

OLYMPIAD · MENTAL ABILITY · OLYMPIAD PREPARATION · SHORT NOTES

Chapter 8: Venn Diagrams

Topic-wise short notes with solved examples

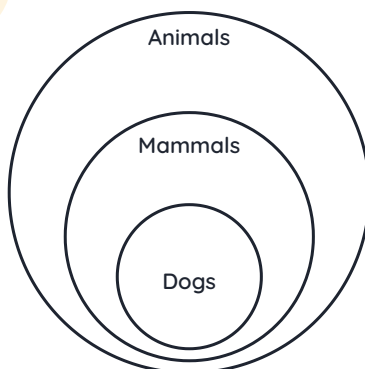
How circles show the relation between groups, how to pick the right diagram, and how to count with two and three groups.

1 Circles show groups

- In a **Venn diagram** each group is drawn as a circle. A thing **inside** the circle belongs to the group.
- Two circles that **overlap** have some members in common. Two circles that are **apart** have no member in common.
- A circle **inside** another circle means every member of the small group is also in the big group.

What the words say	The circles
All A are B	circle A inside circle B
Some A are B	circles A and B overlap
No A is B	circles A and B are separate
A and B are both kinds of C	A and B separate, both inside C

- The same thing can belong to more than one group, so look at the real world: some doctors are women, but not all.



Dogs are mammals, and mammals are animals

Example 1.1 Which diagram shows Pen, Pencil and Stationery?

SOLUTION

A pen is stationery, and a pencil is stationery. A pen is not a pencil.

So there is one big circle for Stationery, with two separate small circles inside it.

Two separate circles inside a larger circle

Example 1.2 Which diagram shows Rose, Flower and Plant?

SOLUTION

Every rose is a flower, and every flower is a plant.

Three circles, each inside the next

2 Counting with two groups

- For two groups A and B , the number in at least one of them is $n(A \cup B) = n(A) + n(B) - n(A \cap B)$.
- The overlap $A \cap B$ is counted twice when you add $n(A)$ and $n(B)$, so it is subtracted once.
- The number that belong to A only is $n(A) - n(A \cap B)$.
- Begin by filling the **overlap**, then the other regions, then the outside.

Example 2.1 In a class of 40, 25 like tea, 20 like coffee and 5 like neither. How many like both?

SOLUTION

The number who like at least one is $40 - 5 = 35$.

$35 = 25 + 20 - n(\text{both})$, so $n(\text{both}) = 45 - 35$.

10

Example 2.2 Of 100 people, 60 read paper A, 50 read paper B and 20 read both. How many read exactly one paper?

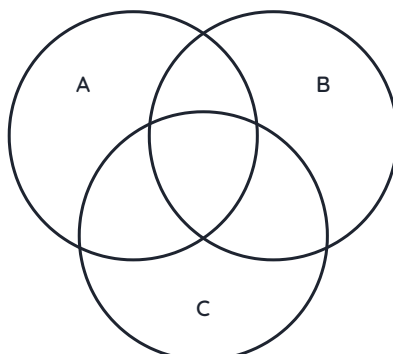
SOLUTION

Only A: $60 - 20 = 40$. Only B: $50 - 20 = 30$.

70

3 Counting with three groups

- Three circles overlap in a pattern that gives seven regions. Start from the centre (all three) and work outwards.



Three overlapping groups: seven regions

Example 3.1 In a survey of 100 students, 40 like maths and 35 like science. 10 like both and 35 like neither. Check that these numbers fit, and find how many like only maths.

SOLUTION

At least one: $40 + 35 - 10 = 65$, and $100 - 35 = 65$, so the numbers fit.

Only maths: $40 - 10$.

30

4 Statements and circles

- Draw the circles for the statements only. A conclusion is true only if it is true in **every** possible drawing.

Example 4.1 All A are B. All B are C. Does it follow that all A are C?

SOLUTION

The circle for A is inside the circle for B, and B is inside C, so A is inside C.

Yes

Example 4.2 All roses are flowers. Some flowers are red. Does it follow that some roses are red?

SOLUTION

The red flowers may all be other flowers, so the roses may not touch the red part.

No, it does not follow

REMEMBER

Draw the least overlap that the statements allow. A conclusion that is not true in that drawing does not follow.