

Sets and Set Notation

Name: _____ Date: _____ Score: _____ / 24

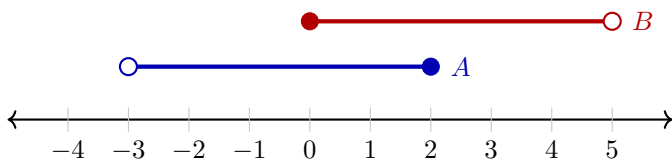
Q Quick Review

A **set** is just a collection of elements, written inside braces: $\{1, 2, 3\}$. Two ways to describe a set are **roster** (list every element) and **set-builder** ($\{x : \text{condition}\}$, read “the set of x such that ...”). **Union** $A \cup B$ keeps everything in either set (no repeats) — think of it as “pour both sets into one bowl.” **Intersection** $A \cap B$ keeps only what’s in *both* — the overlap. **Complement** A^c keeps everything in the universal set U that’s *not* in A — what’s left when you scoop A out of U . **Brackets vs. parens** on intervals: $[$ and $]$ mean *included*; $($ and $)$ mean *excluded*. The **empty set** \emptyset has no elements; $\{0\}$ and $\{\emptyset\}$ are *not* empty (each has one element). And keep \in (element-of) separate from \subseteq (subset-of): $1 \in \{1, 2, 3\}$ is true, but $\{1\} \in \{1, 2, 3\}$ is false because the set $\{1\}$ is not itself an element.

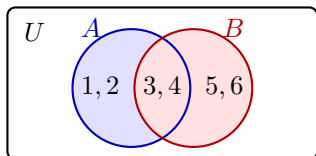
PRACTICE

Express each set, or compute the requested union, intersection, or complement.

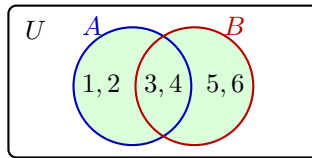
- Set-builder for $[-2, 5)$ _____
- $U = \{1, \dots, 10\}$, $A = \{2, 4, 6, 8\}$; A^c _____
- Which is the empty set: $\{x \in \mathbb{R} : x^2 + 1 = 0\}$ or $\{0\}$? _____
- $A = \{x \in \mathbb{Z} : -3 < x \leq 2\}$, $B = \{x \in \mathbb{Z} : 0 \leq x < 5\}$; find $A \cap B$. Use the number line to see the overlap. _____



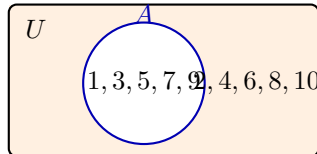
- $U = \{x \in \mathbb{Z} : 1 \leq x \leq 12\}$, $A = \text{evens}$, $B = \text{multiples of 3}$; find $A \cap B$. _____
- Same setup; $A \cup B$ _____
- $U = \{1, \dots, 20\}$, $A = \text{mult. of 4}$, $B = \text{mult. of 6}$; find $|A \cup B|$. _____
- $M = [-4, 3)$, $N = (0, 6]$; $M \cap N$ _____
- $M = [-4, 3)$, $N = (0, 6]$; $M \cup N$ _____
- True or false: $\{1\} \in \{1, 2, 3\}$ _____
- True or false: $\emptyset \subseteq A$ for any set A . _____
- True or false: $A \subseteq A$ _____
- $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5, 6\}$. Use the Venn diagram to find $A \cap B$. _____



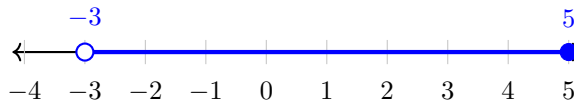
14. Same sets: $A = \{1, 2, 3, 4\}$ and $B = \{3, 4, 5, 6\}$. Use the Venn diagram to find $A \cup B$. _____



15. $U = \{1, \dots, 10\}$ and $A = \{1, 3, 5, 7, 9\}$. Use the Venn diagram to find A^c . _____



16. Interval for $\{x : x > -3 \text{ and } x \leq 5\}$, using the number line below as a check. _____



17. Interval for $\{x : x \geq 0\}$ _____

18. Write the roster for $A = \{x \in \mathbb{Z} : -6 \leq x < 8, x \text{ mult. of } 3\}$. _____

19. $|A|$ where $A = \{2, 4, 6, 8, 10\}$ _____

20. Is $\{1, 2\} \subseteq \{1, 2, 3\}$? _____

◆ Word Problems

21. In a 64-student survey, robotics only = 18, art only = 25, both = 12, and neither = 9. How many students are in A^c ? _____

22. 100 students participate in soccer S , band B , and theater T . The counts are: S only 16, B only 12, T only 14, $S \cap B$ only 6, $S \cap T$ only 9, $B \cap T$ only 5, and all three 4. How many are in $(S \cup T) \cap B^c$? _____

23. Stations 1–30: set A is multiples of 5 and set B is multiples of 4. How many station numbers are in $A \cup B$? _____

24. At a club fair, 80 students chose chess, 90 chose drama, and 50 chose both. How many students chose chess only? _____



Answer Keys

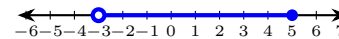
- | | |
|---|----------------------------|
| 1. $\{x : -2 \leq x < 5\}$ | 13. $\{3, 4\}$ |
| 2. $\{1, 3, 5, 7, 9, 10\}$ | 14. $\{1, 2, 3, 4, 5, 6\}$ |
| 3. $\{x \in \mathbb{R} : x^2 + 1 = 0\}$ | 15. $\{2, 4, 6, 8, 10\}$ |
| 4. $\{0, 1, 2\}$ | 16. $(-3, 5]$ |
| 5. $\{6, 12\}$ | 17. $[0, \infty)$ |
| 6. $\{2, 3, 4, 6, 8, 9, 10, 12\}$ | 18. $\{-6, -3, 0, 3, 6\}$ |
| 7. 7 | 19. 5 |
| 8. $(0, 3)$ | 20. yes |
| 9. $[-4, 6]$ | 21. 27 |
| 10. false | 22. 39 |
| 11. true | 23. 12 |
| 12. true | 24. 30 |

Step-by-Step Explanations

- Square bracket on -2 means included $\Rightarrow -2 \leq x$. Parenthesis on 5 means excluded $\Rightarrow x < 5$.
- Complement is "everything in U that's not in A ." Strip the evens out of U ; what's left is $\{1, 3, 5, 7, 9, 10\}$. (Don't forget 10 — it's in U but not in A .)
- One steady path is: $x^2 + 1 = 0$ would need $x^2 = -1$, impossible for real x . No real solutions \Rightarrow empty. The set $\{0\}$ has one element (the number 0), so it's not empty. That gives a quick check on the answer.
- Start with the key idea: $A = \{-2, -1, 0, 1, 2\}$. $B = \{0, 1, 2, 3, 4\}$. Common elements: $\{0, 1, 2\}$. That gives a quick check on the answer.
- A careful way to see it: $A = \{2, 4, 6, 8, 10, 12\}$. $B = \{3, 6, 9, 12\}$. Overlap: $\{6, 12\}$. (These are the multiples of 6 — numbers that are both even *and* divisible by 3 .) That gives a quick check on the answer.
- Keep the rule visible: Combine A and B , no repeats. Listed in order: $2, 3, 4, 6, 8, 9, 10, 12$. That gives a quick check on the answer.
- One steady path is: $A = \{4, 8, 12, 16, 20\}$, $B = \{6, 12, 18\}$. Union (no repeats): $\{4, 6, 8, 12, 16, 18, 20\}$. That's 7 elements. (Adding $5 + 3$ would double-count 12 .) That gives a quick check on the answer.
- Intersection is where both intervals cover. Below 0 only M reaches; above 3 only N reaches. Between them both cover, but N doesn't include 0 and M doesn't include 3 , so it's the open interval $(0, 3)$.
- Combine the coverage. M starts at -4 (included) and N ends at 6 (included). The middle is covered by both. Together: $[-4, 6]$.
- The elements of $\{1, 2, 3\}$ are the numbers $1, 2, 3$ — not sets. So the set $\{1\}$ is not one of them. (However, $1 \in \{1, 2, 3\}$ is true.)
- The empty set is a subset of every set (vacuously — there are no elements to check).
- Start with the key idea: Every set is a subset of itself — every element of A is, of course, in A . That gives a quick check on the answer.
- Intersection keeps only the elements in *both* sets — the overlap. Scan the two lists: 3 and 4 appear in each, while $1, 2$ are only in A and $5, 6$ only in B . So $A \cap B = \{3, 4\}$.
- Union pours both sets into one bowl, listing each element just once. Pull in everything: $1, 2, 3, 4$ from A and the new $5, 6$ from B ($3, 4$ are already counted). Result: $\{1, 2, 3, 4, 5, 6\}$.

- The complement keeps everything in U that's *not* in A . Scoop the odd numbers out of 1 through 10 , and the evens are what remain: $\{2, 4, 6, 8, 10\}$.
- Strict inequality $>$ on the left \Rightarrow parenthesis (open dot at -3). Inclusive \leq on the right \Rightarrow square bracket (closed dot at 5).

Answer graph



- Include 0 (square bracket); infinity always gets a parenthesis (it's not a number you can "land on").
- Multiples of 3 starting at -6 and stopping before 8 . List them: $-6, -3, 0, 3, 6$.
- One steady path is: Cardinality is the count of elements: 5 . This is the part to check before moving on, because it keeps the answer tied to the original question.
- Start with the key idea: Every element of $\{1, 2\}$ (1 and 2) is also in $\{1, 2, 3\}$. So yes, it's a subset. That gives a quick check on the answer.
- A careful way to see it: A^c means everyone *not* in A . From the counts, the regions outside A are: R only (18) and *neither* (9). The center (12) and A -only (25) regions are both inside A , so exclude them. $18 + 9 = 27$ students. That gives a quick check on the answer.
- Keep the rule visible: $S \cup T$ catches anyone in soccer or theater (or both). Intersecting with B^c filters out anyone in band. So we want the parts of $S \cup T$ that sit outside B : soccer only (16), theater only (14), and the $S-T$ overlap that's not in band (9). The triple-overlap region (4) and the $S-B$ and $B-T$ regions (6 and 5) all include band, so leave them out. Add: $16 + 14 + 9 = 39$. That gives a quick check on the answer.
- One steady path is: $A = \{5, 10, 15, 20, 25, 30\}$ (6 elements). $B = \{4, 8, 12, 16, 20, 24, 28\}$ (7 elements). Overlap is multiples of 20 in range: $\{20\}$ (1 element). By inclusion-exclusion: $|A \cup B| = 6 + 7 - 1 = 12$. That gives a quick check on the answer.
- Chess only = total in chess minus the overlap. $80 - 50 = 30$ students. (The 50 "both" students *are* in chess — they're just not chess-only.) As a sanity check the drama-only region holds $90 - 50 = 40$ students, and $30 + 50 + 40 = 120$ in $C \cup D$, leaving $150 - 120 = 30$ in neither club. Numbers balance.



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