



eClassroom

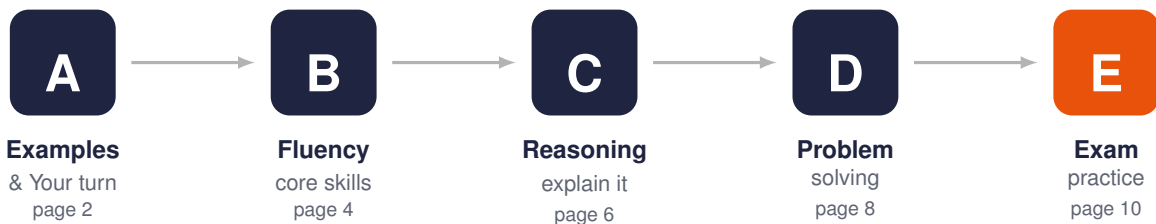
GCSE MATHEMATICS • PROBABILITY

Venn Diagrams

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Free Venn Diagrams worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: read and use set notation, including $A \cap B$, $A \cup B$ and A' • complete Venn diagrams from lists and from numbers • find probabilities from Venn diagrams • *Higher:* probabilities given that something has happened, three-set Venn diagrams and algebra.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: conditional probability from a Venn diagram, three-set Venn diagrams, and Venn diagrams with algebra. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	17
Higher marks	16	14	17	16
My score				

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Name

Class

Date



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A

Worked examples & Your turn

Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

$\xi = \{1, 2, \dots, 10\}$, $A = \{\text{even numbers}\}$ and $B = \{\text{multiples of 3}\}$. List the members of $A \cap B$ and of $A \cup B$.

$\cap$ means in both. $\cup$ means in either, or both.

$$A = \{2, 4, 6, 8, 10\} \quad B = \{3, 6, 9\}$$

$$A \cap B = \{6\}, A \cup B = \{2, 3, 4, 6, 8, 9, 10\}$$

Your turn A1

$\xi = \{1, 2, \dots, 12\}$, $A = \{\text{factors of 12}\}$ and $B = \{\text{odd numbers}\}$. List the members of $A \cap B$.

Worked example A2

40 people were asked. 22 like tea, 18 like coffee and 7 like both. How many like neither?

Put the overlap in first: tea only $22 - 7 = 15$, coffee only $18 - 7 = 11$

$$15 + 7 + 11 = 33 \quad 40 - 33 = 7$$

7

Your turn A2

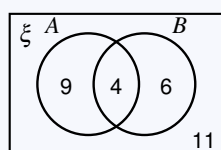
35 students were asked. 20 cycle, 14 swim and 9 do both. How many do neither?

Worked example A3

Find $P(A \cup B)$.

Add the three regions inside the circles.

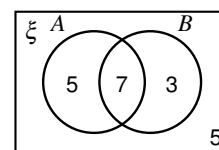
$$9 + 4 + 6 = 19 \text{ out of } 30$$



$\frac{19}{30}$

Your turn A3

Find $P(A')$.



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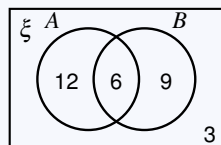
HIGHER*Higher only: conditional probability, three sets and algebra***Worked example A4: given that...**

Find $P(A|B)$, the probability of A given B .

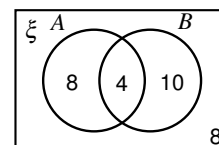
Only look inside B :

$$6 + 9 = 15$$

$$\frac{6}{15} = \frac{2}{5}$$

**Your turn A4**

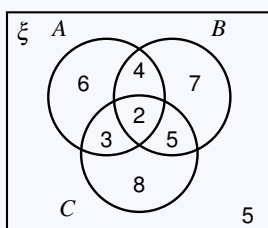
Find $P(B|A)$.

**Worked example A5: three sets**

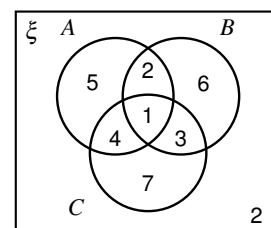
Find the probability that a person is in exactly two of the sets.

The three regions where two circles overlap, but not the centre: $4 + 3 + 5$

$$\frac{12}{40} = \frac{3}{10}$$

**Your turn A5**

Find the probability that a person is in set C .

**Worked example A6: algebra in a Venn diagram**

The regions are x (A only), 5 (both), $2x$ (B only) and 7 (outside). The total is 42. Find $P(B)$.

$$3x + 12 = 42, \text{ so } x = 10$$

$$B = 5 + 20 = 25$$

$$\frac{25}{42}$$

Your turn A6

The regions are $3x$ (A only), x (both), $x + 4$ (B only) and 6 (outside). The total is 50. Find $P(A \text{ only})$.

Worked example A7: probabilities in a Venn diagram

$P(A) = 0.5$, $P(B) = 0.35$ and $P(A \cap B) = 0.2$. Find $P(\text{neither})$.

A only 0.3, B only 0.15, both 0.2

$$1 - 0.65 = 0.35$$

$$0.35$$

Your turn A7

$P(A) = 0.6$, $P(A \cap B) = 0.25$ and $P(\text{neither}) = 0.15$. Find $P(B)$.



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B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION

Everyone starts here

B1 $\xi = \{1, 2, \dots, 10\}$, $A = \{1, 2, 3, 4, 5\}$, $B = \{2, 4, 6, 8\}$ List the members of

(a) $A \cap B$

(b) $A \cup B$

(c) A'

(d) $(A \cup B)'$

[4 marks]

B2 For the sets in B1, write down

(a) $n(A \cap B)$

(b) $n(A \cup B)$

(c) $n(B')$

(d) $n(A \cap B')$

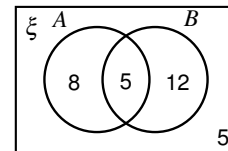
[4 marks]

B3 (a) Find $n(A)$

(b) Find $n(A \cup B)$

(c) Find $P(A \cap B)$

(d) Find $P(B')$



[4 marks]

B4 There are 30 people in each group. Find the missing number.

(a) 12 are in A , 10 are in B , 4 are in both. How many are in neither?

(b) 16 are in A , 12 are in B , 7 are in neither. How many are in both?

(c) 18 are in A , 6 are in B only, 4 are in both. How many are in neither?

(d) Everyone is in A or B or both. 20 are in A and 16 are in B . How many are in both?

[4 marks]



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FOUNDATION continued: probabilities and notation

B5 $P(A) = 0.4$, $P(B) = 0.3$ and $P(A \cap B) = 0.1$. Find

(a) $P(A \text{ only})$

(b) $P(A \cup B)$

(c) $P(\text{neither})$

[3 marks]

B6 Write each region in set notation.

(a) the overlap of A and B

(b) inside A but not inside B

(c) outside both circles

(d) inside B , or outside A , or both

[4 marks]

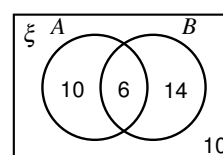
HIGHER Higher tier only

B7 (a) Find $P(A|B)$

(b) Find $P(B|A)$

(c) Find $P(A|B')$

(d) Find $P(B'|A')$



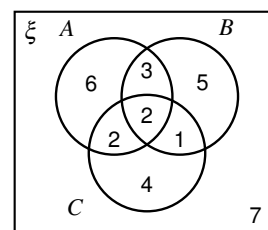
[4 marks]

B8 (a) Find $n(A)$

(b) Find $n(A \cap B)$

(c) How many are in exactly one set?

(d) Find $P(A \cap B \cap C')$



[4 marks]

B9 Each list gives the four regions of a two-set Venn diagram: A only, both, B only, outside.

(a) $x, 2x, 3x, 6$; total 30. Find x

(b) $x, x+2, 2x, 4$; total 30. Find x

(c) $2x, x, 5, 3$; total 32. Find $P(A)$

(d) probabilities $x, 0.2, 2x, 0.35$. Find x

[4 marks]

B10 (a) $P(A) = 0.5$, $P(B) = 0.4$, $P(A \cap B) = 0.15$. Find $P(A \cup B)$

(b) For the same events, find $P(\text{neither})$

(c) For the same events, find $P(A|B)$

(d) $P(A \cup B) = 0.8$, $P(A) = 0.5$, $P(B) = 0.45$. Find $P(A \cap B)$

[4 marks]



C

Reasoning

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

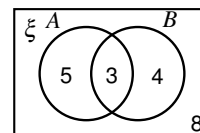
- C1** $P(A) = 0.6$ and $P(B) = 0.5$. Kim says, " $P(A \cup B) = 0.6 + 0.5 = 1.1$ "

Explain why Kim must be wrong.

[2 marks]

- C2** Tom says, " $n(A) = 5$ "

Explain Tom's mistake and write down $n(A)$.



[2 marks]

- C3** There are 20 students in a group. 14 study French and 11 study Spanish.

Ana says, "Nobody studies both." Explain why Ana must be wrong, and find the smallest number who study both.

[3 marks]

- C4** $\xi = \{1, 2, \dots, 20\}$, $A = \{\text{prime numbers}\}$, $B = \{\text{odd numbers}\}$

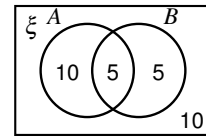
Show that $P(A \cap B) = \frac{7}{20}$

[3 marks]



HIGHER*Higher tier only*

- C5** Jo says, " $P(A|B)$ is always the same as $P(B|A)$ "
Use the Venn diagram to show that Jo is wrong.

**[3 marks]**

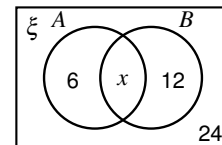
- C6** In a class, 12 students play football, 10 play hockey and 8 play rugby.
Sam says, "So 30 students play at least one of these sports."
Explain why Sam may be wrong. What is the smallest possible number who play at least one of these sports?

[3 marks]

- C7** A two-set Venn diagram has a in A only, b in both and c in B only.
Prove that $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

[3 marks]

- C8** Events A and B are independent when
 $P(A \cap B) = P(A) \times P(B)$
(a) Show that A and B are independent when
 $(6+x)(12+x) = x(42+x)$
(b) Find the value of x that makes A and B
independent.

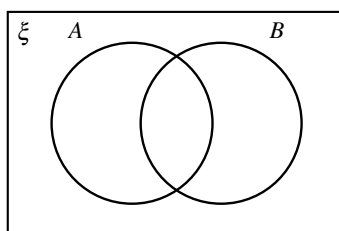
**[5 marks]**

D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION *Everyone starts here*

- D1** There are 28 students in a class. 15 have a sister, 12 have a brother and 5 have both.
A student is chosen at random. Find the probability that the student has a sister but no brother. [3 marks]
- D2** $\xi = \{1, 2, \dots, 20\}$, $A = \{\text{multiples of } 4\}$, $B = \{\text{factors of } 24\}$

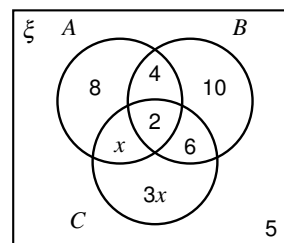


- Complete the Venn diagram. A number is chosen at random from ξ . Find $P(A' \cap B)$. [4 marks]
- D3** 80 customers were asked. 45 bought bread, 30 bought milk and 20 bought neither.
Find the probability that a customer chosen at random bought milk but not bread. [3 marks]
- D4** The probability that it rains tomorrow is 0.4. The probability that it is windy is 0.5. The probability that it is neither rainy nor windy is 0.25
Find the probability that it is both rainy and windy. [3 marks]



HIGHER*Higher tier only*

- D5** 120 students were asked. 70 study chemistry, 55 study physics and 30 study both.
(a) A student who studies physics is chosen at random. Find the probability that they also study chemistry.
(b) A student who does not study chemistry is chosen at random. Find the probability that they study neither subject. [4 marks]
- D6** 50 people were asked about jazz and rock. Twice as many like only jazz as like only rock. 8 like both and 12 like neither.
How many people like jazz? [4 marks]
- D7** $P(A) = 0.6$ and $P(B|A) = 0.5$. The probability of B but not A is 0.1
(a) Find the probability of neither A nor B . (b) Find $P(A|B)$. [4 marks]
- D8** The Venn diagram shows the numbers of people in three sets.
Given that a person is in A , the probability that they are also in C is $\frac{1}{2}$
(a) Find x .
(b) Find $P(C)$.



[5 marks]



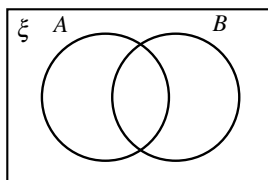
E**Exam practice**

Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION

Foundation and Higher crossover

- E1** $\xi = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$, $A = \{\text{multiples of 3}\}$, $B = \{\text{even numbers}\}$



- (a) Complete the Venn diagram.

(2)

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

.....

(1)

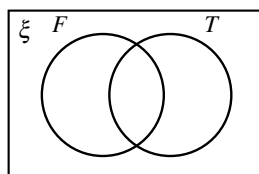
- (c) A number is chosen at random from ξ . Find the probability that it is in $A \cup B$.

.....

(1)

(Total for Question E1 is 4 marks)

- E2** 50 students were asked. 23 play football, 18 play tennis and 7 play both.



- (a) Complete the Venn diagram.

(2)

- (b) A student is chosen at random. Find the probability that they play neither sport.

.....

(1)

(Total for Question E2 is 3 marks)

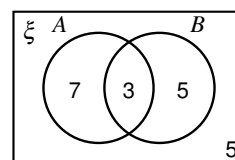


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E3 (a) Find $P(A)$.

(b) Find $P(A' \cap B)$.



(1)

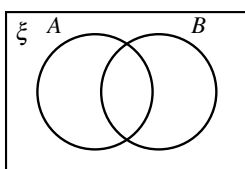
(1)

(Total for Question E3 is 2 marks)

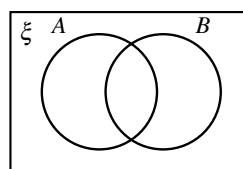
E4 30 people were asked. 12 have a cat, 15 have a dog and 8 have neither.
How many people have both a cat and a dog?

(Total for Question E4 is 3 marks)

E5 On the diagrams, shade the regions (a) $A \cap B'$ (b) $(A \cup B)'$



(a)



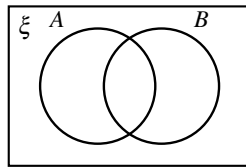
(b)

(Total for Question E5 is 2 marks)



E6 $P(A) = 0.45$, $P(B) = 0.4$ and $P(A \cap B) = 0.15$

(a) Complete the Venn diagram with probabilities.



(2)

(b) Find the probability of neither A nor B .

.....
(1)

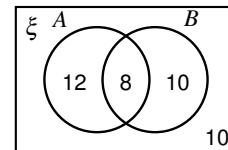
(Total for Question E6 is 3 marks)

HIGHER

Higher tier only

E7 (a) Find $P(A|B)$.

(b) Find $P(B'|A)$.



(2)

(1)

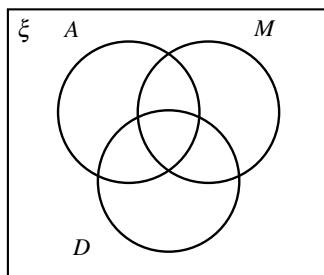
(Total for Question E7 is 3 marks)



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- E8** 60 students choose from art (A), music (M) and drama (D). 25 do art, 20 do music and 22 do drama. 8 do art and music, 7 do art and drama, 6 do music and drama, and 3 do all three.



- (a) Complete the Venn diagram.

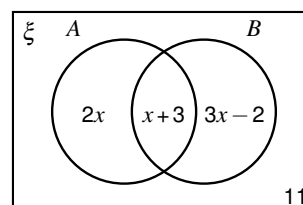
(2)

- (b) A student is chosen at random. Find the probability that they do exactly one of these subjects.

(2)

(Total for Question E8 is 4 marks)

- E9** The Venn diagram shows the numbers of people in two sets. There are 60 people altogether. A person in B is chosen at random. Find the probability that they are also in A .



(Total for Question E9 is 4 marks)



E10 $P(A) = 0.7$, $P(B) = 0.55$ and $P(A \cap B) = x$. The probability of neither A nor B is x^2

(a) Show that $x^2 - x + 0.25 = 0$

(2)

(b) Find x .

(1)

(c) Find $P(B|A)$.

(2)

(Total for Question E10 is 5 marks)

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