

15. [Set Notation]

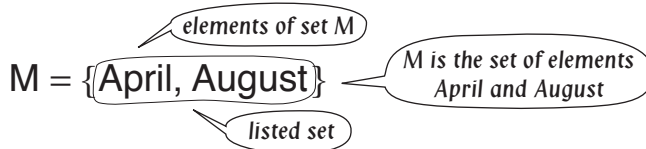
Skill 15.1 Listing the elements of a set.

MM9 11 22 33 44
MM10 11 22 33 44

- Read the description of the set.
Example:



- List all the elements in the set.
Example:



Hint: The elements of a set have to be listed only once.
The order of the elements in the set doesn't matter.
If there isn't any element that is described in the set, then the set is the empty set, \emptyset or $\{ \}$.
Example: $\{ \text{triangles with 4 sides} \} = \emptyset$

- Q.** Write the set $F = \{ \text{factors of 24} \}$ as a listed set.

- A.** Description of elements: factors of 24
1, 2, 3, 4, 6, 8, 12, 24 are factors of 24
Listed set is $\{ \mathbf{1, 2, 3, 4, 6, 8, 12, 24} \}$

- a)** Write the set $M = \{ \text{colours of Olympic medals} \}$ as a listed set.

$M = \{ \text{gold, silver, bronze} \}$

- b)** Write the set $L = \{ \text{letters in word parallelogram} \}$ as a listed set.

$L = \{ \quad \quad \quad \}$

- c)** Write the set $F = \{ \text{common factors of 10 and 15} \}$ as a listed set.

$F = \{ \quad \quad \quad \}$

- d)** Write the set $M = \{ \text{multiples of 4, less than 30} \}$ as a listed set.

$M = \{ \quad \quad \quad \}$

- e)** Write the set $C = \{ \text{colours of Olympic rings} \}$ as a listed set.

$C = \{ \text{black,} \quad \quad \quad \}$

- f)** Write the set $S = \{ \text{suits in a deck of playing card} \}$ as a listed set.

$S = \{ \text{hearts,} \quad \quad \quad \}$

- g)** Write the set $P = \{ \text{perfect squares less than 50} \}$ as a listed set.

$P = \{ 1, \quad \quad \quad \}$

- h)** Write the set $F = \{ \text{factors of 40} \}$ as a listed set.

$F = \{ 1, 2, \quad \quad \quad \}$

- i)** Which describes the empty set \emptyset ?

- A) $\{ \text{planets in the Solar System} \}$
B) $\{ \text{reptiles with fur} \}$
C) $\{ \text{people of 100 years old} \}$

- j)** Which describes the empty set \emptyset ?

- A) $\{ \text{plant species on the Moon} \}$
B) $\{ \text{cards in a deck of playing cards} \}$
C) $\{ \text{colours of the rainbow} \}$

- Write the set as a listed set if possible.
- Count the number of elements in the set.

Example:

3 elements
 $M = \{\text{September, October, November}\}$
M is the set of elements
September, October and November
listed set

number of elements in set $M = 3$

Hint: If the set is the null (empty) set, then the number of elements in the set is 0.

<p>Q. Find the number of elements in: $L = \{\text{letters in the word } \textit{mathematics}\}$</p>	<p>A. $L = \{m, a, t, h, e, i, c, s\}$ listed set L has 8 elements.</p>
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<p>a) Find the number of elements in: $S = \{\text{sides of a pentagon}\}$</p> <p>number of elements in set $S =$ <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>b) Find the number of elements in: $F = \{\text{factors of } 30\}$ F = {1, 2, 3, 5, 6, 10, 15, 30}</p> <p>number of elements in set $F =$ <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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<p>c) Find the number of elements in: $L = \{\text{legs of a spider}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>d) Find the number of elements in: $S = \{\text{stars on the Australian flag}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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<p>e) Find the number of elements in: $M = \{\text{months in a season}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>f) Find the number of elements in: $N = \{\text{numbers on a clock face}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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<p>g) Find the number of elements in: $W = \{\text{weeks in a year}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>h) Find the number of elements in: $F = \{\text{faces in a cube}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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<p>i) Find the number of elements in: $M = \{\text{multiples of } 10 \text{ less than } 99\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>j) Find the number of elements in: $P = \{\text{players in a cricket team}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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<p>k) Find the number of elements in: $D = \{\text{days in a leap year}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>	<p>l) Find the number of elements in: $S = \{\text{signs of the zodiac}\}$</p> <p>..... <input style="width: 50px; height: 20px; border: 1px solid black;" type="text"/></p>
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- Count the number of elements in the set if possible.

Example: $M = \{\text{months of the year}\}$ $\xrightarrow{12 \text{ elements}}$ \Rightarrow M is a finite set

$O = \{\text{odd numbers}\}$ $\xrightarrow{\text{elements cannot be counted}}$ \Rightarrow O is an infinite set

Hint: If the elements in the set can be counted, the set is finite.

If the elements in the set cannot be counted, the set is infinite (there is no end to the elements of the set).

Q. Is the set $P = \{\text{pages in a book}\}$ finite or infinite?

A. P has a certain number of elements that can be counted.

P is a **finite** set.

a) Is the set $M = \{\text{multiples of 12}\}$ finite or infinite?

infinite

b) Is the set $C = \{\text{countries of the world}\}$ finite or infinite?

c) Is the set $F = \{\text{factors of 1000}\}$ finite or infinite?

d) Is the set $I = \{\text{integers less than } -100\}$ finite or infinite?

e) Is the set $E = \{\text{even numbers}\}$ finite or infinite?

f) Is the set $D = \{\text{powers of 4}\}$ finite or infinite?

g) Is the set $B = \{\text{books in a library}\}$ finite or infinite?

h) Is the set $P = \{\text{positive numbers}\}$ finite or infinite?

i) Is the set $S = \{\text{square numbers}\}$ finite or infinite?

j) Is the set $W = \{\text{whole numbers greater than 100}\}$ finite or infinite?

k) Is the set $P = \{\text{positive integers}\}$ finite or infinite?

l) Is the set $A = \{\text{integers between } -100\,000 \text{ and } 0\}$ finite or infinite?

Symbol	Meaning	Use when	Examples
\in	is an element of	an element belongs to a set	$5 \in \{1,3,5,7,9\}$
\notin	is not an element of	an element doesn't belong to a set	$9 \notin \{0,2,4,6,8\}$
\subset	is a subset of	a set is included in another set	$\{4,5\} \subset \{4,5,6,7\}$
$\not\subset$	is not a subset of	a set is not included in another set	$\{5,6\} \not\subset \{1,2,3,5,8\}$
$=$	is equal to	two sets have the same elements	$\{5,6,7\} = \{7,5,6\}$

Q. $\{0,2\}$ $\{0,2,4,6,8\}$
Which symbol makes this statement true?
 \in (is an element of)
 $=$ (is equal to)
 \subset (is a subset of)

A. Set $\{0,2\}$ is included in set $\{0,2,4,6,8\}$
 \Rightarrow Set $\{0,2\}$ is a subset of $\{0,2,4,6,8\}$
 $\Rightarrow \{0,2\} \subset \{0,2,4,6,8\}$

a) $\{\text{whole numbers}\} \subset \{\text{integers}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \subset (is a subset of)
 $\not\subset$ (is not a subset of)

b) $\{\text{insects}\} \subset \{\text{animals}\}$
Which symbol makes this statement true?
 \in (is an element of)
 $=$ (is equal to)
 \subset (is a subset of)

c) $\{1,3,5,7\} \subset \{1,3,5\}$
Which symbol makes this statement true?
 \in (is an element of)
 \subset (is a subset of)
 $\not\subset$ (is not a subset of)

d) $-8 \subset \{\text{integers}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

e) $\{1,2,3\} \subset \{3,2,1\}$
Which symbol makes this statement true?
 \in (is an element of),
 $=$ (is equal to) or
 \subset (is a subset of)

f) $200 \subset \{\text{square numbers}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

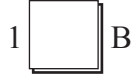
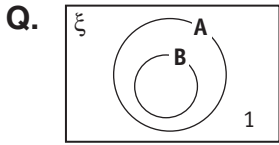
g) $\{0,2,4,6,8\} \subset \{\text{digits}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

h) $4 \subset \{1,3,5,7,9\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

i) $-\sqrt{5} \subset \{\text{irrational numbers}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

j) $-\sqrt{3} \subset \{\text{rational numbers}\}$
Which symbol makes this statement true?
 \in (is an element of)
 \notin (is not an element of)
 \subset (is a subset of)

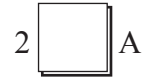
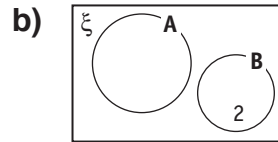
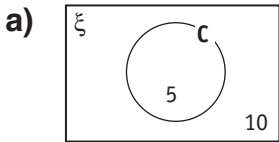
- Look at the Venn diagram:
 Use \in (is an element of) if an element is inside the circle representing the set.
 Use \notin (is not an element of) if an element is outside the circle representing the set.
 Use \subset (is a subset of) if a circle is inside another circle.
 Use $\not\subset$ (is not a subset of) if a circle is exterior to another circle or intersects another circle.



- A.** Element 1 is outside the circle representing set B
 $\Rightarrow 1$ doesn't belong to/is not an element of set B
 \Rightarrow use \notin
 $\Rightarrow 1 \square B$

Which symbol makes this statement true?

- \in (is an element of)
- \notin (is not an element of)
- \subset (is a subset of)

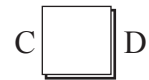
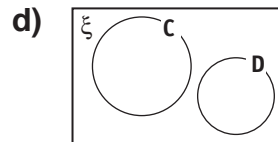
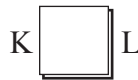
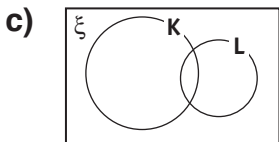


Which symbol makes this statement true?

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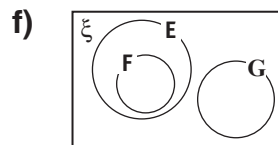
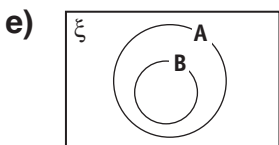


Which symbol makes this statement true?

- \in (is an element of)
- \subset (is a subset of)
- $\not\subset$ (is not a subset of)

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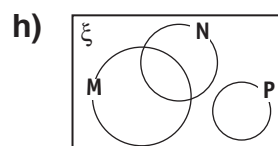
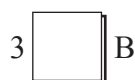
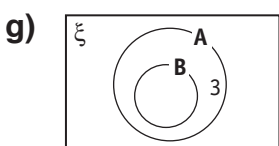


Which symbol makes this statement true?

- \in (is an element of)
- \notin (is not an element of)
- \subset (is a subset of)

Which symbol makes this statement true?

- \in (is an element of)
- \subset (is a subset of)
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Which symbol makes this statement true?

- \in (is an element of)
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- \subset (is a subset of)

Which symbol makes this statement true?

- \in (is an element of)
- \subset (is a subset of)
- $\not\subset$ (is not a subset of)

EITHER

- Compare the elements in each of the sets.
- Choose “disjoint sets” if there are no common elements between the sets.
- Choose “overlapping sets” if there are common elements between the sets.
- Choose “equal sets” if the elements of the sets are identical.

OR

- Look at the Venn diagram.
- Choose “disjoint sets” if the circles are exterior to one another.
- Choose “overlapping sets” if the circles intersect.
- Choose “subset” if a circle is completely inside another circle.

Q. The sets {numbers on a clock face} and {odd numbers} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

common elements

A. Since half of the numbers on a clock face are odd, the two sets have elements in common:

{1,3,5,7,9,11} are odd numbers on a clock face.

The sets are overlapping.

The answer is **B**

a) The sets {1,3,5,7,9} and {0,2,4,6,8} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

no common elements

A

b) The sets {rectangles} and {squares} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

c) The sets {4,5,7,9,10} and {5,10,4,9,7} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

d) The sets {m,s,r,n,t} and {a,e,u} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

e) The sets {planets} and {stars} are:

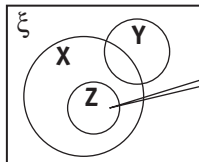
- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

f) The sets {p,r,a,l,t,y} and {a,i,o} are:

- A) disjoint (no common elements)
B) overlapping (some elements in common)
C) equal (the same elements)

g) Which is correct?

- A) X and Y are disjoint (no common elements)
B) Z and Y are overlapping (common elements)
C) Z is a subset of X (set within a set)

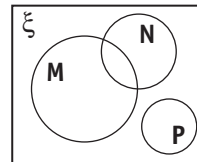


circle Z is inside circle X

C

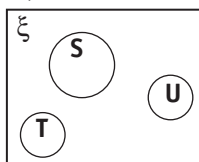
h) Which is correct?

- A) P is a subset of M (set within a set)
B) M and N are overlapping (common elements)
C) M and N are disjoint (no common elements)



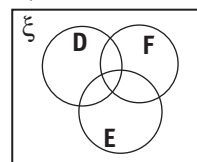
i) Which is correct?

- A) T and S are overlapping (common elements)
B) U is a subset of T (set within a set)
C) S and U are disjoint (no common elements)



j) Which is correct?

- A) F and E are overlapping (common elements)
B) D and F are disjoint (no common elements)
C) D is a subset of E (set within a set)

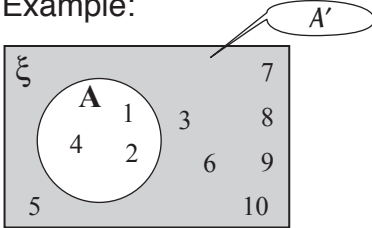


Skill 15.7 Finding the complement, union and intersection of sets (1).

Complement of a set ($'$)

- List all the elements that belong to the universal set (ξ) but don't belong to the set.

Example:

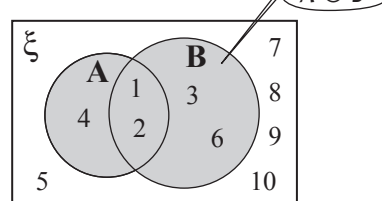


$A' = \{3, 5, 6, 7, 8, 9, 10\}$
(complement of set A)

Union of sets (\cup)

- List all the elements that belong to the first set and all the elements that belong to the second set, without repeating any common values.

Example:

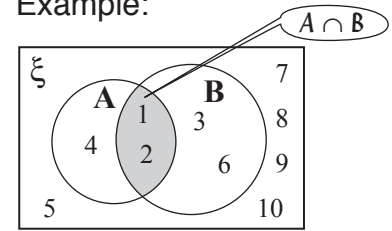


$A \cup B = \{1, 2, 3, 4, 6\}$
(A union B)

Intersection of sets (\cap)

- List all the elements that are common to both sets.

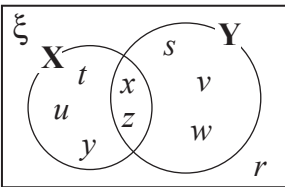
Example:



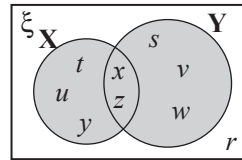
$A \cap B = \{1, 2\}$
(A intersection B)

Hint: The intersection of two disjoint sets is \emptyset .

- Q.** List the elements of set $X \cup Y$ (**X union Y** = all elements in set X or in set Y or in both).



- A.** Write in all the elements of set X: t, u, y, x, z

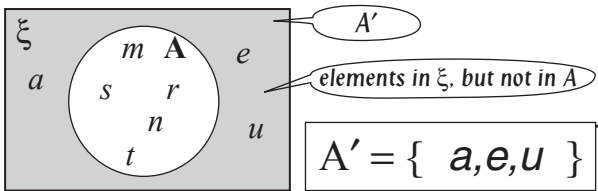


- Write in all the elements of set Y: s, v, w, x, z

Don't write x and z twice.

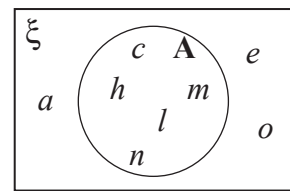
$X \cup Y = \{s, t, u, v, w, x, y, z\}$

- a)** Find the elements of set A' .
 A' = **complement of set A** (all elements of the universal set ξ that are not in set A).



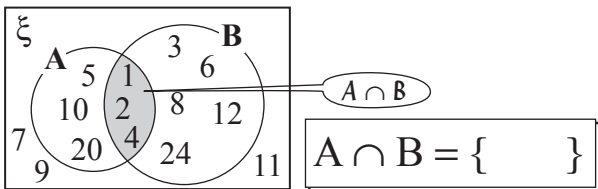
$A' = \{a, e, u\}$

- b)** Find the elements of set A' .
 A' = **complement of set A** (all elements of the universal set ξ that are not in set A).



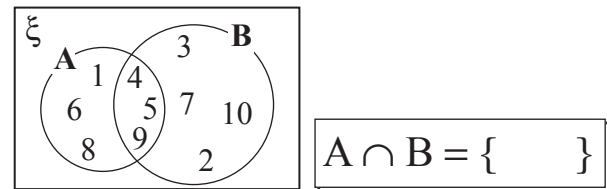
$A' = \{ \quad \}$

- c)** List the elements of the set $A \cap B$.
 $A \cap B$ = **A intersection B** (all elements common to set A and set B).



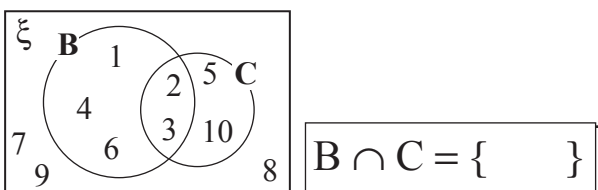
$A \cap B = \{ \quad \}$

- d)** List the elements of the set $A \cap B$.
 $A \cap B$ = **A intersection B** (all elements common to set A and set B).



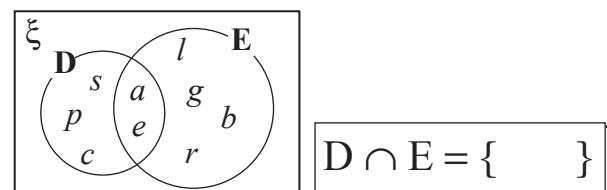
$A \cap B = \{ \quad \}$

- e)** List the elements of the set $B \cap C$.
 $B \cap C$ = **B intersection C** (all elements common to set B and set C).



$B \cap C = \{ \quad \}$

- f)** List the elements of the set $D \cap E$.
 $D \cap E$ = **D intersection E** (all elements common to set D and set E).

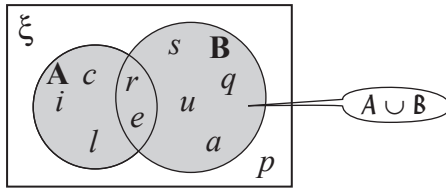


$D \cap E = \{ \quad \}$

Skill 15.7 Finding the complement, union and intersection of sets (2).

- g) List the elements of the set
- $A \cup B$
- .

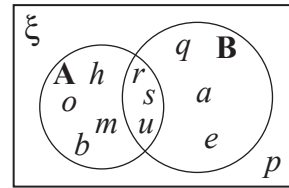
$A \cup B = \mathbf{A \text{ union } B}$ (all elements in set A or in set B or in both).



$$A \cup B = \{ \quad \quad \quad \}$$

- h) List the elements of the set
- $A \cup B$
- .

$A \cup B = \mathbf{A \text{ union } B}$ (all elements in set A or in set B or in both).



$$A \cup B = \{ \quad \quad \quad \}$$

- i)
- $\xi = \{5, 10, 15, 20, 25, 30\}$

$$A = \{10, 20, 30\}$$

Find the elements of set A' (**complement of set A** = all elements of the universal set ξ that are not in set A).

$$A' = \{ \quad \quad \quad \}$$

- j)
- $\xi = \{2, 4, 6, 8, 10, 12\}$

$$B = \{4, 8, 12\}$$

Find the elements of set B' (**complement of set B** = all elements of the universal set ξ that are not in set B).

$$B' = \{ \quad \quad \quad \}$$

- k)
- $\xi = \{a, e, i, o, u\}$

$$P = \{i, o, u\}$$

Find the elements of set P' (**complement of set P** = all elements of the universal set ξ that are not in set P).

$$P' = \{ \quad \quad \quad \}$$

- l)
- $\xi = \{-8, -6, -4, -2, 0\}$

$$M = \{0\}$$

Find the elements of set M' (**complement of set M** = all elements of the universal set ξ that are not in set M).

$$M' = \{ \quad \quad \quad \}$$

- m)
- $A = \{2, 3, 5, 7, 11\}$

$$B = \{1, 2, 3, 4\}$$

Find the elements of $A \cup B$ (**A union B** = all elements in set A or in set B or in both).

$$A \cup B = \{ \quad \quad \quad \}$$

- n)
- $A = \{a, r, e\}$

$$B = \{c, i, r, l, e\}$$

Find the elements of $A \cup B$ (**A union B** = all elements in set A or in set B or in both).

$$A \cup B = \{ \quad \quad \quad \}$$

- o)
- $D = \{v, o, l, u, m, e\}$

$$E = \{c, o, n, e\}$$

Find the elements of $D \cup E$ (**D union E** = all elements in set D or in set E or in both).

$$D \cup E = \{ \quad \quad \quad \}$$

- p)
- $X = \{a, b, c, d, e, f\}$

$$Y = \{c, e, g, h\}$$

Find the elements of $X \cup Y$ (**X union Y** = all elements in set X or in set Y or in both).

$$X \cup Y = \{ \quad \quad \quad \}$$

- q)
- $B = \{1, 3, 5, 7, 9\}$

$$C = \{2, 3, 5, 7\}$$

Find the elements of $B \cap C$ (**B intersection C** = all elements common to set B and set C).

$$B \cap C = \{ \quad \quad \quad \}$$

- r)
- $C = \{0, 2, 4, 6, 8\}$

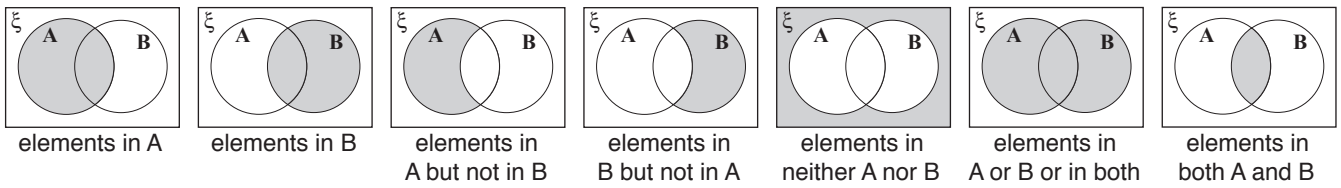
$$D = \{2\}$$

Find the elements of $C \cap D$ (**C intersection D** = all elements common to set C and set D).

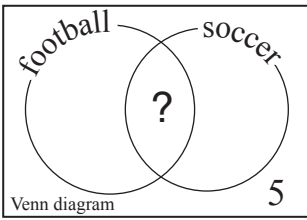
$$C \cap D = \{ \quad \quad \quad \}$$

- Consider various regions on the Venn diagrams.

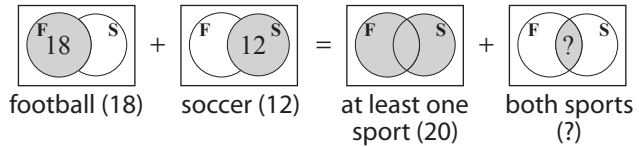
Example:



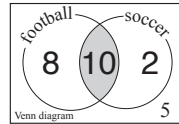
- Q.** Of the 25 students in the class, 18 play football, 12 play soccer and 5 don't play either sport. How many students play both football and soccer?



- A.** $25 - 5 = 20$
- How many students play at least one sport?

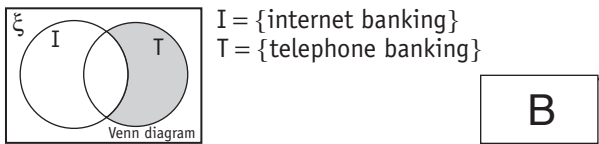


10 students play both sports

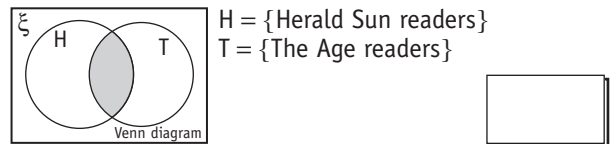


only football + both sports + only soccer + neither sport = class
 $8 + 10 + 2 + 5 = 25$ (true)

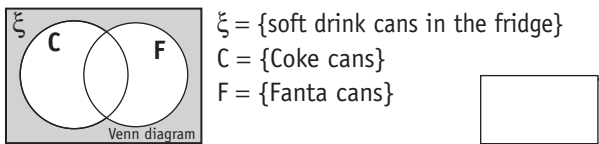
- a)** Which statement describes the shaded area?
 A) people who use internet banking
 B) people who use only telephone banking
 C) people who use both



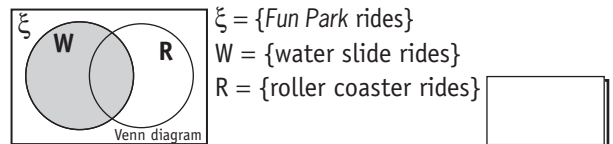
- b)** Which statement describes the shaded area?
 A) people who read only the *Herald Sun*
 B) people who read only *The Age*
 C) people who read both newspapers



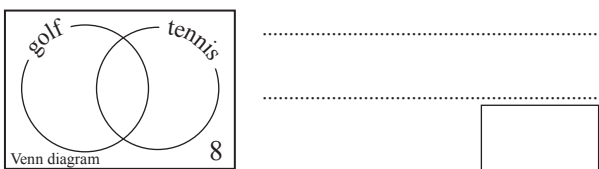
- c)** Which statement describes the shaded area?
 A) cans in the fridge that are neither Coke nor Fanta
 B) Coke cans in the fridge
 C) Fanta cans in the fridge



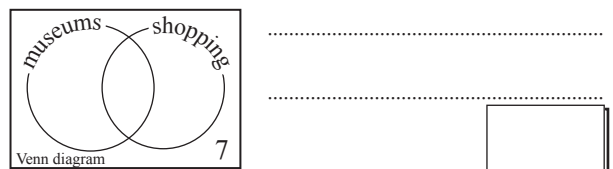
- d)** Which statement describes the shaded area?
 A) *Fun Park* rides
 B) roller coaster rides
 C) water slide rides



- e)** Of the 23 teachers at Sea Star College, 11 play golf, 9 play tennis and 8 don't play either golf or tennis. How many teachers play only tennis?

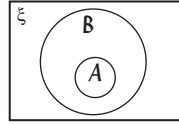


- f)** Of the 50 tourists, 28 are visiting museums, 35 are shopping and 7 are staying at the hotel. How many tourists are only shopping?

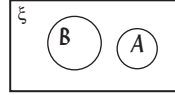


- Consider each premise and check its representation in the Venn diagram.
- Determine if the conclusion is valid or invalid, based on the relationships of the sets in the Venn diagram.

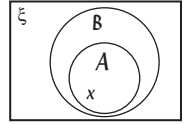
Hint: "All elements of A are included in B" is valid if $A \subset B$.



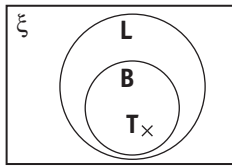
"No element of A is included in B" is valid if A and B are disjoint sets.



"Some elements of A are included in B" is valid if at least one element of A, x, is an element of set B.



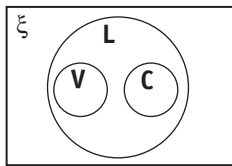
Q. All birds have 2 legs.
Tweety is a bird.
∴ Tweety has 2 legs.
Is the conclusion valid or invalid?



B - birds
L - 2-legged animals
T - Tweety

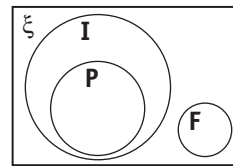
A. $L = \{2\text{-legged animals}\}$
 $B = \{\text{birds}\}$
"All birds have 2 legs" $\Rightarrow B \subset L$
"Tweety is a bird" $\Rightarrow \text{Tweety} \in B$
From the Venn diagram, $\text{Tweety} \in L$, so the conclusion "Tweety has 2 legs" is **valid**.

a) All vowels are letters.
All consonants are letters.
∴ All vowels are consonants.
Is the conclusion valid or invalid?



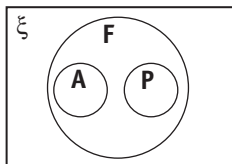
L - letters
V - vowels
C - consonants

b) All prime numbers are integers.
No fraction is an integer.
∴ No fraction is a prime number.
Is the conclusion valid or invalid?



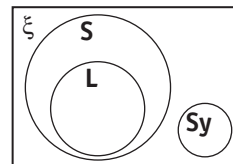
I - integers
P - prime numbers
F - fractions

c) All aeroplanes can fly.
All parrots can fly.
∴ All parrots are aeroplanes.
Is the conclusion valid or invalid?



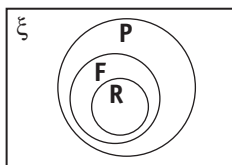
A - aeroplanes
F - can fly
P - parrots

d) All limericks are silly.
No syllogism is silly.
∴ No syllogism is a limerick.
Is the conclusion valid or invalid?



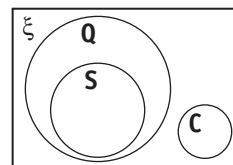
L - limericks
S - silly
Sy - syllogisms

e) All flowers are pretty.
All roses are flowers.
∴ All roses are pretty.
Is the conclusion valid or invalid?



F - flowers
P - pretty
R - roses

f) All squares are quadrilaterals.
No circle is a quadrilateral.
∴ No circle is a square.
Is the conclusion valid or invalid?



Q - quadrilaterals
S - squares
C - circles

- Complete what is given.
 - Consider the meaning of the spaces in the Karnaugh Map.
- Example:

	B	B'	Total
A	$A \cap B$	$A \cap B'$	A
A'	$A' \cap B$	$A' \cap B'$	A'
Total	B	B'	ξ

- A - elements in A
- A' - elements not in A
- B - elements in B
- B' - elements not in B
- $A \cap B$ - elements in both A and B
- $A \cap B'$ - elements in A but not in B
- $A' \cap B$ - elements in B but not in A
- $A' \cap B'$ - elements in neither A and B
- ξ - elements in A and not in A ($A \cup A'$) OR elements in B and not in B ($B \cup B'$)

- Fill in the Karnaugh map.

Q. Of the 220 passengers, 134 travelled internationally (I), 182 travelled economy class (E) and 104 travelled both internationally and economy class. Complete this Karnaugh map.

	I	I'	Total
E			
E'			
Total			

A.

	I	I'	Total
E	104		182
E'			
Total	134		220

Complete what is given

$$E' = \{\text{not economy}\} = 220 - 182 = 38$$

$$I' = \{\text{not international}\} = 220 - 134 = 86$$

	I	I'	Total
E	104		182
E'			38
Total	134	86	220

Complete the totals

$$E \cap I' = 182 - 104 = 78$$

$$E' \cap I = 134 - 104 = 30$$

$$E' \cap I' = 38 - 30 = 8$$

	I	I'	Total
E	104	78	182
E'	30	8	38
Total	134	86	220

Complete the intersections

a) How many male tourists travelled in total?
[Complete the Karnaugh map.]

	M	M'	Total
B	32	25	57
B'	22	19	41
Total	54	44	98

- B - travel business class
- B' - travel other class
- M - male tourists
- M' - female tourists



b) How many black cards are there in a standard deck of playing cards?
[Complete the Karnaugh map.]

	R	R'	Total
H	13		13
H'		26	
Total			52

- R - red suit cards
- R' - black suit cards
- H - hearts
- H' - not hearts



c) Of the people voting at a referendum 1800 were male, 400 of whom voted "No". In fact 1200 people in total voted "No" while 1200 women voted "Yes". Complete this Karnaugh map.

	M	M'	Total
Y			
Y'			
Total			

- M - men
- M' - women
- Y - "yes" votes
- Y' - "no" votes

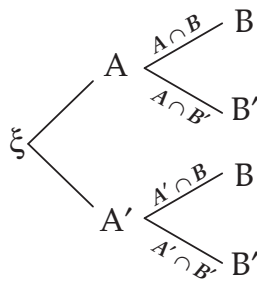
d) Of the 330 people responding to the survey, 265 people voted in favour of the canteen menu, 48 men voted in favour and 62 women voted against. Complete this Karnaugh map.

	M	M'	Total
I			
I'			
Total			

- I - votes in favour
- I' - votes against
- M - men
- M' - women

- Complete what is given.
- Consider the meaning of the branches in the tree diagram.

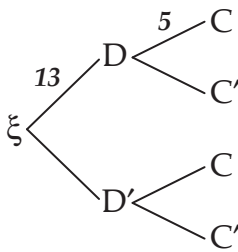
Example:



A	- elements in A
A'	- elements not in A
B	- elements in B
B'	- elements not in B
$A \cap B$	- elements in both A and B
$A \cap B'$	- elements in A but not in B
$A' \cap B$	- elements in B but not in A
$A' \cap B'$	- elements in neither A and B
ξ	- elements in A and not in A ($A \cup A'$) OR elements in B and not in B ($B \cup B'$)

- Fill in the tree diagram.

Q. Of the 25 students in a class, 13 have a dog (D), 9 have a cat (C) and 5 have both a dog and a cat. How many students have neither a dog or a cat?
[Complete the tree diagram.]



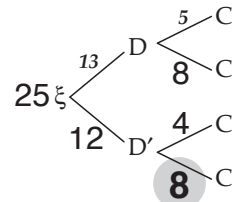
A. 9 students have cats. 5 have a dog and cat, so 4 must have no dog and a cat.

Complete what is given

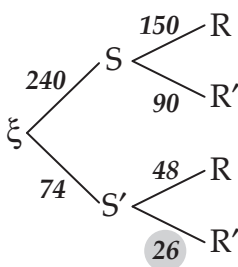
Consider the branches

$$D' = \{\text{no dog}\} = 25 - 13 = 12$$

$$D' \cap C' = \{\text{no dogs, no cats}\} = 12 - 4 = 8$$

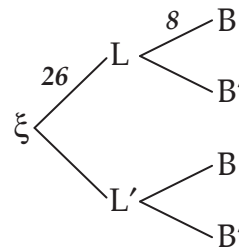


a) How many students in the school participated neither in the swimming events (S), nor in the running events (R)?

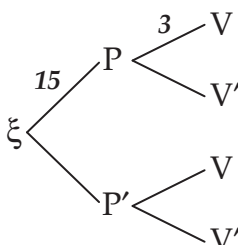


S' - students who didn't swim
R' - students who didn't run

b) Of the 35 students in a class, 26 are members of the library (L), 15 are members of the Book Club (B) and 8 are members of both. How many students are members of the Book Club only? [Complete the tree diagram.]



c) Of the 30 students in a class, 15 play piano (P), 8 play violin (V) and 3 play both instruments. How many students play only violin?
[Complete the tree diagram.]



P' - students who don't play piano
V' - students who don't play violin

d) Of the 62 animals at the Zoo, 40 are mammals (M), 35 are native animals (N) and 15 are both. How many animals are non-native mammals?
[Complete the tree diagram.]

