Venn Diagrams & Survey Problems

Set Theory & Survey Notation Worksheet · Grade 7–9

Name: _____ Date: _____

Learning Objectives

- Interpret Venn diagrams with two subsets and identify each region
- Apply set notation (union, intersection, complement) to solve survey problems
- Calculate cardinalities of sets and subsets from real-world survey data

Problems

1. In a survey, Set A = students who like soccer, Set B = students who like basketball. The Venn diagram shows 45 students only in A, 30 students only in B, and 15 students in the intersection. How many students are in Set A (willing to play soccer)?

$$|A| = 45 + 15$$

2. Using the same survey as Problem 1 (45 only in A, 30 only in B, 15 in intersection), how many students are in Set B (willing to play basketball)?

$$|B| = 30 + 15$$

3. In a school survey, 370 students are willing to donate blood only (Group 1), 120 students are willing to both donate blood and serve breakfast (Group 2), and 210 students are willing to serve breakfast only (Group 3). How many students are in A ∩ B?

$$|A \cap B| = 120$$

4. Using the blood drive survey (Group 1 = 370, Group 2 = 120, Group 3 = 210, Group 4 = 290 outside both sets), how many students are in the union of A and B?

$$|A \cup B| = 370 + 120 + 210$$

5. A survey has 500 total students. Set A (likes art) has 200 students and Set B (likes music) has 180 students, with 80 in both. How many students are in neither set (the complement of A union B)?

Scan to watch

$$|(A \cup B)'| = 500 - (200 + 180 - 80)$$

6. In the blood drive survey (Group 1 = 370, Group 2 = 120, Group 3 = 210, Group 4 = 290), how many students are willing to donate blood but NOT serve breakfast? Express your answer using set notation and give the count.

$$|A \cap B'| = 370$$

7. In a survey of 800 students, 350 like reading (Set A), 275 like writing (Set B), and 125 like both. How many students like reading or writing but NOT both? Express this using set notation.

$$|(A \cup B) - (A \cap B)| = (350 - 125) + (275 - 125)$$

8. A survey of 1000 people finds that 420 exercise regularly (Set A), 380 eat healthy (Set B), and 290 are outside both sets. How many people are in the intersection of A and B? Use the inclusion-exclusion formula.

$$|A \cap B| = |A| + |B| - |A \cup B|$$

9. In a survey, the universal set U has 950 students. Set A (volunteers for cleanup) has 480 students. Set B (volunteers for fundraising) has 390 students. The complement of A union B has 180 students. Find: (a) the number of students in A ∩ B, (b) the number only in A, and (c) the number only in B.

$$|A \cup B| = 950 - 180 = 770, \quad |A \cap B| = 480 + 390 - 770$$

10. A school conducted a survey of 1200 students about two charity activities. Results: 550 chose Activity A only, 310 chose Activity B only, 240 chose both activities. Some students chose neither. If the ratio of students who chose neither to students who chose both is 3:2, verify whether the given data is consistent, then find: the total in Set A, total in Set B, total in A union B, total in neither, and the overall total.

$$\text{Ratio check: } \frac{|(A \cup B)'|}{|A \cap B|} = \frac{3}{2}$$

Scan to watch

Venn Diagrams & Survey Problems — Answer Key

Set Theory & Survey Notation Worksheet · Grade 7–9

Answer Key

1. Answer: 60 students
- Set A includes students only in A AND students in the intersection (A ∩ B).
- |A| = 45 + 15 = 60 students.

2. Answer: 45 students
- Set B includes students only in B AND students in the intersection (A ∩ B).
- |B| = 30 + 15 = 45 students.

3. Answer: 120 students
- A ∩ B represents students willing to do BOTH tasks.
- This is Group 2, which is directly given as 120 students.

4. Answer: 700 students
- A ∪ B includes all students in at least one of the sets: Group 1 + Group 2 + Group 3.
- |A ∪ B| = 370 + 120 + 210 = 700 students.

5. Answer: 200 students
- First find |A ∪ B| = |A| + |B| - |A ∩ B| = 200 + 180 - 80 = 300.
- |(A ∪ B)'| = Total - |A ∪ B| = 500 - 300 = 200 students.

6. Answer: 370 students
- A ∩ B' means students in Set A but NOT in Set B — this is Group 1 only.
- We exclude the intersection (Group 2) since those students also serve breakfast.
- |A ∩ B'| = 370 students.

7. Answer: 375 students
- Students only in A = 350 - 125 = 225.
- Students only in B = 275 - 125 = 150.
- Total in exactly one set = 225 + 150 = 375 students.

8. Answer: 90 people
- First find |A ∪ B| = Total - |(A ∪ B)'| = 1000 - 290 = 710.
- Using inclusion-exclusion: |A ∩ B| = |A| + |B| - |A ∪ B| = 420 + 380 - 710 = 90 people.

9. Answer: (a) 100, (b) 380, (c) 290
- |A ∪ B| = 950 - 180 = 770.
- (a) |A ∩ B| = 480 + 390 - 770 = 100 students.

Scan to watch

- (b) Only in A = |A| - |A ∩ B| = 480 - 100 = 380 students.
- (c) Only in B = |B| - |A ∩ B| = 390 - 100 = 290 students.

10. Answer: |A|=790, |B|=550, |A∪B|=1100, Neither=360, Total=1460 — NOT consistent with 1200; data is inconsistent.

- |A ∩ B| = 240 (given).
- If ratio of neither to both = 3:2, then neither = (3/2) × 240 = 360 students.
- |A ∪ B| = 550 + 310 + 240 = 1100 students.
- Total = 1100 + 360 = 1460 students.
- This does NOT equal 1200, so the given data is inconsistent with the stated total of 1200 students.
- |A| = 550 + 240 = 790; |B| = 310 + 240 = 550.

Scan to watch