

# CHAPTER 1

# Set Theory

## 1.1 INTRODUCTION

The concept of a *set* appears in all mathematics. This chapter introduces the notation and terminology of set theory which is basic and used throughout the text. The chapter closes with the formal definition of mathematical induction, with examples.

## 1.2 SETS AND ELEMENTS, SUBSETS

A *set* may be viewed as any well-defined collection of objects, called the *elements* or *members* of the set. One usually uses capital letters,  $A, B, X, Y, \dots$ , to denote sets, and lowercase letters,  $a, b, x, y, \dots$ , to denote elements of sets. Synonyms for "set" are "class," "collection," and "family."

Membership in a set is denoted as follows:

$a \in S$  denotes that  $a$  belongs to a set  $S$

$a, b \in S$  denotes that  $a$  and  $b$  belong to a set  $S$

Here  $\in$  is the symbol meaning "is an element of." We use  $\notin$  to mean "is not an element of."

### Specifying Sets

There are essentially two ways to specify a particular set. One way, if possible, is to list its members separated by commas and contained in braces  $\{ \}$ . A second way is to state those properties which characterized the elements in the set. Examples illustrating these two ways are:

$$A = \{1, 3, 5, 7, 9\} \quad \text{and} \quad B = \{x \mid x \text{ is an even integer, } x > 0\}$$

That is,  $A$  consists of the numbers 1, 3, 5, 7, 9. The second set, which reads:

$B$  is the set of  $x$  such that  $x$  is an even integer and  $x$  is greater than 0.

denotes the set  $B$  whose elements are the positive integers. Note that a letter, usually  $x$ , is used to denote a typical member of the set; and the vertical line  $|$  is read as "such that" and the comma as "and."

### EXAMPLE 1.1

(a) The set  $A$  above can also be written as  $A = \{x \mid x \text{ is an odd positive integer, } x < 10\}$ .

(b) We cannot list all the elements of the above set  $B$  although frequently we specify the set by

$$B = \{2, 4, 6, \dots\}$$

where we assume that everyone knows what we mean. Observe that  $8 \in B$ , but  $3 \notin B$ .

# An Outline Of Set Theory

**Daniel F McAuley**



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