

1. True or False: A recursive definition of the set of integers \mathbb{Z} is

Basis Step: $20 \in \mathbb{Z}$

Recursive Step: If $x \in \mathbb{Z}$, then $x - 1 \in \mathbb{Z}$

Key idea: To define a set, we need to specify which elements are in and which elements are out. A description that gives some, but not all, integers is not a definition of the set of integers.

2. When $B = \{\mathbf{A}, \mathbf{C}, \mathbf{U}, \mathbf{G}\}$ is the set of RNA bases, consider the recursively defined set X given by:

Basis Step: $\mathbf{AA} \in X, \mathbf{CC} \in X, \mathbf{UU} \in X, \mathbf{GG} \in X$

Recursive Step: If $x \in X$ and $b \in B$ then $bxb \in X$

where bxb is the result of string concatenations.

Give three example elements of X and an English description of the set.

Key idea: To build new example elements we can start with an element from the basis step and then apply a rule from the recursive step finitely many times.

3. Write in roster method the set given by the Cartesian product

$$\{1, 2\} \times \{a, b, c\}$$

Key idea: Cartesian product does not require the sets to have the same size as one another or to have the same types of elements as one another.

4. Consider the function d_2 : The set of ordered pairs of ratings 4-tuples $\rightarrow \mathbb{R}$ given by

$$d_2(((x_1, x_2, x_3, x_4), (y_1, y_2, y_3, y_4))) = \sqrt{\sum_{i=1}^4 (x_i - y_i)^2}$$

Let $z = (1, 1, 1, 1)$ be a ratings 4-tuple and consider the set

$$\{x \mid d_2((x, z)) = 1\}$$

Rewrite this set using the roster method.

Key idea: The input to this function is an ordered pair each of whose components is a ratings 4-tuple.

5. Rewrite the set

$$\{r_{nalen}(x) \mid x \in S \text{ and } r_{nalen}(x) < 2\}$$

using the roster method.

Key idea: The set builder definition for this set can be read as “The collection of all outputs of the function r_{nalen} when the input is taken from the set of RNA strands for which r_{nalen} gives value less than 2.” Informally, we consider just RNA strands whose r_{nalen} value is less than 2 and collect their r_{nalen} values into our set.

6. Which of the following is true? (Select all and only that apply.)

(a) $\exists s \in S \text{ Mut}(s, s)$

(b) $\forall s \in S \text{ Mut}(s, s)$

(c) $\exists s \in S \text{ Ins}(s, \mathbf{A})$

(d) $\exists s \in S \text{ Ins}(\mathbf{A}, s)$

(e) $\exists s \in S \text{ Del}(s, \mathbf{A})$

(f) $\forall s \in S \text{ Del}(s, \mathbf{A})$