

Student Name

Mathematics Stage 5 Paths

PROBABILITY B

Book 3 Describe mutually and non-mutually exclusive events using specific language and calculate related probabilities

Version: 260207

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CONTENTS

1 Subtopic **Error! Bookmark not defined.**

OVERVIEW

SYLLABUS CONTENT

MA5-PRO-P-01 solves problems involving Venn diagrams, 2-way tables and conditional probability

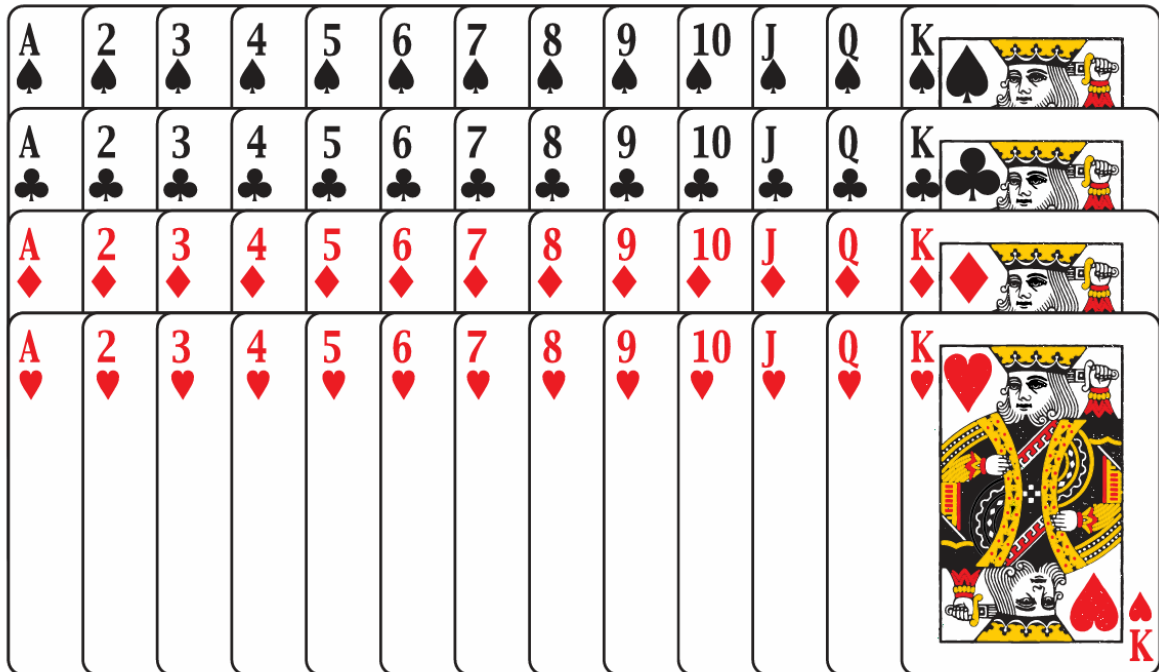
Describe mutually and non-mutually exclusive events using specific language and calculate related probabilities

- Explain the difference between mutually exclusive and non-mutually exclusive events
- Describe compound events using the terms *inclusive or* and *exclusive or*
- Describe non-mutually exclusive events using the terminology *and*, *inclusive or* and *exclusive or*
- Describe events using the terms *at least*, *at most*, *not* and *and*
- Calculate the probability of compound events using strategies including Venn diagrams and 2-way tables

COMPOUND EVENTS

DECK OF CARDS

- Many compound events require you to answer questions based on a deck of 52 playing cards.
- There are four **suits**: ♠ Spades, ♣ Clubs, ♦ Diamonds, ♥ Hearts.
- Spades and clubs are **black**, diamonds and hearts are **red**.
- The **number cards** are Ace (1), 2, 3, 4, 5, 6, 7, 8, 9, 10.
- The **face cards**, or **picture cards**, are Jack, Queen, King.



- 1 How many picture cards are there?
- 2 How many number cards are there?
- 3 How many red cards are there?
- 4 How many black picture cards are there?
- 5 How many red number cards are there?

12

40

26

6

20

COMPOUND EVENTS

- **Compound events** are when we combine two or more outcomes from an experiment.
- We use these words to identify compound event outcomes:
 - And: Both conditions must happen
 - Or (inclusive or/or both): Either one or both conditions can happen
 - Not: The outcome is excluded
 - Neither/nor: Multiple outcomes are excluded
 - Exclusive or: Only one condition can happen, not both

Example Using *and or*.

Worked Solution	Your Turn
A card is chosen from a deck of cards. Calculate:	A card is chosen from a deck of cards. Calculate:
$P(\text{red AND a picture card}) = \frac{6}{52} = \frac{3}{26}$	$P(\text{Black AND a number}) =$
$P(\text{red or ace, OR BOTH}) = \frac{28}{52} = \frac{7}{13}$	$P(\text{red OR picture, OR BOTH}) =$
$P(\text{red or ace, NOT BOTH}) = \frac{26}{52} = \frac{1}{2}$	$P(\text{multiple of 2 OR multiple of 3, NOT BOTH}) =$

AT LEAST, AT MOST

- Greater than: $>$ Every number larger, not including the number.
- Less than: $<$ Every number smaller, not including the number.
- At least: $\geq$ Every number larger, including the number.
- At most: $\leq$ Every number smaller, including the number.

Example Using at least, at most.

Worked Solution	Your Turn
A six-sided die is rolled. Calculate:	A six-sided die is rolled. Calculate:
$P(\text{greater than 3}) = \frac{3}{6} = \frac{1}{2}$	$P(\text{greater than 4}) =$
$P(\text{at least 3}) = \frac{4}{6} = \frac{2}{3}$	$P(\text{at least 4}) =$
$P(\text{less than 3}) = \frac{2}{6} = \frac{1}{3}$	$P(\text{less than 4}) =$
$P(\text{at most 3}) = \frac{3}{6} = \frac{1}{2}$	$P(\text{at most 4}) =$

1 What is the probability that, when one disc is chosen at random, it:

(red)

(red)

(red)

(blue)

(green)



a is red or blue?

$$P(\text{red or blue}) = \frac{4}{5}$$

b is red and blue?

c is red or shows the number 4?

d is red and shows the number 3?

e shows a number of 2 or more?

f shows a number greater than 3?

2 A standard die is rolled once. What is the probability (as a simple fraction) that the number rolled is: (**Hint:** It helps to list the sample space.)

a even or a 5?

b at most 5?

c even and a 5?

d not 5?

e at least 5?

f odd but not 5?

g greater than 5?

h less than 4 and even?

i less than 5?

j less than 4 or even?

k less than 4 or even but not both?

3 A card is drawn from a standard deck of cards. Calculate:

a $P(\text{red})$

b $P(\text{red OR black})$

c $P(\text{red OR queen, or both})$

d $P(\text{red OR queen, but not both})$

e $P(\text{red AND queen})$

f $P(\text{queen OR multiple of 2})$

g $P(\text{multiple of 2 OR multiple of 3, or both})$

h $P(\text{red AND black})$

i $P(7)$

j $P(\text{not } 7)$

k $P(7 \text{ or } 8)$

l $P(\text{not } 7 \text{ AND not } 8)$

m $P(\text{neither } 7 \text{ nor } 8)$

4 Explain why specifying inclusive/exclusive was not required in parts **b**, **f**, or **k**.

5 A letter is chosen from the word

PROBABILITY

Calculate:

a $P(L)$

b $P(\text{not } L)$

c $P(\text{vowel})$

d $P(\text{consonant})$

e $P(\text{vowel and } B)$

f $P(\text{vowel or consonant})$

- 6 A number between 1 and 60 is randomly picked.

a What is the probability that the number is 8?
b What is the probability that the number is not 8?
c What is the probability that the number is less than 10?
d What is the probability that the number is at least 10?
e What do you notice about your answers to c and d? Explain.
.....
.....

7 NAPLAN Band 8

Shane rolls a standard six-sided die. Which of the following events has a probability of less than 0.5?

- ☐ rolling a number greater than 1
- ☐ rolling an odd number
- ☐ rolling a number less than 6
- ☐ rolling a number greater than or equal to 6

8 NAPLAN Band 8

Claire baked 18 cookies. She baked equal numbers of chocolate chip, macadamia nut and plain cookies. Claire randomly picked one of the cookies. What are the chances it was chocolate chip or plain?

- $\frac{2}{18}$

$\frac{1}{18}$

$\frac{10}{18}$

$\frac{2}{3}$

$\frac{1}{3}$
- ☐ ☐ ☐ ☐ ☐

9 NAPLAN Band 10

Cosette rolls a standard dice 100 times and records the results. She calculates the experimental probability of rolling different numbers on this dice.

- rolling an odd number

0.47
- rolling a 4

0.15
- not rolling a 6

0.88

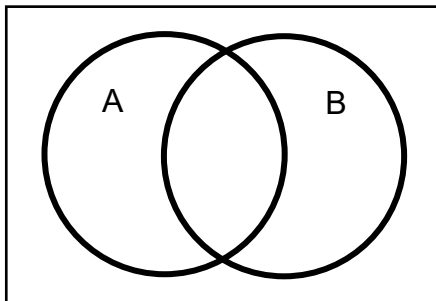
What is the probability of Cosette rolling a 2 on this dice?

PROBABILITY OF COMPOUND EVENTS WITH VENN DIAGRAMS

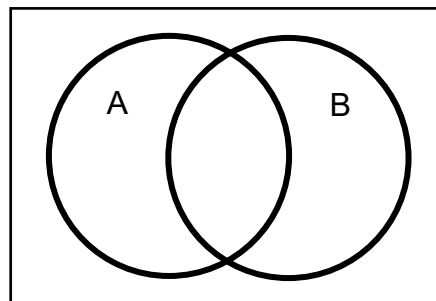
Example Identify compound events with Venn Diagrams.

Shade the area on the Venn diagram that represents:

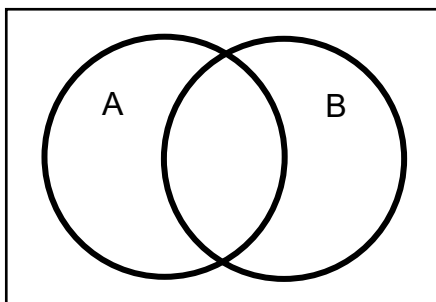
A



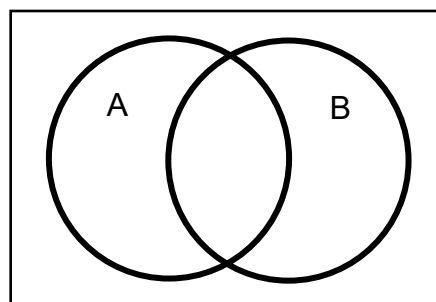
Not A



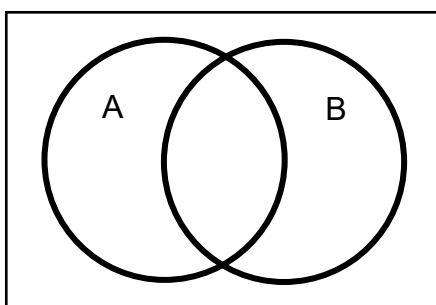
A only



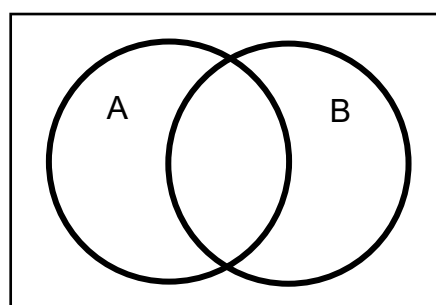
A and B



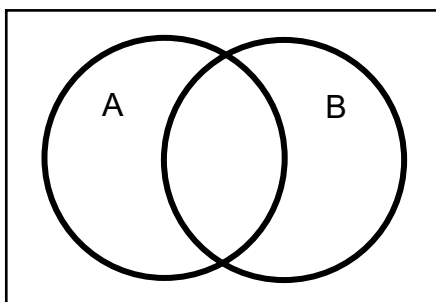
A or B, or both.



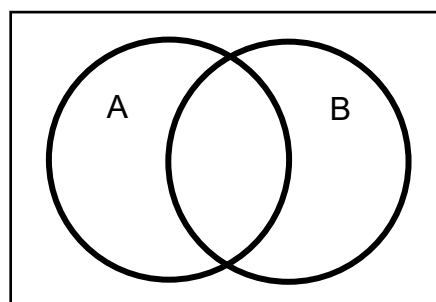
A or B, but not both.



Neither A nor B

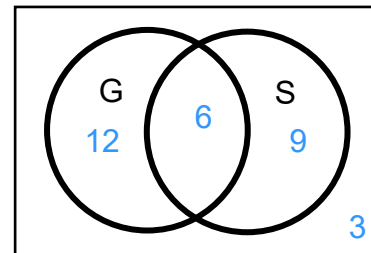
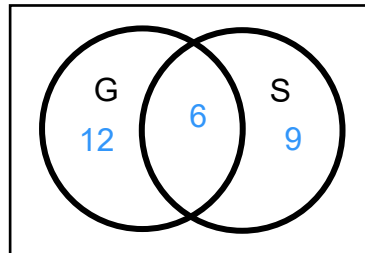
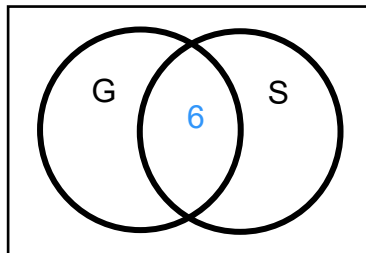


The sample space



Example Calculate probability of compound events using Venn diagrams.

30 students were surveyed on how they relaxed after school.
 18 people play games on their computer.
 15 play sport.
 6 play sports and play on their computer.



If a student is selected at random, find:

$$P(S \text{ only}) = \frac{9}{30} = \frac{3}{10}$$

$$P(S \text{ or } G, \text{ not both}) = \frac{12 + 9}{30} = \frac{21}{30} = \frac{7}{10}$$

$$P(\text{Not } S) = 1 - P(S) = 1 - \frac{15}{30} = \frac{1}{2}$$

How did we work out 9 people play sport only?

..... people play sport and people play both, so 12 people play sport only.

Shade the region on the Venn diagram for S or G but not both.

Why did we subtract $P(S)$ from 1 to find $P(\text{not } S)$?

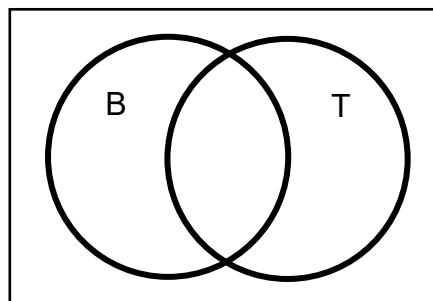
It is more efficient to subtract the event from 1.

12 students were surveyed on whether they take the bus or a train to school.

7 people take the bus.

6 people take the train.

1 person gets driven directly to school.



If a student is selected at random, find:

$P(T \text{ only})$

$P(B \text{ or } T, \text{ or both})$

$P(\text{Not } B)$

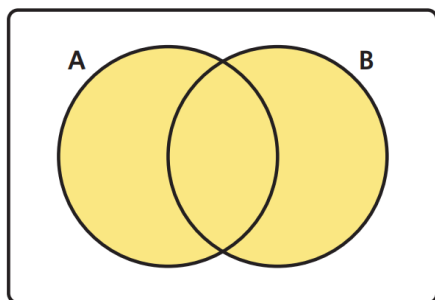
$\frac{1}{3}$

$\frac{11}{12}$

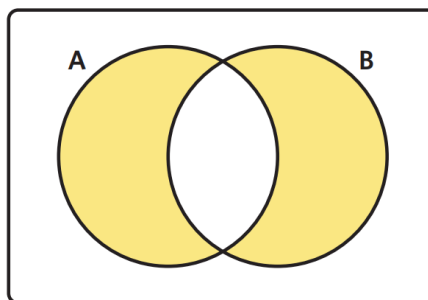
$\frac{5}{12}$

1 Consider these Venn diagrams.

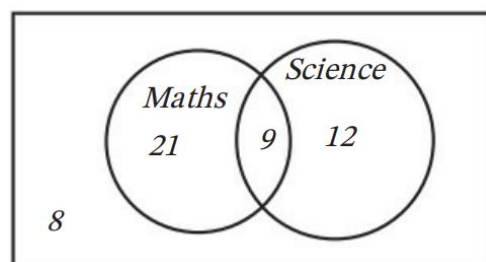
Venn diagram 1:



Venn diagram 2:

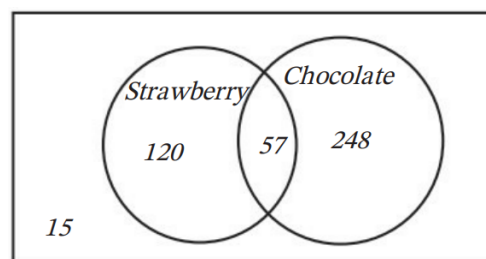


- a Which diagram shows “A or B or both”?
 - b Which diagram shows “A or B but not both”?
 - c What wording tells you whether to use ‘*inclusive or*’ or ‘*exclusive or*’
 - d Draw a third Venn diagram above showing “A and B”.
- 2 A group of students were asked whether they liked Maths or Science. How many students:
- a Were surveyed?
 - b Liked maths but not science?
 - c Liked maths or science, or both?
 - d Liked maths or science, but not both?
 - e Did not like either subject?
 - f Liked maths and science?



3 An ice cream shop surveyed people on popular flavours. How many people:

- a were surveyed?
- b liked strawberry or chocolate, but not both?
- c liked neither strawberry nor chocolate?



4 Some students were surveyed on whether they swim or go to the gym.

a How many students were surveyed?

	Swim	Not Swim	Total
Gym	13	2	15
Not Gym	9	3	12
Total	22	5	27

b How many people don't swim?

c How many students go to the gym or swim, but not both?

d How many students neither swim nor go the gym?

e How many students only swim?

f How many students swim, or gym, or both?

5 Calculate:

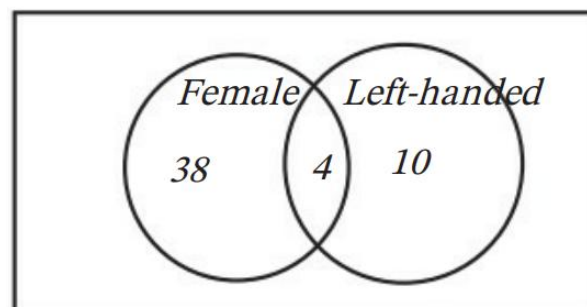
a $P(\text{female})$

b $P(\text{female, not left handed})$

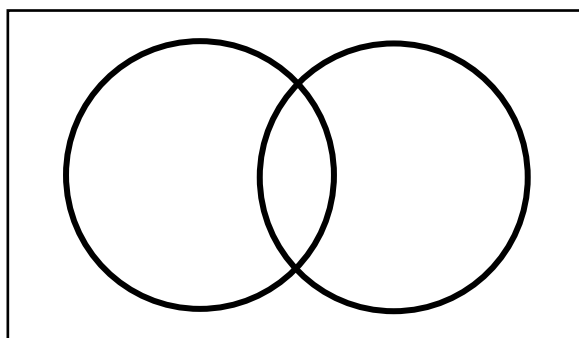
c $P(\text{female or left handed, or both})$

d $P(\text{female or left handed, but not both})$

e $P(\text{not female nor left handed})$



6 In a group of 30 students, 10 play both cricket and soccer, 5 play only cricket and 7 play only soccer. Construct a Venn diagram and two-way table.



			Total
Total			

How many students:

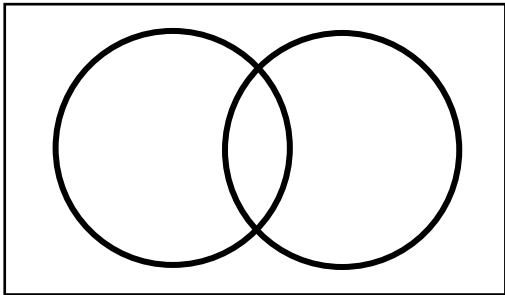
a Play neither cricket nor soccer?

b Play cricket?

c Play cricket or soccer or both?

d Play either cricket or soccer but not both?

7 In a survey of a music class it was found that 9 students played the piano, 4 played the guitar and no students played both piano and guitar. There were 18 students in the class. Construct a Venn diagram and two-way table.

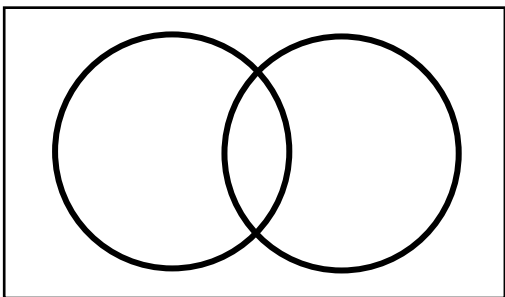


			Total
Total			

How many students:

- a Do not play guitar?
- b Do not play piano?
- c Play at least one instrument?
- d Play at most one instrument?

8 In a class of 30 students, 25 passed the mathematics test, 24 passed the science test and 23 students passed both tests.



			Total
Total			

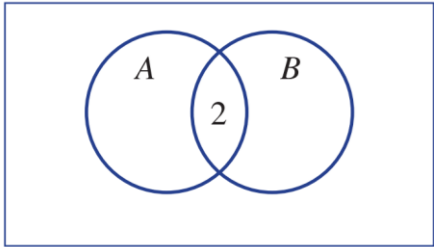
How many students:

a did not pass mathematics?	b did not pass science?
c passed neither mathematics nor science?	d passed mathematics or science or both?
e passed mathematics or science but not both?	f passed mathematics but not science?
g passed science but not mathematics?	h passed at least one subject?
i passed at most one subject?	j failed at least one subject?
k failed at most one subject?	

9 Complete the table and Venn diagram, then calculate the probabilities.

a

	<i>A</i>	Not <i>A</i>	Total
<i>B</i>	2		8
Not <i>B</i>			
Total		7	12



P(*A*)

P(not *A*)

P(*A* and *B*)

P(*A* or *B*, or both)

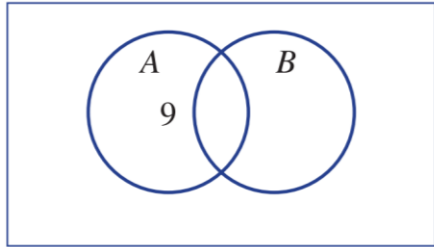
P(*A* or *B*, but not both)

P(*B* only)

P(neither *A* nor *B*)

b

	<i>A</i>	Not <i>A</i>	Total
<i>B</i>		4	
Not <i>B</i>	9		13
Total	12		



P(*A*)

P(not *A*)

P(*A* and *B*)

P(*A* or *B*, or both)

P(*A* or *B*, but not both)

P(*B* only)

P(neither *A* nor *B*)