Chapter 3: Set Theory

Section 3.1: Set Definitions and Notation

The concept of a set : A SET IS A COLLECTION OF ITEMS THAT SHARE A COMMON CHARACTERISTIC CALLED ELEMENTS.

$M = \{x \mid x \text{ IS IN MATH 142 AT 8am}\}$ ⇐ WELL DEFINED, FINITE

"x SUCH THAT x IS A STUDENT IN MATH 142 AT 8am"

$S = \{x \mid x \text{ IS A SNOWFLAKE THAT HAS FALLEN ON EARTH}\}$ ⇐ WELL DEFINED, FINITE

$C = \{x \mid x \text{ ARE US CITIZENS INFECTED WITH COVID}\}$ ⇐ WELL DEFINED FINITE

Common Sets in Mathematics

① THE SET OF NATURAL NUMBERS (COUNTING NUMBERS)

$\mathbb{N} = \{1, 2, 3, 4 \ldots\}$

② THE SET OF WHOLE NUMBERS

$W = \{0, 1, 2, 3, 4 \ldots\}$

WELL DEFINED

INFINITE

③ THE SET OF INTEGERS

$\mathbb{Z} = \{\ldots -3, -2, -1, 0, 1, 2, 3 \ldots\}$

④ THE SET OF RATIONAL NUMBERS

$\mathbb{Q} = \{\ldots -2.5, -\frac{2}{3}, \frac{1}{3}, 10.9, 17, 22 \ldots\}$

⑤ THE SET OF IRRATIONAL NUMBERS

$\mathbb{I} = \{\sqrt{2}, \pi \ldots\}$

⑥ THE SET OF REAL NUMBERS

$\mathbb{R} = \{$ANY NUMBER THAT CAN BE FOUND ON A NUMBER LINE$\}$

Set Notation, Definitions, and Symbolic Notation

"An element of" notation $\in$

$x \in \mathbb{N}$ "x IS AN ELEMENT OF THE NATURAL NUMBERS."

Subset SET A IS CALLED A SUBSET OF SET B IF EVERY ELEMENT IN SET A IS ALSO IN SET B.

$A \subseteq B$ "SET A IS A SUBSET OF SET B."

Set Equality SET A IS EQUAL TO SET B IF EVERY ELEMENT IN SET A IS ALSO IN SET B. $A = B$.

The empty set : A SET WITH NO ELEMENTS IS THE EMPTY SET.

$\emptyset, \{\}$

The Universal Set THE UNIVERSAL SET IS THE SET OF ALL ELEMENTS FOR A PARTICULAR SITUATION.

U = "UNIVERSAL SET"

Examples of Set Notations and Definitions (True or False).

① $U = \{0, 1, 2, 3, 4, 5, 6\}$

$A = \{3, 4, 5\}$ $B = \{3, 5\}$

$C = \{2, 4, 6\}$ $D = \{5, 4, 3\}$

TRUE/FALSE : $5 \in A, B$ T $D = A$ T

$3 \notin C$ T $C \subseteq A$ F

$A \subseteq B$ F

$B \subseteq A$ T

TRUE/FALSE

① $\mathbb{N} \subseteq \mathbb{Z}$ T

② $\mathbb{W} \subseteq \mathbb{R}$ T

③ $\mathbb{Z}^- \subseteq \mathbb{N}$ F

④ $\mathbb{Z}^+ \subseteq \mathbb{Q}$ T

Subset Examples and Creating Subsets

EXAMPLE: ① $S = \{ERIK, ELIZABETH\}$

SUBSETS = $\{ERIK\}$
$\{ELIZABETH\}$
$\{ERIK, ELIZABETH\}$
$\{\}$

4 SUBSETS

② $S = \{ERIK, ELIZABETH, KARL\}$

SUBSETS : $\{ERIK\}$ $\{ELIZABETH, KARL\}$
$\{ELIZABETH\}$ $\{ERIK, ELIZABETH\}$
$\{KARL\}$ $\{ERIK, ELIZABETH, KARL\}$
$\{ERIK, KARL\}$ $\{\}$

8 SUBSETS

③ $S = \{ERIK, ELIZABETH, KARL, PETER\}$

SUBSETS : FORGET IT!

16 SUBSETS

To find the number of subsets in any given set: 2^n (n IS THE NUMBER OF ELEMENTS)

CAITLIN : 17 IN THE FAM : $2^{17} = 131,072$

SUBSETS FOR: $\{0\}$: $2^1 = 2$ SUBSETS $\Rightarrow \{0\}, \{\}$

SUBSETS FOR: $\{\}$: $2^0 = 1$ SUBSET $\Rightarrow \{\}$