1. Determine whether $G$ is the graph of a function $f: \{1, 2, 3\} \to \{1, 2, 3\}$. If so, find the value of $f$ at each $x$. If not, explain why not.
   (a) $G = \{(1, 2), (2, 2), (3, 2)\}$
   (b) $G = \{(1, 1), (2, 3)\}$
   (c) $G = \{(1, 2), (1, 3), (3, 1)\}$

2. Find the graph of $f$.
   (a) $f: \mathbb{R} \to \mathbb{R}$ is given by $f(x) = x^2 + x - 1$
   (b) $f: \mathbb{R} \to \mathbb{R}^2$ is given by $f(x) = (x, x - 7)$

3. Find a rule for $f$.
   (a) $f: \mathbb{R} \to \mathbb{R}$ has graph $G = \{(x, \sin x) \mid x \in \mathbb{R}\}$
   (b) $f: \mathbb{R} \to \mathbb{R}^2$ has graph $G = \{(x, (y, z)) \mid y = x^2 \text{ and } z = 5 - x\}$

4. Given $f: \mathcal{P}(\mathbb{N}) \to \mathcal{P}(\mathbb{N})$, find $f(\emptyset)$, $f(\mathbb{N})$, and $f(\{1, 2, 3\})$.
   (a) $f(A) = A \cap \{15\}$
   (b) $f(A) = \mathbb{N} \setminus A$
Answers

1. (a) Yes, \( f(1) = f(2) = f(3) = 2 \)
   (b) No, (i) fails. Why?
   (c) No, (i) and (ii) fail. Why?

2. (a) \( G = \{ (x, y) \mid y = x^2 + x - 1 \} \)
   (b) \( G = \{ (x, (y, z)) \mid y = x \text{ and } z = x - 7 \} \)

3. (a) \( f(x) = \sin x \)
   (b) \( f(x) = (x^2, 5 - x) \)

4. (a) \( f(\emptyset) = \emptyset, f(\mathbb{N}) = \{15\}, f(\{1, 2, 3\}) = \emptyset \)
   (b) \( f(\emptyset) = \mathbb{N}, f(\mathbb{N}) = \emptyset, f(\{1, 2, 3\}) = \{4, 5, 6, \ldots\} \)