NAME:_____

This quiz contains 4 problems worth 30 points. You may not use books, notes, or a calculator. You have 30 minutes to take the quiz.

_____

1. (5 points) List all strings over $X = \{0, 1\}$ of length 3 or less.

2. (10 points) Let $s_n = 2n - 3$ for $n \geq 1$.

   (a) List the first four terms of s_n.

   (b) List the first four terms of the sequence $b_k = \sum_{n=1}^{k} s_n$.

   (c) List the first four terms of the sequence $b_k = \prod_{n=1}^{k} s_n$.

3. (12 points) Let $X = \{1, 2, 3, 4\}$, $Y = \{a, b, c, d\}$ and $Z = \{A, B, C, D, E\}$. Determine whether each set forms $\boxed{\text{a function or not}}$ and, if it is a function, whether it is $\boxed{\text{one-to-one, onto, or a bijection}}$
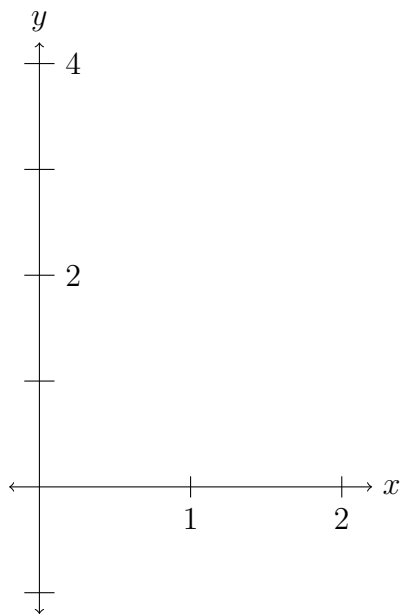
  (a) $f : X \to Z$, defined as $f = \{(1, A), (2, C), (3, D), (4, B)\}$

  (b) $f : Z \to Y$, defined as $f = \{(A, b), (B, b), (C, c), (D, d), (E, a)\}$

  (c) $f : X \to Y$, defined as $f = \{(1, a), (2, b), (3, c), (4, d), (3, d)\}$

  (d) $f : X \to Y$, defined as $f = \{(1, a), (2, a), (3, a), (4, a)\}$

4. (4 points) Sketch $f(x) = \lceil 2x - 1 \rceil$ on the axes below.

5. (4 points) Let $f : \mathbb{Z} \times \mathbb{Z} \to \mathbb{Z}$ by $f(m, n) = m - n$. Determine whether f is one-to-one, onto, or both and $\boxed{\text{justify your answer.}}$