# Exercises 2

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## 2.9

### a)

$$x \in \overline{A \cap B \cap C} \equiv x \notin A \cup B \cup C \equiv x \notin A \vee x \notin B \vee x \notin C \equiv x \in \overline{A} \vee x \in \overline{B} \vee x \in \overline{C} \equiv x \in \overline{A} \cup \overline{B} \cup \overline{C}$$

### b)

| $A\ B\ C$ | $A \cap B \cap C$ | $\overline{A \cap B \cap C}$ | $\overline{A}\ \overline{B}\ \overline{C}$ | $\overline{A} \cup \overline{B} \cup \overline{C}$ |
|---|---|---|---|---|
| 0 0 0 | 0 | 1 | 1 1 1 | 1 |
| 0 0 1 | 0 | 1 | 1 1 1 | 1 |
| 0 1 0 | 0 | 1 | 1 1 1 | 1 |
| 0 1 1 | 0 | 1 | 1 1 1 | 1 |
| 1 0 0 | 0 | 1 | 1 1 1 | 1 |
| 1 0 1 | 0 | 1 | 1 1 1 | 1 |
| 1 1 0 | 0 | 1 | 1 1 1 | 1 |
| 1 1 1 | 1 | 0 | 1 1 1 | 0 |

## 2.12

$x \in A \cup (B \cap C) \equiv x \in A \vee x \in (B \cap C) \equiv x \in A \vee (x \in B \wedge x \in C) \equiv (x \in A \vee x \in B) \wedge (x \in A \vee x \in C) \equiv x \in (A \cup B) \cap (A \cup C)$

## 2.13

**a)** $A \cap B \cap C = \{4, 6\}$
**b)** $A \cap B \cap C = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$
**c)** $A \cap B \cap C = \{4, 5, 6, 8, 10\}$
**d)** $A \cap B \cap C = \{0, 2, 4, 5, 6, 7, 8, 9, 10\}$

## 3.1

**a)** $f(0)$ is not defined.
**b)** $f(x)$ is not defined when $x < 0$.
**c)** $f(x)$ has two value assigned to x. **a)** $\lceil \frac{3}{4} \rceil = 1$ **b)** $\lfloor \frac{7}{8} \rfloor = 0$ **c)** $\lceil -\frac{3}{4} \rceil = 0$ **d)** $\lfloor -\frac{7}{8} \rfloor = -1$
**e)** $\lceil 3 \rceil = 3$ **f)** $\lfloor -1 \rfloor = -1$ **g)** $\lfloor \frac{1}{2} + \lceil \frac{3}{2} \rceil \rfloor = 2$ **h)** $\lfloor \frac{1}{2} \cdot \lfloor \frac{5}{2} \rfloor \rfloor = 1$

## 3.7

**a)** $f(n) = n - 1$ is a onto.
**b)** $f(n) = n^2 + 1$ is not a onto.
**c)** $f(n) = n^3$ is a onto.
**d)** $f(n) = \lfloor n/2 \rfloor$ is a onto.

## 3.12

**a)** $f(x) = 2x + 1$ is a bijection.
**b)** $f(x) = x^2 + 1$ is not a bijection.
**c)** $f(x) = x^3$ is a bijection.
**d)** $f(x) = (x^2 + 1)/(x^2 + 2)$ is a bijection.

## 3.16

**a)** $f(S) = \{0, 1, 3\}$.
**b)** $f(S) = \{0, 1, 3, 5, 8\}$.
**c)** $f(S) = \{0, 8, 16, 40\}$.
**d)** $f(S) = \{1, 12, 33, 65\}$.