Exercises 1 Sets
Intersection, complement, union, number sets

Objectives

- understand what a set, an element of a set, an intersection, a union, a complement is.
- know the set of real numbers, rational numbers, integers, natural numbers.
- be able to perform basic set operations.

Problems

1.1 Look at the sets A, B, and C:

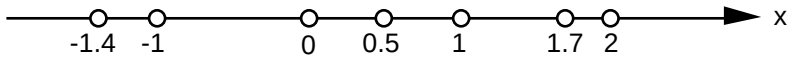
A = Set of all the cities of the world
B = Set of all the European cities
C = Set of all the coastal cities of the world

Find at least four elements of the following sets:

a) $B \cap C$ b) $B \setminus C$

c) $C \setminus B$ d) $A \setminus (B \quad C)$

1.2 When calculating we usually deal with **real numbers**. The set $\mathbb{R}$ of real numbers can be thought of as an infinitely long continuous number line. Each point of the number line represents a real number x:



The following number sets are subsets of $\mathbb{R}$:

$\mathbb{N}$ = Set of **natural numbers** = {1, 2, 3, 4, ...}

$\mathbb{Z}$ = Set of **integers** = {..., -4, -3, -2, -1, 0, 1, 2, 3, 4, ...}

$\mathbb{Q}$ = Set of **rational numbers** = $\left\{ x \mid x = \frac{m}{n};\ m \quad \mathbb{Z};\ n \quad \mathbb{Z} \setminus \{0\} \right\}$

A rational number x is a number that can be expressed as a fraction $\frac{m}{n}$, where both numerator m and denominator n are integers and n is not zero.

a) Determine the following sets:

i) $\mathbb{Z} \setminus \mathbb{N}$ ii) $\mathbb{Z} \quad \mathbb{N}$ iii) $\mathbb{Z} \cap \mathbb{N}$

b) Decide whether each statement is true or false:

i) $\mathbb{N} \quad \mathbb{Z}$ ii) $\mathbb{Z} \quad \mathbb{Q}$ iii) $\mathbb{Q} \quad \mathbb{R}$

c) Try to think of numbers that are elements of the set $\mathbb{R} \setminus \mathbb{Q}$

1.3 Harshbarger/Reynolds: Exercises 0.3, pages 6 to 9 (photocopies)

(Harshbarger, R.J. and Reynolds, J.J.: Mathematical Applications for the Management, Life, and Social Sciences, Houghton Mifflin Company, Boston / New York 2007, 8th edition, ISBN 978-0-618-73162-6)

Answers

1.1 a) $B \cap C$ = {Lisbon, Copenhagen, Barcelona, Naples, Stockholm, ...}

b) $B \setminus C$ = {London, Paris, Madrid, Berlin, Rome, ...}

c) $C \setminus B$ = {Tokyo, San Francisco, Sydney, Rio de Janeiro, ...}

d) $A \setminus (B \quad C)$ = {Chicago, Mexico City, Nairobi, Beijing, ...}

1.2 a) i) $\mathbb{Z} \setminus \mathbb{N} = \{0, -1, -2, -3, ...\}$

ii) $\mathbb{Z} \quad \mathbb{N} = \mathbb{Z}$

iii) $\mathbb{Z} \cap \mathbb{N} = \mathbb{N}$

b) i) true

ii) true

iii) true

c) $\mathbb{R} \setminus \mathbb{Q} = \{\sqrt{2}, \sqrt{3}, \pi, ...\}$

1.3 see Harshbarger/Reynolds (photocopies)