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To recap, the goals of this workbook are: to introduce students transitioning from highschool to reading and writing mathematical proofs, in particular to enforce the importance of reading the workbook rather than « skim 'til you find an example that shows you how to do one problem like that. » The pedagodical method to enforce this progressive study is by inserting many autograded quizzes/exercises/checks within all paragraphs rather than at the end.

# Chapter 1 - Introduction and notation

## 1.1 Basic sets

Probably most people will agree that the natural numbers { 1 , 2 , 3 , 4 , ... } are a natural construct – they are the numbers we use to count things. Traditionally, the natural numbers are denoted ℕ.

The concepts of zero { 0 } and negative values { -1 , -2 , -3 , -4 , ... } seem (to many people) to be unnatural constructs. Indeed, otherwise intelligent people are still known to rail against the concept of a negative quantity – “How can you have negative three apples?” The concept of zero is also somewhat profound. At this point in time there seems to be no general agreement about the status of zero (0) as a natural number. Are there collections that we might possibly count that have no members? Well, yes – I’d invite you to consider the collection of gold bars that I keep in my basement...

The traditional view seems to be that ℕ = { 1 , 2 , 3 , 4 , ... } i.e. that the naturals don’t include 0. My personal preference would be to make the other choice (i.e. to include 0 in the natural numbers), but for the moment, let’s be traditionalists. Be advised that this is a choice. We are adopting a definition or convention. If in some other course, or other mathematical setting you find that the other definition is preferred, well, it’s good to learn flexibility.

**Q1**. The set of natural numbers ℕ = { 1 , 2 , 3 , 4 , ... } is made of those listed elements because:

(A) it is GOD's manifestation

(B) it is a personal definition or choice or convention by the mathematician

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<ws365><code><id>sec1</id><lang>coq</lang><format/></code></ws365>

**From** Qoc **Require** **Import** Jisuanji .

归纳的 infiniteNumbers :=

Zero : infiniteNumbers

| NextOne : infiniteNumbers -> infiniteNumbers.

校验 (NextOne Zero). 校验 (NextOne (NextOne Zero)).

**Lemma** myLemma0: Zero = Zero.

**Proof**.

reflexivity.

**Qed**.

▽

NextOne Zero

: infiniteNumbers

▽

NextOne (NextOne Zero)

: infiniteNumbers

▽

★ 1 goal.

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Zero = Zero

Now click the toolbar «WorkSchool365». A task pane will appear on the right, pre-filled with this COQ code above. You may need to firstly download WorkSchool365 « [https://1337777.github.io/workschool365](https://1337777.github.io/workschool365.xml)[.xml](https://1337777.github.io/coq365.xml) », then upload it onto Word by clicking the toolbar « Insert >> Add-ins ».

**Q2**. The finite code above suggests that

infiniteNumbers = { Zero , (NexOne Zero) , (NextOne (NextOne Zero)) , ... } :

(A) Yes. A finite description (in human/math language) can generate an infinite collection.

(B) No. Finite cannot generate infinite.

**S1**. How do you like this workbook so far? (A) OK. (B) KO. (C) LOL.

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However, the low language of an electrical circuit ("on", "off") cannot easily describe/communicate such an infinite collection.

Optional: only to enable anonymous grading without transcripts :

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<solution><id>Q1</id><content>B</content></solution>

<solution><id>Q2</id><content>A</content></solution>

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