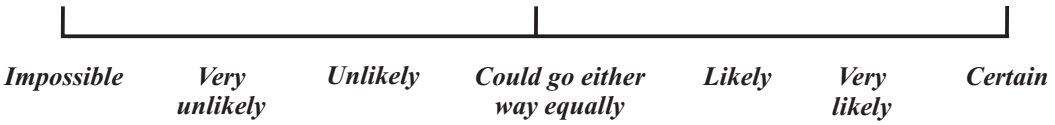
Probability

Probability

Probability is defined as the chance or likelihood of something occurring. We often talk about the probability of certain events occurring.

Examples
What is the chance of rain tomorrow?
What is the likelihood of meeting someone you know at a party?
What is the chance of a player kicking a goal?
What is the chance of tossing a coin and turning up heads?

Whenever probability is discussed the likelihood of the event occurring ranges on a scale from impossible to certain. The diagram below shows this scale.



Examples
It is very unlikely that it will snow in summer.
It is certain that Wednesday will follow Tuesday.
It is impossible to be born on the 30th of February.
It is likely that someone in a class likes chocolate.

In all situations when probability is discussed, there will be a number of possible ***outcomes***.

Examples
When tossing a coin either heads or tails will be the outcome.
The temperature tomorrow will less than 20°, 20° or greater than 20°.
When a baby is born it will be a boy or a girl.
It is equally possible to roll a 1, 2, 3, 4, 5 or 6 on a die.

In the mathematics of probability there are several other terms that are often used.

Equally likely outcomes

When all the possible outcomes of an event have the same probability.

Examples

1. Tossing a coin.
There are two possible outcomes - heads and tails.
There is the same probability of either outcome occurring.

2. Rolling a die.
There are six possible outcomes - 1, 2, 3, 4, 5 or 6.
There is the same probability of any number being rolled.

Outcomes that are not equally likely

When the probability of possible outcomes of an event are not equal.

Examples

1. The winner of a sporting contest.
In many sporting contests the probabilities of the teams/opponents winning are different. There is often a favourite.

2. A class has an uneven number of boys and girls. If a student is chosen randomly the probability of a boy being chosen will be different to that of a girl being chosen.

Sample space

The sample space is the list of all possible outcomes.

Note - { } these brackets are used for a sample space.

Examples

1. Tossing a coin.
Sample space = {heads, tails}

2. Rolling a die.
Sample space = {1, 2, 3, 4, 5, 6}

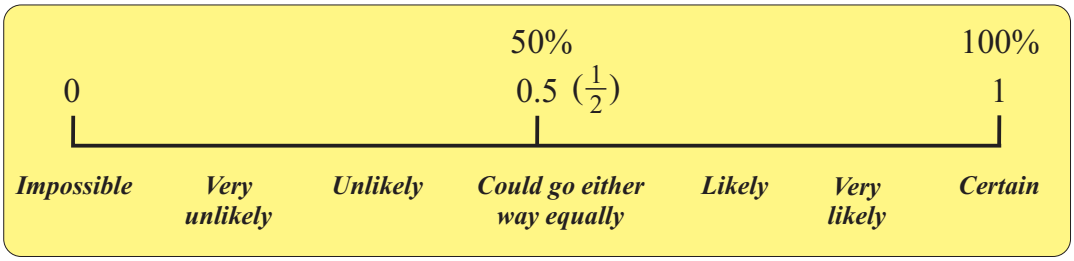
3. Picking a card from a deck of cards and observing the colour.
Sample space = {red, black}

Chance Events
Chance events are events that occur by accident.
Examples
1. Weather events.
2. Car accidents.

Trials and Experiments
To find the probability that a certain outcome will occur, an experiment can be performed that consists of a number of trials.
Example
A company that produces balloons wants to find the probability of a balloon bursting before it reaches a diameter of 40 cm. It could conduct an experiment involving inflating 1000 balloons (1000 trials). If, for example, 13 balloons burst, the company could then state that, based on this experiment, the probability of a balloon bursting before reaching 40 cm in diameter is 13 in 1000.

Favourable Outcomes
A favourable outcome is that outcome for which the probability is being calculated.
Example
A bag contains 11 balls. Three of the balls are black. What is the probability of randomly choosing a black ball?
In this example the favourable outcome is ***choosing a black ball***.

It has been discussed that probability is often referred to in descriptive terms - impossible, unlikely, likely, certain, etc. In mathematics, probability is given a value that can be a decimal, fraction or percentage. As a decimal or fraction, probability will range from 0 (impossible) to 1 (certain). As a percentage it will range from 0 (impossible) to 100% (certain). This can be shown on the scale from earlier.



The higher the value of the probability (closer to 1) the more likely it is to occur.

The lower the value of the probability (closer to 0) the less likely it is to occur.

Examples

Rate the probability of the following events occurring.
Give answers as decimals, fractions and percentages when not 0 or 1.

1. Rolling a 7 on a standard die.
There is ***no chance*** of rolling a 7 on a standard die.
The probability = **0**

2. You will get wet if you fall into the sea.
You will ***definitely*** get wet if you fall into the sea.
The probability = **1**

3. The maximum temperature on New Year's Day in Perth will be above 20°.
It is ***very likely*** that the maximum temperature will be above 20° in Perth on New Year's Day.
The probability would be about 0.9. (This is an estimate)

$$\mathbf{0.9 = \frac{9}{10} = 90\%}$$

Examples continued

4. The maximum temperature on Christmas Day in Sydney will be below 20°.

The maximum temperature is less likely to be below 20° than above 20°.
The probability would be about 0.2. (This is an estimate)

$$\mathbf{0.2} = \frac{\mathbf{2}}{\mathbf{10}} = \frac{\mathbf{1}}{\mathbf{5}} \text{ (simplest form)} = \mathbf{20\%}$$

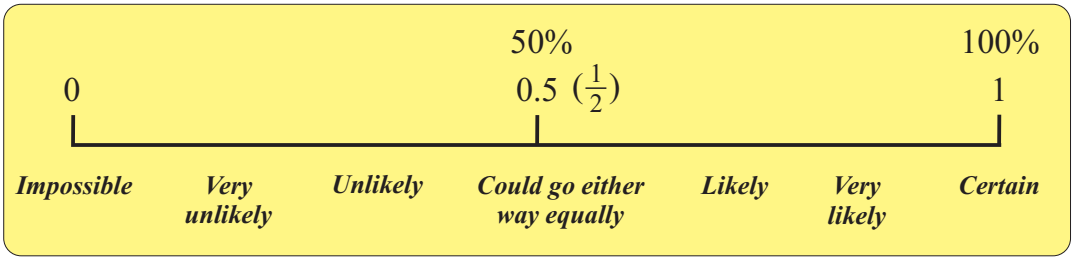
5. When a baby is born it will be a boy.

There is usually a 50-50 chance that a baby will be a boy.
The probability = 0.5.

$$\mathbf{0.5} = \frac{\mathbf{5}}{\mathbf{10}} = \frac{\mathbf{1}}{\mathbf{2}} \text{ (simplest form)} = \mathbf{50\%}$$

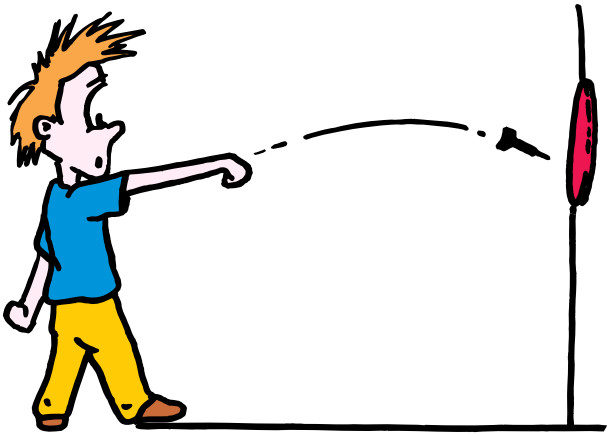
EXERCISE 18A

1. Rate the probability of the following events according to the scale below. For several of the events the answers will vary depending on circumstances. Give answers as decimal numbers.



(a) It will be cloudy tomorrow.
(b) It will rain every day in January.
(c) It will rain every day in July.
(d) It will rain on Melbourne Cup day.
(e) The temperature will be 30°C on Christmas Day.
(f) You will buy a tattslotto ticket and win first division.
(g) Your mathematics teacher will tell a joke today.

(h) If you had one free throw in basketball you will score.
(i) Your mathematics teacher would score from a free throw.
(j) You could throw a cricket ball from 10 metres from the stumps and hit them.
(k) If you threw an egg up into the air and caught it again without it breaking.
(l) You could throw a dart at a dart board and score a bull's-eye.
(m) You could throw a dart at a dart board and hit the board!



(n) March will be the month after February.
(o) Next year will be 2030.
(p) You can guess how many stars are in the box below.
(Count them to see if your guess is correct).

2. List two events (not listed in question 1) that have the following probabilities of occurring:
(a) 0 (b) 0.1 - 0.3 (c) 0.5 (d) 0.6 - 0.8 (e) 1

Finding Probabilities

Write the following probabilities as fractions in their simplest form.

Examples

1. What is the probability of tossing tails on a coin?

There are two possible outcomes - {***heads, tails***}.

Tossing tails is one of these two outcomes.

Tails is ***one*** of the outcomes

The probability of tossing tails = $\frac{1}{2}$

There are ***two*** possible outcomes

The probability of tossing tails = $\mathbf{\frac{1}{2}}$

2. What is the probability of rolling a 6 on a die?

There are six possible outcomes - {***1, 2, 3, 4, 5, 6***}

Rolling a 6 is one of these outcomes

6 is ***one*** of the outcomes

The probability of rolling a 6 = $\mathbf{\frac{1}{6}}$

There are ***six*** possible outcomes

The probability of rolling a 6 = $\mathbf{\frac{1}{6}}$

3. What is the probability of rolling a number less than 3 on a die?

There are six possible outcomes - {***1, 2, 3, 4, 5, 6***}

There are two ways of rolling a number less than 3 - {***1, 2***}

The probability of rolling a number less than 3 $= \frac{2}{6}$

There are ***two*** ways of rolling a number less than 3

There are six possible outcomes

The probability of rolling a number less than 3 $= \frac{2}{6} = \mathbf{\frac{1}{3}}$ (Simplest form)

4. In a year 8 class of 25 students there are 15 boys.
What is the probability of randomly choosing a boy?

There are 25 possible outcomes (25 students in the class).

There are 15 ways of choosing a boy.

The probability of choosing a boy $= \frac{15}{25}$

There are ***15 boys***

There are ***25 students***

The probability of choosing a boy $= \frac{15}{25} = \mathbf{\frac{3}{5}}$ (Simplest form)

5. In a outdoor activity group there are 10 boys and 12 girls. All their names are put in a hat and one drawn to be the group leader. What is the probability the leader will be a girl?

There are 22 possible outcomes (10 boys + 12 girls).

There are 12 ways a girl could be chosen.

The probability of choosing a girl = $\frac{12}{22}$

There are ***12 girls***

There are ***22*** in the group

The probability of choosing a girl = $\frac{12}{22} = \mathbf{\frac{6}{11}}$ (Simplest form)

6. Damon was practising free throw shooting at basketball training. He had 40 free throws and 28 went in.

(a) Based on these figures what is the probability that when Damon shoots a free throw he scores?

(b) If Damon attempted 30 free throws, based on this probability, how many would be expected to go in?

Answers

(a) The probability of scoring a free throw = $\frac{28}{40}$

28 scored

40 attempts

The probability of scoring a free throw = $\frac{28}{40} = \mathbf{\frac{7}{10}}$ (Simplest form)

(b) If Damon had 30 free throws he would expect to score:

$$\frac{7}{10} \times 30$$

$$= \mathbf{21\ scores}$$

7. A box contains 8 black balls and 6 white balls.

(a) A ball is chosen at random. What is the probability that it is a white ball?

(b) This white ball is not placed back in the box and another ball is randomly chosen. What is the probability that it is also white?

Answers

(a) There are 14 possible outcomes (8 black balls + 6 white balls).

There are 6 ways a white ball could be chosen.

The probability of choosing a white ball = $\frac{6}{14}$

There are ***6 white balls***

There are ***14 balls*** in the box

The probability of choosing a white ball = $\frac{6}{14} = \mathbf{\frac{3}{8}}$ (Simplest form)

(b) With one white ball already chosen there are only 5 white balls remaining.

There are now 13 possible outcomes (8 black balls + 5 white balls).

There are 5 ways a white ball could be chosen.

The probability of choosing a white ball = $\frac{5}{13}$

There are ***5 white balls***

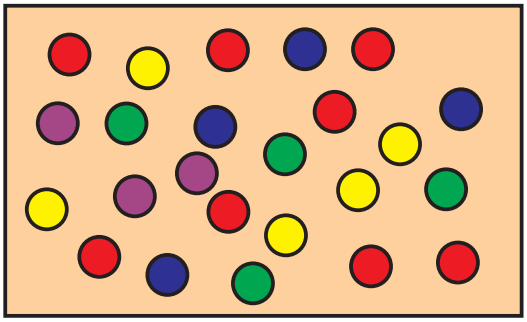
There are ***13 balls*** in the box

The probability of choosing a white ball = $\mathbf{\frac{5}{13}}$ (Simplest form)

EXERCISE 18B

Give answers to the following problems as fractions in their simplest form.

1. Find the probability of:
(a) rolling a number greater than 4 on a die.
(b) rolling a number less than 6 on a die.
(c) rolling a number greater than 6 on a die.
(d) rolling a number less than 5 on a die.
(e) rolling a number less than 7 on a die.
(f) tossing tails on a coin.
(g) randomly choosing a red ball from this box.
(h) randomly choosing a white ball from this box.
(i) randomly choosing a yellow ball from this box.



2. Sachin bought a bag of sweets that contained 10 chocolates and 8 caramels, all wrapped in paper. Sachin chooses a sweet at random.
(a) What is the probability that the sweet will be a:
(i) chocolate? (ii) caramel?
(b) After eating 2 chocolates he offers the bag to a friend who chooses a sweet at random. What is the probability that the sweet that Sachin's friend chooses is a:
(i) chocolate? (ii) caramel?

3. Jonas has 10 pairs of socks - 6 black and 4 brown.
(a) One Monday morning he chooses a pair at random. What is the probability that the pair is:
(i) black? (ii) brown?
(b) If he chose a brown pair on Monday, what is the probability that on Tuesday he will choose a:
(i) black pair? (ii) brown pair?
(c) He ended up wearing brown socks on Monday, Tuesday, Wednesday and Thursday. What is the probability that on Friday the pair he chooses is:
(i) black? (ii) brown?

4. Sandie and Celine were practising their goal shooting at netball.
Sandie had 80 shots at goal and 60 went in.
Celine had 60 shots and 45 went in.
(a) Use these statistics to find the probability that each player will score a goal.
(b) If Sandie had 100 shots at goal, how many would be expected to score a goal?

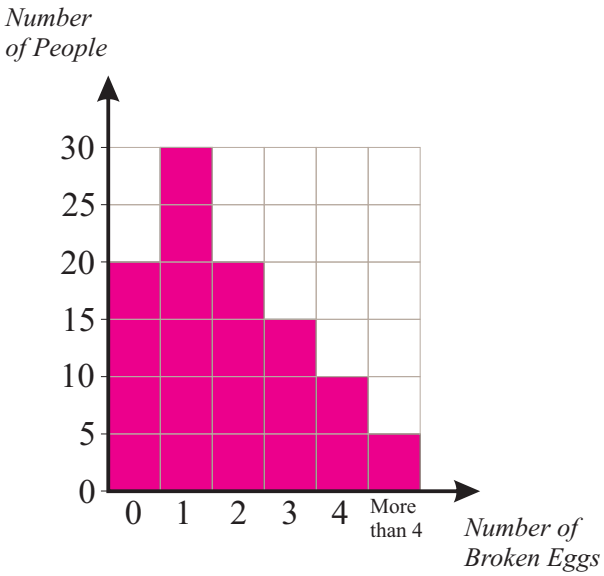
5. Find the probability that in any year your birthday will be:
(a) on a Thursday.
(b) on a weekend.
(c) on a week day.
(d) in March.

6. What is the probability that a letter chosen at random from the alphabet will be a:
(a) vowel?
(b) consonant?

7. As part of the fund raising for the local library there was a raffle with 500 tickets that each cost $2. There were three prizes to be won.
(a) Trevor bought one ticket.
(i) What is the probability that Trevor won first prize?
(ii) What is the probability that Trevor won a prize?
(b) Ed bought 10 tickets. What is the probability that Ed won first prize?
(c) Gwen really wanted to win the first prize. She bought $100 worth of tickets. What is the probability that Gwen won first prize?
(d) John wanted to buy enough tickets to have a one in four chance of winning first prize (probability of $\frac{1}{4}$). How much will he need to spend on tickets?

8. Taomi went to a circus where there was a game that required balls to be thrown into boxes. There were 15 blue boxes, 4 red boxes and 1 white box. Every ball that was thrown landed in a box.
If a ball lands in the white box you win two cinema tickets.
If a ball lands in a red box you win a teddy bear.
If a ball lands in a blue box you don't win a prize.
If Taomi throws one ball randomly:
(a) what is the probability that she wins the cinema tickets?
(b) what is the probability that she wins a teddy bear?
(c) what is the probability that she wins a prize?

9. The Choc-a-Lot company produces boxes of Easter eggs. People who bought the boxes of Easter eggs were asked how many of the eggs were broken in the box they bought.
The information from these people is shown in this graph.
Use this information to find the probability that in a box of the Easter eggs there will be:
(a) none broken.
(b) one broken.
(c) more than one broken.
(d) less than 4 broken.



As discussed earlier, probabilities can be expressed as fractions, decimals or percentages.

Example

Kate has five keys on her key ring and in the dark she randomly tries one to open her front door.
What is the probability that she chooses the correct key?

There is one correct key.

$$\text{Probability} = \frac{1}{5}$$

There are five from which to choose.

This probability could also be expressed as a decimal and a percentage.

As a decimal the probability of choosing the correct key = **0.2**
As a percentage the probability of choosing the correct key = **20%**

EXERCISE 18C

Write the following probabilities as:
(a) fractions (b) decimals (c) percentages

1. What is the probability of rolling a number ***less than*** **4** on a die?

2. Liam is sitting a multiple choice test where there are four answers for each question - **A**, **B**, **C** and **D**. He doesn't know one question so he guesses the answer. What is the probability of guessing the ***correct*** answer?

3. Jenny, Harry, James, Olive and Eve all want to be captain of their netball team. They put their names in a hat and choose one randomly.
What is the probability the captain will be a ***boy***?

4. From a litter of 10 puppies three were males. Kylie chooses one randomly.
What is the probability it will be a ***male***?

5. What is the probability of rolling a **3** on a die? Round the decimal and percentage correct to one decimal place.

Complementary Events

Example

In a deck of cards there are four suits - hearts, diamonds, clubs and spades. If a card is chosen randomly, what is the probability it will be a heart?

Probability of choosing a heart = $\frac{1}{4}$, **0.25** or **25%**

The probability of ***not*** choosing a heart is called the ***complementary probability***.
In all situations the probability of an event occurring plus the probability of the complementary event occurring equals one.

The probability of an event occurring	+	***The probability of the complementary event occurring***	= **1**

In the above example the complementary event would be randomly choosing a card that is ***not a heart***.

Probability of ***not*** choosing a heart = $\frac{3}{4}$, **0.75** or **75%**

EXERCISE 18D

The following questions are the complementary events for the questions in Exercise 18C. Write the probabilities as:
(a) fractions (b) decimals (c) percentages

1. What is the probability of rolling a number **4**, **5** or **6** on a die?

2. Liam is sitting a multiple choice test where there are four answers for each question - **A**, **B**, **C** and **D**. He doesn't know one question so he guesses the answer. What is the probability of ***not*** guessing the correct answer?

3. Jenny, Harry, James, Olive and Eve all want to be captain of their netball team. They put their names in a hat and choose one randomly.
What is the probability the captain will be a ***girl***?

4. From a litter of 10 puppies three were males. Kylie chooses one randomly.
What is the probability it will be a ***female***?

5. What is the probability of ***not*** rolling a 3 on a die? Round the decimal and percentage correct to one decimal place.

EXERCISE 18E

1. The weather forecast predicted a 30% probability of rain.
What is the probability it will ***not*** rain?

2. Sharon had calculated that she had a 65% probability of scoring a free throw in basketball. Based on this figure, what is the probability she will miss a free throw?

3. In a deck of cards there are 52 cards. Of these there are four aces.
(a) If a card is drawn at random, what is the probability it is an ace? Give answer as a fraction in its simplest form.
(b) If a card is drawn at random, what is the probability it is ***not*** an ace? Give answer as a fraction in its simplest form.

4. In a group of 20 people there were two left-handers.
(a) If a person is chosen at random, what is the probability they will be left-handed? Give answer as a decimal.
(b) If a person is chosen at random, what is the probability they will be right-handed? Give answer as a decimal.

5. A potter found that for every 50 vases that he made, 4 cracked in the kiln.
(a) Based on these figures, what is the probability that a vase will crack when placed in the kiln to dry? Give answer as:
(i) fraction in its simplest from (ii) decimal (iii) percentage
(b) Based on these figures, what is the probability that a vase will ***not*** crack when placed in the kiln to dry? Give answer as:
(i) fraction in its simplest form (ii) decimal (iii) percentage

Listing Outcomes

In some situations it is convenient to list all possible outcomes when finding the probability of a certain outcome.

Example

(a) List all the numbers that can be formed using the digits 1, 2 & 3?

(b) What is the probability that if one of these is chosen at random it is an even number?

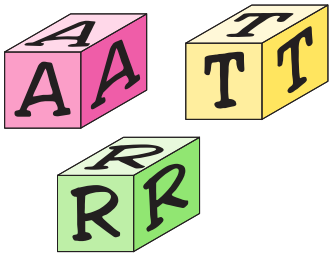
Answers

(a) **123, 132, 213, 231, 312, 321**

(b) 132 and 312 are the only even numbers = 2 out of 6 = $\frac{2}{6} = \frac{1}{3}$

EXERCISE 18F

1. A child is playing with the three blocks shown here and arranges them in a line.



(a) List all the different combinations of the three letters that could be formed.

(b) What is the probability that the child could form an actual word?

2. A game at a show involved putting two balls, one at a time, into the mouth of a clown machine. The balls would then drop into numbered boxes. The boxes were numbered 1, 5, 7 and 10.

(a) List all the combinations of numbers that could be achieved with the two balls. (Note - 1,5 is different from 5,1)

The two numbers are added and the following totals receive the prizes shown.

An even total receives a chocolate bar.

An odd total receives an ice-cream.

A total over 15 receives a show bag.

(b) Find the sum of the numbers for each pair in part (a).

(c) What is the probability of someone winning a chocolate bar?

(d) What is the probability of someone winning an ice-cream?

(e) What is the probability of someone winning a show bag?

3. Herchelle was a contestant on the game show 'Guess It - Win It'. If he correctly guessed the cost of a holiday he would win the holiday. He was given three clues for the cost.

> ***1. It was between $3000 and $7000.***
> ***2. It was an odd number.***
> ***3. It contained the digits 2, 3, 5 and 7.***

(a) Using these clues, list all the possible combinations of numbers for the cost of the holiday.
(b) What is the probability that Herchelle won the holiday?

4. Jane Bond is a secret agent who finds herself in a room from which she needs to escape. There are four doors (**A**, **B**, **C** and **D**) from the room. Behind each door is a tunnel (**T**), a rope to climb (**R**) and a pole (**P**) to slide down. Only one of the paths leading from the room is the escape route.

(a) Using the abbreviations (**A**, **B**, **C**, **D**, **T**, **R**, **P**), list all the possible escape routes. (**AT**, **AR**, etc)
(b) What is the probability that Jane escapes?
(c) What is the probability that Jane does not escape?

5. Secret Agent Jane Bond is in another life and death situation! A bomb is about to explode and Jane needs to disarm it. There are three control panels on the bomb and she needs to press the correct button on each panel to stop the bomb from exploding.
The first panel has three buttons - a red, a yellow and a green (**R**, **Y**, **G**).
The second panel has four buttons numbered from **1** to **4** (**1**, **2**, **3**, **4**).
The third panel has two buttons - a black and a white (**B**, **W**).
(a) Using the abbreviations, list all the possible combinations of pressing the buttons. (**R1B**, **R1W**, **R2B**, etc)
(b) What is the probability that Jane selects the correct combination?
(c) What is the probability that the bomb explodes?
(d) If Jane gets the first and second buttons correct, what is the probability that she disarms the bomb?

Combined Probability

Example

Saffy wants to go sailing at the weekend. The probability that the weather will be safe enough to sail on a particular day is 0.6.

1. What is the probability she can sail on both days?
2. What is the probability she can sail on one day only?
3. What is the probability she can sail on at least one day?
4. What is the probability she ***cannot*** sail on either day of the weekend?

Solution

Step 1 List all the possible outcomes.

In this example use **S** to represent safe enough to sail and **N** to represent not safe enough to sail.

Possible outcomes	
Saturday	***Sunday***
S	**S**
S	**N**
N	**S**
N	**N**

Step 2 List the probabilities for all the possible outcomes.
(Remember the two probabilities add to 1)

Probability of **S** = 0.6
Probability of **N** = 0.4

SS = 0.6 and 0.6
SN = 0.6 and 0.4
NS = 0.4 and 0.6
NN = 0.4 and 0.4

Continued on next page

In the mathematics of probability it is important to know the following.

'and' = ×
'or' = +

Step 3 Calculate the probabilities.

1. What is the probability she can sail on both days (**SS**)?

SS = 0.6 ***and*** 0.6
Probability of **SS** = 0.6 × 0.6
= **0.36**

'and' = ×

2. What is the probability she can sail on one day only?
This can happen two ways: **SN** or **NS**

SN = 0.6 ***and*** 0.4
NS = 0.4 ***and*** 0.6
Probability of **SN** = 0.6 × 0.4
= **0.24**
Probability of **NS** = 0.4 × 0.6
= **0.24**

'and' = ×

Probability of **SN** ***or*** **NS** = 0.24 + 0.24
= **0.48**

'or' = +

3. What is the probability she can sail on at least one day?
This means one day or both days: **SN** or **NS** or **SS**

Probability of **SN** = **0.24**
Probability of **NS** = **0.24**
Probability of **SS** = **0.36**

Probability of **SN** ***or*** **NS** ***or*** **SS** = 0.24 + 0.24 + 0.36
= **0.84**

'or' = +

Continued on next page

4. What is the probability she ***cannot*** sail on either day of the weekend (**NN**)?

NN = 0.4 ***and*** 0.4

Probability of **NN** = 0.4 × 0.4

= **0.16**

'and' = ×

It can be seen that the sum of the probabilities of all of the possible outcomes should equal 1.
This can be used as a check of the answers.

Probability of **SS** = 0.36
Probability of **SN** = 0.24
Probability of **NS** = 0.24
Probability of **NN** = 0.16

0.36 + 0.24 + 0.24 + 0.16 = 1

EXERCISE 18G

1. The probability that Bree scores from a free throw in basketball is 0.7. Bree has two free throws.
(a) What is the probability she scores just one free throw?
(b) What is the probability she scores both free throws?
(c) What is the probability she scores at least one free throw?
(d) What is the probability she scores no free throws?

2. Harley caught a tram into the city on Monday and Tuesday to study. He calculated that the probability of getting a seat on a tram was 0.9.
(a) What is the probability he would get a seat on just one day?
(b) What is the probability he would get a seat on both days?
(c) What is the probability he would get a seat on at least one day?
(d) What is the probability he would not get a seat on either day?

3. Holly has five different coloured pairs of socks - ***red***, ***green***, ***blue***, ***yellow*** and ***pink***. She also has five different coloured shorts - ***red***, ***green***, ***blue***, ***yellow*** and ***pink***. One day she randomly chooses a pair of socks and shorts.

(a) What is the probability the socks will be ***pink***?
Give answer as a decimal.

(b) What is the probability the shorts will be ***pink***?
Give answer as a decimal.

(c) What is the probability they will both be ***pink***?

(d) What is the probability that neither will be ***pink***?

(e) What is the probability they will both be ***red***?

4. Bindi is a wildlife guide and conducts night walks in a park to spot animals.
She says the probability of seeing a sugar glider on any night is 0.3.
Zana and Kiama go out with Bindi on two nights to hopefully see a sugar glider.

(a) What is the probability they will see a sugar glider on at least one of the nights?

(b) What is the probability they will see a sugar glider on both nights?

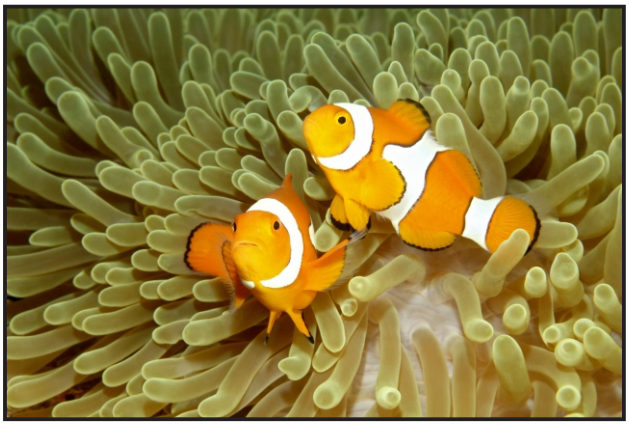
(c) What is the probability they will not see a sugar glider on either night?

5. Hervey bought two clownfish for his aquarium - one male and one female. He was told that clownfish had a 10% chance of changing sex when placed in a new environment. Give the following answers as decimals and percentages.

(a) What is the probability that Hervey will end up with two males?

(b) What is the probability that Hervey will end up with two females?

(c) What is the probability that Hervey will end up with one male and one female?



Two-way Tables

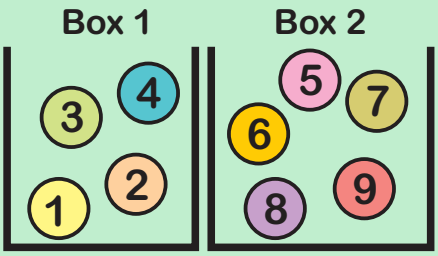
Two-way tables can be used when there is a large number of possible outcomes.

Example 1

A ball is chosen at random from each of these boxes and the numbers ***added***.

1. What is the probability that the sum of the numbers is greater than 10?

2. What is the probability that the sum of the numbers is equal to 10?



Step 1 Construct a two-way table as shown here.

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

Total number of outcomes = 20

Step 2 Use this to find the probabilities.

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

6 of the 20 outcomes are greater than 10

1. The probability that the sum of the numbers is greater than 10 $= \frac{6}{20} = \mathbf{\frac{3}{10}}$ (Simplest form)

		Box 1			
		1	2	3	4
Box 2	5	6	7	8	9
	6	7	8	9	10
	7	8	9	10	11
	8	9	10	11	12
	9	10	11	12	13

4 of the 20 outcomes are equal to 10

2. The probability that the sum of the numbers is equal to 10 $= \frac{4}{20} = \frac{\mathbf{1}}{\mathbf{5}}$ (Simplest form)

Example 2

The names of the players in two mixed basketball teams are shown below.

The Beebees: Adam, Jenny, Ben, Damien and Kate
The Hotshots: Andrew, William, Emma, Brooke, James and Mike

After these teams play each other, one player is chosen from each team to score the next game in the competition. If one player is chosen at random from each team, what is the probability they will both be boys?

Solution

Using the letters **B** (boys) and **G** (girls) construct a two-way table.

		Beebees				
		B	G	B	B	G
Hotshots	B	BB	BG	BB	BB	BG
	B	BB	BG	BB	BB	BG
	G	GB	GG	GB	GB	GG
	G	GB	GG	GB	GB	GG
	B	BB	BG	BB	BB	BG
	B	BB	BG	BB	BB	BG

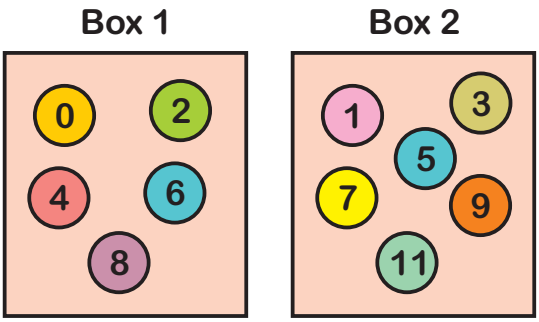
12 of the 30 possible outcomes are both boys

The probability that they are both boys $= \frac{12}{30} = \frac{\mathbf{2}}{\mathbf{5}}$ (Simplest form)

EXERCISE 18H

Write the answers to the following questions as fractions in their simplest form.

1. A ball is taken at random from each of these boxes and the numbers are ***added***.



(a) Construct a two-way table to show all the possible outcomes.
(b) What is the probability that the sum of the two numbers is less than 12?
(c) What is the probability the sum of the two numbers is equal to 9?
(d) What is the probability the sum of the two numbers is greater than 5?

2. A ball is taken at random from each of the boxes in question 1 and the numbers are ***multiplied***.
(a) Construct a two-way table to show all the possible outcomes.
(b) What is the probability that the product of the two numbers is less than 50?
(c) What is the probability the product of the two numbers is equal to 50?
(d) What is the probability the product of the two numbers is greater than 70?

3. Tammy has five skirts in one drawer - ***blue***, ***green***, ***pink***, ***red*** and ***orange***.
She has five shirts in another drawer that are the same colours as the skirts - ***blue***, ***green***, ***pink***, ***red*** and ***orange***.
One morning, in the dark, she randomly chooses a skirt and shirt.
(a) Construct a two-way table to show all the possible outcomes for the combinations of skirt and shirt.
(b) What is the probability that she chose the ***green*** skirt and the ***red*** shirt?
(c) What is the probability that she chose two colours that were the same?
(d) What is the probability that she chose a ***blue*** and ***orange*** combination?

(e) What is the probability that she chose two colours that were different?
(f) What is the probability that ***at least*** one item of clothing was ***pink***?

4. Two dice are rolled and the numbers are ***added***.

(a) Construct a two-way table to show all the possible outcomes.
(b) What is the probability that the sum of the two numbers is 5?
(c) What is the probability that the sum of the two numbers is less than 5?
(d) What is the probability that the sum of the two numbers is greater than 8?
(e) What is the probability that the sum of the two numbers is an even number?
(f) What is the probability that the sum of the two numbers is an odd number?
(g) What sum/s of the numbers has the highest probability of occurring?
(h) What sum/s of the numbers has the lowest probability of occurring?

5. Two dice are rolled and the numbers are ***multiplied***.
(a) Construct a two-way table to show all the possible outcomes.
(b) What is the probability that the product of the two numbers is 12?
(c) What is the probability that the product of the two numbers is less than 20?
(d) What is the probability that the product of the two numbers is greater than 20?
(e) What is the probability that the product of the two numbers is between 10 and 20?
(f) What is the probability that the product of the two numbers is a single digit number?
(g) What is the probability that the product of the two numbers is an even number?
(h) What is the probability that the product of the two numbers is an odd number?
(i) What product/s of the numbers has the highest probability of occurring?
(j) What product/s of the numbers has the lowest probability of occurring?

Another type of two-way table can be used when data from surveys, for example, is being displayed.

Example

A number of boys and girls at a school were asked if they would prefer indoor or outdoor activities at lunch.

45 boys were asked and 10 of these preferred indoor activities.
55 girls were asked and 30 of these preferred indoor activities.

This information can be displayed on the two-way table shown below.

	Boys	***Girls***	***Total***
Indoor	10	25	
Outdoor			
Total	45	55	

The table can be completed by calculating the other numbers.
The number of boys who prefer outdoor activities = 45 - 10 = 35
The number of girls who prefer outdoor activities = 55 - 25 = 30
The total number of students who prefer indoor activities = 10 + 25 = 35
The total number of students who prefer outdoor activities = 35 + 30 = 65
The total number of students surveyed = 45 + 55 = 35 + 65 = 100

	Boys	***Girls***	***Total***
Indoor	10	25	35
Outdoor	35	30	65
Total	45	55	100

These figures can then be used to find probabilities. ***See next page***

	Boys	*Girls*	*Total*
Indoor	10	25	35
Outdoor	35	30	65
Total	45	55	100

Use this information to find the following probabilities.
Give answers as fractions in their simplest form.

1. What is the probability that a boy prefers an outdoor activity?

2. What is the probability that someone who prefers an indoor activity is a girl?

3. What is the probability that a student prefers an outdoor activity?

Solutions

1. The probability that a boy prefers an outdoor activity $= \frac{35}{45} = \frac{\mathbf{7}}{\mathbf{9}}$

number of boys who prefer an outdoor activity

total number of boys

2. The probability that someone who prefers an indoor activity is a girl $= \frac{25}{35} = \frac{\mathbf{5}}{\mathbf{7}}$

number of girls who prefer an indoor activity

total number of students who prefer an indoor activity

3. The probability that a student prefers an outdoor activity $= \frac{65}{100} = \frac{\mathbf{13}}{\mathbf{50}}$

number of students who prefer an outdoor activity

total number of students

EXERCISE 18I

Give all probabilities as fractions in their simplest form.

1. 80 students were asked if they wanted to visit a zoo or a museum.
50 of the students asked were boys and 30 of these wanted to visit a museum.
20 of the girls asked wanted to visit a zoo.
(a) Copy and complete the table below displaying this information.

	Boys	*Girls*	*Total*
Zoo			
Museum			
Total			

(b) What was the probability that a student wanted to visit a zoo?
(c) What was the probability that a girl wanted to visit a museum?
(d) What was the probability that a student who wanted to visit a zoo was a boy?

2. A number of students and parents were asked if a school lunch shop should add more healthy meals to the menu.
Of the 40 students asked 15 agreed that there should be more healthy meals.
Of the 60 parents asked 50 agreed that there should be more healthy meals.
(a) Copy and complete the table below displaying this information.

	Students	*Parents*	*Total*
Agreed			
Did not agree			
Total			

(b) What was the probability that a student agreed that there should be more healthy meals?
(c) What was the probability that a parent did not think there needed to be more healthy meals?
(d) What was the probability that one of the people asked agreed that there should be more healthy meals?

3. 100 bowlers from different cricket clubs were surveyed.
24 of the 100 were left-handed.
62 of the 100 were fast bowlers.
10 of the left-handed bowlers were slow bowlers.
(a) Copy and complete the table below displaying this information.

	Left-handed	***Right-handed***	***Total***
Fast			
Slow			
Total			

Based on these figures:
(b) what is the probability that a left-handed bowler is a slow bowler?
(c) what is the probability that a bowler is a fast bowler?
(d) what is the probability that a fast bowler is right-handed?
(e) what is the probability that a bowler is left-handed?

4. 200 shoppers in a supermarket were surveyed.
160 of the 200 were females.
30 males spent less than $100.
120 of the shoppers spent more than $100.
(a) Copy and complete the table below displaying this information.

	Female	***Male***	***Total***
Spent less than $100			
Spent more than $100			
Total			

Based on these figures:
(b) what is the probability that a female shopper spent less than $100?
(c) what is the probability that a male shopper spent more than $100?
(d) what is the probability that a shopper was male?
(e) what is the probability that a shopper spent more than $100?

Venn Diagrams

Venn diagrams are another way of representing data and providing a way to help calculate probabilities.

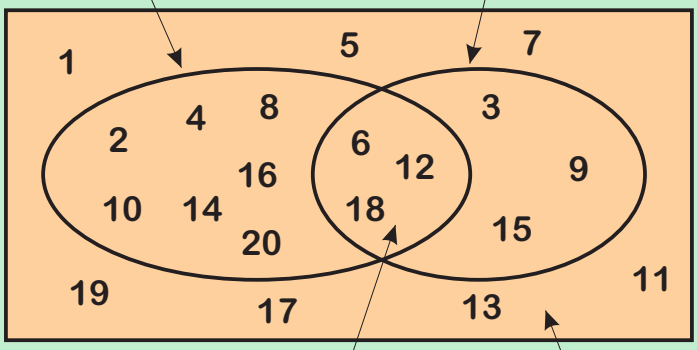
Example 1

From the numbers 1-20 a number is chosen at random.
(a) What is the probability that it is a multiple of 2?
(b) What is the probability that it is a multiple of 3?
(c) What is the probability that it is a multiple of 2 ***and*** 3?
(d) What is the probability that it is ***not*** a multiple of 2 ***or*** 3?
(e) What is the probability that it is a multiple of 2 but ***not*** 3?
(f) What is the probability that it is a multiple of 3 but ***not*** 2?
(g) Given that the number is ***greater*** than 12, what is the probability that it is a multiple of 3?
(h) Given that the number is ***less*** than 10, what is the probability that it is a multiple of 2 and 3?

The Venn diagram for this problem is shown below.

Numbers in this ellipse are multiples of 2.

Numbers in this ellipse are multiples of 3.



Numbers in the section where the two ellipses overlap are multiples of 2 and 3.

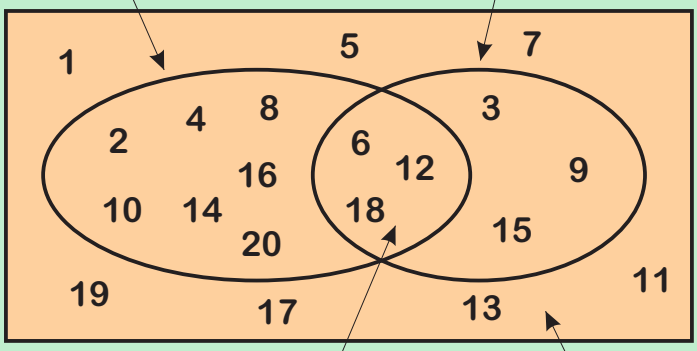
Numbers outside the ellipses are ***not*** multiples of 2 or 3.

Continued on next page

To calculate the probabilities, the number of numbers in each section need to be stated.

10 numbers in this ellipse (multiples of 2)

6 numbers in this ellipse (multiples of 3)



3 numbers in the section where the two ellipses overlap (multiples of 2 and 3)

7 numbers outside the ellipses (not multiples of 2 or 3)

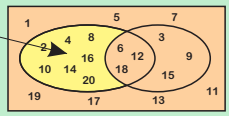
(a) Probability that it is a multiple of 2 $= \frac{10}{20} = \mathbf{\frac{1}{2}}$ (Simplest form)

(b) Probability that it is a multiple of 3 $= \frac{6}{20} = \mathbf{\frac{3}{10}}$ (Simplest form)

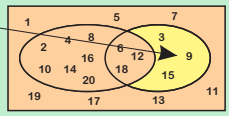
(c) Probability that it is a multiple of 2 ***and*** 3 $= \mathbf{\frac{3}{20}}$

(d) Probability that it is ***not*** a multiple of 2 ***or*** 3? $= \mathbf{\frac{7}{20}}$

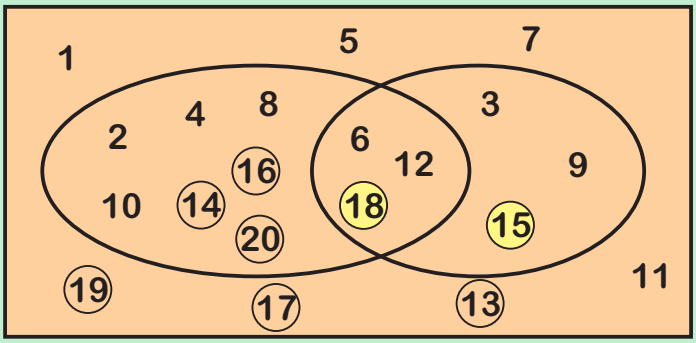
(e) Probability that it is a multiple of 2 but ***not*** 3? $= \mathbf{\frac{7}{20}}$



(f) Probability that it is a multiple of 3 but ***not*** 2? $= \mathbf{\frac{3}{20}}$

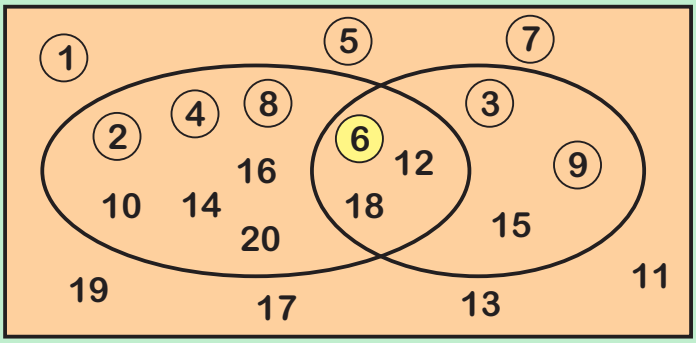


(g) Given that the number is ***greater*** than 12, what is the probability that it is a multiple of 3?
This means that the number chosen is greater than 12. There are eight numbers greater than 12 and these are circled below.
The numbers from these that are multiples of 3 are coloured. There are two of these.



Given that the number is ***greater*** than 12, the probability that it is a multiple of 3 $= \frac{2}{8} = \frac{1}{4}$ (Simplest form)

(h) Given that the number is ***less*** than 10, what is the probability that it is a multiple of 2 and 3?
This means that the number chosen is less than 10. There are nine numbers less than 10 and these are circled below.
The numbers from these that are multiples of 2 and 3 are coloured. There is one of these.



Given that the number is ***less*** than 10, the probability that it is a multiple of 2 and 3 $= \frac{1}{9}$

EXERCISE 18J

1. (a) Draw a Venn diagram with two ellipses. Write all the numbers from 1 to 20 such that:
* One ellipse shows the numbers that are multiples of 3.
* The other ellipse shows the numbers that are multiples of 4.
* Note there will be some numbers in the section where the two ellipses overlap.

From the numbers 1-20, a number is chosen at random.
(b) What is the probability that it is a multiple of 3?
(c) What is the probability that it is a multiple of 4?
(d) What is the probability that it is a multiple of 3 ***and*** 4?
(e) What is the probability that it is ***not*** a multiple of 3 ***or*** 4?
(f) What is the probability that it is a multiple of 3 but ***not*** 4?
(g) Given that the number is ***greate***r than 10, what is the probability that it is a multiple of 3?
(h) Given that the number is ***greater*** than 10, what is the probability that it is a multiple of 4?
(i) Given that the number is ***greater*** than 10, what is the probability that it is a multiple of 3 and 4?
(j) Given that the number is ***greater*** than 10, what is the probability that it is a multiple of 3 or 4?
(k) Given that the number is ***less*** than 10, what is the probability that it is a multiple of 3?
(l) Given that the number is ***less*** than 10, what is the probability that it is a multiple of 3 and 4?

2. (a) Draw a Venn diagram with two ellipses that shows the following.
* All the numbers from 1 to 30.
* One ellipse shows all the numbers that are multiples of 4.
* The other ellipse shows all the numbers that are multiples of 5.

From the numbers 1-30 a number is chosen at random.
(b) What is the probability that it is a multiple of 4?
(c) What is the probability that it is a multiple of 4 ***and*** 5?
(d) What is the probability that it is a multiple of 4 ***or*** 5?
(e) What is the probability that it is ***not*** a multiple of 4?
(f) What is the probability that it is a multiple of 4 but ***not*** 5?
(g) Given that the number is ***greate***r than 10, what is the probability that it is a multiple of 4?
(h) Given that the number is ***less*** than 16, what is the probability that it is a multiple of 5?

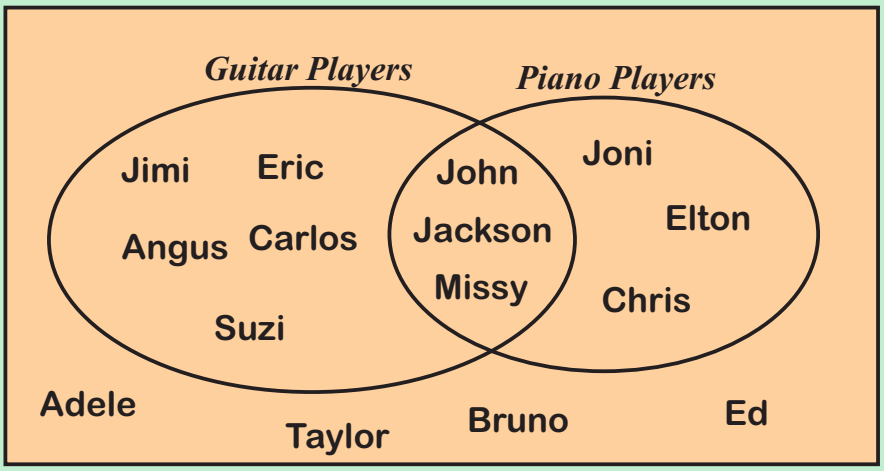
Example 2

15 people attended a music camp.
Jimi, Eric, Carlos, Suzi and Angus played guitar.
Elton, Joni and Chris played piano.
John, Jackson and Missy played guitar and piano.
Adele, Taylor, Bruno and Ed did not play guitar or piano.

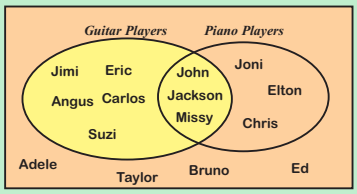
1. Draw a Venn diagram to display this information.
2. A person is chosen at random from the group. Find the probability of the following.
(a) The person plays guitar.
(b) The person does not play guitar.
(c) The person plays guitar or piano.
(d) The person only plays piano.
(e) The person plays guitar and piano.
(f) Given that the person chosen plays an instrument, find the probability that they only play guitar.
(g) Given that the person chosen plays an instrument, find the probability that they play guitar and piano.

Answers

1.

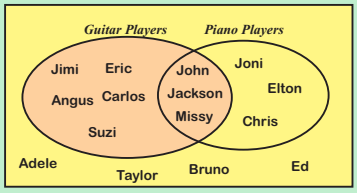


2. (a) The probability that the person plays guitar.
There are 8 out of the 15 people that play guitar.



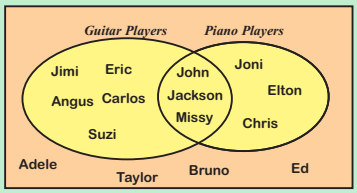
Probability that a person chosen at random plays guitar $= \frac{8}{15}$

(b) The probability that the person does not play guitar.
There are 7 out of the 15 people that do not play guitar.



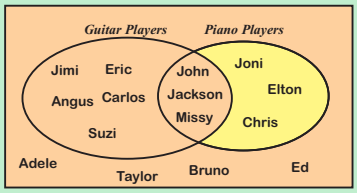
Probability that a person chosen at random does not play guitar $= \frac{7}{15}$

(c) The probability that the person plays guitar or piano.
There are 11 out of the 15 people that play guitar or piano.



Probability that a person chosen at random plays guitar or piano $= \frac{11}{15}$

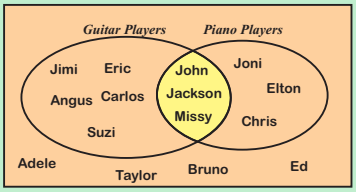
(d) The probability that the person only plays piano.
There are 3 out of the 15 people that only play piano.



Probability that a person chosen at random only plays piano $= \frac{3}{15}$

$= \frac{1}{5}$ (Simplest form)

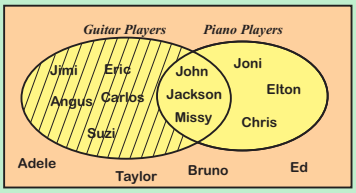
(e) The probability that the person plays guitar and piano.
There are 3 out of the 15 people that play guitar and piano.



Probability that a person chosen at random plays guitar and piano $= \dfrac{3}{15}$

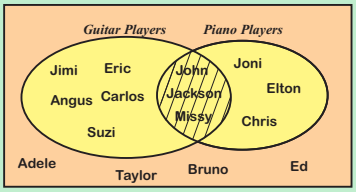
$= \dfrac{1}{5}$ (Simplest form)

(f) Given that the person chosen plays an instrument, find the probability that they only play guitar.
There are 11 people that play an instrument. ***Given that the person chosen plays an instrument*** means one of these 11 people is chosen at random. Of these 5 play guitar only.



Given that the person chosen plays an instrument the probability that they only play guitar. $= \dfrac{5}{11}$

(g) Given that the person chosen plays an instrument, find the probability that they play guitar and piano.
There are 11 people that play an instrument. ***Given that the person chosen plays an instrument*** means one of these 11 people is chosen at random. Of these 3 play guitar and piano.



Given that the person chosen plays an instrument the probability that they play guitar and piano. $= \dfrac{3}{11}$

EXERCISE 18K

Write the answers to the following probabilities as fractions in their simplest form.

1. 20 students were asked if they played basketball and/or tennis.
Amelia, Ben, Carrie, Delta, Eve and Faran played basketball but not tennis.
Garth, Harry, Indie, Jaan and Kiera played tennis but not basketball.
Liam, Mia, Nellie and Ollie played both basketball and tennis.
Pat, Quinn, Rose, Sian and Tilly did not play either sport.
(a) Draw a Venn diagram to display this information.
A student is chosen at random from the group. Find the probability of the following.
(b) The student plays basketball but not tennis.
(c) The student plays tennis.
(d) The student plays tennis and basketball.
(e) The student does not play either sport.
(f) The student does not play basketball.
(g) The student does not play both sports.
(h) Given that the student chosen plays basketball and/or tennis, find the probability that they play both sports.
(i) Given that the student chosen plays basketball and/or tennis, find the probability that they play only basketball.
(j) Given that the student chosen does not play basketball, find the probability that they play tennis.
(k) Given that the student chosen does not play tennis, find the probability that they do not play one of the sports.

2. Students in a visual art class were asked if they wanted to study painting, photography or another type of visual arts.
Nell, Lonie, Keiren, Xavier, Tye, Peta, Georgia and Marvin wanted to study painting but not photography.
Kyle, Oscar, Hilda, Josh, Wanda and Fleur wanted to study photography but not painting.
Rohan, Darian, Jueban and Bessy wanted to study both painting and photography.
Zena, Will, Tasha, Crosby, Vera and Clara wanted to study other types of visual arts.
(a) Draw a Venn diagram to display this information.
A student is chosen at random from the group. Find the probability of the following.
(b) The student wants to study only painting.
(c) The student does not want to study painting.
(d) The student does not want to study painting or photography.
(e) The student wants to study painting and photography.
(f) Given that the student chosen wants to study painting and/or photography, what is the probability that they want to study both?
(g) Given that the student chosen wants to study painting and/or photography, what is the probability that they want to study painting?
(h) Given that the student chosen does not want to study painting, what is the probability that they want to study photography?
(i) Given that the student chosen does not want to study photography, what is the probability that they don't want to study painting?

Example 3

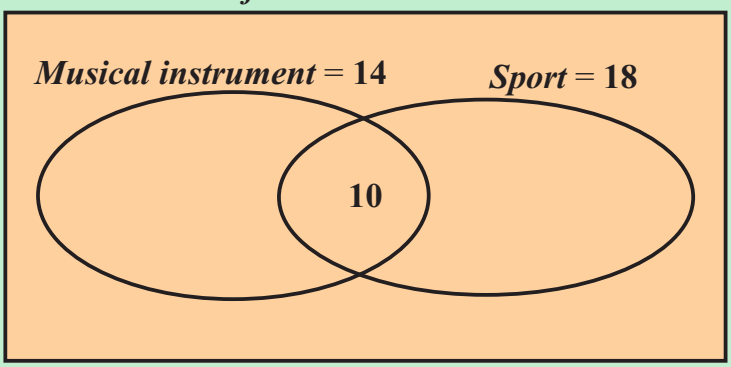
There are 25 students in a class.
14 of them play a musical instrument.
18 of them play sport.
10 play a musical instrument and play sport.

1. Draw a Venn diagram to display this information.
2. Complete all sections of the Venn diagram.
3. Find the following:
(a) How many students play a musical instrument but don't play sport?
(b) How many students play sport but not a musical instrument?
(c) How many students don't play a musical instrument and don't play sport?
4. A student is chosen at random.
(a) What is the probability that they sport?
(b) What is the probability that they play a musical instrument but don't play sport?
(c) Given that the student chosen plays sport, what is the probability that they also play a musical instrument?

Answers

1. The Venn diagram with known information is shown below.

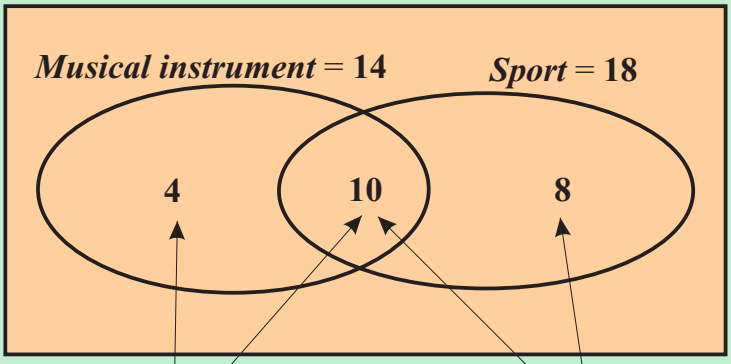
***Total number of students* = 25**



2. Complete the other sections of the Venn diagram in two steps.

Step 1

Total number of students **= 25**

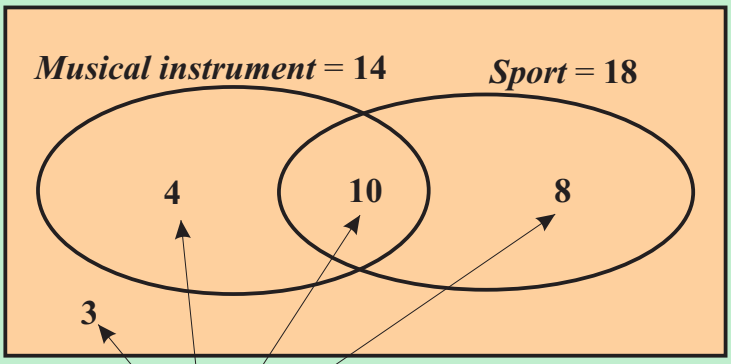


These two add to 14
(students playing a
musical instrument)

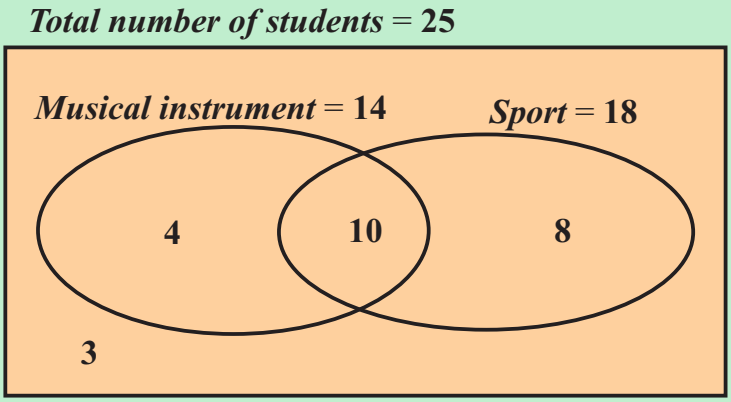
These two add to 18
(students playing sport)

Step 2

Total number of students **= 25**



These four must add to 25
(the total number of students)



Use the Venn diagram to solve the following questions.

3. (a) **4** students play a musical instrument but don't play sport.
(b) **8** students play sport but don't play a musical instrument.
(c) **3** students don't play a musical instrument and don't play sport.

4. (a) The probability a student chosen at random plays sport $= \frac{\mathbf{18}}{\mathbf{25}}$

(b) The probability a student chosen at random plays a musical instrument but doesn't play sport $= \frac{\mathbf{4}}{\mathbf{25}}$

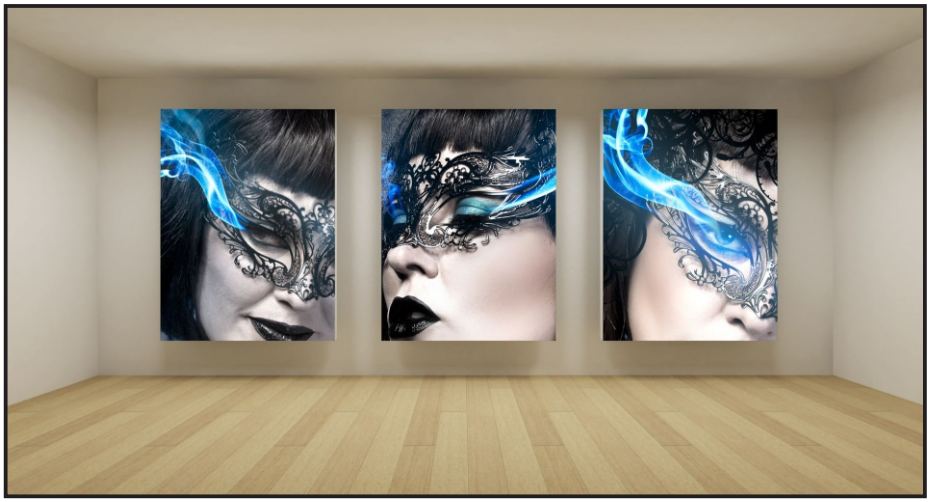
(c) Given that the student plays sport, the probability that they also play a musical instrument $= \frac{10}{18} = \frac{\mathbf{5}}{\mathbf{9}}$ (Simplest form)

EXERCISE 18L

1. 50 people were asked if they had a pet dog and/or cat.
26 had a dog, 15 had a cat and 8 of these had both.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many of the people only had a dog?
(d) How many of the people only had a cat?
(e) How many had neither a dog nor a cat?
A person is chosen at random from the group.
(f) What is the probability that the person owns a dog and cat?
(g) What is the probability that the person only owns a dog?
(h) Given that the person chosen owns a dog, what is the probability that they also own a cat?

2. At a school there were 60 students in year 8.
32 studied graphics, 18 studied art and 6 of these studied both.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many students studied graphics but not art?
(d) How many students studied art but not graphics?
(e) How many students did not study graphics or art?
A student is chosen at random from the group.
(f) What is the probability that they studied art?
(g) What is the probability that they studied art and graphics?
(h) Given that they studied art, what is the probability that they also studied graphics?

3. 80 people were asked if they had been to see an AFL game or visit an art exhibition in the last year.
35 had seen an AFL game, 23 had seen an art exhibition and 12 of these had seen both.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many of the people had only seen an AFL game?
(d) How many of the people had only seen an art exhibition?
(e) How many had seen neither?
One of these people was chosen at random.
(f) What is the probability that they had been to an AFL game and an art exhibition?
(g) What is the probability that they had seen an art exhibition but not been to an AFL game?
(h) Given that the person had been to an AFL game, what is the probability that they had not seen an art exhibition?



4. 65 students were asked if they had cereal and/or fruit juice for breakfast.
42 had cereal, 27 had both cereal and fruit juice and 9 had neither cereal nor fruit juice for breakfast.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many had cereal but not fruit juice for breakfast?
(d) How many had fruit juice but not cereal?
(e) How many had fruit juice for breakfast?
(f) If one of the students was chosen at random, what is the probability that they had both cereal and fruit juice for breakfast?

5. 100 people were asked if they had travelled overseas and/or to another state in Australia.
37 had not travelled overseas or to another state.
6 had travelled overseas but not interstate.
16 had travelled overseas and interstate.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) How many of the people had travelled overseas?
(d) How many of the people had travelled interstate but not overseas?
(e) How many of the people had travelled interstate?
(f) If one of these people was chosen at random, what is the probability that they had travelled to another state in Australia?

6. 120 companies were surveyed to see if they used the internet for advertising or newspapers.
48 used only the internet.
16 used only newspapers.
13 didn't use either.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) If one of the companies was chosen at random, what is the probability that they had advertised in a newspaper and the internet?

7. An ice-cream seller recorded how many people had chocolate and/or crushed nuts on their ice-creams. Out of 110 ice-creams sold, 75 had chocolate, 36 had crushed nuts and 21 had neither chocolate nor crushed nuts.
(a) Draw a Venn diagram to show this information.
(b) Complete all sections of the Venn diagram.
(c) If one of these people was chosen at random, what is the probability that they had both chocolate and crushed nuts?

PROBLEM SOLVING

1. A college wanted to install combination locks on all the students' lockers. The locks would consist of two digits that the students would need to press in the correct order to open their locker.
(a) How many different combinations could be made using two digits? (i.e. 00, 01, 02, 03 .....98, 99)
(b) If a student forgets their digits, what is the probability that they could guess the correct combination?

2. The college realised there weren't enough combinations for the number of school lockers. Find the number of combinations if they used the following code systems.
(a) A number followed by a letter. (i.e. 0A, 0B, 0C 9X, 9Y, 9Z)
(b) Two letters. (i.e. AA, AB, AC, AD .....ZX, ZY, ZZ)

PUZZLES

1. Unscramble the letters from the following phrases to find words from this chapter. Each phrase forms one word.
(a) ***semi lip sob*** (b) ***nice art*** (c) ***cot mouse*** (d) ***I'm into bacon***
(e) ***Bali boy trip*** (f) ***mad Ron*** (g) ***fetid fern*** (h) ***ill key***

2. Find words from this chapter hidden in these sentences.

Example A keyboard is used for typing.

(a) Magdalena loved ice-cream and peaches for dessert.
(b) The church bell I could hear rang especially for the wedding.
(c) The chemistry student studied the adsorption rate of chemicals.
(d) Duncan put the taco in the oven to heat it up.
(e) The salad I eat regularly for lunch has a special dressing.
(f) The dancer tainted her performance by falling off the stage!
(g) Qatar and Oman are small countries near Saudi Arabia.

CHAPTER REVIEW

1. Match the terms below with the probabilities.
(a) certain to occur
(b) unlikely to occur
(c) could go either way equally
(d) impossible
(e) likely to occur

A 50% **B** 0.3 **C** 1 **D** $\frac{7}{10}$ **E** 0

2. Find the following probabilities. Give answers as fractions in their simplest form.
(a) Rolling a 3 on a die.
(b) Rolling a 7 on a die.
(c) Rolling a number greater than 2 on a die.
(d) Rolling an even number on a die.
(e) Randomly choosing a black ball from a box with eight black balls and six white balls.
(f) Randomly choosing a boy from a class of 24 students that has 10 girls.

3. (a) The probability of winning a prize in a game is 0.2. What is the probability of ***not*** winning a prize?
(b) The probability of rain on a particular day was predicted to be 60%. What is the probability of rain ***not*** falling?

4. (a) List all the combinations of the numbers 6, 8 and 1.
(b) If these three numbers are randomly arranged, what is the probability that the resultant number is larger than 700? Give answer as a fraction in its simplest form.

5. The probability of catching a fish on a fishing trip was 0.8. Harley goes on the fishing trip on Saturday and Sunday.
(a) What is the probability of catching fish on both days?
(b) What is the probability of not catching a fish on either day?
(c) What is the probability of catching a fish on at least one day?

6. A ball is taken from each of the two boxes shown and the numbers ***multiplied***.

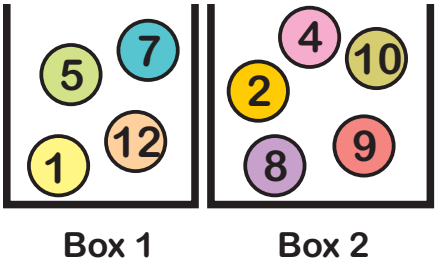
(a) Construct a two-way table to show all possible outcomes.

(b) What is the probability that the product of the numbers is:

(i) greater than 100?

(ii) less than 50?

(iii) between 30 and 100?



7. 200 students were surveyed and asked if they thought a famous musician or a famous astronaut should be invited to speak at the school.
120 of the students asked were girls.
50 of the boys wanted an astronaut to visit.
110 of the students wanted a musician to visit.

(a) Copy and complete the two-way table shown below.

(b) What is the probability that a girl wanted a musician to visit?

(c) What is the probability that a boy wanted an astronaut to visit?

(d) What is the probability that a student wanted a musician to visit?

	Boys	***Girls***	***Total***
Musician			
Astronaut			
Total			

8. 50 people who lived in a large city were surveyed to see if they owned a car and/or a bicycle.
32 owned a car, 18 owned a bicycle and 10 owned both.

(a) Draw a Venn diagram to show this information.

(b) Complete all sections of the Venn diagram.

(c) How many of the people owned a car but not a bicycle?

(d) How many of the people did not own either a car or bicycle?

(e) If a person was chosen at random, what is the probability that they owned a bicycle but not a car?

(f) If a person is chosen at random and given they owned a car and/or a bicycle, what is the probability that they owned a car?