3.1 Set Definitions and Operations

3.1.1 Common Sets

Common sets we will see in this chapter:

$\mathbb{N}$, the set of natural numbers	These numbers are "counting numbers". This set contains 0 and positive integers.
$\mathbb{Z}$, the set of integers	This set contains all integers: positive, negative, and zero.
$\mathbb{Q}$, the set of rational numbers	This set contains all numbers that can be characterized as ratios, such as $\frac{1}{2}$, $\frac{-17}{4}$, or even $\frac{3}{1}$.
$\mathbb{R}$, the set of all real numbers	These can be thought of as decimal numbers with possibly unending strings of digits after the decimal point.

Question 1

For the following numbers, which set(s) do they belong to?

	$\mathbb{N}$	$\mathbb{Z}$	$\mathbb{Q}$	$\mathbb{R}$
10				
-5				
12/6				
π				
2.40				

Question 2

Give examples for each of the following types of sets:

a. List three numbers that are in the set of all integers, $\mathbb{Z}$, but are NOT in the set of natural numbers, $\mathbb{N}$.

b. List three numbers that are in the set of rational numbers, $\mathbb{Q}$, but are NOT in the set of integers, $\mathbb{Z}$.

c. List three numbers that are in the set of all real numbers $\mathbb{R}$, but are NOT in the set of rational numbers, $\mathbb{Q}$.

Writing out sets
When we are building a discrete (finite) set, we usually give the set a capital letter as its identifier. Then, the elements of the set are written within curly-braces, like this:

$$A = \{2, 4, 6, 8\}$$

The elements here are 2, 4, 6, and 8. The index of the element 2 is 1 - it is at position 1 of the set - so $A_1 = 2$.

Question 3

Create sets that meet the following criteria. Give the sets any letter identifier that you want.

a. All elements of the set are odd integers.

b. All elements of the set are fractions such that, when divided, they result in an infinite string of numbers to the right of the decimal place (e.g., $3.333333\bar{3}$...)

c. Create two sets of integers, where the two sets have exactly two elements in common.

d. Create two sets of natural numbers, where the two sets have NO elements in common.

e. Create a set that is empty.

3.1.2 Subsets

Subsets and existence within sets:

x exists in A	The notation $x \in A$ means "x is an element of A" which means that x is one of the member elements of A.
A is a subset of B	A is a subset of B (written as $A \subseteq B$) if every element in A is also an element in B. Formally, this means that for every x, if $x \in A$, then $x \in B$.
A is equal to B	A is equal to B (written $A = B$) means that A and B have exactly the same members. This is expressed formally by saying, $A \subseteq B$ and $B \subseteq A$.
An Empty set	A set that contains no elements is called an empty set, and it is denoted by $\{\}$ or $\emptyset$.
The Universal set	For any given discussion, all the sets will be subsets of a larger set called the universal set (or universe) We commonly use the letter U to denote this set.

Question 4

Given theset sets:

$U = \{1,2,3,4,5,6\}$ $A = \{1,1,2,2,2,4,4\}$ $B = \{2,2\}$

$C = \{1,2,4,5,6\}$ $D = \{6,5,4,2,1\}$ $E = \{1,4\}$

a. Which of these statements are true? Mark with a ✓

b. Fill in the blanks with either $\subseteq$ (is a subset of), or $\not\subseteq$ (is not a subset of), or $=$ (is equal to) for the following:

Question 5

Question 6