# Worksheet 2 Sets

**Task 1**

The notation for common sets is:

* + **N** = set of natural numbers: {0, 1, 2,…}
  + **Z+** = set of positive integers: {1, 2, 3,…}
  + **Z** = set of all integers: {…, -2,-1, 0,1, 2,…}
  + **Q** = set of rational numbers (can be expressed as a fraction)
  + **R** = set of real numbers

1. The set of even numbers >= 0 can be expressed as

S = { x | x ∈ N ᴧ x is even } using **set comprehension**.   
  
 Using set **enumeration**, S can be expressed as {0, 2, 4, 6, …}

Use set enumeration to express the set: S = {t | t is a letter in “pepper”}

1. Indicate whether each of the following is True or False:

|  |  |  |
| --- | --- | --- |
|  |  | **T or F** |
| **1** | A set is unordered |  |
| **2** | A set can contain duplicate values |  |
| **3** | A set is usually denoted by a lowercase letter |  |
| **4** | A member is usually denoted by a lowercase letter |  |
| **5** | 5 ∈ {1, 2, 3, 4, 5, 6, 7, 8} |  |
| **6** | 3 ∉ {2, 4, 6, 8, 10} |  |
| **7** | a ∈ {c | c is a letter in “computing”} |  |
| **8** | a ∈ {d | d is a letter in “abacus”} |  |
| **9** | a ∉ ø |  |
| **10** | Ø and {} both denote an empty set |  |
| **11** | {a,b,c} ∈ {a, b, c, d, e} |  |

1. Complete the tables to show the definitions of sets.

|  |  |
| --- | --- |
| **Definition** | **Set Comprehension** |
| T = {1, 2, 3, 4} |  |
|  | C = {x | x ∈ **Z** ᴧ x2 – 2 = 0} |
|  | X = {y | y ∈ **R** ᴧ y2 – 2 = 0} |
| T = {5, 10, 15, …} |  |
|  | C = {x | x ∈ **N** ᴧ x + 7 = 10} |

|  |  |
| --- | --- |
| **Definition (Strings)** | **Compact Representation** |
|  | T = {10n | n ≥ 1} |
| Y = {1100, 111000} |  |
| T = {1000, 110000, 11100000,1111000000, …} |  |
|  | C = {(01)n | n > 0} |

**Task 2**

Remember the symbols

∈ ∉ ∪ ∩ \ { } ø

1. Given sets: A = {1, 2, 3, 4, 5} B = {3, 4, 5, 6, 7} C = {2, 3, 8, 9} D = {3, 4}
2. A ∪ B =
3. A ∩ B =
4. C \ B =
5. Is it true that 3 ∈ C?
6. Is it true that 4 ∉ C?
7. Is it true that {3} ∈ B?
8. (D \ A) ∪ B =
9. Is it true that (A ∩ B) \ D = (B \ D) ∩ A? Show your working.
10. Is it true that (D \ A) ∪ B = D \ (A ∪ B)? Show your working.
11. Write an expression to construct a set T = {1, 2, 3, …9} from the sets A to D
12. Write an expression to construct a set T = {1, 4, 5, 6, 7} from the sets A to D
13. Write an expression to construct a set T = {6, 7, 8, 9} from the sets A to D

**Task 3**

1. Sets: A = {1, 2, 3, 4, 5} B = {4, 5, 6, 7} C = {2, 3, 8, 9} D = {3, 4} E = {5, 7, 6, 4}
2. Is it true that D ⊆ A?
3. Is it true that E = B?
4. Is it true that D ⊆ C?
5. Is it true that E ⊂ B?
6. Is it true that D ⊂ A?
7. Is it true that E ⊆ B?
8. State the name of the set X where X ⊆ A and X ⊆ B and X ⊆ C and X ⊆ D and X ⊆ E.
9. Recall the common sets (**N, Z+, Z, Q, R**). Use the subset operator (⊆) to produce a true statement about their relationship.
10. Is it true that A ∩ B ⊆ D? Show your working.
11. Is it true that D ∩ E ⊆ B? Show your working.
12. Is it true that D ⊆ D?

**Task 4**

1. Given sets: A = {1, 2, 3} B = {w, x} C = {2, 3, 4} D = {a, b, c}
2. C x D =
3. A x B =
4. Is it true that C x D = D x C? Show your working.
5. Construct a set T = {(w,w), (w,x), (x,w), (x,x)} from the set B using the Cartesian product operation.
6. (A x B) ∩ (C x B) =
7. (A x B) \ (C x B) =
8. Construct an expression to generate the set: {(1,2), (1,3), (1,4), (2,4), (3,4)}. Show your working.

Hint: Which sets only use numbers? Which operator do you need to generate an ordered pair? Which operators reduce the size of sets?

h) What is the cardinality of A X C?

**Extension task**

1. Extension: Many programming languages support list and set operations, and have special tools to iterate over sets. However, a Cartesian product can be implemented using simple constructs common to all programming languages.

Given setA = {1, 2, 3, 4} and setB = {5, 6}, write a procedure to generate the Cartesian product. Here are some sample outputs.

 