2: a: $A \cap B = \{\alpha\}$

b: $A \cap C = \{\beta, \gamma\}$

c: $A \cup B = \{\alpha, \beta, \gamma, a, \bigstar, \oplus\}$

d: $A \cup C = \{\alpha, \beta, \gamma, \text{read}, \oplus\}$

e: $\emptyset \cup A = \{\alpha, \beta, \gamma\}$

f: $\emptyset \cap C = \emptyset$

g: $C - A = \{\text{read}, \oplus\}$

h: $B \cap C = \{\oplus\}$

i: $A \cup (B \cap C) = \{\alpha, \beta, \gamma, \oplus\}$

j: $B \cap (A \cup C) = \{\alpha, \oplus\}$

3: a: $A \cup B = \mathbb{N}$ $\quad A \cap B = \emptyset$

$A = \{a \mid a = 2x,\ x \in \mathbb{N}\} = \{0, 2, 4, 6, \dots\}$

$B = \{b \mid b = 2x+1,\ x \in \mathbb{N}\} = \{1, 3, 5, 7, \dots\}$

The definition of A represents the set of all even natural numbers while the definition of B represents the set of all odd natural numbers. Because all elements in the set of natural numbers are either even or odd, this means $A \cup B = \mathbb{N}$ and $A \cap B = \emptyset$.

b:

$D = \{d \mid d = 3x,\ x \in \mathbb{N}\} = \{0, 3, 6, 9, 12, \dots\}$

$E = \{e \mid e = 2x,\ x \in \mathbb{N} \text{ and } x \text{ is not divisible by } 3 \text{ and } x \neq 0\} = \{2, 4, 8, 10, 14, 16, \dots\}$

$F = \{f \mid f = x,\ x \in \mathbb{N} \text{ and } x \text{ is not divisible by } 3 \text{ and } x \text{ is not divisible by } 2 \text{ and } x \neq 0\} = \{1, 5, 7, 11, 13, 17, \dots\}$

The definition of D represents the set of all natural numbers in which 0 is an element followed by all natural numbers that are a multiple of three.

The definition of E represents the set of all natural numbers that are a multiple of 2 and are not a multiple of 3.

Lastly, the definition of F represents the set of all natural numbers that are not a multiple of 2 and not a multiple of 3. Because D considers 0 and all elements in the set of natural numbers that are a multiple of 3 and E considers all elements in the set of natural numbers that are multiples of 2, excluding elements that are also multiples of 3, and F considers the remaining elements that are not a multiple of 3 or a multiple of 2, this information indicates $D \cup E \cup F = \mathbb{N}$ and $\{D, E, F\}$ is disjoint.

c: $S = \{$

$\{0, 1, 2, 4, 6, 8, 10, 12, 14, \ldots\}$

$\{3, 9, 15, 21, 27, 33, \ldots\}$

$\{5, 25, 35, 55, 65, 85, 95, \ldots\}$

$\{7, 49, 77, 91, 119, 132, \ldots\}$

$\{11, 121, 143, \ldots\}$

$\vdots$

$\}$

The definition of S represents an infinite set of infinite sets where the union of all of the infinite sets of S represent the set of natural numbers and the intersection of all the infinite sets of S represent the empty set. The first infinite set has 0 and 1 as elements followed by all natural numbers that are a multiple of two. The second infinite set of S covers all natural numbers that are multiples of three, excluding those that are also multiples of two. The third infinite set of S contains all natural numbers that are multiples of five, excluding those that are also multiples of two or three. This pattern continues where the infinite sets of S will have elements that are multiples of specific values while excluding those that were already an element of a prior infinite set due to also being a multiple of another value.

This information indicates that $\bigcup_{A \in S} A = \mathbb{N}$ and S is disjoint.