



Department of
Education

AUSTRALIAN CURRICULUM

MATHEMATICS YEAR 7

Probability

MATHEMATICS

YEAR 7

Probability

Student's name: _____

Teacher's name: _____

First published 2012

ISBN 9780730744481

SCIS 1564098

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Signposts

Each symbol is a sign to help you.

Here is what each one means:



The recommended time you should take to complete this section.



An explanation of key terms, concepts or processes.



A written response.
Write your answer or response in your journal.



Correct this task using the answers at the end of the resource.



Calculators may not be used here.



Make notes describing how you attempted to solve the problem. Keep these notes to refer to when completing the Self-evaluation task. Your teacher may wish you to forward these notes.

Introduction

This resource should take you approximately two weeks to complete. It comprises seven learning sections, a summary section and a review task section.

The learning sections have the following headings:

- **Key words**
These are the main words that you need to understand and use fluently to explain your thinking.
- **Warm-up**
Warm-up tasks should take you no longer than 10 minutes to complete. These are skills from previous work you are expected to recall from memory, or mental calculations that you are expected to perform quickly and accurately. If you have any difficulties in answering these questions, please discuss them with your teacher.
- **Review**
Some sections have reviews immediately after the warm-up. The skills in these reviews are from previous work and are essential for that section. You will use these to develop new skills in mathematics. Please speak to your teacher immediately if you are having any trouble in completing these activities.
- **Focus problem**
Focus problems are designed to introduce new concepts. They provide examples of the types of problems you will be able to solve by learning the new concepts in this resource. Do not spend too long on these but do check and read the solutions thoroughly.
- **Skills development**
These help you consolidate new work and concepts. Most sections include skills development activities which provide opportunities for you to become skilled at using new procedures, apply your learning to solve problems and justify your ideas. Please mark your work after completing each part.

Correcting your work

Please mark and correct your work as you go. Worked solutions are provided to show how you should set out your work. If you are having any difficulty in understanding them, or are getting the majority of the questions wrong, please speak to your teacher immediately.

Journal

Please keep an exercise book to record your notes and to summarise your learning. At the end of each section, write definitions for the key words that were introduced for that section.

Curriculum details

Content Descriptions

This resource provides learning and teaching to deliver the Australian Curriculum: Mathematics for the following Year 7 Content Descriptions.

Construct sample spaces for single-step experiments with equally likely outcomes (ACMSP167)

Assign probabilities to the outcomes of events and determine probabilities for events (ACMSP168)

Content Descriptions	1	2	3	4	5	6	7	R
ACMSP167								
ACMSP168								



Indicates the content description is explicitly covered in that section of the resource.

Previous relevant Content Descriptions

The following Content Descriptions should be considered as prior learning for students using this resource.

At Year 5 level

List outcomes of chance experiments involving equally likely outcomes and represent probabilities of those outcomes using fractions (ACMSP116)

Recognise that probabilities range from 0 to 1 (ACMSP117)

At Year 6 level

Describe probabilities using fractions, decimals and percentages (ACMSP144)

Proficiency strand statements at Year 7 level

At this year level:

Understanding includes describing patterns in uses of indices with whole numbers, recognising equivalences between fractions, decimals, percentages and ratios, plotting points on the Cartesian plane, identifying angles formed by a transversal crossing a pair of lines, and connecting the laws and properties of numbers to algebraic terms and expressions

Fluency includes calculating accurately with integers, representing fractions and decimals in various ways, investigating best buys, finding measures of central tendency and calculating areas of shapes and volumes of prisms

Problem Solving includes formulating and solving authentic problems using numbers and measurements, working with transformations and identifying symmetry, calculating angles and interpreting sets of data collected through chance experiments

Reasoning includes applying the number laws to calculations, applying known geometric facts to draw conclusions about shapes, applying an understanding of ratio and interpreting data displays

General capabilities

General capabilities	1	2	3	4	5	6	7	R
Literacy								
Numeracy								
Information and communication technology (ICT) capability								
Critical and creative thinking								
Personal and social capability								
Ethical behaviour								
Intercultural understanding								



Indicates general capabilities are explicitly covered in that section of the resource.

Cross-curriculum priorities

Cross-curriculum priorities	1	2	3	4	5	6	7	R
Aboriginal and Torres Strait Islander histories and cultures								
Asia and Australia's engagement with Asia								
Sustainability								



Indicates cross-curriculum priorities are explicitly covered in that section of the resource.

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1. Reviewing probability

When you complete this section you should be able to:

- recognise that probabilities range from 0 to 1.

Key words

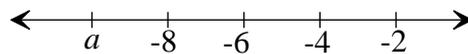
- probability
- experiment
- outcome

Warm-up 1

1. List the factors of seven. _____

2. $15 + 9 =$ _____

3. What is the missing number? _____



$a =$ _____

4. Circle the greater fraction. $\frac{3}{4}$ or $\frac{5}{8}$

5. Find half of 7. _____

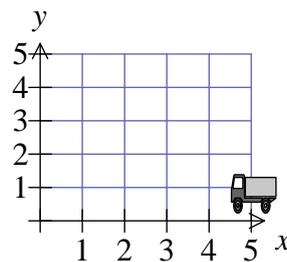
6. $8.6 - 2.9 =$ _____

7. $5.2 \times 7 =$ _____

8. Write 2.1 as a mixed fraction. _____

9. What is the next number: 389, 392, 395, 398, _____

10. What are the coordinates of the truck?



Review 1

If there is no chance of an **outcome** from an **experiment**, then its **probability** is zero.

For example, the probability of rolling a 7 on a normal die is zero.

If the outcome of an experiment is certain to happen, then its probability is one.

For example, the probability of getting a number less than 7 when a die is rolled is one.

All other probabilities are in the range from zero to one.



Example

What is the probability of getting a 12 when you roll one die?

Solution

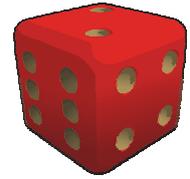
This has no chance of happening so the probability is zero.

1. Match the probability of the outcomes below with one of the following probabilities.

0 $\frac{1}{52}$ $\frac{1}{6}$ 0.5 0.75 0.9 1

- (a) the probability of getting a one when you roll a die _____
- (b) the probability of the sun coming up tomorrow _____
- (c) the probability of finding a frog in bottled water _____
- (d) the probability of getting a head when you flip a coin _____
- (e) the probability of a random person having a birthday in the next 9 months _____
- (f) the probability of drawing the ace of spades from a deck of cards _____
- (g) the probability of a car needing petrol sometime in the next week _____

Focus problem 1



The six faces of a die are commonly marked with dots showing the numbers 1 to 6.

Hence, the sample space for a normal die is 1, 2, 3, 4, 5, 6.

The formula for calculating probabilities is: $\text{probability} = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}}$.

The **probabilities** on a die can be used to show the range in possible values of probability.

1. Use the probability formula to find the probability of rolling a 7 on a normal die.

This **outcome** is impossible and the probability is the lowest value of probability.

2. Use the probability formula to find the probability of rolling a number less than 7 on a normal die.

This outcome is certain and the probability is the highest value of probability.

3. Use the probability formula to find the probability of rolling an even number on a normal die.

This outcome gives a probability between zero and one, the complete range of probability values.



Check your work before continuing.

Dice

Although normal dice have 6 faces numbered with dots from one to six, other dice are available with different numbers of faces.

The die shown here, which is an icosahedral die, has 20 faces. Others are available with 4, 8 and 12 faces. Each of these dice is based on a Platonic solid.



2. Card probabilities

When you complete this section you should be able to:

- represent probabilities from equally likely outcomes.

Key words

- probability
- equally likely
- event
- sample space

Warm-up 2

1. Circle the largest common factor of 20 and 40. 4, 6, 8, 10, 12

2. $17 - 9 =$ _____

3. The temperature was 2 degrees but it dropped 13 degrees.

What is the new temperature? _____

4. Insert $<$, $>$ or $=$ to make the following sentence true. $\frac{6}{10} \square \frac{2}{4}$

5. $\frac{5}{2} \times 8 =$ _____

6. Round 5.51 to a whole number. _____

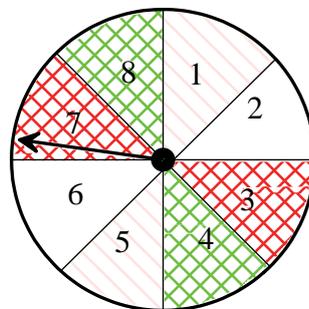
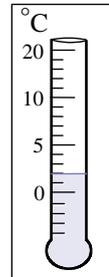
7. $8 \overline{)72.08}$ _____

8. Write $16\frac{2}{3}\%$ as a decimal. _____

9. What is the next number? 1.00, 1.03, 1.06, 1.09, _____

10. Determine the probability this spinner will land on a number greater than 5.

Express your answer as a decimal.



Review 2

Probabilities range from zero to one. They can be represented as decimals, fractions or percentages.

Example

A coin has two **equally likely** faces, heads or tails. What is the probability of a coin coming up heads when flipped?



Solution

The probability of a coin coming up heads when flipped can be written as $\frac{1}{2}$, 0.5 or 50%.

1. For each of the probabilities given here complete the line showing them as fractions, decimals and percentages.

- (a) the probability of a boy or girl child

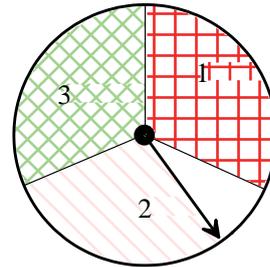
Fraction: _____, decimal: 0.5, percentage: _____

- (b) the probability of getting a six on a die roll

Fraction: $\frac{1}{6}$, decimal: _____, percentage: _____

- (c) the probability of getting a 2 on this spinner

Fraction: _____, decimal: _____, percentage: $33\frac{1}{3}\%$



2. Complete the probability equivalences in this table.

Fraction	$\frac{1}{4}$			$\frac{1}{52}$
Decimal		0.1		
Percentage			20%	

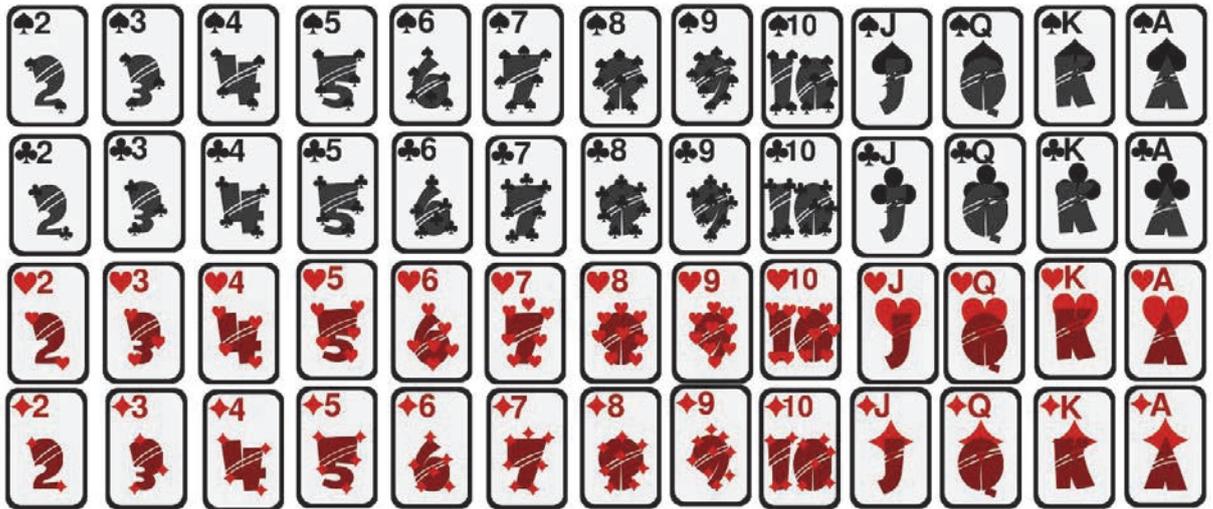
Focus problem 2

The image here shows a complete pack of playing cards.

There are four suits: spades ♠, clubs ♣, hearts ♥ and diamonds ♦.

Spades and clubs are black cards, hearts and diamonds are red cards.

In each suit there are thirteen cards, from 2 to 10 plus jack, queen, king and ace.



- How many cards are there altogether in the complete pack?

- If the cards are shuffled and one is drawn from the pack, does each card have an equal **probability** of being chosen?

The 52 **equally likely** cards make up the **sample space** for the experiment 'drawing a single card from a normal deck of cards'. Once the sample space for an experiment has been defined, probabilities of **events** can be calculated using the probability formula.

- What is the probability that a single card drawn from a shuffled pack is the 7 of hearts?

- How many red cards are in the pack?

- What is the probability that a single card drawn from a shuffled pack is a red card?

6. What is the probability that a single card drawn from a shuffled pack is a club?

7. What is the **probability** that a single card drawn from a shuffled pack is a ten?

8. What is the probability that a single card drawn from a shuffled pack is a jack, queen or king?

9. What is the probability that a single card drawn from a shuffled pack is less than a six? (An ace counts as a one.)

10. What is the probability that a single card drawn from a shuffled pack is a red king?



Check your work before continuing.

Playing cards

There are records to show that playing cards were first used in China over one thousand years ago.

Packs of cards similar to today's with 52 cards in the four suits, however, are only a few hundred years old. Some packs also include two extra cards, the jokers.

The card game solitaire was one of the earliest computer games but many card games have been developed and played over the years. Well known card games include, bridge, rummy, poker, fish and snap.



Skills development 2

An **event** defines a part of a **sample space**. In rolling a die, one event could be defined as ‘getting an even number’. The sample space is a list of all of the outcomes. In rolling a die, the sample space is 1, 2, 3, 4, 5, 6. These are all of the possible **equally likely** outcomes.

Example

What is the **probability** of the event ‘getting a prime number’ on a single roll of a die?

Solution

The sample space for rolling a single die is 1, 2, 3, 4, 5, 6. Each of these outcomes is equally likely.

The event ‘getting a prime number’ has the favourable outcomes 2, 3 and 5.

Hence, the probability of a prime number is $\frac{3}{6}$ which is equivalent to $\frac{1}{2}$ or 0.5 or 50%.

3 is the number of favourable outcomes for the event.

6 is the number of possible outcomes in the sample space.

1. In the sample space of a pack of 52 cards, list the outcomes for each of these events.

(It might help to use these symbols: ♠, ♥, ♣, ♦.)

- (a) selecting an ace

- (b) selecting a club

- (c) selecting a picture card (jack, queen or king)

- (d) selecting a red four

2. Use your results from question 1 to find the following probabilities.

(a) probability (selecting an ace)

(b) probability (selecting a club)

(c) probability (selecting a picture card – jack, queen or king)

(d) probability (selecting a red four)



Check your work before continuing.

3. Spinner probabilities

When you complete this section you should be able to:

- represent probabilities from equally likely outcomes
- list sample spaces.

Key words

- outcome
- equally likely
- probability
- sample space

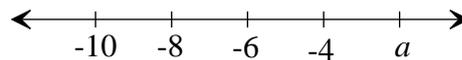
Warm-up 3

1. Circle the prime numbers. 15, 16, 17, 18, 19, 20

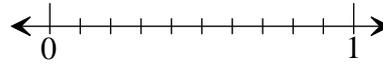
2. $7 \times 3 =$ _____

3. What is the missing number?

$a =$ _____



4. Locate 0.6 on the number line.



5. Find three-quarters of 24. _____

6. Estimate the sum by first rounding to whole numbers

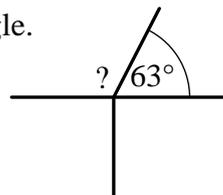
$64.9 + 5.8 \approx$ _____

7.
$$\begin{array}{r} 6.32 \\ \times \quad 7 \\ \hline \end{array}$$

8. Write $2\frac{1}{2}$ as a percentage. _____

9. What is the next number: $2, 4\frac{1}{4}, 6\frac{2}{4}, 8\frac{3}{4},$ _____

10. Determine the size of the missing angle.



Review 3

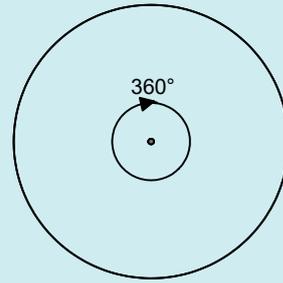
A circle has 360° as its central angle.

Example

If a circle is divided into three equal sectors, how many degrees in each sector?

Solution

$360^\circ \div 3 = 120^\circ$ per sector.



- Complete the table below by calculating the degrees for each sector if a circle is evenly divided into the given number of sectors.

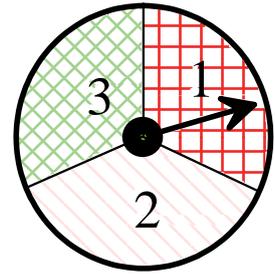
Number of sectors	Degrees for each sector
2	
3	120°
4	
5	
6	
7	
8	
9	
10	



Check your work before continuing.

Focus problem 3

The spinner drawn here has three equally-sized sectors.



1. What size angle can be found at the point of each sector? _____

Explain how you know this.

2. What are the three **outcomes** possible with this spinner?

3. Are the three outcomes **equally likely**? Explain.

4. What is the **probability** of each of the outcomes?

5. What is the sum of the probabilities of the three outcomes?

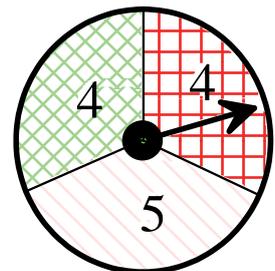
6. If the spinner had four sectors of 90° , what would be the probability for each sector?

7. Use the spinner to the right to answer the following.

- (a) Would the probability of each sector be equally likely?

- (b) Would the probability of each outcome be equally likely?

- (c) What would the probability of each outcome be?



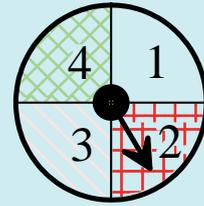
Check your work before continuing.

Skills development 3

Probabilities can be easily calculated once a **sample space** of **equally likely** outcomes has been constructed. The sample space will contain all possible outcomes of the experiment.

Example

List the sample space for this spinner and calculate the probability of the event, spinning a three.



Solution

Sample space: 1, 2, 3, 4

$$\text{Probability of a 3} = P(3) = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}} = \frac{1}{4}$$

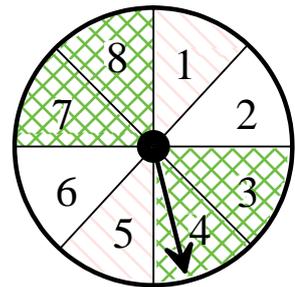
Note the use here of the symbol $P(3)$ and what it represents.

1. (a) List the sample space for the spinner. _____

(b) Find $P(5)$. _____

(c) Find $P(\text{even number})$. _____

(d) Find $P(\text{number less than 8})$. _____

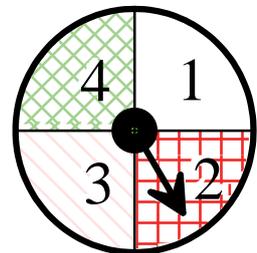


2. (a) List the sample space for the spinner. _____

(b) Find $P(2)$. _____

(c) Find $P(\text{even number})$. _____

(d) Find $P(\text{number less than 5})$. _____

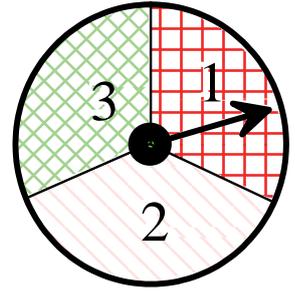


3. (a) List the **sample space** for the spinner. _____

(b) Find $P(1 \text{ or } 2)$. _____

(c) Find $P(\text{even number})$. _____

(d) Find $P(\text{number greater than } 3)$. _____

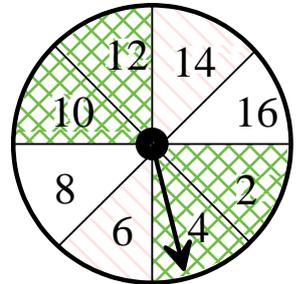


4. (a) List the sample space for the spinner. _____

(b) Find $P(5)$. _____

(c) Find $P(\text{even number})$. _____

(d) Find $P(\text{number less than } 18)$. _____



Check your work before continuing.

4. Alphabet probabilities

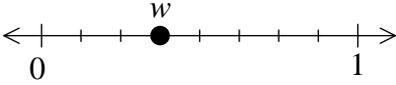
When you complete this section you should be able to:

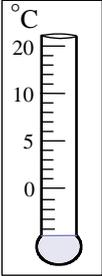
- assign probabilities from equally likely outcomes
- assign probabilities to events from a sample space
- list sample spaces.

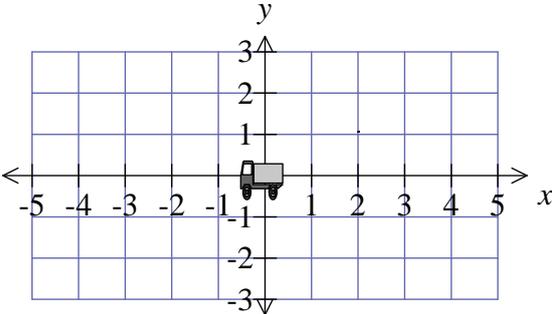
Key words

- sample space
- event
- experiment

Warm-up 4

- Fill in the missing value. 64, 49, _____, 25, 16, 9
- $48 \div 12 =$ _____
- The temperature was minus 8 degrees but it went up 15 degrees.
What is the new temperature? _____
- Express the value of w as a fraction. 
- $\frac{4}{3} \times 15 =$ _____
- $3700 \div 1000 =$ _____
- $8.204 \div 4 =$ _____
- Write 150% as fraction. _____
- What is the next number? 596, 581, 566, 551, _____
- The truck here is shown at (0, 0).
If the truck moves 2 units left and 3 units down, where will it then be?





Review 4

The formula for probability, $\text{probability} = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}}$, will always give a fraction. However, there are equivalent decimal or percentage representations for any fraction.

Example

Write the probability $\frac{5}{8}$ as a decimal and as a percentage.

Solution

$$\frac{5}{8} = 0.625 = 62.5\%$$

- Complete the table below showing probabilities in the equivalent forms of fraction, decimal and percentage.

Fraction	Decimal	Percentage
$\frac{1}{2}$		
	0.6	
$\frac{4}{6}$		
		75%
	0.9	
$\frac{13}{52}$		25%
	0.33 ...	
$\frac{5}{26}$		

Focus problem 4

The alphabet consists of 26 letters:

a, b, c, d, e, f, g, h, i, j, k, l, m, n, o, p, q, r, s, t, u, v, w, x, y, z.

Five of these letters are vowels:

a, e, i, o, u.

Twenty-one of these letters are consonants:

b, c, d, f, g, h, j, k, l, m, n, p, q, r, s, t, v, w, x, y, z.

If a chance **experiment** is selecting one letter from the alphabet, what is the probability of the following outcomes?

1. $P(a)$ _____

2. $P(x)$ _____

3. $P(8)$ _____

An **event** can be defined as a group of outcomes from a **sample space**. What are the probabilities for the following events, where the sample space is the alphabet?

4. $P(\text{vowel})$ _____

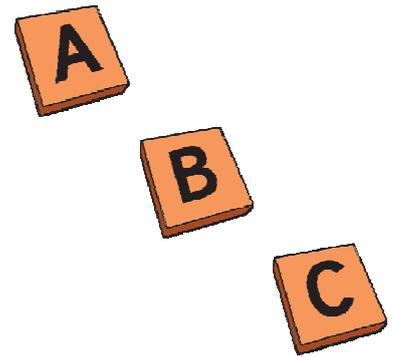
5. $P(\text{consonant})$ _____

6. $P(x \text{ or } y \text{ or } z)$ _____

7. $P(\text{not } p)$ _____



Check your work before continuing.



Alphabets

The alphabet used in the English language is the Latin alphabet. It is also used for a number of other languages such as French.

Mathematics also uses many of the symbols from the Greek alphabet. Capitals and lower case letters of the Greek alphabet are shown here.

A	α	B	β	Γ	γ	Δ	δ
E	ε	Z	ζ	H	η	Θ	θ
I	ι	K	κ	Λ	λ	M	μ
N	ν	Ξ	ξ	O	ο	Π	π
P	ρ	Σ	σς	T	τ	Υ	υ
Φ	φ	X	χ	Ψ	ψ	Ω	ω

Skills development 4**Example**

What is the probability of spelling out the word CAT if three letters A, C and T are jumbled.

Solution

The **sample space** has six possible outcomes: ACT, ATC, CAT, CTA, TAC, TCA.

Hence the probability is $\frac{1}{6}$ as one of the six outcomes is CAT.

1. (a) Construct the sample space if the letters D, O and G are jumbled.

- (b) How many outcomes are in the sample space?

- (c) What is the probability that the three letters will spell the word DOG?

- (d) What is the probability that the three letters will start with the letter G?

- (e) What is the probability that the three letters will have the O before the D?

2. (a) Construct the **sample space** if the letters A, B, E and L are jumbled.

- (b) How many outcomes are in the sample space?

- (c) What is the probability that the four letters will spell the word BALE?

- (d) What is the probability that the four letters will start with the letter A?

- (e) What is the probability that the four letters will have the A before the B?

- (f) What is the probability that the four letters will contain the letter E?

- (g) What is the probability that the four letters will not contain an A?



Check your work before continuing.

5. Sampling probabilities

When you complete this section you should be able to:

- assign probabilities to events when sampling from a collection.

Key words

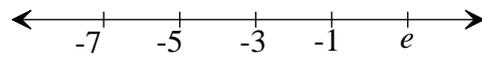
- random
- equally likely

Warm-up 5

1. Express 12 as factors of primes. _____

2. $24 + 109 =$ _____

3. What is the missing number?



$e =$ _____

4. $\frac{3}{7} + \frac{2}{7} =$ _____

5. Find two-fifths of 25. _____

6. 784 mm = _____ m

7. $8 + 7 \times 6 =$ _____

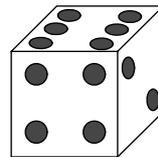
8. Write $1\frac{1}{3}$ as decimal. _____

9. What is the next number? 112.1, 109.8, 107.5, 105.2, _____

10. A six-sided die is rolled.

Express, as a fraction, the probability that

it lands on a square number.



Review 5

Example

Suggest an event from rolling a die that would have a probability of $\frac{1}{2}$.

Solution

The probability of a number greater than 3

1. Suggest two events from rolling a normal die that would have to each of these probabilities.

(a) $\frac{1}{6}$ _____

(b) $\frac{1}{2}$ _____

(c) $\frac{1}{3}$ _____

2. The picture here shows an octahedral die that has eight faces numbered 1 to 8. Suggest two events from rolling an octahedral die that would have each of these probabilities.



(a) $\frac{1}{8}$ _____

(b) $\frac{1}{2}$ _____

(c) $\frac{1}{4}$ _____

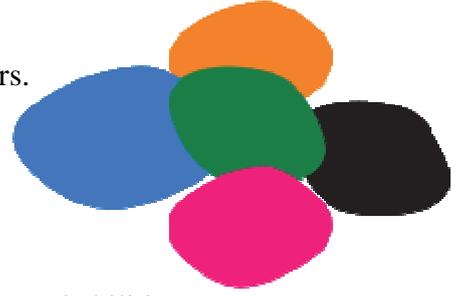
Focus problem 5

Mixed bags of lollies contain 20 jubes of five different colours.

The jubes are orange, blue, green, black and pink.

A particular bag contains the following 20 jubes:

4 orange, 5 blue, 6 green, 2 black and 3 pink.



If a jube is drawn from the bag at **random**, find the following probabilities.

1. P(green) _____
2. P(pink) _____
3. P(yellow) _____
4. P(not black) _____
5. P(blue or green) _____
6. Is each jube in the bag **equally likely** to be drawn? Explain your answer.

7. Is each colour equally likely to be drawn? Explain your answer.

8. Work out how many jubes of each colour there will be in a bag if there are 20 jubes and the following probabilities apply.

$$P(\text{black}) = \frac{3}{10} \quad P(\text{pink}) = \frac{1}{10} \quad P(\text{pink}) = P(\text{green}) \quad P(\text{orange}) = P(\text{blue})$$



Check your work before continuing.

Skills development 5

Example

A bag contains 9 blue balls and 1 red ball. Explain why the probability of **randomly** selecting a blue or red ball is not one half.

Solution

Although there are two colours, these are not **equally likely**.

The sample space is B, B, B, B, B, B, B, B, B, R. There are ten equally likely outcomes.

Hence the probability of a blue ball = $\frac{9}{10}$ and the probability of a red ball = $\frac{1}{10}$.

1. A bag contains 3 red, 4 blue and 8 green balls.
 - (a) List the sample space to show equally likely outcomes when a ball is randomly selected from the bag.

 - (b) What is the probability a randomly selected ball will be red? _____
 - (c) What is the probability a randomly selected ball will be blue? _____
 - (d) What is the probability a randomly selected ball will be green? _____
 - (e) What is the probability a randomly selected ball will be yellow? _____
 - (f) What is the probability a randomly selected ball will be red or green? _____
 - (g) What is the probability a randomly selected ball will not be red? _____



Check your work before continuing.

6. Not equally likely

When you complete this section you should be able to:

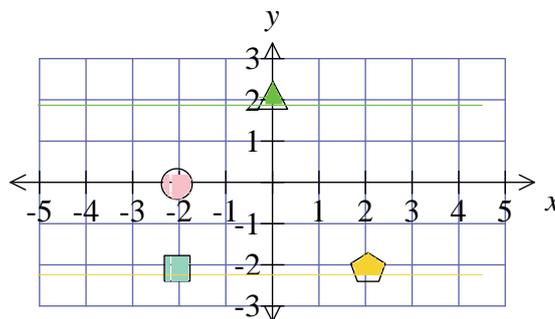
- distinguish between outcomes that are equally likely and outcomes that are not equally likely.

Key words

- equally likely

Warm-up 6

- $3.06 \times 10 =$ _____
- $563 - 43 =$ _____
- The temperature is minus 7 degrees.
How much will it need to increase to get to zero degrees? _____
- $\frac{9}{5} - \frac{2}{5} =$ _____
- $\frac{2}{5} \times 30 =$ _____
- $0.8 \text{ g} =$ _____ mg
- $12 \div 6 \times 2 =$ _____
- Write 2.5 as a percentage. _____
- What is the next number? $9, 7\frac{5}{10}, 6, 4\frac{5}{10},$ _____
- What shape is at $(2, -2)$?



Review 6

Example

What is the probability of getting an A if one letter is selected from the 'word' ANTEATEREATER?

Solution

There are 13 equally likely letters in the 'word' ANTEATEREATER of which there are 3 A s. Hence the probability of selecting an A is $\frac{3}{13}$.

1. What are the probabilities of selecting the following letters from ANTEATEREATER?

(a) $P(N) =$ _____

(b) $P(T) =$ _____

(c) $P(E) =$ _____

(d) $P(R) =$ _____

2. One letter is selected at random from the words in the following formula,

$$\text{probability} = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}}.$$

What are the following probabilities?

(a) $P(p) =$ _____

(b) $P(o) =$ _____

(c) $P(e) =$ _____

(d) $P(f) =$ _____

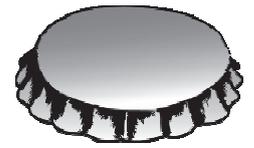


Check your work before continuing.

Focus problem 6

Bottle tops and drawing pins

To complete these two chance experiments you will need a bottle top and a drawing pin. The bottle top can be from a milk, juice or soft drink bottle.



Experiment 1

1. Flip the bottle top 60 times and record the way it lands in this table. Fill in the tally until you have flipped 60 times, then total up to get the frequency.

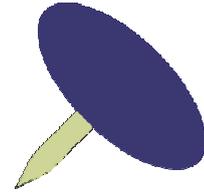
Outcome	Tally	Frequency
opening up		
opening down		
on edge		

2. Did you get equal frequencies for each outcome? _____
3. If the three outcomes were **equally likely** it would be expected that the three frequencies were about the same. What frequency would you expect for each outcome if they were equally likely?

4. Do you think the three outcomes are equally likely?

Experiment 2

1. Flip the drawing pin 60 times and record the way it lands in this table. Fill in the tally until you have flipped 60 times, then add up the tally to get the frequency.



Outcome	Tally	Frequency
point down		
point up		

2. Did you get equal frequencies for each outcome? _____
3. If the two outcomes were **equally likely** it would be expected that the two frequencies were about the same. What frequency would you expect for each outcome if they were equally likely?

4. Do you think the two outcomes are equally likely? Explain.

5. List three chance experiments where the outcomes are equally likely.



Check your work before continuing.

Skills development 6

Equally likely outcomes are those with an equal probability of occurring.

Example

Which of the following have equally likely outcomes:

flipping a coin, flipping a bottle top, rolling a die?

Solution

Both a coin and a die have equally likely outcomes due to the way they are made. A bottle top though, often has different likelihoods of landing on either side, or there may be a small likelihood it could land on an edge. It does not necessarily have equally likely outcomes.

1. A six-sided die was rolled 600 times with the following results.

Outcome	1	2	3	4	5	6
Frequency	100	100	200	100	0	100

- (a) Do these results support the statement that the die is equally likely to come up with the numbers 1 to 6?

- (b) On checking the die, it was noticed that two faces had the same number on them. Which number do you think was on two faces and which number was missing?

- (c) Complete this table for a die rolled 600 times if it had these faces: 1, 2, 2, 5, 5, 5.

Outcome	1	2	3	4	5	6
Frequency						

2. Which of these tables are the most likely to result from a fair die? (A fair die is one where all six faces are equally likely.)

(a)

Outcome	1	2	3	4	5	6
Frequency	99	101	102	100	99	99

(b)

Outcome	1	2	3	4	5	6
Frequency	100	150	100	99	50	101

(c)

Outcome	1	2	3	4	5	6
Frequency	98	104	103	93	97	105

(d)

Outcome	1	2	3	4	5	6
Frequency	85	90	92	87	93	153

3. If you used a two-headed coin, suggest a table of results below for 100 flips of the coin.

Outcome	Heads	Tails
Frequency		



Check your work before continuing.

Two-headed coins

It is possible to get hold of two-headed coins. However, it is very unlikely they were made by the mint. Two-headed coins can be made by gluing together two reduced halves or by inserting a reduced coin into a hollowed-out coin.

The first type can be identified by the join. The second type is hard to make and hard to identify.

Two-headed coins are usually used for magic tricks, but you could use them to unfairly 'win the toss' with a friend.

7. Assigning probabilities

When you complete this section you should be able to:

- assign probabilities to outcomes.

Key words

- probability

Warm-up 7

1. $4.02 \div 10 =$ _____

2. $845 \div 5 =$ _____

3. The temperature is 4 degrees.

How much will it need to decrease to get to minus 10 degrees? _____

4. $\frac{1}{2} + \frac{3}{5} =$ _____

5. $\frac{1}{6} \times 42 =$ _____

6. $1.6 \text{ kL} =$ _____ L

7. $16 \div 2 - 3 =$ _____

8. Find 50% of \$75. _____

9. Describe the rule for the following pattern.

80, 86, 92, 98, 104, ... _____

10. Determine the size of the missing angle. _____



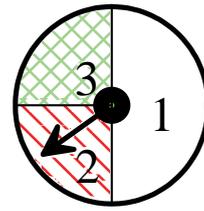
Focus problem 7

The spinner shown here has a central angle of 180° for the outcome 1 and 90° each for the outcomes 2 and 3.

To write a sample space for this spinner with equally likely outcomes it is necessary to think of the spinner having four sectors each of 90° .

This sample space would be: 1, 1, 2, 3.

Hence the **probabilities** of 1, 2, and 3 are not $\frac{1}{3}$.



Using the sample space with equally likely outcomes, 1, 1, 2 and 3, find the following probabilities for the spinner.

1. $P(1) =$ _____

2. $P(2) =$ _____

3. $P(3) =$ _____

On a die it is possible to have probabilities of one third as well as one sixth.

A die with its six faces marked 1, 2, 2, 3, 4, and 5 would have the following probabilities.

$$P(1) = P(3) = P(4) = P(5) = \frac{1}{6} \quad \text{and} \quad P(2) = \frac{1}{3}$$

4. Work out what numbers would be required on the six faces of a die to get the following probabilities.

$$P(1) = \frac{1}{2} \quad P(2) = \frac{1}{3} \quad P(3) = \frac{1}{6} \quad P(4) = P(5) = P(6) = 0$$



Check your work before continuing.

Skills development 7

Fractions can be converted to a decimal by dividing the numerator by the denominator. This decimal can then be converted to a percentage.

Example

Write the **probability** of getting a 3 on a die as a fraction, decimal and percentage.

Solution

$$P(3) = \frac{1}{6}$$

$$\frac{1}{6} = 1 \div 6 = 0.1666\dots = 0.17 \text{ (rounded to 2 decimal places)} = 17\%$$

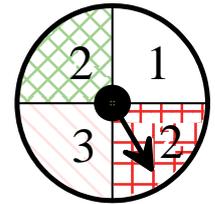
$$\text{ie } P(3) = \frac{1}{6} = 0.17 = 17\%$$

1. (a) Write down a sample space that would represent equally likely outcomes for this spinner.

- (b) For the spinner find $P(1)$. Write the probability as a fraction, a decimal, and a percentage.

- (c) For the spinner find $P(2)$. Write the probability as a fraction, a decimal, and a percentage.

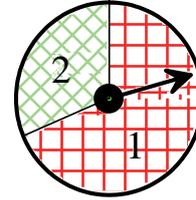
- (d) For the spinner find $P(3)$. Write the probability as a fraction, a decimal, and a percentage.



2. (a) Write down a sample space that would represent equally likely outcomes for this spinner.

- (b) For the spinner find $P(1)$. Write the probability as a fraction, a decimal, and a percentage.

- (c) For the spinner find $P(2)$. Write the probability as a fraction, a decimal, and a percentage.



3. Work out what numbers to mark on the faces of a 12 sided die so that the following **probabilities** apply.

$$P(7) = \frac{1}{4} \quad P(12) = \frac{1}{3} \quad P(3) = \frac{1}{6}$$

$$P(4) = P(8) = P(11) = \frac{1}{12}$$

$$P(1) = P(2) = P(5) = P(6) = P(9) = P(10) = 0$$



Check your work before continuing.

Dodecahedron

A three dimensional object with 12 regular pentagons as faces is known as a dodecahedron. A dodecahedron is one of the five Platonic solids.

8. Summary

- Probabilities can range from zero to one and can be expressed as fractions, decimals or percentages.
- The formula for probability is: $\text{probability} = \frac{\text{number of favourable outcomes}}{\text{number of possible outcomes}}$
- The notation $P(x)$ can be used to represent the probability of x .
- A sample space is a list of the outcomes for a chance experiment. The sample space must contain equally likely outcomes to be used to calculate probabilities.
- An event defines a part of a sample space. In rolling a die, one event could be defined as 'getting an even number'.

9. Review tasks

The following tasks will assist you to consolidate your learning and understanding of the concepts introduced in this resource, and assist you to prepare for assessments.

Task A

Name: _____

Suggested time: 40 minutes

Actual time taken: _____

Instructions

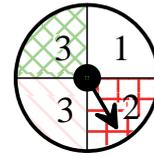
Complete this work on your own.

You may use a calculator, but show how you got your answer.

Attempt every question. Take as long as you need and record the time in the space provided above after you have finished.

- Match the following probabilities with the outcomes below: 0, 0.25, 0.5, 1.
 - the probability of getting an even number when rolling a die _____
 - the probability of getting a number less than 10 when you roll a die _____
 - the probability of getting a heart when you select a card from a pack _____
 - the probability of not getting a head or a tail when you flip a coin _____
- In a sample space of 52 playing cards list the outcomes for the event 'selecting a red three'.

3. (a) List the sample space of equally likely outcomes for this spinner.



(b) Find $P(1)$. _____

(c) Find $P(\text{even number})$. _____

4. (a) Construct the sample space if the letters A, B and C are written in any order.

(b) What is the probability that the jumbled letters A, B and C will spell out the word CAB?

5. A lolly bag has 3 red, 5 orange and 8 blue gumballs.

(a) What is the probability that a gumball selected randomly from the bag is a red one?

(b) What is the probability that a gumball selected randomly from the bag is not blue?

6. Complete this table for the expected results of a die rolled 300 times.

Outcome	1	2	3	4	5	6
Frequency						

7. Work out what numbers would be required on the eight faces of an octahedral die to get the following probabilities.

$$P(1) = \frac{3}{8} \quad P(2) = \frac{1}{4} \quad P(3) = P(4) = P(5) = \frac{1}{8} \quad P(6) = P(7) = P(8) = 0$$

Task B

Name: _____

Suggested time: 40 minutes

Actual time taken: _____

Instructions

Complete this work on your own.

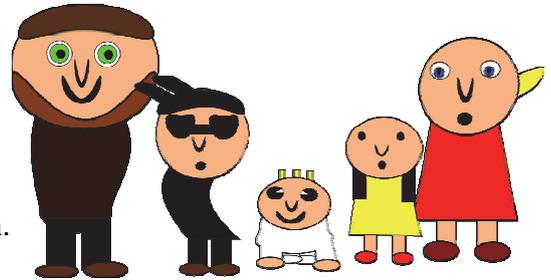
You may use a calculator, but show how you got your answer.

Attempt every question. Take as long as you need and record the time in the space provided above after you have finished.

Family Planning

It is commonly accepted that the probability of a new child being born a boy or a girl is equal to one-half.

This probability can be simulated by flipping a coin. So a family of three children could be simulated by flipping a coin three times.



If it came up H H T we could say that matches a family of B B G (head = boy, tail = girl).

1. If the flipped coin came up T H T what family would this represent? _____
2. Why is flipping a coin a good way of simulating the gender of a new child?

3. Write down a sample space showing all the different three-child families. Hint: There are 8 in total, and two of them, B B G and G B G have already been looked at.

4. Use your sample space from question 3 to work out the probability of a three child family having three boys.

5. Write the sample space for two child families.

6. What is the probability in a two-child family of the children being a boy and a girl, in that order (ie B G)?

7. By flipping a coin three times, or by flipping three coins, simulate forty families of three children. Write out your 40 families.

8. How many families out of your forty have three boys?

9. Using your probability from question 4, how many families out of forty would you expect to have three boys?

Self-evaluation task

Please complete the following.

How well did you manage your own learning using this resource?

	Always	Usually	Rarely	Not sure
Each section took approximately 45 minutes to complete.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I needed extra help.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I marked and corrected my work at the end of each section.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I made the journal entries and summaries when asked.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I have kept to my work schedule.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

How much mathematics have you learnt using this resource?

	Always	Usually	Rarely	Not sure
<i>Understanding</i>				
I understand how to write a sample space.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I understand how to determine equally likely outcomes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Fluency</i>				
I can calculate probabilities.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can convert probabilities between fraction, decimal and percentage form.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
I can recall definitions of the key words.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Problem Solving</i>				
I can interpret data from chance experiments.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<i>Reasoning</i>				
I can distinguish between equally likely and not equally likely outcomes.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Write a list of topics for which you need additional assistance. Discuss these with your teacher.

Solutions

1. Reviewing probability

Solutions to Warm-up 1

- 1, 7
- 24
- (-10)
- $\frac{3}{4}$
- 3.5
- 5.7
- 36.4
- $2\frac{1}{10}$
- 401
- (5, 1)

Solutions to Review 1

- (a) $\frac{1}{6}$
(b) 1
(c) 0
(d) 0.5
(e) 0.75
(f) $\frac{1}{52}$
(g) 0.9

Solution to Focus problem 1

- $\frac{0}{6} = 0$
- $\frac{6}{6} = 1$
- $\frac{3}{6} = 0.5$

2. Card probabilities

Solutions to Warm-up 2

- 10
- 8
- (-11) degrees
- >
- 20

6. 6
7. 9.01
8. 16.666 ...
9. 1.12
10. $\frac{3}{8} = 0.375$

Solutions to Review 2

1. (a) $\frac{1}{2}$, 50%
 (b) 0.166..., 16.66...%
 (c) $\frac{1}{3}$, 0.33..., $33\frac{1}{3}\%$
- 2.

Fraction	$\frac{1}{4}$	$\frac{1}{10}$	$\frac{1}{5}$	$\frac{1}{52}$
Decimal	0.25	0.1	0.2	0.0192 (4dp)
Percentage	25%	10%	20%	approx 2%

Solution to Focus problem 2

1. 52
2. Yes
3. $\frac{1}{52}$
4. 26
5. $\frac{26}{52} = \frac{1}{2}$
6. $\frac{13}{52} = \frac{1}{4}$
7. $\frac{4}{52} = \frac{1}{13}$
8. $\frac{12}{52} = \frac{3}{13}$
9. $\frac{20}{52} = \frac{5}{13}$
10. $\frac{2}{52} = \frac{1}{26}$

Solutions to Skills development 2

1. (a) A♦, A♥, A♣, A♠
 (b) A♣, 2♣, 3♣, 4♣, 5♣, 6♣, 7♣, 8♣, 9♣, 10♣, J♣, Q♣, K♣
 (c) J♦, Q♦, K♦, J♥, Q♥, K♥, J♣, Q♣, K♣, J♠, Q♠, K♠
 (d) 4♦, 4♥

2. (a) $\frac{4}{52} = \frac{1}{13}$
 (b) $\frac{13}{52} = \frac{1}{4}$
 (c) $\frac{12}{52} = \frac{3}{13}$
 (d) $\frac{2}{52} = \frac{1}{26}$

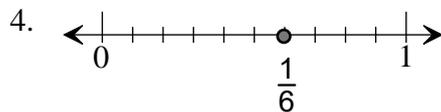
3. Spinner probabilities

Solutions to Warm-up 3

1. 17, 19 should be circled.

2. 21

3. (-2)



5. 18

6. 71

7. 44.24

8. 250%

9. 11

10. 117°

Solutions to Review 3

1.

Number of sectors	Degrees for each sector
2	180°
3	120°
4	90°
5	72°
6	60°
7	51.4° (1dp)
8	45°
9	40°
10	36°

Solution to Focus problem 3

1. 120° – it is 360° divided by three.
2. 1, 2 or 3
3. Yes – they are each 120° .
4. $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$
5. 1
6. $\frac{1}{4}$
7. (a) Yes
(b) No
(c) Probability of a 4 = $\frac{2}{3}$
Probability of a 5 = $\frac{1}{3}$

Solutions to Skills development 3

1. (a) 1, 2, 3, 4, 5, 6, 7, 8
(b) $\frac{1}{8}$
(c) $\frac{4}{8} = \frac{1}{2}$
(d) $\frac{7}{8}$
2. (a) 1, 2, 3, 4
(b) $\frac{1}{4}$
(c) $\frac{1}{2}$
(d) 1
3. (a) 1, 2, 3
(b) $\frac{2}{3}$
(c) $\frac{1}{3}$
(d) 0
4. (a) 2, 4, 6, 8, 10, 12, 14, 16
(b) 0

(c) $\frac{8}{8} = 1$

(d) $\frac{8}{8} = 1$

4. Alphabet probabilities

Solutions to Warm-up 4

1. 36
2. 4
3. 7 degrees
4. $\frac{3}{8}$
5. 20
6. 3.7
7. 2.051
8. $1\frac{1}{2}$ or $\frac{3}{2}$
9. 536
10. (-2, -3)

Solutions to Review 4

1.

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50%
$\frac{3}{5}$	0.6	60%
$\frac{4}{6}$	0.66...	66.66...%
$\frac{3}{4}$	0.75	75%
$\frac{9}{10}$	0.9	90%
$\frac{13}{52}$	0.25	25%
$\frac{1}{3}$	0.33 ...	33.33...%
$\frac{5}{26}$	0.19 (2 dp)	19% (nearest percent)

Solution to Focus problem 4

1. $\frac{1}{26}$
2. $\frac{1}{26}$
3. 0
4. $\frac{5}{26}$
5. $\frac{21}{26}$
6. $\frac{3}{26}$
7. $\frac{25}{26}$

Solutions to Skills development 4

1. (a) DGO, DOG, GDO, GOD, ODG, OGD
(b) 6
(c) $\frac{1}{6}$
(d) $\frac{2}{6} = \frac{1}{3}$
(e) $\frac{3}{6} = \frac{1}{2}$
2. (a) ABEL, ABLE, AEBL, AELB, ALBE, ALEB,
BAEL, BALE, BEAL, BELA, BLAE, BLEA,
EABL, EALB, EBAL, EBLA, ELAB, ELBA,
LABE, LAEB, LBAE, LBEA, LEAB, LEBA
(b) 24
(c) $\frac{1}{24}$
(d) $\frac{6}{24} = \frac{1}{4}$
(e) $\frac{12}{24} = \frac{1}{2}$
(f) 1
(g) 0

5. Sampling probabilities

Solutions to Warm-up 5

1. $2 \times 2 \times 3$
2. 133
3. 1
4. $\frac{5}{7}$
5. 10
6. 0.784
7. 50
8. 1.333 ...
9. 102.9
10. $\frac{2}{6} = \frac{1}{3}$

Solutions to Review 5

Various answers are possible. Two possible answers are shown for each part.

1. (a) P(1), P(2)
(b) P(even), P(prime)
(c) P(<3), P(>4)
2. (a) P(1), P(2)
(b) P(even), P(prime)
(c) P(<3), P(>6)

Solution to Focus problem 5

1. $\frac{6}{20} = \frac{3}{10}$
2. $\frac{3}{20}$
3. 0
4. $\frac{18}{20} = \frac{9}{10}$
5. $\frac{11}{20}$
6. Yes, each of the 20 jubes has the same chance of being drawn randomly.
7. No, there are varying numbers of each colour so they are not equally likely.
8. Black: 6, pink: 2, green: 2, orange: 5, blue: 5.

Solutions to Skills development 5

- (a) R, R, R, B, B, B, B, G, G, G, G, G, G, G, G
(b) $\frac{3}{15} = \frac{1}{5}$
(c) $\frac{4}{15}$
(d) $\frac{8}{15}$
(e) 0
(f) $\frac{11}{15}$
(g) $\frac{12}{15} = \frac{4}{5}$

6. Not equally likely

Solutions to Warm-up 6

- 30.6
- 520
- 7 degrees
- $\frac{7}{5}$
- 12
- 800
- 4
- 250%
- 3
- Pentagon

Solutions to Review 6.

- (a) $\frac{1}{13}$
(b) $\frac{3}{13}$
(c) $\frac{4}{13}$
(d) $\frac{2}{13}$
- (a) $\frac{2}{61}$

- (b) $\frac{9}{61}$
- (c) $\frac{6}{61}$
- (d) $\frac{1}{61}$

Solution to Focus problem 6

Experiment 1

1. The table can have varying frequencies. An example is given.

Outcome	Tally	Frequency
opening up		28
opening down		30
on edge		2

2. Results will vary but it is very unlikely that frequencies will be equal.
3. 20
4. No

Experiment 2

1. The table can have varying frequencies. An example is given.

Outcome	Tally	Frequency
point down		32
point up		28

2. Result will vary.
3. 30
4. It is unlikely they are the same as the pin is not physically symmetrical.
5. Answers will vary, but three examples are rolling a die, flipping a coin and drawing a card from a pack.

Solutions to Skills development 6

1. (a) No – they are not roughly equal.
- (b) There was an extra 3 and the 5 was missing.
- (c) The values could vary slightly in a real trial.

Outcome	1	2	3	4	5	6
Frequency	100	200	0	0	300	0

- The most likely are (a) and (c).
- Outcomes should be roughly the same.

Outcome	Heads	Tails
Frequency	50	50

7. Assigning probabilities

Solutions to Warm-up 7

- 0.402
- 169
- 14 degrees
- $\frac{11}{10} = 1\frac{1}{10}$
- 7
- 1600
- 5
- \$37.50
- Add 6 each time.
- 19°

Solution to Focus problem 7

- $\frac{2}{4} = \frac{1}{2}$
- $\frac{1}{4}$
- $\frac{1}{4}$
- Three 1s, two 2s, one 3 and no 4, 5 or 6s.

Solutions to Skills development 7

- 1, 2, 2, 3
 - $\frac{1}{4} = 0.25 = 25\%$
 - $\frac{2}{4} = \frac{1}{2} = 0.5 = 50\%$
 - $\frac{1}{4} = 0.25 = 25\%$
- 1, 1, 2
 - $\frac{2}{3} = 0.66... = 66.66...%$
 - $\frac{1}{3} = 0.33... = 33.33...%$
- Four 12s, three 7s, two 3s, one 4, 8 and 11 and no others

Solutions to Review tasks

Solutions to Task A

- 0.5
 - 1
 - 0.25
 - 0
- 3♦, 3♥
- 1, 2, 3, 3
 - $\frac{1}{4}$
 - $\frac{1}{4}$
- ABC, ACB, BAC, BCA, CAB, CBA
 - $\frac{1}{6}$
- $\frac{3}{16}$
 - $\frac{8}{16} = \frac{1}{2}$
- Frequencies should be roughly these.

Outcome	1	2	3	4	5	6
Frequency	50	50	50	50	50	50

- Three 1s, two 2s, one 3, 4 and 5 and no others

Solutions to Task B

- GBG
- It is random with a probability of one-half.
- BBB, BBG, BGB, BGG, GBB, GBG, GGB, GGG
- $\frac{1}{8}$
- BB, BG, GB, GG
- $\frac{1}{4}$
- Results will vary here.
- Results will vary, but it is expected to be about five.
- 5



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PROBABILITY
ISBN: 9780730744481