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)	$1.67\overline{854} \in \mathbb{Q}$	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:
> Documents > 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).

a) Study the theory (pages 9 to 13).

b) Do the exercises (pages 13 to 15).

*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)
- ☐ $\mathbb{N} \cup \mathbb{Z} = \mathbb{Q}$
- ☐ $\mathbb{Q} \setminus \mathbb{Z} = \mathbb{N}$
- ☐ $\mathbb{Q} \cap \mathbb{R} = \mathbb{Q}$
- ☐ $\mathbb{Z} \setminus \mathbb{N} = \{-1, -2, -3, ...\}$

b)
- ☐ $\mathbb{N} = [1,\infty)$
- ☐ $3 \in (3,4)$
- ☐ $[3,4] \cup (3,4) = (3,4)$
- ☐ $[3,4] \setminus (3,4) = \{3,4\}$

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.

Answers

2.1	a)	true	b)	true	c)	false
	d)	true	e)	true	f)	true
	g)	true	h)	true	i)	true
	j)	true	k)	true	l)	false

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

b) $\mathbb{Z} \cup \mathbb{N} = \mathbb{Z}$

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

d) $\mathbb{Q} \cap (\mathbb{R} \setminus \mathbb{Q}) = \{\}$

e) $\mathbb{Q} \cup (\mathbb{R} \setminus \mathbb{Q}) = \mathbb{R}$

f) $(\mathbb{Q} \setminus \mathbb{Z}) \cap \mathbb{N} = \{\}$

2.3 see Harshbarger/Reynolds (page A1)

Note:
- Only answers of the odd-numbered exercises (1, 3, 5, ...) are available.

2.4 a) 3rd statement

b) 4th statement

c) 1st statement