

## Exercises 2                      Numbers Number sets, intervals, absolute value

### Objectives

- know the definition and elements of natural numbers, integers, rational numbers, and real numbers.
- know and understand what an open, half-open, and closed interval is.
- know and understand what the absolute value of a real number is.
- be able to perform basic operations with real numbers.

### Problems

2.1     Decide whether each statement is true or false:

- |                                      |  |   |
|--------------------------------------|--|---|
| a) $4 \in \mathbb{N}$                | b) $-\frac{14}{7} \in \mathbb{Z}$      | c) $\sqrt{2} \in \mathbb{Q}$                      |
| d) $\sqrt{9} \in \mathbb{N}$         | e) $\sqrt{9} \in \mathbb{Q}$           | f) $\sqrt{9} \in \mathbb{R}$                      |
| g) $1.67854 \in \mathbb{Q}$          | h) $1.6\overline{7854} \in \mathbb{Q}$ | i) $\mathbb{N} \subset \mathbb{Z}$                |
| j) $\mathbb{Z} \subseteq \mathbb{Q}$ | k) $\mathbb{Q} \subset \mathbb{R}$     | l) $\mathbb{R} \setminus \mathbb{Z} = \mathbb{N}$ |

2.2     Determine the following sets:

- |  |  |  |
|--|--|--|
| a) $\mathbb{Z} \setminus \mathbb{N}$                   | b) $\mathbb{Z} \cup \mathbb{N}$                        | c) $\mathbb{Z} \cap \mathbb{N}$                        |
| d) $\mathbb{Q} \cap (\mathbb{R} \setminus \mathbb{Q})$ | e) $\mathbb{Q} \cup (\mathbb{R} \setminus \mathbb{Q})$ | f) $(\mathbb{Q} \setminus \mathbb{Z}) \cap \mathbb{N}$ |

2.3     You will find a pdf-file with scanned pages of the textbook Harshbarger/Reynolds\* on Moodle:  
“Algebraic Concepts (Harshbarger/Reynolds)”  
(pages 2 to 55 of chapter “0 Algebraic Concepts” and pages A1 to A5)

Go to section “0.2 The Real Numbers” (pages 9 to 15).

- Study the theory (pages 9 to 13).
- Do the odd-numbered exercises 1 to 45 (pages 13 and 14).

\*Harshbarger, R.J., 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

2.4     Decide which statements are true or false. Put a mark into the corresponding box.  
In each problem a) to c), exactly one statement is true.

- |    |                          |   |
|----|--------------------------|---|
| a) | <input type="checkbox"/> | $\mathbb{N} \cup \mathbb{Z} = \mathbb{Q}$                 |
|    | <input type="checkbox"/> | $\mathbb{Q} \setminus \mathbb{Z} = \mathbb{N}$            |
|    | <input type="checkbox"/> | $\mathbb{Q} \cap \mathbb{R} = \mathbb{Q}$                 |
|    | <input type="checkbox"/> | $\mathbb{Z} \setminus \mathbb{N} = \{-1, -2, -3, \dots\}$ |
| b) | <input type="checkbox"/> | $\mathbb{N} = [1, \infty)$                                |
|    | <input type="checkbox"/> | $3 \in (3, 4)$  |
|    | <input type="checkbox"/> | $[3, 4] \cup (3, 4) = (3, 4)$                             |
|    | <input type="checkbox"/> | $[3, 4] \setminus (3, 4) = \{3, 4\}$                      |
| c) |                          | (see next page)   |

c) Assume that  $x$  is a rational number. Therefore, it can be concluded that  $x$  is ...

- ... a real number.
- ... an integer.
- ... a fraction where both numerator and denominator are natural numbers.
- ... a natural number.