## 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.

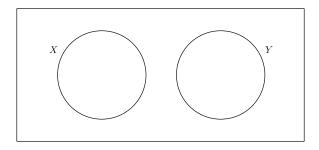
Learning outcomes:

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**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.