C10

Set notation and Venn diagrams

CHAPTER ASSIGNMENT · 182 MARKS

Name _____ Class _____ No. _____ Date _____

Answer every question in the space given. Write sets with curly brackets, e.g. {2, 4, 6}. Where a question shows a Venn diagram, its regions are listed in a table: "A only" means in A but not in B, and "outside" means in $\mathscr{E}$ but in none of the circles. Draw a Venn diagram in the box where a question asks for one.

Practice questions from *Cambridge IGCSE Mathematics Core and Extended* (4th edition), Chapter 10 (Set notation and Venn diagrams), for classroom use. The book's Venn diagrams are given here as tables of regions. The Check yourself and Chapter quiz questions are Guru Jazzy's own.

Exercise 10.1 · Sets

10.1.1 In the following questions: (i) describe the set in words, (ii) write down another two elements of the set.

(a) {Asia, Africa, Europe, ...} [2]

(b) {2, 4, 6, 8, ...} [2]

(c) {Sunday, Monday, Tuesday, ...} [2]

(d) {January, March, July, ...} [2]

(e) {1, 3, 6, 10, ...} [2]

(f) {Mehmet, Michael, Mustapha, Matthew, ...} [2]

(g) {11, 13, 17, 19, ...} [2]

(h) {a, e, i, ...} [2]

(i) {Earth, Mars, Venus, ...} [2]

(j) $A = \{x: 3 \leq x \leq 12\}$ [2]

(k) $S = \{y: -5 \leq y \leq 5\}$ [2]

10.1.2 The number of elements in a set A is written as n(A). Give the value of n(A) for the finite sets in questions 1. a–k above. [4]

Exercise 10.2 · Subsets

10.2.1 P = {whole numbers less than 30}

(a) List the subset Q {even numbers}. [1]

(b) List the subset R {odd numbers}. [1]

(c) List the subset S {prime numbers}. [1]

(d) List the subset T {square numbers}. [1]

(e) List the subset U {triangle numbers}. [1]

10.2.2 A = {whole numbers between 50 and 70}

(a) List the subset B {multiples of 5}. [1]

(b) List the subset C {multiples of 3}. [1]

(c) List the subset D {square numbers}. [1]

10.2.3 J = {p, q, r}

(a) List all the subsets of J. [2]

(b) List all the proper subsets of J. [2]

10.2.4 State whether each of the following statements is true or false:

a	b	c	d
{Algeria, Mozambique} ⊆ {countries in Africa}	{mango, banana} ⊆ {fruit}	{1, 2, 3, 4} ⊆ {1, 2, 3, 4}	{1, 2, 3, 4} ⊂ {1, 2, 3, 4}
e	f	g	h
{volleyball, basketball} ∉ {team sport}	{4, 6, 8, 10} ⊄ {4, 6, 8, 10}	{potatoes, carrots} ⊆ {vegetables}	{12, 13, 14, 15} ⊄ {whole numbers}

Exercise 10.3 · The universal set and Venn diagrams

10.3.1 Using the Venn diagram, indicate whether the following statements are true or false. ∈ means 'is an element of' and ∉ means 'is not an element of'.

The Venn diagram (two overlapping circles A and B):

Region	Elements
A only	5, 15
A ∩ B	10, 20
B only	30, 40, 50

True or false?

a	b	c	d	e	f
5 ∈ A	20 ∈ B	20 ∉ A	50 ∈ A	50 ∉ B	A ∩ B = {10, 20}

10.3.2 Complete the statement A ∩ B = {...} for each of the Venn diagrams below.

Diagram	A only	A ∩ B	B only
a	2, 8, 10	4, 6	3, 9, 13, 18

Diagram	A only	A ∩ B	B only
b	1, 16	4, 9	5, 6, 7, 8
c	Red, Orange, Blue, Indigo, Violet	Yellow, Green	Purple, Pink

(a) A ∩ B = [1]

(b) A ∩ B = [1]

(c) A ∩ B = [1]

10.3.3 Complete the statement A ∪ B = {...} for each of the Venn diagrams in question 2 above.

(a) A ∪ B = [1]

(b) A ∪ B = [1]

(c) A ∪ B = [1]

10.3.4 The Venn diagram shows $\mathscr{E}$ with one circle A. Copy and complete the following statements:

Region	Elements
A	p, q, r, s, t
outside A	a, b

(a) $\mathscr{E}$ = {...} [1]

(b) $A' = \{...\}$ [1]

10.3.5 The Venn diagram shows $\mathscr{E}$ with two overlapping circles A and B. Copy and complete the following statements:

Region	Elements
A only	5, 7
$A \cap B$	2, 3
B only	1, 4, 8
outside	6

(a) $\mathscr{E} = \{...\}$ [1]

(b) $A' = \{...\}$ [1]

(c) $A \cap B = \{...\}$ [1]

(d) $A \cup B = \{...\}$ [1]

(e) $(A \cap B)' = \{...\}$ [1]

(f) $A \cap B' = \{...\}$ [1]

10.3.6 The Venn diagram shows three overlapping circles A, B and C.

Region	Elements
A only	2, 10, 14
B only	3, 9, 15
C only	16, 20
A and B only	6
A and C only	4, 8
B and C only	(empty)
A, B and C	12

(i) Describe in words the elements of set A. **[1]**

(ii) Describe in words the elements of set B. **[1]**

(iii) Describe in words the elements of set C. **[1]**

(i) Copy and complete: $A \cap B = \{...\}$ **[1]**

(ii) $A \cap C = \{...\}$ **[1]**

(iii) $B \cap C = \{...\}$ **[1]**

(iv) $A \cap B \cap C = \{...\}$ **[1]**

(v) $A \cup B = \{...\}$ [1]

(vi) $C \cup B = \{...\}$ [1]

10.3.7 The Venn diagram shows two overlapping circles A and B, with a third circle C drawn wholly inside A (and not touching B). No rectangle is drawn, so take $\mathscr{E}$ to be every number shown.

Region	Elements
C (inside A)	6, 7
A only, outside C	1, 2
$A \cap B$	4, 5
B only	3, 8, 9

(i) Copy and complete: $A = \{...\}$ [1]

(ii) $B = \{...\}$ [1]

(iii) $C' = \{...\}$ [1]

(iv) $A \cap B = \{...\}$ [1]

(v) $A \cup B = \{...\}$ [1]

(vi) $(A \cap B)' = \{...\}$ [1]

(b) State, using set notation, the relationship between C and A. [1]

10.3.8 The Venn diagram shows two overlapping circles W and X. Circle Y is drawn wholly inside W (outside X). Circle Z is drawn wholly inside X and overlaps W. No rectangle is drawn, so take $\mathscr{E}$ to be every number shown.

Region	Elements
Y (inside W only)	4, 10
W only, outside Y	1, 5
W ∩ X, outside Z	6, 7
W ∩ Z	2, 9
Z, outside W	3
X only, outside Z	8

(i) Copy and complete: W = {...} [1]

(ii) X = {...} [1]

(iii) Z' = {...} [1]

(iv) W ∩ Z = {...} [1]

(v) W ∩ X = {...} [1]

(vi) Y ∩ Z = {...} [1]

(b) Which of the named sets is a subset of X? [1]

Exercise 10.4 · Drawing Venn diagrams

10.4.1 A = {Egypt, Libya, Morocco, Chad}, B = {Iran, Iraq, Turkey, Egypt}

(a) Draw a Venn diagram to illustrate the above information. [2]

(i) Copy and complete the following statements: A ∩ B = {...} [1]

(ii) A ∪ B = {...} [1]

10.4.2 P = {2, 3, 5, 7, 11, 13, 17}, Q = {11, 13, 15, 17, 19}

(a) Draw a Venn diagram to illustrate the above information. [2]

(i) Copy and complete the following statements: P ∩ Q = {...} [1]

(ii) $P \cup Q = \{...\}$ [1]

10.4.3 $B = \{2, 4, 6, 8, 10\}$, $A \cup B = \{1, 2, 3, 4, 6, 8, 10\}$, $A \cap B = \{2, 4\}$. Represent the above information on a Venn diagram. [3]

10.4.4 $X = \{a, c, d, e, f, g, l\}$, $Y = \{b, c, d, e, h, i, k, l, m\}$, $Z = \{c, f, i, j, m\}$. Represent the above information on a Venn diagram. [4]

10.4.5 $P = \{1, 4, 7, 9, 11, 15\}$, $Q = \{5, 10, 15\}$, $R = \{1, 4, 9\}$. Represent the above information on a Venn diagram. [4]

Exercise 10.5 · Problems involving sets

10.5.1 In a class of 35 students, 19 take Spanish, 18 take French and 3 take neither. Calculate how many take:

(a) both French and Spanish, [2]

(b) just Spanish, [1]

(c) just French. [1]

10.5.2 In a year group of 108 students, 60 liked football, 53 liked tennis and 10 liked neither. Calculate the number of students who liked football but not tennis. [3]

10.5.3 In a year group of 113 students, 60 liked hockey, 45 liked rugby and 18 liked neither. Calculate the number of students who:

(a) liked both hockey and rugby, [2]

(b) liked only hockey. [1]

10.5.4 One year, 37 students sat an examination in Physics, 48 sat Chemistry and 45 sat Biology. 15 students sat Physics and Chemistry, 13 sat Chemistry and Biology, 7 sat Physics and Biology and 5 students sat all three.

(a) Draw a Venn diagram to represent this information. [3]

(b) Calculate $n(P \cup C \cup B)$. [2]

Student assessment 1

SA1.1 Describe the following sets in words:

(a) {2, 4, 6, 8} [1]

(b) {2, 4, 6, 8, ...} [1]

(c) {1, 4, 9, 16, 25, ...} [1]

(d) {Arctic, Atlantic, Indian, Pacific} [1]

SA1.2 Calculate the value of n(A) for each of the sets shown below:

(a) A = {days of the week} [1]

(b) A = {prime numbers between 50 and 60} [1]

(c) A = {x: x is an integer and $5 \leq x \leq 10$} [1]

(d) A = {days in a leap year} [1]

SA1.3 Copy out the Venn diagram (a rectangle $\mathscr{E}$ with two overlapping circles A and B) twice.

(a) On one copy, shade and label the region which represents $A \cap B$. [1]

(b) On the other copy, shade and label the region which represents $A \cup B$. [1]

SA1.4 If A = {a, b}, list all the subsets of A. [2]

SA1.5 If $\mathscr{E}$ = {m, a, t, h, s} and A = {a, s}, what set is represented by A'? [1]

Student assessment 2

SA2.1 If A = {2, 4, 6, 8}, write all the proper subsets of A with two or more elements. [3]

SA2.2 J = {London, Paris, Rome, Washington, Canberra, Ankara, Cairo}, K = {Cairo, Nairobi, Pretoria, Ankara}

(a) Draw a Venn diagram to represent the above information. [2]

(b) Copy and complete the statement J ∩ K = {...}. [1]

(c) Copy and complete the statement J' ∩ K = {...}. [1]

SA2.3 M = {x: x is an integer and $2 \leq x \leq 20$}, N = {prime numbers less than 30}

(a) Draw a Venn diagram to illustrate the information above. [2]

(b) Copy and complete the statement $M \cap N = \{...\}$. [1]

(c) Copy and complete the statement $(M \cap N)' = \{...\}$. [2]

SA2.4 $\mathscr{E}$ = {natural numbers}, M = {even numbers} and N = {multiples of 5}.

(a) Draw a Venn diagram and place the numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 in the appropriate places in it. [3]

(b) If $X = M \cap N$, describe set X in words. [1]

SA2.5 In a region of mixed farming, farms keep goats, cattle or sheep. There are 77 farms altogether. 19 farms keep only goats, 8 keep only cattle and 13 keep only sheep. 13 keep both goats and cattle, 28 keep both cattle and sheep and 8 keep both goats and sheep.

(a) Draw a Venn diagram to show the above information. [3]

(b) Calculate $n(G \cap C \cap S)$. [2]

Student assessment 3

SA3.1 $M = \{a, e, i, o, u\}$

(a) How many subsets are there of M? [1]

(b) List the subsets of M with four or more elements. [3]

SA3.2 X = {lion, tiger, cheetah, leopard, puma, jaguar, cat}, Y = {elephant, lion, zebra, cheetah, gazelle}, Z = {anaconda, jaguar, tarantula, mosquito}

(a) Draw a Venn diagram to represent the above information. [3]

(b) Copy and complete the statement $X \cap Y = \{...\}$. [1]

(c) Copy and complete the statement $Y \cap Z = \{...\}$. [1]

(d) Copy and complete the statement $X \cap Y \cap Z = \{...\}$. [1]

SA3.3 A group of 40 people were asked whether they like cricket (C) and football (F). The number liking both cricket and football was three times the number liking only cricket. Adding 3 to the number liking only cricket and doubling the answer equals the number of people liking only football. Four said they did not like sport at all.

(a) Draw a Venn diagram to represent this information. [2]

(b) Calculate $n(C \cap F)$. [3]

(c) Calculate $n(C \cap F')$. [1]

(d) Calculate $n(C' \cap F)$. [1]

SA3.4 The Venn diagram shows the number of elements in three overlapping sets P, Q and R.

Region	Number of elements
P only	10 + x
Q only	13 + x
R only	28 + x
P and Q only	15 − x
P and R only	10 − x
Q and R only	12 − x
P, Q and R	x

If $n(P \cup Q \cup R) = 93$ calculate:

(a) x [2]

(b) n(P) [1]

(c) n(Q) [1]

(d) n(R) [1]

(e) n(P ∩ Q) [1]

(f) n(Q ∩ R) [1]

(g) n(P ∩ R) [1]

(h) n(R ∪ Q) [1]

(i) n(P ∩ Q)' [1]

Check yourself

1. Explain the difference between A ⊆ B and A ⊂ B, with an example of each. [2]

2. A set has 6 elements. How many subsets does it have? Explain how you know. [2]

3. $\mathscr{E}$ = {1, 2, ..., 12}, A = {multiples of 2} and B = {multiples of 3}. Draw a Venn diagram and list A ∩ B′. [3]

4 $n(\mathscr{E}) = 50$, $n(A) = 30$, $n(B) = 25$ and 8 are in neither. Find $n(A \cap B)$ and show your working. [3]

5 Shade $(A \cup B)'$ on a Venn diagram and describe the region in words. [2]

Chapter quiz

Q1 A = {3, 5, 7, 9}. What is n(A)?

A	B	C	D
3	4	9	24

Q2 Which statement is true for A = {2, 4, 6}?

A	B	C	D
$4 \notin A$	$5 \in A$	$6 \in A$	$2 \notin A$

Q3 How many integers are in {x: x is an integer and $4 \leq x \leq 9$}?

A	B	C	D
5	6	9	13

Q4 How many subsets does {a, b, c, d} have?

A	B	C	D
4	8	15	16

Q5 Which statement is false?

A	B	C	D
{1, 2} ⊂ {1, 2, 3}	∅ ⊆ {1, 2}	{1, 2, 3} ⊂ {1, 2, 3}	{3} ⊆ {1, 2, 3}

Q6 $\mathscr{E}$ = {1, 2, 3, 4, 5, 6} and A = {2, 4, 6}. What is A′?

A	B	C	D
{2, 4, 6}	{1, 3, 5}	{1, 2, 3, 4, 5, 6}	∅

Q7 P = {1, 2, 3, 4} and Q = {3, 4, 5}. What is P ∩ Q?

A	B	C	D
{3, 4}	{1, 2, 3, 4, 5}	{1, 2}	{5}

Q8 P = {1, 2, 3, 4} and Q = {3, 4, 5}. What is P ∪ Q?

A	B	C	D
{3, 4}	{1, 2, 5}	{1, 2, 3, 4, 5}	{1, 2, 3, 3, 4, 4, 5}

Q9 On a two-circle Venn diagram, which region is A ∩ B′?

A	B	C	D
The overlap	A only	B only	Outside both circles

Q10 What does (A ∪ B)′ shade on a Venn diagram?

A	B	C	D
The overlap only	A only and B only	Both circles	Outside both circles

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Q11 30 students: 18 do art, 15 do music, 4 do neither. How many do both?

A	B	C	D
3	7	11	33

Q12 n(A) = 14, n(B) = 10 and n(A ∩ B) = 6. What is n(A ∪ B)?

A	B	C	D
18	24	30	8

End of assignment · Check your answers against the chapter at gurujazzy.com/subjects/o-level-mathematics/chapter-10-set-notation-and-venn-diagrams/