JUNIOR CYCLE MATHS · FREE REVISION SHEET

Sets & Venn diagrams

↗ Léim

Learning outcomes (2018 specification): N.5, U.4. Play the game: **leim.ie/venn-sorter.html**

1. The language of sets

A **set** is a well-defined collection of **elements**. **List** it, A = {2, 4, 6, 8}, or give a **rule**: the even numbers from 1 to 9.

∈ / ∉	is / is not an element of: 4 ∈ A, 5 ∉ A
#A	the number of elements: #A = 4
⊂	subset (every element is also in A): {2, 8} ⊂ A
ø or { }	the empty (null) set
U	the universal set: everything in the question (the box)

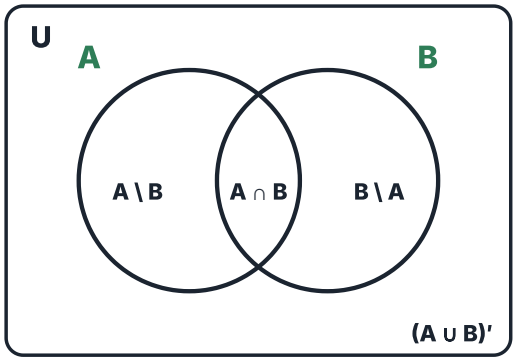
2. The four operations

U = {1, …, 8}, A = {1, 2, 3, 4, 6}, B = {2, 4, 6, 8}

A ∩ B	in A **and** B	{2, 4, 6}
A ∪ B	in A **or** B (or both)	{1, 2, 3, 4, 6, 8}
A \ B	in A **but not** B	{1, 3}
A′	**not** in A	{5, 7, 8}

Order: A ∩ B = B ∩ A and A ∪ B = B ∪ A (commutative); (A ∩ B) ∩ C = A ∩ (B ∩ C), same for ∪ (associative). But A \ B ≠ B \ A.

3. Venn diagrams



4. Counting

#(A ∪ B) = #A + #B − #(A ∩ B): adding #A and #B counts the overlap twice.

5. Survey questions

Fill the **middle first** (call it **x** if unknown). Then each circle "only" = total − overlap (15 − x). "Neither" goes **outside** the circles, inside the box. All regions add up to the total: solve for x.

3 sets: centre → the three "two only" parts → the "one only" parts → outside. "Exactly two" leaves out the centre; "at least two" includes it.

Exam tip: draw the box for U and label every circle. List each element once, in set brackets { }. An empty answer is ø, not 0. Read "only", "neither", "exactly" and "at least" carefully, and show the equation when you find x.

PRACTICE · 34 QUESTIONS

Have a go

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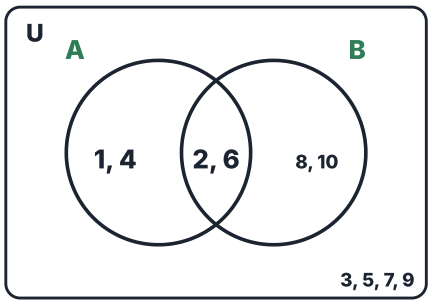
A. Set language

1. List the elements of the set: the factors of 18. _____
2. A = {2, 3, 5, 7, 11}. True or false: 9 ∈ A? _____
3. B = {1, 3, 5, 7, 9}. Write down #B. _____
4. Is {3, 5} ⊂ B? Explain. _____
5. List the even numbers in A = {2, 3, 5, 7, 11}. _____
6. List the set of letters in the word VENN. _____

B. U = {1, 2, …, 12}, A = {2, 3, 5, 7, 11}, B = {1, 3, 5, 7, 9}

7. A ∩ B = _____
8. A ∪ B = _____
9. A \ B = _____
10. B \ A = _____
11. A′ = _____
12. B′ = _____
13. (A ∪ B)′ = _____
14. #(A ∪ B) = _____

C. Use the Venn diagram



15. List A. _____
16. List B. _____
17. List A ∩ B. _____
18. List A ∪ B. _____
19. List A \ B. _____
20. List B′. _____
21. List (A ∪ B)′. _____
22. Write down #A. _____

D. Write in set notation: the elements that are…

23. in A and in B _____
24. in A or in B (or both) _____
25. in A but not in B _____
26. not in A _____
27. in all three of A, B and C _____
28. in none of A, B and C _____
29. A = {1, 2, 3} and B = {3, 4}. List A \ B and B \ A. Are they equal? _____
30. A = {1, 2}, B = {2, 3}, C = {3, 4}. Show that (A ∪ B) ∪ C = A ∪ (B ∪ C). _____

Questions 31–34 are on the next page.

EXAM-STYLE · THEN CHECK

Exam corner + answers

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E. Exam-style questions (show your work)

31. 30 students were asked if they play rugby (R) or soccer (S). 17 play rugby, 14 play soccer and 4 play neither. x play both. (a) Draw a Venn diagram. (b) Find x. (c) How many play rugby only?

32. 120 people were asked how they read the news. 70 read it online, 45 read a paper and 20 do both. (a) How many do neither? (b) How many use exactly one?

33. 40 students were asked which languages they study: French (F), German (G), Spanish (S). 2 study all three; 5 study French and German, 6 German and Spanish, 7 French and Spanish; 18 study French, 15 German and 20 Spanish. (a) Draw the Venn diagram. (b) How many study none? (c) How many study exactly two?

34. U = {1, 2, ..., 20}. P = the prime numbers, E = the even numbers, T = the multiples of 3. List (a) $P \cap E$ (b) $E \cap T$ (c) $P \cap T$ (d) $P \cap E \cap T$. (e) Find $\#(E \cup T)$.

Answers

A	1. {1, 2, 3, 6, 9, 18} · 2. False · 3. 5 · 4. Yes: 3 ∈ B and 5 ∈ B · 5. {2} · 6. {E, N, V}
B	7. {3, 5, 7} · 8. {1, 2, 3, 5, 7, 9, 11} · 9. {2, 11} · 10. {1, 9} · 11. {1, 4, 6, 8, 9, 10, 12} · 12. {2, 4, 6, 8, 10, 11, 12} · 13. {4, 6, 8, 10, 12} · 14. 7
C	15. {1, 2, 4, 6} · 16. {2, 6, 8, 10} · 17. {2, 6} · 18. {1, 2, 4, 6, 8, 10} · 19. {1, 4} · 20. {1, 3, 4, 5, 7, 9} · 21. {3, 5, 7, 9} · 22. 4
D	23. $A \cap B$ · 24. $A \cup B$ · 25. $A \setminus B$ · 26. A' · 27. $A \cap B \cap C$ · 28. $(A \cup B \cup C)'$ · 29. $A \setminus B = \{1, 2\}$, $B \setminus A = \{4\}$: not equal · 30. both = {1, 2, 3, 4}
E	31. $(17 - x) + x + (14 - x) + 4 = 30$, so $35 - x = 30$, **x = 5**; rugby only **12** · 32. (a) 70 + 45 − 20 = 95, so **25** (b) 50 + 25 = **75** · 33. Centre 2; two only 3, 4, 5; one only F 8, G 6, S 9. (b) 40 − 37 = **3** (c) 3 + 4 + 5 = **12** · 34. (a) **{2}** (b) **{6, 12, 18}** (c) **{3}** (d) **ø** (e) 10 + 6 − 3 = **13**

Got one wrong? Check: did you list each element once? Did you take the overlap away for "only"? Did you put "neither" outside the circles? Then play **Venn Sorter** at leim.ie/venn-sorter.html: the "Go back over these" list at the end shows the rule for each mistake.

All questions written by Léim. Léim is independent and not connected with the State Examinations Commission or the NCCA.