

SETS, SET NOTATION, AND OPERATIONS WITH SETS

SETS AND SET NOTATION

A **set** is a collection of objects called elements or members. The members of a set are either written using **roster notation**, which lists all the members of the set, or **set-builder notation**, which tells how the set is created. The elements of a set are displayed between brackets-- $\{ \}$ and sets are named using capital letters.

For the multiples of five larger than 20,

Roster notation is $\{25, 30, 35, 40, 45, \dots\}$. The three dots indicate to continue the pattern.

Set-builder notation is $\{x|x > 20 \text{ and } x \text{ is a multiple of } 5\}$. This is read "the set of all x such that x is greater than 20 and a multiple of five."

Some very commonly used sets are:

\mathbb{Z} --the set of integers

\mathbb{N} --the set of natural numbers

\mathbb{Q} --the set of rational numbers, and

\mathbb{R} --the set of real numbers

Examples

Write in roster and set-builder notation.

M, the set of whole numbers less than ten.

B, the set of even, negative numbers.

roster: $M = \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$

roster: $B = \{\dots -8, -6, -4, -2\}$

set-builder: $M = \{x|x \text{ is whole and } x < 10\}$

set-builder: $B = \{x|x \text{ is even and } x < 0\}$

Problems

Write in roster and set-builder notation.

1. A, the set of integers greater than or equal to -5 .
2. B, the integers divisible by three.
3. C, the integers between -2 and 2 inclusive.
4. D, the prime numbers less than 20 .
5. E, the perfect squares between 10 and 100 .
6. F, the odd integers less than 10 .

UNION OF SETS

The **union** of two sets A and B, written $A \cup B$, is found by combining all of the elements that are in A, in B, or in both. When two mathematical equations or inequalities are joined by the word "or," it means to find the union of the two individual solutions.

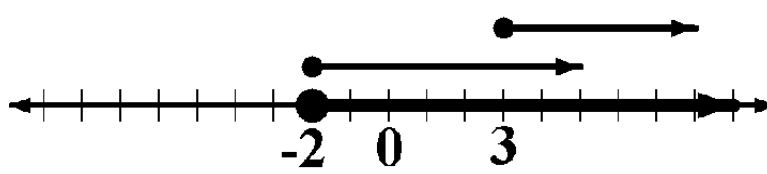
Examples

Find the union of each pair of sets.

If $A = \{1, 3, 6, 10\}$ and $B = \{3, 6, 9, 12, 15\}$ then $A \cup B = \{1, 3, 6, 9, 10, 12, 15\}$

If $S = \{2, 4, 6, 8, 10\}$ and $T = \{4, 6, 10\}$ then $S \cup T = \{2, 4, 6, 8, 10\} = S$

Graph $\{x|x \geq -2\}$ or $\{x|x \geq 3\}$. The solution is the union of the two graphs.



Problems

Find the union of the two given sets.

7. $A = \{-3, -2, -1, 0, 1\}$ and $B = \{0, 1, 2, 3\}$
8. $C = \{0, 1, 2, 3, 4, 5\}$ and $D = \{0, 5, 10, 15\}$
9. $E = \{\dots -4, -2, 0, 2, 4, \dots\}$ and $F = \{\dots -3, -1, 1, 3, \dots\}$
10. $G = \{0, 2, 4, 6, 8, \dots\}$ and $H = \{0, 4, 8, 12, \dots\}$

Graph the solution.

11. $\{x|x \leq 3\}$ or $\{x|x \leq 5\}$
12. $\{x|x \geq 2\}$ or $\{x|x \leq -3\}$
13. $\{x|x \geq 2\}$ or $\{x|x \leq 3\}$

INTERSECTION OF SETS

The **intersection** of two sets A and B, written $A \cap B$, is found by listing all the elements that are common to both A and B. When two mathematical equations or inequalities are joined by the word "and," it means to find the intersection of the two individual solutions.

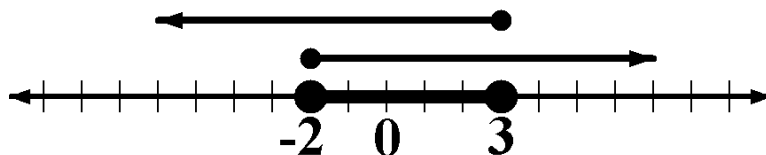
Examples

Find the intersection of each pair of sets.

If $A = \{1, 3, 6, 10\}$ and $B = \{3, 6, 9, 12, 15\}$ then $A \cap B = \{3, 6\}$

If $S = \{2, 4, 6, 8, 10\}$ and $T = \{4, 6, 10\}$ then $S \cap T = \{4, 6, 10\} = T$

Graph $\{x|x \geq -2\}$ and $\{x|x \leq 3\}$. The solution is the intersection of the two graphs.



If two sets or two graphs have no common elements then their intersection is the empty set written $\{ \}$ or \emptyset .

Problems

Find the intersection of the two given sets.

14. $A = \{0, 5, 10, 15, 20\}$ and $B = \{0, 10, 20, 30, 40\}$
15. $C = \{-3, -1, 0, 1, 3, 5, 7\}$ and $D = \{2, 3, 5, 7, 11, 13\}$
16. $E = \{0, 2, 4, 6, \dots\}$ and $F = \{0, 4, 8, 12, \dots\}$
17. $G = \{1, 3, 5, 7, \dots\}$ and $H = \{0, 10, 20, 30, \dots\}$

Graph the solution.

18. $\{x|x \geq 2\}$ and $\{x|x \leq 5\}$
19. $\{x|x \leq -2\}$ and $\{x|x \leq 5\}$
20. $\{x|x \leq -2\}$ and $\{x|x \geq 2\}$

Answers

1. $A = \{-5, -4, -3, -2, -1, 0, \dots\}$ $A = \{x x \text{ is integer and } x \geq -5\}$	2. $B = \{\dots, -6, -3, 0, 3, \dots\}$ $B = \{x x \text{ is divisible by } 3\}$
3. $C = \{-2, -1, 0, 1, 2\}$ $C = \{x x \text{ is integer and } -2 \leq x \leq 2\}$	4. $D = \{2, 3, 5, 7, 11, 13, 17\}$ $D = \{x x \text{ is prime and } x < 20\}$
5. $E = \{16, 25, 36, 49, 64, 81\}$ $E = \{x x \text{ is square and } 10 < x < 100\}$	6. $F = \{\dots, -1, 1, 3, 5, 7, 9\}$ $F = \{x x \text{ is odd integer and } x < 10\}$
7. $\{-3, -2, -1, 0, 1, 2, 3\}$	8. $\{0, 1, 2, 3, 4, 5, 10, 15\}$
9. $\{\dots, -2, -1, 0, 1, 2, \dots\}$ or Z	10. $\{0, 2, 4, 6, \dots\}$
11. 	12.
13. all real numbers 	14. $\{0, 10, 20\}$
15. $\{3, 5, 7\}$	16. $\{0, 4, 8, 12, \dots\}$
17. \emptyset	18.
19. 	20. \emptyset