

Venn Diagrams and Set Notation

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (3 marks)

$$\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$$

$$A = \{1, 2, 3, 4, 5\}$$

$$B = \{2, 4, 6, 8, 10\}$$

(a) List the members of $A \cap B$.

$A \cap B$ means the numbers in A **and** in B .

2 and 4 are in both lists.

Answer: 2, 4

(b) List the members of $A \cup B$.

$A \cup B$ means the numbers in A or B or both.

List each number once, even if it is in both sets.

Answer: 1, 2, 3, 4, 5, 6, 8, 10

(c) List the members of B' .

B' means the numbers in ξ that are **not** in B .

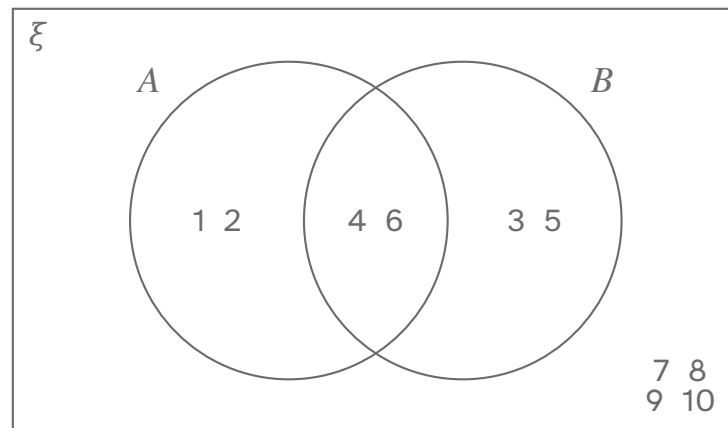
B is the even numbers, so B' is the odd numbers in ξ .

Answer: 1, 3, 5, 7, 9

Tip: The dash in B' means “not”. B' is everything in ξ that is outside B . Do not list B itself.

2 (4 marks)

Here is a Venn diagram.



- (a) List the members of $A \cap B$.

$A \cap B$ is the overlap of the two circles.

Answer: 4, 6

- (b) List the members of A' .

A' is everything outside circle A .

That is the B -only part (3, 5) and the outside (7, 8, 9, 10).

Answer: 3, 5, 7, 8, 9, 10

- (c) A number is chosen at random from ξ .
Find the probability that the number is in $A \cup B$.

$A \cup B$ is everything inside either circle: 1, 2, 3, 4, 5, 6

That is 6 numbers.

There are 10 numbers in ξ altogether (count the ones outside too).

Answer: $\frac{6}{10}$

Tip: $A \cup B$ (union) is the whole of both circles, not just the overlap. The overlap is $A \cap B$.

Marks: 1 mark for 6 numbers in $A \cup B$ or a fraction out of 10. 1 mark for $\frac{6}{10}$.

3 (6 marks)

$\xi = \{\text{whole numbers from 1 to 16}\}$

$A = \{\text{square numbers}\}$

$B = \{\text{prime numbers}\}$

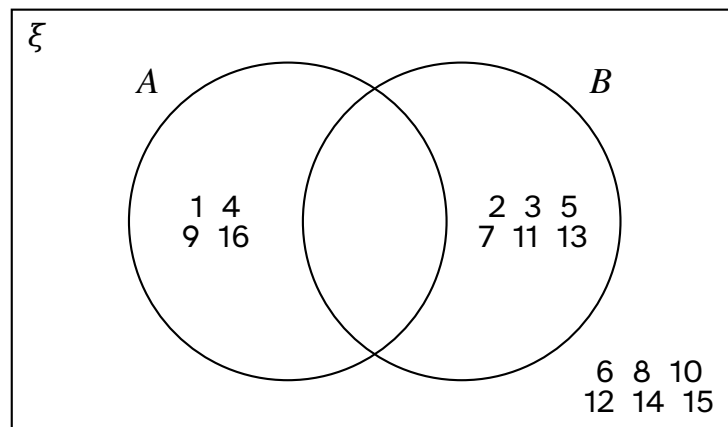
(a) Complete the Venn diagram for this information.

Square numbers up to 16: 1, 4, 9, 16

Prime numbers up to 16: 2, 3, 5, 7, 11, 13

No number is both square and prime, so the overlap is empty.

All the other numbers go outside the circles: 6, 8, 10, 12, 14, 15



Answer: See diagram

Tip: 1 is a square number (1×1) but it is not prime. Write each number exactly once, and use every number from 1 to 16.

Marks: 4 marks for a fully correct diagram. You lose marks for each region with numbers missing or in the wrong place.

- (b) One of the numbers in ξ is chosen at random.
Find the probability that the number is in $A \cup B$.

$A \cup B$: the 4 square numbers and the 6 prime numbers.

$4 + 6 = 10$ numbers, out of 16.

Answer: $\frac{10}{16}$

Marks: 1 mark for 10 numbers or a fraction out of 16. 1 mark for $\frac{10}{16}$.

4 (2 marks)

$\xi = \{\text{whole numbers from 1 to 12}\}$

$A = \{\text{factors of 18}\}$

$B = \{\text{even numbers}\}$

Ravi is going to show this information on a Venn diagram.

- (a) Write down the numbers that go in $A \cap B$, the overlap of the two circles.

A (factors of 18 in ξ): 1, 2, 3, 6, 9

B (even numbers in ξ): 2, 4, 6, 8, 10, 12

Numbers in both lists: 2 and 6

Answer: 2, 6

Tip: 18 is a factor of 18, but it is not in ξ , so it does not go anywhere on the diagram.

- (b) Write down the numbers that go outside both circles.

These are the numbers in ξ that are in neither A nor B .

$A \cup B$ is 1, 2, 3, 4, 6, 8, 9, 10, 12

The numbers left over are 5, 7 and 11.

Answer: 5, 7, 11

Tip: Every number in ξ must go somewhere on the diagram, even if it is not in A or B .

5 (4 marks)

60 people were asked if they drank tea (T) or coffee (C) yesterday.

38 of the people drank tea.

27 of the people drank coffee.

8 of the people drank neither tea nor coffee.

(a) Complete the Venn diagram.

8 drank neither, so they go outside the circles.

So $60 - 8 = 52$ people are inside the circles.

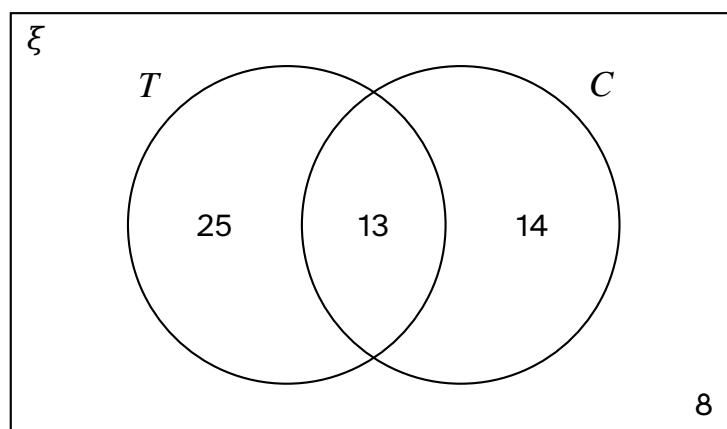
$38 + 27 = 65$, which is 13 more than 52.

So 13 people drank both.

Tea only: $38 - 13 = 25$

Coffee only: $27 - 13 = 14$

Check: $25 + 13 + 14 + 8 = 60$ ✓



Answer: 25, 13, 14, 8

Tip: 38 is **all** the tea drinkers, including those who drank both. Check that your four numbers add up to 60.

Marks: 1 mark for 52. 1 mark for 13 in the overlap. 1 mark for a fully correct diagram.

(b) One of the 60 people is chosen at random.

Find the probability that this person had tea but not coffee.

Tea but not coffee is the tea-only part: 25 people.

There are 60 people altogether.

Answer: $\frac{25}{60}$

6 (6 marks)

$\xi = \{\text{whole numbers from 1 to 15}\}$

$A = \{\text{even numbers}\}$

$B = \{\text{multiples of 3}\}$

$C = \{\text{factors of 12}\}$

(a) Complete the Venn diagram for this information.

A (even): 2, 4, 6, 8, 10, 12, 14

B (multiples of 3): 3, 6, 9, 12, 15

C (factors of 12): 1, 2, 3, 4, 6, 12

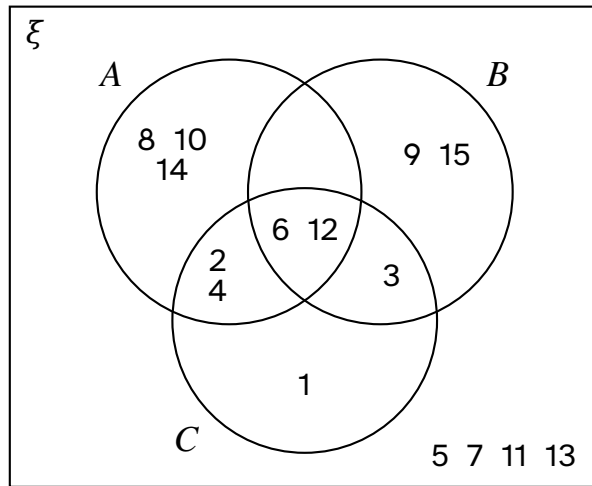
6 and 12 are in all three sets, so they go in the very middle.

2 and 4 are in A and C only. 3 is in B and C only.

No number is in A and B but not C , so that region is empty.

A only: 8, 10, 14. B only: 9, 15. C only: 1

5, 7, 11, 13 are in no set, so they go outside the circles.



Answer: See diagram

Tip: Start with the numbers in more than one set. A region can be empty: 6 and 12 are in A and B , but they are also in C , so they go in the middle.

Marks: 4 marks for a fully correct diagram. 3 marks for 6 and 12 in the centre with 2, 4 and 3 correct. 2 marks for 6 and 12 in the centre and at least 4 other numbers correct. 1 mark for 6 and 12 in the centre.

- (b) A number is chosen at random from ξ .
Find the probability that the number is a member of $A \cap C$.

$A \cap C$ is everything inside both circle A and circle C .

That includes the centre: $A \cap C = \{2, 4, 6, 12\}$

That is 4 of the 15 numbers.

Answer: $\frac{4}{15}$

Tip: $A \cap C$ includes the middle region too, because 6 and 12 are in A and in C .

Marks: 1 mark for a fraction out of 15 or the 4 numbers listed. 1 mark for $\frac{4}{15}$.