



# Venn Diagrams

Mana Maths

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# Te reo Māori terms



**tūponotanga**

probability

Open in Te Aka

**tūtahi**

diagram

Open in Te Aka

**pūtahi**

intersection

Open in Te Aka

**putanga**

outcome

Open in Te Aka

# Venn Diagrams

## Notes & Steps



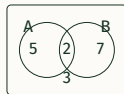
### Key idea

A Venn diagram sorts items into regions. Each region tells you whether an item belongs to one set, both sets, or neither set.

### Two-set reading steps

1. Read each separate region, not just each whole circle.
2. To find a whole set total, add every region inside that circle.
3. To find “at least one”, add all regions inside the circles.
4. The outside region means “neither”.

### Example diagram



- ▶ A has  $5 + 2 = 7$
- ▶ B has  $2 + 7 = 9$
- ▶  $A \cup B$  has  $5 + 2 + 7 = 14$
- ▶ Neither set has 3

### Common mistake

Adding whole set totals without thinking about the overlap. The overlap belongs to both sets, so it gets double-counted if you are careless.

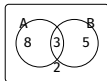
# Venn Diagrams

## Notes & Steps



### Example 1: two sets

In a survey, 8 like pizza only, 3 like both pizza and pasta, 5 like pasta only, and 2 like neither.



So:

$$\text{pizza} = 8 + 3 = 11, \quad \text{pasta} = 3 + 5 = 8$$

$$\text{at least one} = 8 + 3 + 5 = 16$$

### Example 2: finding a missing region

Suppose set  $A$  has 10, set  $B$  has 11,  $A$  only is 6, and  $B$  only is 7. Let the overlap be  $x$ .

$$6 + x = 10 \Rightarrow x = 4$$

Check with set  $B$ :

$$4 + 7 = 11$$

So the overlap is 4.

### Try these

1. If  $A$  has 12,  $B$  has 9, and both has 4, how many are in  $A \cup B$ ?
2. If 5 are outside both circles, what does that mean?
3. How do you find the number in exactly one set?



# Venn Diagrams

## Notes & Steps



### Example 3: three sets

In a three-set Venn diagram, the middle region belongs to all three sets.



Exactly two sets means:

$$2 + 3 + 2 = 7$$

Exactly one set means:

$$4 + 5 + 6 = 15$$

At least one set means add every inside region.

### Example 4: probability from a diagram

If the total number of items is 20 and 5 are in the overlap, then:

$$P(\text{both}) = \frac{5}{20} = \frac{1}{4}$$

If 6 are outside every set, then:

$$P(\text{neither}) = \frac{6}{20} = \frac{3}{10}$$

Probability is always:

$$\frac{\text{favourable}}{\text{total}}$$

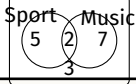
### Common mistake

In a three-set diagram, the centre is not just part of one pair. It belongs to all three sets, so it needs careful counting when you add totals.

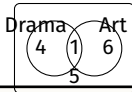
# Start Tasks



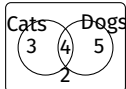
**1.** How many are in Sport only?



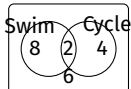
**2.** How many are in Art only?



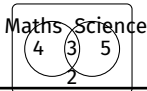
**3.** How many are in both circles?



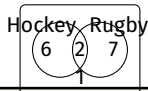
**4.** How many are in neither set?



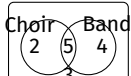
**5.** How many students are shown altogether?



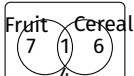
**6.** How many are in Hockey?



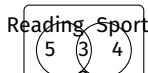
**7.** How many are in Band?



**8.** How many are in at least one set?



**9.** How many are in exactly one set?



# Start Tasks – Answers



1. 5

4. 6

7. 9

2. 6

5. 14

8. 14

3. 4

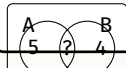
6. 8

9. 9

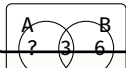
# Start Tasks



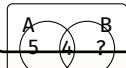
**10.** Set A has 9, set B has 8, and A only is 5. Find the overlap.



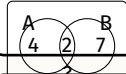
**11.** Set A has 10 and the overlap is 3. Find A only.



**12.** Set B has 11 and the overlap is 4. Find B only.



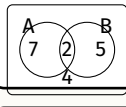
**13.** There are 18 students altogether. Find neither.



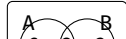
**14.** There are 21 students altogether. Find the missing total outside both sets.



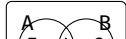
**15.** Which is larger: A only or both?



**16.** Write the probability of choosing someone in set A.



**17.** Write the probability of choosing someone in both sets.



**18.** Write the probability of choosing someone in neither set.

# Start Tasks – Answers



10. 4

13. 5

16.  $\frac{2}{3}$

11. 7

14. 7

17.  $\frac{2}{7}$

12. 7

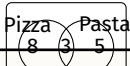
15. A only

18.  $\frac{1}{4}$

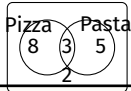
# Start Tasks



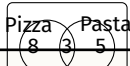
**19.** In the diagram, how many like both pizza and pasta?



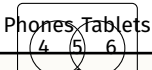
**20.** How many like pizza or pasta?



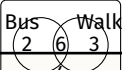
**21.** How many like neither pizza nor pasta?



**22.** How many students are in one set only?



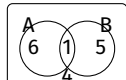
**23.** Which is more likely: both sets or neither?



**24.** A student adds 7 and 6 to get 13 in set A. What should they do instead?



**25.** How many are not in set B?



**26.** Explain why the overlap belongs to both circles.



**27.** Set A has 11, set B has 9, and the overlap is 4. How many are in A or B?

# Start Tasks – Answers



19. 3

22. 10

25. 10

20. 16

23. Both is more likely

26. It is the group in both sets

21. 2

24. Use  $7 + 2 = 9$ , not  
 $7 + 6$

27. 16

# Build Tasks

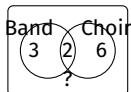


1. 12 play football, 9 play tennis, and 4 play both. Find football only.

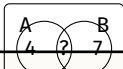
Football Tennis

4. There are 24 students altogether. Set A has 10, set B has 13, and both is 4. Find neither.

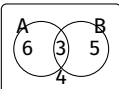
2. 15 students are shown. Find neither.



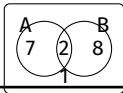
3. Set B has 11 and B only is 7. Find the overlap.



5. How many are in A or B?



6. How many are in exactly one set?



7. Write the probability of choosing someone in A or B.



8. Write the probability of choosing someone in exactly one set.

9. Write the probability of choosing someone not in A.



# Build Tasks – Answers



1. 8

4. 5

7.  $\frac{3}{5}$

2. 4

5. 14

8.  $\frac{13}{20}$

3. 4

6. 15

9.  $\frac{9}{16}$

# Build Tasks



**10.** 18 students were asked about milk and juice. 11 chose milk, 9 chose juice, and 5 chose both. How many

**11.** 26 students were asked about maths club and chess club. 14 chose maths, 13 chose chess, and 6 chose

**12.** A diagram has 7 in A only, 4 in both, 5 in B only, and 6 outside. How many are not in B?

**13.** A diagram has 3 in A only, 5 in both, 4 in B only, and 8 outside. Which probability is larger: both or

**14.** If A only is 8, both is 3, and A total is 11, what check shows the diagram is consistent?

**15.** Set A has 15, set B has 12, and both has 5. How many are in A only? How many are in B only?

**16.** Find the missing B only count. There are 20 students altogether, 4 in neither, 6 in A

**17.** Find the missing overlap. There are 19 students altogether, 5 in A only, 7 in B only,

**18.** Write the probability of choosing someone in neither set if the regions are 5,

# Build Tasks – Answers



10. 3

13. Neither is larger

16. 7

11. 15

14.  $8 + 3 = 11$

17. 4

12. 13

15. **A only** = 10, **B only**  
= 7

18.  $\frac{1}{4}$

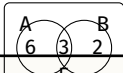
# Build Tasks



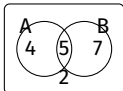
**19.** A student says  $12 + 9 = 21$ , so 21 students are in  $A \cup B$ . But 4 are in both sets. What is the correct

**20.** Why do you subtract the overlap when finding the total in  $A \cup B$ ?

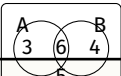
**21.** Which is more likely: only A or not in either set?



**22.** How many are in set B but not set A?



**23.** How many are outside both sets or in both sets?



**24.** Write a sentence describing the overlap in this context: Music and Sport.

Music Sport

**25.** Find the total number of students if A only is 9, both is 4, B only is 6, and neither

**26.** Find the number in one set only if A only is 7 and B only is 8.

**27.** Set A has 18, set B has 14, and 6 are in both. Find the number in  $A \cup B$ .

# Build Tasks – Answers



**19. 17**

**22. 7**

**25. 22**

**20. Subtract the double-counted overlap**

**23. 11**

**26. 15**

**21. Only A**

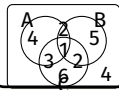
**24. Students who chose both music and sport**

**27. 26**

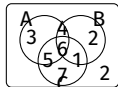
# Push Tasks



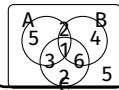
**1.** How many are in set A only?



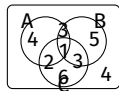
**2.** How many are in all three sets?



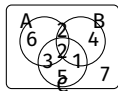
**3.** How many are in exactly two sets?



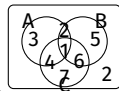
**4.** How many are in at least one set?



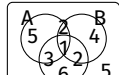
**5.** How many are in none of the sets?



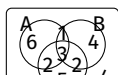
**6.** How many are in set C?



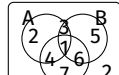
**7.** How many are in A or B but not C?



**8.** How many are in exactly one set?



**9.** How many are in B and C?



# Push Tasks – Answers



1. 4

4. 24

7. 11

2. 6

5. 7

8. 15

3. 11

6. 18

9. 7

# Push Tasks



**10.** 35 students were surveyed. 4 are outside all sets. The seven inside regions are 5, 3, 4, 2, 1, 6, and ?.

**13.** A student adds the three set totals and gets 39. Explain why that does not equal the number of

**16.** Write the probability of choosing someone in all three sets.

**11.** Set A has 14. In the diagram, A only is 5, A and B only is 3, A and C only is 4. Find the middle region.

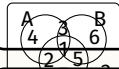
**14.** In a three-set Venn diagram, which regions are counted twice when you add the three individual set

**17.** Write the probability of choosing someone in no sets.



**12.** Set C has 16. In the diagram, C only is 7, A and C only is 3, B and C only is 4. Find the middle region.

**15.** Which is larger: exactly one set or exactly two sets?



**18.** Write the probability of choosing someone in set B.



# Push Tasks – Answers



**10. 10**

**13. Overlaps are counted more than once**

**16.  $\frac{1}{6}$**

**11. 2**

**14. AB only, AC only, BC only twice; centre three times**

**17.  $\frac{3}{14}$**

**12. 2**

**15. Exactly one set**

**18.  $\frac{2}{5}$**

# Push Tasks



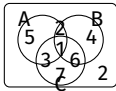
**19.** A sports survey has inside regions 6, 2, 5, 3, 1, 4, 7 and 2 outside. How many like at least one sport?

**20.** Using the same survey, how many like exactly two sports?

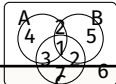
**21.** Using the same survey, how many like football and hockey?

**22.** The three pair totals add to 12. The middle is 3. How many are in exactly two sets?

**23.** How many are not in set A?



**24.** Which is more likely: only C or outside all sets?



**25.** What does the centre region mean?

**26.** In  $A \cup B \cup C$ , is the centre counted once? Explain.

**27.** Give eight region counts with the outside region largest.

# Push Tasks – Answers



**19. 28**

**22. 3**

**25. It means the items belong to all three sets**

**20. 9**

**23. 19**

**26. Yes, once in the final union total**

**21. 4**

**24. Only C**

**27. Example:**  
1, 2, 1, 0, 1, 1, 2, 8