2.12, 2.13
- **Section 2.3 – Disjunctions and Conjunctions:** 2.15, 2.16, 2.17, 2.18
- **Section 2.4 – Implications:** 2.19, 2.20, 2.21, 2.23, 2.24, 2.29
- **Section 2.5 – More on Implications:** 2.30, 2.31, 2.33, 2.34
- **Section 2.6 – Biconditionals:** 2.35, 2.36, 2.38, 2.40, 2.43
- **Section 2.7 – Tautologies and Contradictions:** 2.46, 2.47, 2.49, 2.50
- **Section 2.8 – Logical Equivalence:** 2.53, 2.54, 2.57, 2.58
- **Section 2.9 – Some Fundamental Properties of Logical Equivalence:** 2.60, 2.61, 2.62, 2.63, 2.64, 2.65, 2.66
- **Section 2.10 – Quantified Statements:** 2.67, 2.69, 2.71, 2.72, 2.73, 2.74, 2.75, 2.80, 2.81

3) Direct Proof and Proof by Contrapositive

- **Section 3.1 – Trivial and Vacuous Proofs:** 3.1, 3.2
- **Section 3.2 – Direct Proofs:** 3.8, 3.11, 3.13, 3.15
- **Section 3.3 – Proof by Contrapositive:** 3.16, 3.18, 3.19, 3.23
- **Section 3.4 – Proof by Cases:** 3.26, 3.30, 3.34, 3.35, 3.37, 3.39

- **Section 3.5 – Proof Evaluations:** 3.41, 3.42, 3.43, 3.44, 3.48

4) More on Direct Proof and Proof by Contrapositive

- **Section 4.1 – Proofs Involving Divisibility of Integers:** 4.1, 4.3, 4.5, 4.6
- **Section 4.2 – Proofs Involving Congruence of Integers:** 4.14, 4.15, 4.18, 4.21
- **Section 4.3 – Proofs Involving Real Numbers:** 4.25, 4.27, 4.30, 4.31
- **Section 4.4 – Proofs Involving Sets:** 4.42, 4.44
- **Section 4.5 – Fundamental Properties of Set Operations:** 4.52, 4.53, 4.54, 4.55, 4.56
- **Section 4.6 – Proofs Involving Cartesian Products of Sets:** 4.61, 4.62, 4.65, 4.67
- **Section 14.3 –**

5) Existence and Proof by Contradiction

- **Section 5.1 – Counterexamples:** 5.2, 5.3, 5.4, 5.5
- **Section 5.2 – Proof by Contradiction:** 5.12, 5.18, 5.21, 5.33
- **Section 5.3 – A Review of Three Proof Techniques:** 5.36, 5.39
- **Section 5.4 – Existence Proofs:** 5.42, 5.46, 5.51, 5.53
- **Section 5.5 – Disprove Existence Statements:** 5.55, 5.57

6) Mathematical Induction

- **Section 6.1 – The Principle of Mathematical Induction:** 6.1, 6.4, 6.5, 6.11, 6.16
- **Section 6.2 – A More General Principle of Mathematical Induction:** 6.19, 6.22, 6.27
- **Section 6.3 – The Strong Principle of Mathematical Induction:** 6.33, 6.36

9) Equivalence Relations

- **Section 9.1 – Relations:** 9.1–9.10
- **Section 9.2 – Properties of Relations:** 9.11–9.19, 9.23
- **Section 9.3 – Equivalence Relations:** 9.24–9.30, 9.32–9.35
- **Section 9.4 – Properties of Equivalence Classes:** 9.36–9.42
- **Section 9.5 – Congruence Modulo n :** 9.44–9.53
- **Section 9.6 – The Integers Modulo n :** 9.54–9.61

10) Functions

- **Section 10.1 – The Definition of Function:** 10.1–10.11, 10.12(b, c, d, f), 10.14, 10.16
- **Section 10.2 – One-to-one and Onto Functions:** 10.20–10.26, 10.28, 10.29
- **Section 10.3 – Bijective Functions:** 10.30–10.33
- **Section 10.4 – Composition of Functions:** 10.37–10.43, 10.45–10.48
- **Section 10.5 – Inverse Functions:** 10.49–10.61

11) Cardinalities of Sets

- **Section 11.1 – Numerically Equivalent Sets:** 11.1, 11.2
- **Section 11.2 – Denumerable Sets:** 11.3–11.12, 11.14–11.19
- **Section 11.3 – Uncountable Sets:** 11.20, 11.22–11.25
- **Section 11.4 – Comparing Cardinalities of Sets:** 11.26–11.29, 11.31
- **Section 11.5 – The Schröder-Bernstein Theorem:** p. 296 (only Theorem 11.20 without the proof)

15) Proofs in Group Theory

- **Section 15.1 – Binary Operations:** 15.1, 15.2, 15.3, 15.4, 15.5, 15.7
- **Section 15.2 – Groups:** 15.9, 15.10, 15.11, 15.12

"This list is subject to change"