ILLAWARRA TUTORING

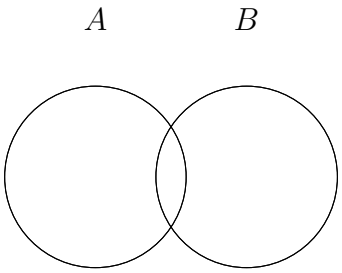
In this worksheet you will learn to represent events using set notation and Venn diagrams. You will practise writing sets in roster form, performing basic operations (union, intersection, complement, difference) and representing these relationships using clear Venn diagrams.

Easy Questions

1. Write the set $A = [2, 4, 6, 8]$ in roster form.
2. Write the set of vowels in the English alphabet using set notation.
3. Given $B = [1, 3, 5, 7]$, state whether $3 \in B$. Explain your answer.
4. Write the set $C = \{x \in \mathbb{N} : x < 4\}$ in roster form.
5. For the set $D = [1, 2, 3, 4, 5]$, write the cardinality of D.

Intermediate Questions

6. Let $A = [1, 2, 3]$ and $B = [3, 4, 5]$. Write $A \cup B$ in roster form.
7. With $A = [1, 2, 3]$ and $B = [3, 4, 5]$, write $A \cap B$ in roster form.
8. Using the following definitions, study the diagram and label the regions. Let A and B be two sets.



   Write the expressions for the following regions: (a) Only in A, (b) Only in B, and (c) In $A \cap B$.
9. Let $A = [2, 4, 6, 8, 10]$ and $B = [3, 6, 9, 12]$. Write the set $A \cap B$ in roster form.
10. Given the universal set $U = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]$ and $A = [1, 3, 5, 7, 9]$, write A' (the complement of A) with respect to U.

11. Let $A = [1, 2, 3, 4, 5]$ and $B = [4, 5, 6, 7]$. Write the set difference $A - B$ in roster form.

12. Consider three sets A, B, and C. Explain briefly how a three-set Venn diagram represents all possible intersections among these sets.

13. Write the set expression $(A \cap B) \cup C$ in words.

14. Describe in words the region represented by $A - B$ in a Venn diagram.

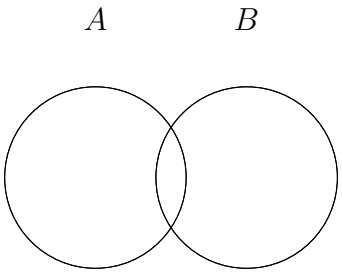
15. Prove that if $A \subseteq B$, then $A \cap B = A$. Explain your reasoning.

16. Given $A = [1, 2, 3, 4, 5]$ and $B = [4, 5, 6, 7, 8]$, list the elements of $A \cap B$.

17. Let $A = x \in \mathbb{Z} : x$ is even and consider the set $B = [1, 2, 3, 4, 5, 6, 7, 8, 9, 10]$. List the elements of $A \cap B$.

18. Express the complement of the union $(A \cup B)'$ in terms of the complements of A and B.

19. Draw the Venn diagram for two sets A and B (using the provided diagram below) and shade the region representing the symmetric difference, defined as $(A - B) \cup (B - A)$.



Identify in words which parts of the diagram represent $(A - B)$ and $(B - A)$.

20. Let $A = x \in \mathbb{N} : 2 \leq x \leq 6$ and $B = x \in \mathbb{N} : 4 \leq x \leq 8$. List the elements of $A \cap B$.

Hard Questions

21. Consider three sets A, B, and C. List all seven regions that appear in a three-set Venn diagram and briefly describe what each region represents.

22. Prove that $(A \cup B)' = A' \cap B'$ using a verbal explanation and a simple Venn diagram.

23. Show that $(A \cap B)' \cup (A \cup B) = U$, where U is the universal set. Provide a step-by-step explanation.

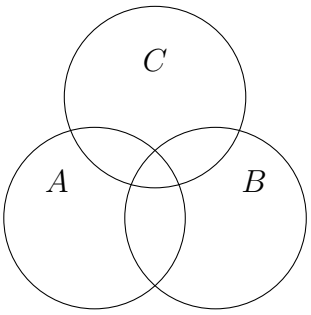
24. Let $A = n \in \mathbb{N} : n$ is a multiple of 3 and $n < 20$ and $B = n \in \mathbb{N} : n$ is prime. List $A \cap B$ and $A \cup B$ in roster form.

25. Given the universal set $U = [1, 2, 3, \ldots, 20]$, let A be the set of multiples of 4 and B be the set of multiples of 5. Write the sets $A \cap B$ and $A \cup B$ in roster form.

26. Let $A = x \in \mathbb{Z} : 2 \leq x \leq 10$ and $B = x \in \mathbb{Z} : 5 \leq x \leq 15$. Find $A - B$ and $B - A$, and list their elements.

27. For sets A, B, and C, write, in set notation, the region described by: the elements that are in A and not in B, or are in C but not in A. (That is, express $(A \cap B') \cup (C - A)$ in words.)

28. The diagram below shows three overlapping circles representing sets A, B, and C. Label each of the eight distinct regions (including the region outside all three sets) with a unique letter (for example, R, S, T, U, V, W, X, Y). Then, choose a region and describe its meaning in set notation.



29. Prove that if $A \subseteq B$, then $A' \cup B = U$, where U is the universal set. Provide a clear written explanation.

30. For any sets A and B (subsets of U), prove that $(A-B) \cup (B-A) = (A \cup B) - (A \cap B)$. Write a brief proof using set algebra.