Directions: You may work to solve these problems in groups, but all written work must be your own. **Show your work**; See "Guidelines and advice" on the course webpage for more information.

1. Let $A = \{1, 2\}$, let $B = \{2, 3, (4, 5)\}$, and let $C = \{\emptyset, \{1, 2\}, \{2, 1\}\}$, $D = \{2, 3, (5, 4)\}$.
   (a) Determine $|A|$, $|B|$, and $|C|$.
   (b) Determine the sets $A \times B$ and $A \times C$.
   (c) True or False: $C \subseteq \mathcal{P}(A)$
   (d) True or False: $A \subseteq \mathcal{P}(C)$
   (e) Determine the set $B \triangle D$.

2. A *bitstring* is an ordered list of zeros and ones; for example, 0110 and 10100 are bitstrings of lengths 4 and 5, respectively. As a special case, we use ε to denote the empty bitstring, which has length 0.
   (a) Show that the set of all bitstrings of finite length is countable.
   (b) Is the set of all bitstrings of infinite length countable? Justify your answer.

3. Let L be the set of lines in the plane which (1) intersect the x-axis and the y-axis at integral points, and (2) do not contain the origin $(0, 0)$. For example, L contains the graph of $y = \frac{2}{3}x+4$ since this line meets the y-axis at $y = 4$ and the x-axis at $x = -6$. But L does not contain the graph of $y = 4x + 3$, since this line meets the x-axis at $x = -\frac{3}{4}$, and $-\frac{3}{4}$ is not an integer, and L does not contain the graph of $y = x$, since this line passes through the origin $(0, 0)$. Is the set L countable? Justify your answer.