

Set Theory Problems

Short-answer problems about sets.

Problem 1 Given two sets X and Y , explain what is meant by $X \cup Y$.

Free Response: $X \cup Y$ is the set of elements that are in X or in Y (or both, as the “or” is inclusive).

Problem 2 Given two sets X and Y , explain what is meant by $X \cap Y$.

Free Response: $X \cap Y$ is the set of elements that are in X and in Y .

Problem 3 Given two sets X and Y , explain what is meant by $X - Y$.

Free Response: $X - Y$ is the set of elements that are in X but not in Y .

Problem 4 Explain the difference between the symbols \in and \subset .

Free Response: The notation $X \in Y$ would mean that X is a single element in the set Y . In this case, X might not be a set. The notation $X \subset Y$ would require that both X and Y are sets and also that every element of X is also in Y .

Problem 5 How is $\{\emptyset\}$ different from \emptyset ?

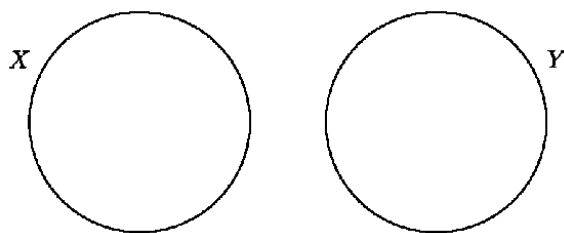
Free Response: The empty set, \emptyset , is a set that contains no elements. The set $\{\emptyset\}$ contains 1 element that is itself a set.

Learning outcomes:
Author(s):

Problem 6 Draw a Venn diagram for the set of elements that are in X or Y but not both. How does it differ from the Venn diagram for $X \cup Y$?

Free Response: Same as the Venn diagram for $X \cup Y$, except that the $X \cap Y$ part is not shaded.

Problem 7 If we let X be the set of “right triangles” and we let Y be the set of “equilateral triangles” does the picture below show the relationship between these two sets?



Explain your reasoning.

Free Response: Yes. The picture is accurate because no right triangles are also equilateral triangles.

Problem 8 If $X = \{1, 2, 3, 4, 5\}$ and $Y = \{3, 4, 5, 6\}$ find:

- (a) $X \cup Y$
- (b) $X \cap Y$
- (c) $X - Y$
- (d) $Y - X$

Free Response: (a) $X \cup Y = \{1, 2, 3, 4, 5, 6\}$

- (b) $X \cap Y = \{3, 4, 5\}$
- (c) $X - Y = \{1, 2\}$
- (d) $Y - X = \{6\}$

Problem 9 If $X \cup Y = X$, what can we say about the relationship between the sets X and Y ? Explain your reasoning.

Free Response: $Y \subset X$ because every element of Y must already be in X .

Problem 10 If $X \cap Y = X$, what can we say about the relationship between the sets X and Y ? Explain your reasoning.

Free Response: $X \subset Y$ because every element of X must already be in Y .

Problem 11 If $X - Y = \emptyset$, what can we say about the relationship between the sets X and Y ? Explain your reasoning.

Free Response: $X \subset Y$ because that would mean X contains no elements that are not also in Y .
