

Exam 4 will be on Friday 24 April during our regular class time. It will include Chapter 12 and Chapter 14 Sections 1-2. You will have one hour to complete the exam. You may bring a single 3 in by 5 in notecard with writing on both sides.

This review only discusses new material. However, you are expected to know all of the terms and proof techniques from the whole semester.

### Definitions

For all of the terms below, you must be able to formally state and use the definition from your textbook.

1. function, domain, codomain, range
2. injective (or one-to-one), surjective (or onto), bijective
3. composition of functions
4. inverse relations (or functions)
5. image, preimage, and associated notation
6. cardinality, countably infinite, countable, uncountable

### Facts To Know

1. Pigeonhole principle
2.  $|\mathbb{N}| = |\mathbb{Z}| = |\mathbb{Q}| \neq |\mathbb{R}|$
3. A set is countably infinite if and only if the elements of  $A$  can be written as an infinite sequence.
4. If  $A$  and  $B$  are countably infinite, then  $A \cup B$  and  $A \times B$  are countably infinite.

### Things to Keep in Mind

1. If a proof technique is not prescribed, you must state the method you are using.
2. You should put in the “boiler-plate” language even if you cannot figure out the whole proof.
3. You should expect to **use** all of the hypotheses.
4. I will **not** ask you to prove something that is false.

## What the Midterm Will Look Like

1. Problem 1 (two parts): Prove a particular function is injective. Prove a particular function is surjective
2. Problem 2: Suppose  $f : A \rightarrow B$  and  $g : A \rightarrow B$ . Prove that if  $f$  and  $g$  are injective (surjective), then  $g \circ f$  is injective (surjective).
3. Problem 3: A Pigeonhole Principle problem
4. Problem 4: Prove that two sets have the same cardinality.
5. Problem 5: Short Answer which will come from questions like:
  - Show a relation is (is not) a function
  - Show a function is **not** injective (surjective)
  - Determine image/preimage of a set given a function and/or its inverse
  - Demonstrating the mechanics of function composition
  - Determine the inverse relation of a function
  - Determine if a set is countable or uncountable