

VCE VM Numeracy Unit 2

Chapter 4 — Uncertainty

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Theory

About the data in this section. The weather apps, fete games, matches and chances here are **made up** (not real): pretend places and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

Will it rain on market day? Will the coin land heads? Will your ticket be the one drawn out of the drum? Every one of these questions is about **chance** — how likely something is to happen. This section draws on two parts of the study design (Unit 2, Area of Study 7): how likely everyday events are to happen, and the everyday words for chance and the numbers that match them — for example, an even chance is 0.5, or 50%.

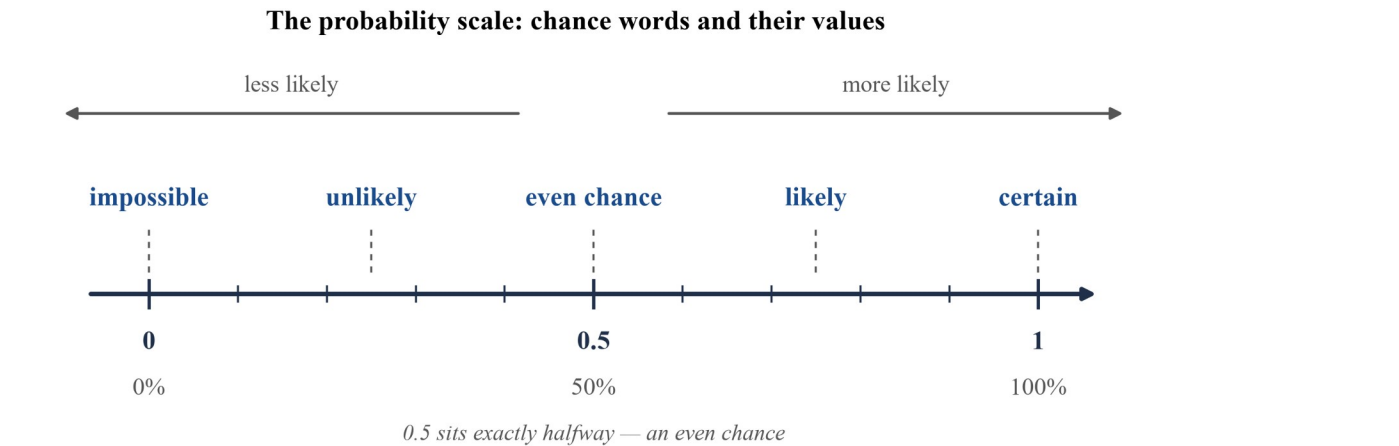
Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

What this section covers.

The five **chance words** — impossible, unlikely, even chance, likely, certain — and the numbers they sit with on the 0-to-1 **probability scale**; placing familiar events on that scale and putting them in order; everyday ways of saying a chance, such as *fifty-fifty* and *sure thing*; and the swap between an event happening and not happening. Writing likelihoods as fractions, and working out chances by counting outcomes, are sections 4B and 4C — they are not needed here.

The five chance words.

Five words do most of the work of saying how likely something is. The table gives each word’s meaning and a familiar example; the figure puts the words on one scale, so you can see which word is bigger than which.



Word	What it tells you	Example
impossible	cannot happen at all	a standard die showing a 9
unlikely	could happen, but probably will not	rain on a day with a 20% chance of rain
even chance	just as likely to happen as not	a fair coin landing heads
likely	will probably happen	your team winning when they are clear favourites
certain	will definitely happen	the sun rising tomorrow morning

The probability scale.

The **probability** of an event is a number that says how likely the event is — its chance of happening. Probabilities live on a scale from 0 to 1. The left end, 0, means impossible; the right end, 1, means certain; everything in between can happen but is not sure. Further right means more likely. Three anchor values do most of the work: 0, 0.5 and 1. The same scale can be read in percent: 0 is 0%, 0.5 is 50%, and 1 is 100%.

Refresher — decimals between 0 and 1.

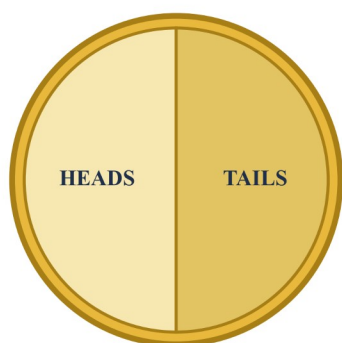
A decimal like 0.2 or 0.8 is a number between 0 and 1. The first place after the point is **tenths**, so 0.2 is two tenths of the way from 0 to 1, and 0.8 is eight tenths of the way. A bigger decimal sits further right on the scale, so it means more likely: 0.8 is more likely than 0.3, because $0.8 > 0.3$. In order from least to most likely: 0.1, then 0.5, then 0.9.

Refresher — percentages.

“Percent” means “out of 100”, so a percent is the scale decimal multiplied by 100. $0.5 \times 100 = 50$, so 0.5 is 50%; $0.9 \times 100 = 90$, so 0.9 is 90%. The three anchors in percent are 0% (impossible), 50% (even chance) and 100% (certain). A percent between 0% and 50% is unlikely; a percent between 50% and 100% is likely.

‘Even chance’ three ways.

An **even chance** is the halfway point of the scale, and it has three everyday names: 0.5 as a decimal, 50% as a percent, and *fifty-fifty* in speech. All three say the same thing — the event is just as likely to happen as not. A fair coin is the classic picture: two sides, either one can come up, so heads is an even chance.

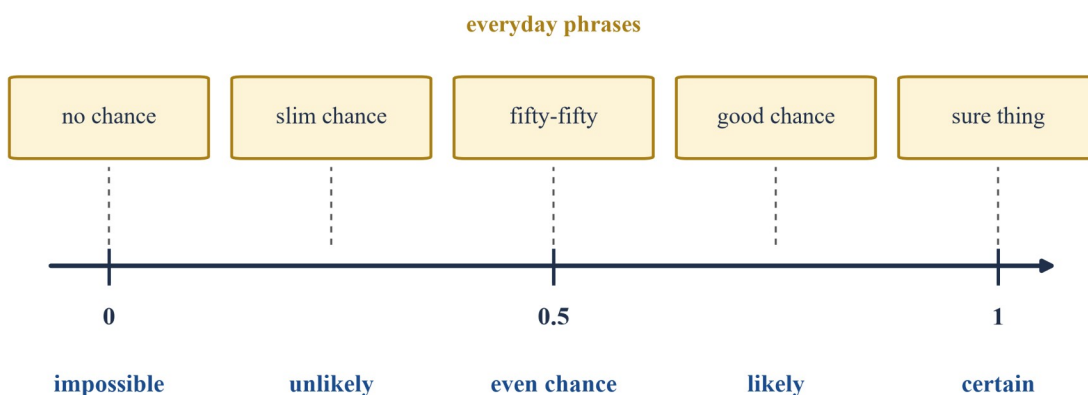


A fair coin: either side can come up — heads is an even chance ($0.5 = 50\%$).

Everyday ways to say it.

At the fete or the footy, people rarely say “0.5”. They reach for everyday phrases, and each phrase sits at its own spot on the same scale.

Everyday phrases sit on the same scale



The same scale, said in everyday words.

Everyday phrase	Scale word	Value on the scale
no chance	impossible	0 (0%)
slim chance	unlikely	between 0 and 0.5

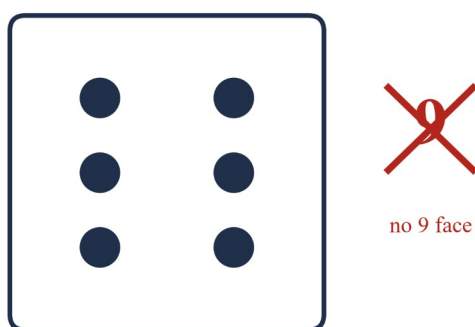
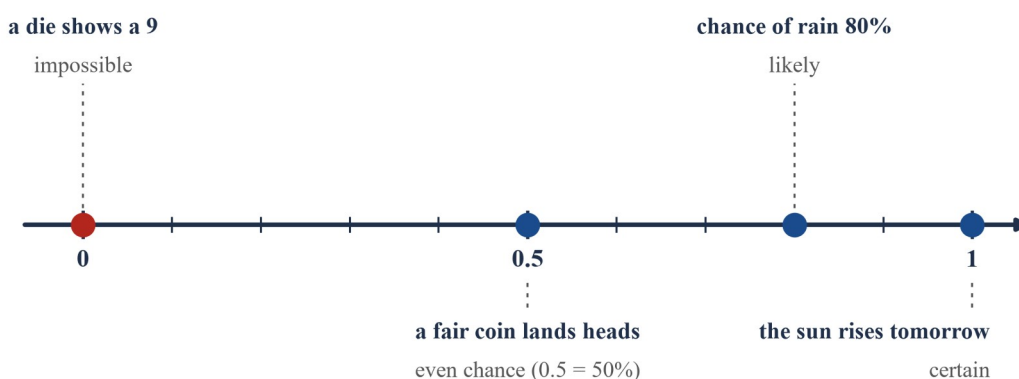
Everyday phrase	Scale word	Value on the scale
fifty-fifty, could go either way	even chance	0.5 (50%)
good chance	likely	between 0.5 and 1
sure thing	certain	1 (100%)

Placing events on the scale.

To place an event on the scale, ask one question: can it not happen at all, could it happen but probably not, is it as likely as not, will it probably happen, or will it definitely happen? Then pick the matching spot. Four familiar events, worked:

- The sun rises tomorrow morning: it will definitely happen — **certain**, value 1 (100%).
- A fair coin lands heads: either side can come up — **even chance**, value 0.5 (50%).
- A standard die shows a 9: a standard die has faces 1, 2, 3, 4, 5, 6 only, so a 9 cannot show — **impossible**, value 0 (0%).
- The weather app puts the chance of rain at 80%: above the 50% mark and below 100% — **likely**.

Familiar events placed on the scale



A standard die: faces 1, 2, 3, 4, 5, 6 only.

Made-up data: the weather app and its 80% are made up for this section.

Less likely, more likely — ordering.

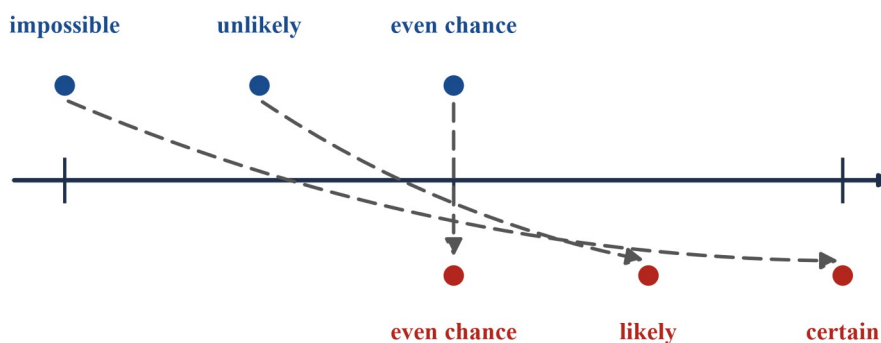
Putting events in order is just reading the scale from left to right: left means less likely, right means more likely. Of 5%, 30% and 95%, the smallest is 5% and the largest is 95%, so from least likely to most likely the order is 5%, then 30%, then 95%. Decimals order the same way: 0.1, then 0.5, then 0.9.

Happening and not happening.

Every event has a partner: the event *not* happening. Not happening flips the scale end for end. If rain is **unlikely**, then no rain is **likely**. If an event is **impossible**, then it not happening is **certain** — and the other way around. An even chance is the one spot that flips to itself: on a fair coin, not heads is tails, still 0.5.

Happening and not happening swap ends of the scale

the event happens



the event does NOT happen

if rain is unlikely, then no-rain is likely

Talking carefully about chance.

Three habits keep chance talk honest. First, *might* does not mean fifty-fifty: “it might rain” only says the chance is not 0% — it might be 10%, it might be 40%. Second, *sure thing* is a very big claim: it says value 1, 100%, nothing can go wrong — save it for things that cannot fail, like the sun rising. Third, “either it happens or it doesn’t” does not make an event 0.5: tomorrow either rains or doesn’t, but if the app says 10%, rain is still **unlikely** — the two outcomes are not equally likely, so they are not fifty-fifty.

Units 3 & 4 preview. In Units 3 and 4 chances are worked out by counting all the equally-likely outcomes an event can land on — not in this book, and not in its tests.

Worked examples

Example 1 — scaffolded

Here are three events from around Cobble Creek, lettered A, B and C.

Example 1 — the three events

A	B	C
		
A fair coin is tossed. It lands heads.	Tomorrow morning, the sun rises over Cobble Creek.	A standard die (faces 1–6) is rolled. It shows a 9.

For each event, give the chance word, the value on the 0-to-1 scale, and the percent.

Working

Comment

Purpose and question(s): place three events on the

Three events, the same three questions each — list them

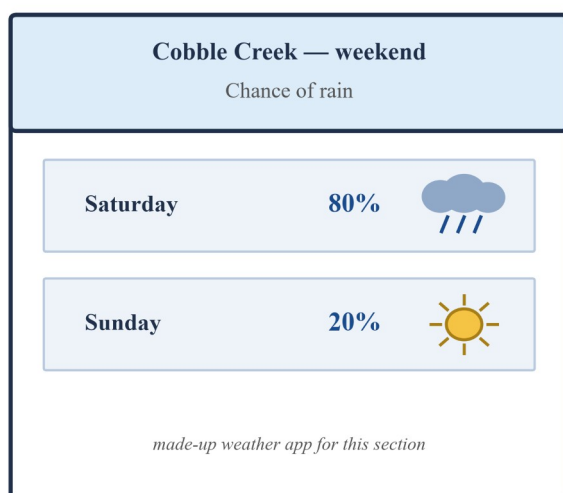


Working	Comment
chance scale. Questions: for each of A, B and C, the chance word, the scale value and the percent.	before starting.
Mathematics in the context: A, a fair coin lands heads; B, the sun rises over Cobble Creek tomorrow morning; C, a standard die (faces 1–6) shows a 9.	Match each event to a spot: cannot happen, as likely as not, or definitely happens.
Step 1: A — two sides, and either can come up, so heads is an even chance : value 0.5, which is 50%.	Halfway on the scale: as likely to happen as not.
Step 2: B — the sun rising tomorrow cannot fail, so it is certain : value 1, which is 100%.	The right-hand end of the scale.
Step 3: C — a standard die has faces 1, 2, 3, 4, 5, 6 only; there is no 9 face, so showing a 9 is impossible : value 0, which is 0%.	The left-hand end of the scale.
Check: the three values line up left to right as $0 < 0.5 < 1$ — impossible, even chance, certain, in scale order.	Trace the three spots on the scale figure to see the order.

Event A is an even chance (0.5, or 50%), event B is certain (1, or 100%), and event C is impossible (0, or 0%).

Example 2 — scaffolded

The Cobble Creek weather app shows the chance of rain for the coming weekend.



Made-up data: the weather app and every percent here are made up for this section.

Give the chance word for Saturday and for Sunday, and say which day is the better one for an outdoor market.

Working	Comment
Purpose and question(s): read two percents off the app and place them on the scale. Questions: the word for Saturday; the word for Sunday; the drier day for an outdoor market.	Percents are scale values — compare each with the 50% mark.
Mathematics in the context: Saturday's chance of rain is 80%; Sunday's chance of rain is 20%.	Above 50% is likely; below 50% is unlikely.
Step 1: Saturday's 80% sits between 50% and 100%, closer to 100% — rain on Saturday is likely .	More than halfway: it will probably happen.
Step 2: Sunday's 20% sits between 0% and 50%, closer to 0% — rain on Sunday is unlikely .	Less than halfway: it probably will not happen.
Step 3: the market wants the drier day; 20% is less than	A lower chance of rain means a drier day.

80%, so **Sunday** is the better day for it.

Check: 80% and 20% sit on opposite sides of the 50% mark — one likely, one unlikely, exactly as the two words say. Two days, two sides of even chance.

Saturday's rain is likely (80%), Sunday's rain is unlikely (20%), so Sunday is the better day for the outdoor market.

Example 3 — unscaffolded

Darcy checks the weather app before market day: the chance of rain is 0.2. (a) Write 0.2 as a percent. (b) Give the chance word for rain. (c) Darcy says “it's sure to rain, so why bother reading the app at all?” Is Darcy right? Say why.

Made-up data: Darcy's app reading and every number here are made up for this section.

Multiplying by 100 turns the scale decimal into a percent: $0.2 \times 100 = 20$, so 0.2 is 20% — twenty out of every hundred mornings like this one would rain. 20% sits between 0% and 50%, closer to 0%, so rain is **unlikely**. “Sure to rain” claims **certain** — value 1, 100% — but the app says 20%, so Darcy has the wrong word: an unlikely event can still happen, which is exactly why the app is worth reading.

∴ (a) 0.2 is 20%; (b) rain is **unlikely**; (c) no — “sure” means certain (100%), and the app says 20%.

Example 4 — unscaffolded

Cleo's sock drawer holds 8 socks, and every one of them is black. She grabs one sock without looking. (a) Give the chance word and the scale value for “the sock is black”. (b) Give the chance word and the scale value for “the sock is red”. (c) Cleo says “black or not black — it's fifty-fifty.” Is Cleo right? Say why.

Every sock in the drawer is black — all 8 of the 8 — so whichever sock Cleo grabs, it is black: **certain**, value 1 (100%). There is not a single red sock in the drawer, so pulling a red one cannot happen at all: **impossible**, value 0 (0%). Cleo's “fifty-fifty” claims an even chance, 0.5, as if black and not-black were equally likely; but with all eight socks black, not-black cannot happen, so the chance of black is 1, not 0.5 — two outcomes that are not equally likely are not fifty-fifty.

∴ (a) black is **certain**, value 1; (b) red is **impossible**, value 0; (c) no — all-black socks make black certain, not fifty-fifty.

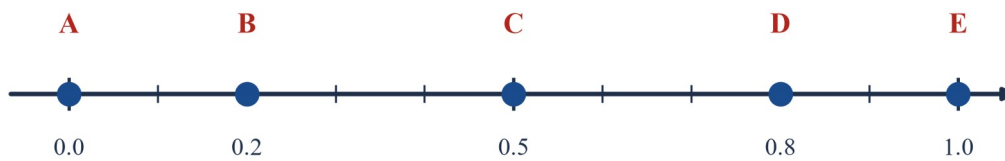
Practice questions

Scaffolded

Q1. Here are the five chance words: *impossible · unlikely · even chance · likely · certain*. (a) Match each word with its meaning: *cannot happen at all, could happen but probably will not, just as likely to happen as not, will probably happen, will definitely happen*. (b) A fair coin is tossed and lands tails. Which word fits? (c) A bag holds only blue balls. You pull out one ball and it is white. Which word fits?

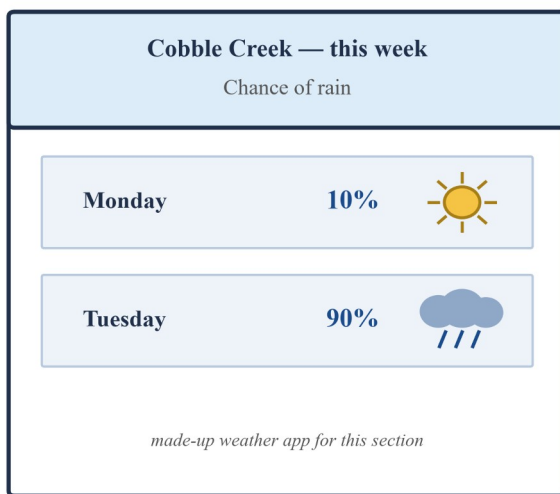
Q2. The chance scale runs from 0 to 1. (a) What value on the scale means impossible? (b) Write an even chance as a decimal and as a percent. (c) Which of 0.9 and 0.2 is closer to certain?

Q3. Five points sit on the chance scale, lettered A to E.



- Give the chance word at point A and at point E.
- Which letter sits at even chance?
- Give the chance word at point B and at point D.

Q4. The Cobble Creek weather app shows the chance of rain for Monday and Tuesday.



Made-up data: the weather app and every percent here are made up for this section.

- Give the chance word for rain on Monday.
- Give the chance word for rain on Tuesday.
- You will carry an umbrella on one of these two days. Which day, and why?

Q5. Here are five everyday chance phrases: *no chance* · *slim chance* · *fifty-fifty* · *good chance* · *sure thing*. (a) Match each phrase with its scale word: *impossible* · *unlikely* · *even chance* · *likely* · *certain*. (b) Which phrase means value 1 on the scale? (c) “Could go either way” is one more way of saying fifty-fifty. What percent is that?

Q6. The Cobble Creek fete posts its guess at the chance of winning three of its games:

- tennis-ball match: 30%
- sack race: 95%
- egg-and-spoon race: 5%

Made-up data: the fete, its games and every percent here are made up for this section.

- Which game is closest to certain?
- Which game is the least likely to be won?
- Put the three percents in order from least likely to most likely.

Unscaffolded

Q7. A standard die (faces 1, 2, 3, 4, 5, 6) is rolled once. (a) Give the chance word and the scale value for “the number rolled is less than 7”. (b) Give the chance word and the scale value for “the number rolled is a 9”. (c) Which is more likely: rolling a number less than 7, or rolling a 6? Say why in one sentence.

Q8. Mabel says “the app says it *might* rain, so that’s an even chance.” The app actually shows a 10% chance of rain. (a) Is Mabel right that *might* means an even chance? (b) What does *might* tell you about the chance of rain? (c) Give the chance word for a 10% chance of rain.

Made-up data: the app reading here is made up for this section.

Q9. Here are four events: (i) the sun rises over Cobble Creek tomorrow; (ii) a fair coin lands heads; (iii) Rory’s ticket is drawn first from a drum holding hundreds of tickets; (iv) Rory rolls a 7 on a standard die. (a) Which event is the most likely? (b) Which event is the least likely? (c) Put all four events in order from least likely to most likely.

Q10. A sign at the fete reads “95% of players win a prize!” Silas says “that’s only a slim chance of winning.” (a) Give the chance word for 95%. (b) Is 95% above or below the even-chance mark on the scale? (c) Is Silas’s word right? Say why.

Made-up data: the sign and its 95% are made up for this section.

Q11. Flip each event over to the event NOT happening, and give the chance word for that partner event: (a) an event that is unlikely to happen; (b) an event that is certain; (c) an event that is an even chance.

Q12. True or false? (a) A chance of value 0 means the event is impossible. (b) The word *likely* means the event has value 1. (c) 0.5 and 50% say the same chance.

Q13. (a) Write an even chance as a decimal. (b) Write an even chance as a percent. (c) A made-up weather app puts the chance of rain at 0.4. Write 0.4 as a percent and give the chance word for rain.

Made-up data: the app reading in (c) is made up for this section.

Q14. A poster for the Cobble Creek Wombats’ grand final reads “SATURDAY: A SURE THING!” (a) What scale value and what percent does *sure thing* claim? (b) Is a footy match ever really that value? Say why. (c) This season the Wombats have won about 90% of their matches. Give a better chance word for Saturday than *sure thing*.

Made-up data: the poster, the team’s record and every number here are made up for this section.

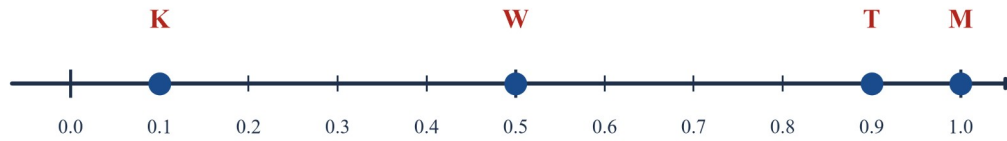
Q15. A work crew’s forecast for Friday says: chance of rain 20%; chance of a hot day (over 30 degrees) 80%. (a) Give the chance word for rain. (b) Give the chance word for a hot day. (c) The crew packs for the more likely weather. Do they pack raincoats, or drinking water and shade? Say why.

Made-up data: the forecast and every percent here are made up for this section.

Q16. Exactly one of these sentences uses its chance word correctly. Which one? (a) It is **impossible** that it rains in Cobble Creek tomorrow. (b) A fair coin landing heads is an **even chance**. (c) The Cobble Creek Wombats winning on Saturday is **certain**. Then say in one sentence each why the chance word is wrong in (a) and in (c).

Q17. At the lucky door, Rory says “my chance of winning is slim.” (a) Which scale word matches *slim*? (b) Give the chance word for Rory NOT winning. (c) Rory adds “and someone will win for sure, so really it’s fifty-fifty for me.” Is Rory right? Say why.

Q18. Four letters sit on the chance scale below. Match these four events to the letters: the sun rises tomorrow; a fair coin lands tails; Cleo pulls the winning straw from the jar; the Cobble Creek Market is open on Saturday.



Made-up data: Cleo's straw jar, the market and every value here are made up for this section.

- (a) Which letter is an even chance? (b) Which event sits at letter K? (c) Which letter is closest to certain without being certain?
-

Answers

Q1. (a) impossible = cannot happen at all; unlikely = could happen but probably will not; even chance = just as likely to happen as not; likely = will probably happen; certain = will definitely happen. (b) even chance. (c) impossible. **Q2.** (a) 0. (b) 0.5 and 50%. (c) 0.9. **Q3.** (a) A impossible, E certain. (b) C. (c) B unlikely, D likely. **Q4.** (a) unlikely. (b) likely. (c) Tuesday — its 90% chance of rain makes it the wetter day. **Q5.** (a) no chance = impossible; slim chance = unlikely; fifty-fifty = even chance; good chance = likely; sure thing = certain. (b) sure thing. (c) 50%. **Q6.** (a) the sack race (95%). (b) the egg-and-spoon race (5%). (c) 5%, 30%, 95%. **Q7.** (a) certain, value 1. (b) impossible, value 0. (c) a number less than 7 — every face is less than 7, so it cannot fail. **Q8.** (a) No. (b) that the chance is not 0% — rain could still happen. (c) unlikely. **Q9.** (a) (i). (b) (iv). (c) (iv), (iii), (ii), (i). **Q10.** (a) likely. (b) above. (c) No — 95% is near 100%, while *slim* means near 0%. **Q11.** (a) likely. (b) impossible. (c) even chance. **Q12.** (a) True. (b) False — likely sits under 1. (c) True. **Q13.** (a) 0.5. (b) 50%. (c) 40%, unlikely. **Q14.** (a) 1 (100%). (b) No — either team can lose, so a match is never value 1. (c) likely. **Q15.** (a) unlikely. (b) likely. (c) drinking water and shade — the hot day (80%) is the more likely weather. **Q16.** sentence (b). (a) rain is still possible tomorrow, so its chance is not 0. (c) a match is never guaranteed, so its chance is not 1. **Q17.** (a) unlikely. (b) likely. (c) No — “someone wins” is certain, but Rory’s own chance is still slim. **Q18.** (a) W. (b) Cleo pulls the winning straw. (c) T.

Fully-worked solutions

Q1. (a) impossible = cannot happen at all; unlikely = could happen but probably will not; even chance = just as likely to happen as not; likely = will probably happen; certain = will definitely happen. (b) A fair coin lands tails just as often as heads, so it is an **even chance**. (c) The bag holds only blue balls, so a white ball cannot come out: **impossible**.

Q2. (a) Impossible is the left end of the scale: value 0. (b) An even chance is the halfway point: 0.5 as a decimal, and $0.5 \times 100 = 50$, so **50%** as a percent. (c) Certain is 1; 0.9 is one tenth below it while 0.2 is much further away, so 0.9 is closer to certain.

Q3. (a) A sits at 0, the impossible end, and E sits at 1, the certain end: **A impossible, E certain**. (b) Even chance is 0.5, the halfway mark, which is point **C**. (c) B sits at 0.2, between 0 and 0.5, so **unlikely**; D sits at 0.8, between 0.5 and 1, so **likely**.

Q4. (a) Monday’s 10% sits between 0% and 50%, so rain on Monday is **unlikely**. (b) Tuesday’s 90% sits between 50% and 100%, so rain on Tuesday is **likely**. (c) Carry the umbrella on **Tuesday** — its 90% chance of rain is the wetter of the two days, so that is the day rain will probably arrive.

Q5. (a) no chance = impossible; slim chance = unlikely; fifty-fifty = even chance; good chance = likely; sure thing = certain. (b) Value 1 is certain, and the phrase for certain is **sure thing**. (c) Fifty-fifty is the halfway point, 0.5, and $0.5 \times 100 = 50$: **50%**.

Q6. (a) Closest to certain means closest to 100%: the **sack race** at 95%. (b) Least likely means nearest 0%: the **egg-and-spoon race** at 5%. (c) Reading the percents from smallest to largest: **5%, 30%, 95%** — egg-and-spoon, then tennis-ball match, then sack race.

Q7. (a) Every face of a standard die (1, 2, 3, 4, 5, 6) is less than 7, so the event cannot fail: **certain, value 1**. (b) A standard die has no 9 face, so a 9 cannot show: **impossible, value 0**. (c) **A number less than 7** is more likely — it is certain, while rolling a 6 can fail (the other five faces can show), so it is not certain and must sit lower on the scale.

Q8. (a) **No** — *might* says nothing about being halfway; it only says the event could happen. (b) *Might* tells you the chance of rain is **not 0%** — rain is possible, however small the chance. (c) 10% sits between 0% and 50%, closer to 0%, so rain is **unlikely**.

Q9. (a) The sun rising tomorrow cannot fail: **(i)** is the most likely (certain). (b) A standard die has no 7 face, so Rory cannot roll a 7: **(iv)** is the least likely (impossible). (c) From least to most likely: **(iv), (iii), (ii), (i)** — impossible (rolling a 7), unlikely (one ticket among hundreds), even chance (the coin), certain (the sun).

Q10. (a) 95% sits between 50% and 100%, close to certain, so it is **likely**. (b) The even-chance mark is 50%, and 95% is **above** it. (c) **No** — *slim* means near 0%, but 95% is near 100%; the sign says winning will probably happen, the opposite of slim.

Q11. (a) Not happening flips unlikely across the scale: **likely**. (b) Not happening flips certain to the other end: **impossible**. (c) An even chance flips to itself: **even chance**.

Q12. (a) **True** — 0 is the impossible end of the scale. (b) **False** — *likely* sits between 0.5 and 1, under 1; value 1 is certain. (c) **True** — $0.5 \times 100 = 50$, so 0.5 and 50% are the same chance, an even chance.

Q13. (a) An even chance as a decimal is 0.5. (b) $0.5 \times 100 = 50$, so as a percent it is **50%**. (c) $0.4 \times 100 = 40$, so 0.4 is **40%**; 40% sits between 0% and 50%, so rain is **unlikely**.

Q14. (a) *Sure thing* is the word for certain: value 1, which is **100%**. (b) **No** — on the day either team can lose, so a real match is never value 1; it sits somewhere below certain. (c) Winning about 90% of matches is between 50% and 100%, so the better word is **likely**.

Q15. (a) 20% sits between 0% and 50%, so rain is **unlikely**. (b) 80% sits between 50% and 100%, so a hot day is **likely**. (c) They pack **drinking water and shade** — the hot day at 80% is the more likely weather, while rain at 20% probably stays away.

Q16. The correct sentence is (b): a fair coin lands heads just as often as not, so even chance is exactly right. (a) *Impossible* means value 0, cannot happen at all — but rain is still possible in Cobble Creek tomorrow, so its chance is not 0. (c) *Certain* means value 1, cannot fail — but either team can lose on Saturday, so the win is not value 1.

Q17. (a) *Slim* sits near the impossible end: **unlikely**. (b) Not winning flips unlikely across the scale: **likely**. (c) **No** — “someone wins” is certain because every ticket belongs to someone, but Rory’s own two outcomes (Rory wins, Rory does not) are not equally likely: with hundreds of tickets, his win stays slim, not fifty-fifty.

Q18. Matching first: the sun rising tomorrow is certain, so M (1); a fair coin landing tails is an even chance, so W (0.5); one winning straw in a jar of many is very unlikely, so K (0.1); the market being open on Saturday, as it usually is, is likely but not sure, so T (0.9). (a) The even chance is letter **W**. (b) Letter K (0.1) holds **Cleo pulls the winning straw** — the very unlikely event. (c) Closest to certain without being certain is **T** at 0.9 (M at 1 is certain itself).

Chapter 4 Uncertainty — 4B Likelihood as fractions, decimals and percentages

Theory

About the data in this section. The raffles, spinners, bags, wheels, weather apps and team numbers in this section are **made up** (not real): pretend games and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

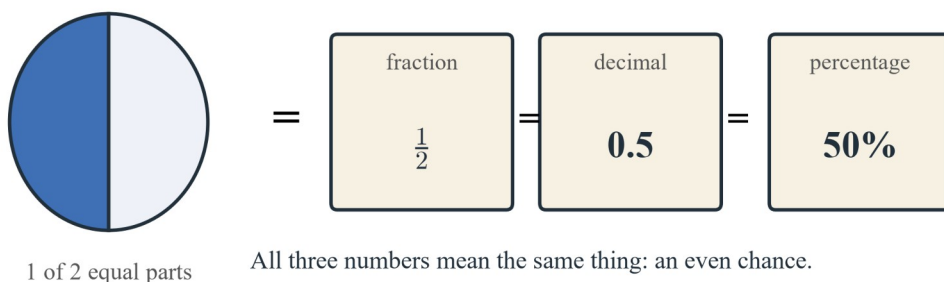
This section builds one skill from the study design (Unit 2, Area of Study 7): estimating and stating how likely an everyday event is, using a simple fraction, decimal or percentage — for example $\frac{1}{5}$, $\frac{1}{3}$, $\frac{1}{2}$, 0.5 or 50%.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

What this section covers. In Section 4A you met the chance words: impossible, unlikely, even chance, likely, certain. This section puts **numbers** on those chances. You will count outcomes, turn the count into a fraction, and move that fraction between its three outfits — fraction, decimal and percentage. Section 4C then uses these numbers to compare chances and check everyday claims about them.

A likelihood is a number. Every chance in this section is one number between 0 and 1. Zero means it cannot happen, 1 means it always happens, and everything else sits in between. The same likelihood can be written three ways, and all three mean exactly the same size:

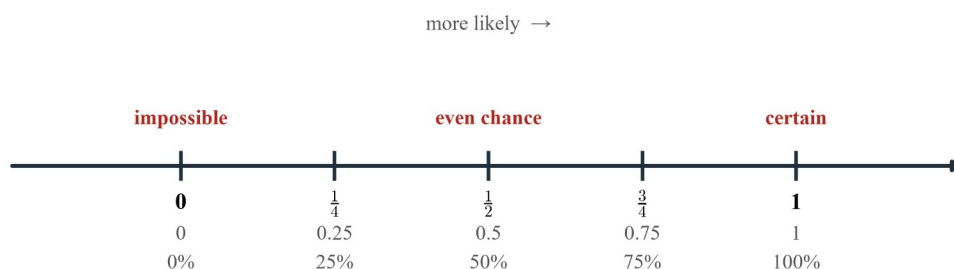
One likelihood, three ways of writing it



We write **P()** as a short form for “the chance that”. So $P(\text{red})$ is read “the probability of red” — the chance that the thing you pick, spin or draw is red. A **percentage** is simply a number out of 100: 100 % is the whole thing, the same as 1.

The likelihood scale. Putting the three outfits on the 0-to-1 scale gives one picture you can use all section:

The likelihood scale: every likelihood is a number from 0 to 1



Point on the scale	Fraction	Decimal	Percentage	Chance word from Section 4A
bottom of the scale	0	0	0%	impossible

Point on the scale	Fraction	Decimal	Percentage	Chance word from Section 4A
a quarter of the way	$\frac{1}{4}$	0.25	25 %	between impossible and an even chance
the middle	$\frac{1}{2}$	0.5	50 %	an even chance
three-quarters of the way	$\frac{3}{4}$	0.75	75 %	between an even chance and certain
top of the scale	1	1	100 %	certain

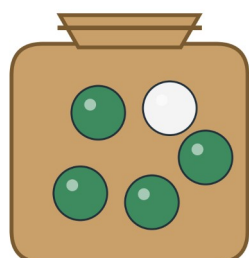
Counting your way to a fraction. When something is **random** — nobody can choose or foresee the result — each single result is called an **outcome**. The outcomes we are hoping for are the **favourable outcomes**. If every outcome is **equally likely** (a fair die, a well-shuffled barrel, a bag of marbles all the same size), then the chance of an event is just a count:

$$P(\text{event}) = \frac{\text{favourable outcomes}}{\text{total outcomes}}$$

Refresher — what a fraction means. A **fraction** is a part of a whole. The bottom number (the **denominator**) says how many equal parts the whole is cut into; the top number (the **numerator**) says how many of those parts you have. So $\frac{4}{5}$ means “cut into 5 equal parts, take 4 of them” — which is exactly “4 favourable outcomes out of 5 total outcomes”.

Here is the counting model on a made-up bag:

Counting outcomes: 4 of the 5 marbles are green



4 green + 1 white = 5 marbles

favourable outcomes (green): 4

total outcomes: 5

$$P(\text{green}) = \frac{4}{5} = 0.8 = 80\%$$

Made-up bag of marbles, drawn for this book.

Four of the five marbles are green, so $P(\text{green}) = \frac{4}{5}$. Then $4 \div 5 = 0.8$, and $0.8 \times 100 = 80$, so the same chance is

$$\frac{4}{5} = 0.8 = 80\%.$$

Refresher — equivalent fractions and simplifying. Dividing the top and the bottom of a fraction by the same number gives an **equivalent fraction** — the same size, smaller numbers. A fraction is in **simplest form** when no whole number bigger than 1 divides both top and bottom.

Start	Divide top and bottom by	Simplest form
$\frac{2}{4}$	2	$\frac{1}{2}$

Start	Divide top and bottom by	Simplest form
$\frac{4}{6}$	2	$\frac{2}{3}$
$\frac{3}{9}$	3	$\frac{1}{3}$
$\frac{5}{50}$	5	$\frac{1}{10}$

Always simplify your fraction answer, then check the decimal and percentage still match the simplified fraction — they will, because the size never changed.

Moving between the three forms. The three outfits convert with two small moves each way:

Moving between the three forms



percentage to fraction: write over 100 and simplify — $60\% = \frac{60}{100} = \frac{3}{5}$

The arrows work both ways: the same likelihood, three outfits.

Refresher — fraction to decimal. Divide the top by the bottom: $\frac{4}{5} = 4 \div 5 = 0.8$. Some divisions never end:

$1 \div 3 = 0.3333\dots$, where the dots mean the 3s keep going forever.

Refresher — rounding to 2 decimal places. Look at the third decimal digit. If it is 5 or more, round the second digit up; if it is 4 or less, leave the second digit alone. So $0.3333\dots$ becomes 0.33, and $0.6666\dots$ becomes 0.67.

Rounding a percentage “to the nearest whole number” works the same way on the first decimal digit: $33.33\dots\%$ becomes 33%.

Refresher — decimal to percentage. Multiply by 100: $0.8 \times 100 = 80$, so $0.8 = 80\%$. That is what “per cent” means — out of 100.

Refresher — percentage to decimal and fraction. Divide by 100 to get the decimal: $60\% = 60 \div 100 = 0.6$. For the fraction, write the number over 100 and simplify: $60\% = \frac{60}{100} = \frac{3}{5}$.

The common values worth knowing. These come up so often that they are worth recognising on sight:

Fraction	Decimal	Percentage
0	0	0%
$\frac{1}{10}$	0.1	10%
$\frac{1}{5}$	0.2	20%
$\frac{1}{4}$	0.25	25%

Fraction	Decimal	Percentage
$\frac{1}{3}$	0.33 (to 2 decimal places)	33 % (to the nearest whole number)
$\frac{1}{2}$	0.5	50 %
$\frac{2}{3}$	0.67 (to 2 decimal places)	67 % (to the nearest whole number)
$\frac{3}{4}$	0.75	75 %
$\frac{4}{5}$	0.8	80 %
$\frac{9}{10}$	0.9	90 %
1	1	100 %

Refresher — a percentage of an amount. “20% of 10” means $0.2 \times 10 = 2$. Turn the percentage into a decimal first, then multiply by the amount.

Estimating a likelihood. Often you only need a feel for a chance, not the exact number. Place it against the scale: $\frac{9}{10}$ sits close to 1, so that event is very likely; $\frac{1}{6}$ sits close to 0, so that event is unlikely. Asking “is it closer to 0, to $\frac{1}{2}$, or to 1?” is a fast way to estimate.

Refresher — “1 in 5” talk. Chance is often said as “1 in 5”. That means 1 favourable outcome in 5 tries: $\frac{1}{5} = 0.2 = 20\%$.

The chance of something NOT happening. The chance an event does not happen is what is left over from the whole. In fractions the whole is 1; in percentages the whole is 100 %. So if the chance of rain is $\frac{3}{10}$, the chance of no rain is $1 - \frac{3}{10} = \frac{7}{10}$; in percentages, $100 - 30 = 70$, so 70 %.

Using technology. A calculator’s $\div$ and $\times$ keys do every conversion in this section: top $\div$ bottom for the decimal, then $\times 100$ for the percentage. Phone calculators, spreadsheet apps and weather apps all show chances in these forms too, and are good for checking — but pen, paper and a basic calculator are enough for every question here.

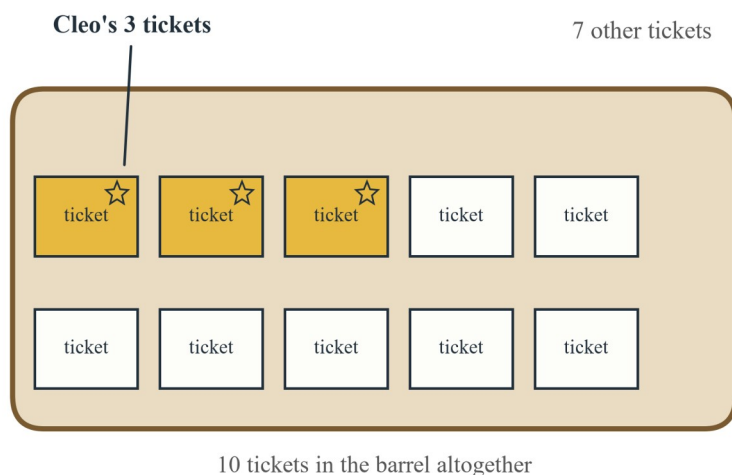
Units 3 & 4 preview. Later studies combine several events with counting rules; this book stops at single, simple events, and nothing in this preview is assessed in your tests.

Worked examples

Example 1 — scaffolded

A school raffle barrel holds 10 tickets, all equally likely to be drawn. Cleo bought 3 of them. What is the chance that the winning ticket is one of Cleo’s? Write it as a fraction, a decimal and a percentage.

The raffle barrel: 10 tickets, 3 of them Cleo's



Made-up raffle barrel, drawn for this book.

Working

Total outcomes: 10 tickets in the barrel.

Favourable outcomes: Cleo's 3 tickets.

$$P(\text{Cleo wins}) = \frac{3}{10}$$

$$3 \div 10 = 0.3$$

$$0.3 \times 100 = 30, \text{ so } 30\%$$

Check: $\frac{3}{10}$ is less than $\frac{1}{2}$.

Comment

Any one of the 10 could be drawn.

Cleo wins only if one of her tickets comes out.

Favourable over total.

Top $\div$ bottom gives the decimal.

Decimal to percentage is $\times 100$.

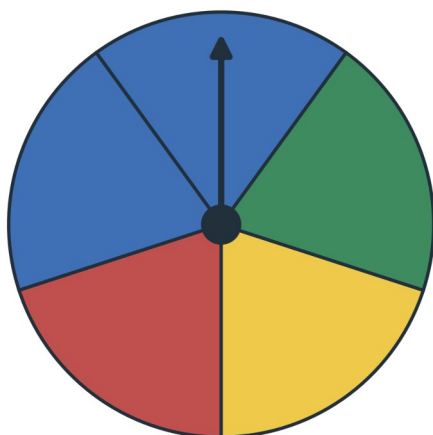
3 of 10 is under half, so under an even chance — sensible.

The chance the winning ticket is Cleo's is $\frac{3}{10} = 0.3 = 30\%$.

Example 2 — scaffolded

Nellie's board-game spinner has 5 equal sections: 2 blue, 1 red, 1 yellow and 1 green. She spins it once. (a) Write $P(\text{blue})$ as a fraction. (b) Write it as a decimal. (c) Write it as a percentage.

Nellie's spinner: 5 equal sections



2 of the 5 equal sections are blue

Made-up spinner, drawn for this book.

Working

5 equal sections, so 5 equally likely outcomes.

(a) Favourable: 2 blue sections, so $P(\text{blue}) = \frac{2}{5}$.

(b) $2 \div 5 = 0.4$

(c) $0.4 \times 100 = 40$, so 40 %

Check: 40 % is a little below 50 %.

Comment

Equal sections share the spin equally.

Favourable over total.

Top $\div$ bottom gives the decimal.

Decimal to percentage is $\times 100$.

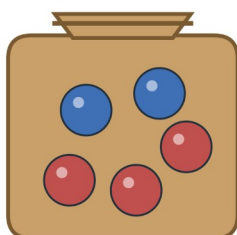
2 of 5 sections is a little under half the spinner.

Nellie's chance of spinning blue is $\frac{2}{5} = 0.4 = 40\%$.

Example 3 — unscaffolded

Marlee's bag holds 3 red marbles and 2 blue marbles, all the same size and weight. She picks one marble without looking. What is the chance it is red? Give your answer as a fraction, a decimal and a percentage.

The bag: 3 red and 2 blue marbles



3 red

2 blue

5 marbles

One marble is picked without looking.

Made-up bag of marbles, drawn for this book.

There are $3 + 2 = 5$ marbles altogether, all equally likely, and 3 of them are favourable (red):

$$P(\text{red}) = \frac{3}{5}$$

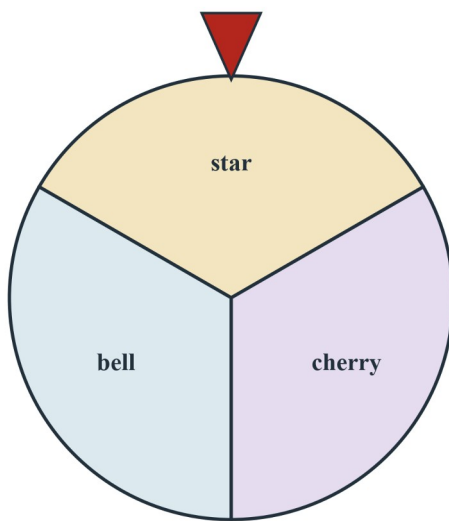
$$3 \div 5 = 0.6, \text{ and } 0.6 \times 100 = 60$$

$\therefore$ The chance of picking red is $\frac{3}{5} = 0.6 = 60\%$.

Example 4 — unscaffolded

The show's prize wheel has 3 equal sections: star, bell and cherry. Esme gets one spin. What is the chance of landing on star? Give your answer as a fraction, as a decimal correct to 2 decimal places, and as a percentage to the nearest whole number.

The prize wheel: 3 equal sections



1 of the 3 equal sections is a star

Made-up prize wheel, drawn for this book.

One of the 3 equal sections is a star, so $P(\text{star}) = \frac{1}{3}$. The division does not end: $1 \div 3 = 0.3333\dots$. We write $0.3333\dots \approx 0.33$, where $\approx$ means “is approximately equal to” — here, rounded to 2 decimal places. As a percentage, $0.3333\dots \times 100 = 33.33\dots\%$, which is 33% to the nearest whole number.

$$\therefore P(\text{star}) = \frac{1}{3} \approx 0.33 \approx 33\%.$$

Practice questions

Scaffolded

Q1. A weather app shows the chance of rain as a fraction. Write each chance as a decimal and as a percentage.

(a) Monday: $\frac{1}{2}$

(b) Tuesday: $\frac{1}{5}$

(c) Wednesday: $\frac{1}{4}$

Q2. A footy website lists each team's chance of winning this weekend as a percentage. Write each chance as a decimal and as a fraction in simplest form.

- (a) Comets: 50 %
- (b) Merrick Park Magpies: 20 %
- (c) Falcons: 10 %

Q3. Sunita's bag holds 10 counters: 7 black and 3 white, all the same size. She picks one counter without looking.

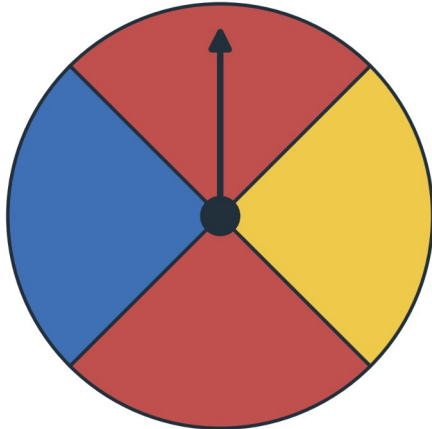
- (a) Write $P(\text{black})$ as a fraction.
- (b) Write it as a decimal.
- (c) Write it as a percentage.

Q4. A fair six-sided die is rolled once.

- (a) Write $P(\text{rolling a } 4)$ as a fraction.
- (b) Write it as a decimal, correct to 2 decimal places.
- (c) Write it as a percentage, to the nearest whole number.

Q5. The spinner below has 4 equal sections: 2 red, 1 blue and 1 yellow. It is spun once.

The spinner: 4 equal sections



2 red, 1 blue, 1 yellow

Made-up spinner, drawn for this book.

- (a) Write $P(\text{red})$ as a fraction.
- (b) Simplify your fraction.
- (c) Write the chance as a decimal and as a percentage.

Q6. A forecast says there is a 30 % chance of rain tomorrow.

- (a) Write the chance of rain as a decimal.
- (b) Write it as a fraction in simplest form.
- (c) Write the chance of **no** rain tomorrow as a percentage.

Unscaffolded

Q7. A fair coin is tossed once. Write the chance of heads as a fraction, a decimal and a percentage.

Q8. Jasmine’s bag holds 4 green marbles and 2 purple marbles, all the same size. She picks one marble without looking. Write the chance of green as a fraction in simplest form, then as a decimal correct to 2 decimal places, then as a percentage to the nearest whole number.

Q9. Wen’s jar holds 9 tokens: 3 have a star on them and 6 are blank. One token is drawn without looking. Write the chance of a star as a fraction in simplest form, then as a decimal correct to 2 decimal places, then as a percentage to the nearest whole number.

Q10. A raffle sells 50 tickets and Hollis buys 5 of them. One ticket is drawn. Write Hollis’s chance of winning as a fraction in simplest form, then as a decimal, then as a percentage.

Q11. A forecast says there is a 40 % chance of rain on Saturday. Write the chance of rain as a decimal and as a fraction in simplest form, and write the chance of no rain as a percentage.

Q12. Pearl’s bag holds 8 marbles and every one of them is red. She picks one marble without looking.

- (a) Write $P(\text{red})$ as a fraction, then as a decimal and a percentage.
- (b) Write $P(\text{blue})$ as a fraction, then as a decimal and a percentage.
- (c) Which word fits each event: certain or impossible?

Q13. Perrie’s raffle has 8 tickets and 2 of them are winners. Cass’s raffle has 15 tickets and 3 of them are winners. Each buys one ticket in their own raffle. Whose chance of winning is higher? Show both chances as simplified fractions and as decimals.

Q14. A bag holds 20 tokens numbered 1 to 20. One token is drawn without looking. Write the chance that the number is greater than 17 as a fraction, a decimal and a percentage.

Q15. The fete’s scratch-card box says “1 in 5 cards wins a prize”. Write that chance as a fraction, a decimal and a percentage.

Q16. The Cobble Creek bakery packs a box of 10 doughnuts, and 20 % of the box is jam doughnuts.

- (a) How many jam doughnuts are in the box?
- (b) Write the chance of picking a jam doughnut as a fraction in simplest form.
- (c) Write that chance as a decimal.

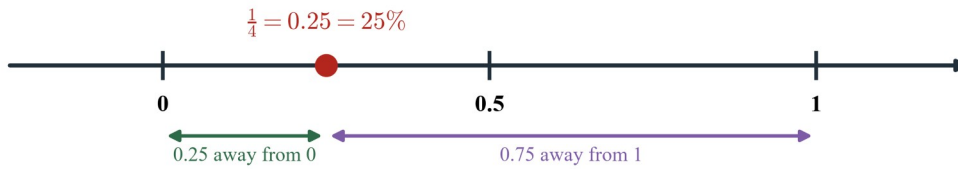
Q17. Tess’s bag holds 9 red marbles and 1 blue marble, all the same size. She picks one marble without looking.

- (a) Write $P(\text{red})$ as a percentage.
- (b) Which of 0 %, 50 % or 100 % is closest to $P(\text{red})$?
- (c) Write $P(\text{blue})$ as a percentage.

Q18. At the fete duck race, 12 ducks are floated and 3 of them carry a star. You win a prize if a starred duck finishes first, and every duck is equally likely to win.

Where does 0.25 sit on the likelihood scale?

0.25 is closer to 0 than to 1.



- (a) Write the chance a starred duck wins as a fraction, then simplify it.
- (b) Write that chance as a decimal and as a percentage.
- (c) On the likelihood scale above, is 0.25 closer to 0 or closer to 1?

Answers

Q1. (a) 0.5, 50 %. (b) 0.2, 20 %. (c) 0.25, 25 %.

Q2. (a) $0.5, \frac{1}{2}$. (b) $0.2, \frac{1}{5}$. (c) $0.1, \frac{1}{10}$.

Q3. (a) $\frac{7}{10}$. (b) 0.7. (c) 70 %.

Q4. (a) $\frac{1}{6}$. (b) 0.17 (to 2 decimal places). (c) 17 % (to the nearest whole number).

Q5. (a) $\frac{2}{4}$. (b) $\frac{1}{2}$. (c) 0.5, 50 %.

Q6. (a) 0.3. (b) $\frac{3}{10}$. (c) 70 %.

Q7. $\frac{1}{2} = 0.5 = 50 \%$.

Q8. $\frac{2}{3}$; 0.67 (to 2 decimal places); 67 % (to the nearest whole number).

Q9. $\frac{1}{3}$; 0.33 (to 2 decimal places); 33 % (to the nearest whole number).

Q10. $\frac{1}{10}$; 0.1; 10 %.

Q11. 0.4; $\frac{2}{5}$; 60 %.

Q12. (a) $\frac{8}{8} = 1 = 100 \%$. (b) $\frac{0}{8} = 0 = 0 \%$. (c) red is certain, blue is impossible.

Q13. Perrie $\frac{1}{4} = 0.25$; Cass $\frac{1}{5} = 0.2$; Perrie's chance is higher.

Q14. $\frac{3}{20}$; 0.15; 15 %.

Q15. $\frac{1}{5}$; 0.2; 20 %.

Q16. (a) 2 jam doughnuts. (b) $\frac{2}{10} = \frac{1}{5}$. (c) 0.2 (the 20 % the box states).

Q17. (a) 90 %. (b) 100 %. (c) 10 %.

Q18. (a) $\frac{3}{12} = \frac{1}{4}$. (b) 0.25, 25 %. (c) closer to 0.

Fully-worked solutions

Q1. (a) $\frac{1}{2} = 1 \div 2 = 0.5$, and $0.5 \times 100 = 50 \%$. (b) $\frac{1}{5} = 1 \div 5 = 0.2$, and $0.2 \times 100 = 20 \%$. (c) $\frac{1}{4} = 1 \div 4 = 0.25$, and $0.25 \times 100 = 25 \%$.

Q2. (a) $50\% = 50 \div 100 = 0.5$, and $\frac{50}{100} = \frac{1}{2}$ after dividing top and bottom by 50. (b) $20\% = 0.2$, and $\frac{20}{100} = \frac{1}{5}$ after dividing by 20. (c) $10\% = 0.1$, and $\frac{10}{100} = \frac{1}{10}$ after dividing by 10.

Q3. (a) 7 of the 10 counters are black, so $P(\text{black}) = \frac{7}{10}$. (b) $7 \div 10 = 0.7$. (c) $0.7 \times 100 = 70\%$.

Q4. (a) One face of the six shows a 4, so $P(4) = \frac{1}{6}$. (b) $1 \div 6 = 0.1666\dots$; the third decimal digit is 6, so round the second digit up: 0.17 to 2 decimal places. (c) $0.1666\dots \times 100 = 16.66\dots\%$, which is 17% to the nearest whole number.

Q5. (a) 2 of the 4 equal sections are red: $\frac{2}{4}$. (b) Divide top and bottom by 2: $\frac{1}{2}$. (c) $1 \div 2 = 0.5$ and $0.5 \times 100 = 50\%$.

Q6. (a) $30 \div 100 = 0.3$. (b) $\frac{30}{100} = \frac{3}{10}$ after dividing top and bottom by 10. (c) No rain is what is left of the whole: $100 - 30 = 70\%$.

Q7. A fair coin has 2 equally likely outcomes and 1 of them is heads: $\frac{1}{2}$. Then $1 \div 2 = 0.5$ and $0.5 \times 100 = 50$, so $P(\text{heads}) = \frac{1}{2} = 0.5 = 50\%$.

Q8. 4 of the 6 marbles are green: $\frac{4}{6}$, and dividing top and bottom by 2 gives $\frac{2}{3}$. Then $2 \div 3 = 0.6666\dots$, which is 0.67 to 2 decimal places, and $0.6666\dots \times 100 = 66.66\dots\%$, which is 67% to the nearest whole number.

Q9. 3 of the 9 tokens carry a star: $\frac{3}{9}$, and dividing top and bottom by 3 gives $\frac{1}{3}$. Then $1 \div 3 = 0.3333\dots$, which is 0.33 to 2 decimal places, and $33.33\dots\%$ is 33% to the nearest whole number.

Q10. Hollis holds 5 of the 50 tickets: $\frac{5}{50}$, and dividing top and bottom by 5 gives $\frac{1}{10}$. Then $1 \div 10 = 0.1$ and $0.1 \times 100 = 10\%$.

Q11. $40 \div 100 = 0.4$, and $\frac{40}{100} = \frac{2}{5}$ after dividing top and bottom by 20. No rain is what is left of the whole: $100 - 40 = 60\%$.

Q12. (a) All 8 marbles are red: $\frac{8}{8} = 1$, which is 100%. (b) No marble is blue: $\frac{0}{8} = 0$, which is 0%. (c) Picking red is **certain** (it always happens); picking blue is **impossible** (it never happens).

Q13. Perrie: $\frac{2}{8} = \frac{1}{4} = 1 \div 4 = 0.25$. Cass: $\frac{3}{15} = \frac{1}{5} = 1 \div 5 = 0.2$. Because $0.25 > 0.2$, **Perrie's chance is higher**.

Q14. The numbers greater than 17 are 18, 19 and 20 — 3 favourable outcomes out of 20: $\frac{3}{20}$. Then $3 \div 20 = 0.15$ and $0.15 \times 100 = 15\%$.

Q15. “1 in 5” means 1 favourable outcome in 5: $\frac{1}{5}$. Then $1 \div 5 = 0.2$ and $0.2 \times 100 = 20\%$.

Q16. (a) 20% of 10 is $0.2 \times 10 = 2$ jam doughnuts. (b) 2 of the 10 doughnuts are jam: $\frac{2}{10} = \frac{1}{5}$. (c) $1 \div 5 = 0.2$ — the same as the 20% the box states.

Q17. (a) 9 of the 10 marbles are red: $\frac{9}{10} = 0.9 = 90\%$. (b) 90% sits near the top of the scale, so the closest of the three is 100%. (c) 1 of the 10 marbles is blue: $\frac{1}{10} = 0.1 = 10\%$ (or $100 - 90 = 10$).

Q18. (a) 3 of the 12 ducks carry a star: $\frac{3}{12}$, and dividing top and bottom by 3 gives $\frac{1}{4}$. (b) $1 \div 4 = 0.25$ and $0.25 \times 100 = 25\%$. (c) 0.25 is 0.25 away from 0 but 0.75 away from 1, so it is **closer to 0** — a starred duck winning is unlikely.

Chapter 4 Uncertainty — 4C Sample spaces, simple inference and changing likelihood

Theory

About the situations and numbers in this section. The spinners, bags, dice, wheels and weather apps in this section are **made up** (not real): pretend games and pretend numbers, built for this book so you can practise the maths. Nothing here is real data about a real business, person or place.

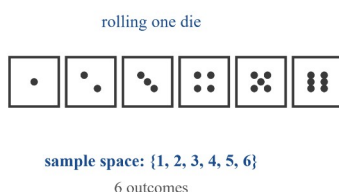
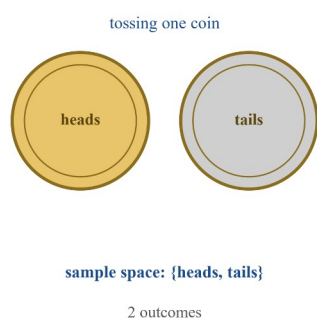
This section builds two skills from the study design (Unit 2, Area of Study 7): listing every result, or option, that an everyday event can have — its sample space; and seeing that some events are more likely than others, and how to make an event more likely or less likely.

Source: VCAA, VCE Vocational Major Numeracy Study Design, retrieved 2026-10-09.

The sample space is the full list of what can happen.

When you run a chance experiment — toss a coin, roll a die, spin a spinner — you cannot know the result ahead of time, but you can list every result that is possible. That full list is the **sample space**, and each single result on the list is an **outcome**.

Sample spaces of everyday chance objects



Made-up chance objects, drawn for this book.

- Tossing one coin: sample space {heads, tails} — 2 outcomes.
- Rolling one die: sample space {1, 2, 3, 4, 5, 6} — 6 outcomes.
- Spinning the spinner shown: sample space {1, 2, 3} — 3 outcomes.

Refresher — probability as a fraction. The **probability** of an event is a number between 0 and 1 that says how likely the event is. When every outcome in the sample space is equally likely, it is one fraction:

$P(\text{event}) = \text{number of favourable outcomes} \div \text{number of equally likely outcomes}$

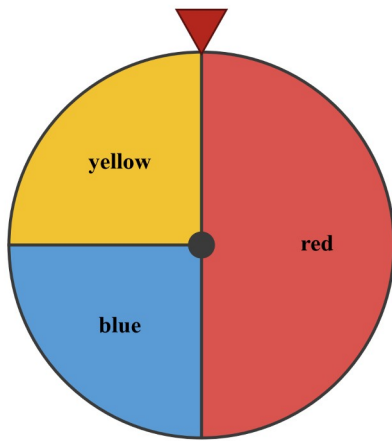
The **favourable** outcomes are the ones that count as a “yes” for the event you care about, and there can be several of them. Picture a bag holding 2 red and 3 blue counters that all feel the same, so any of the 5 is as likely as any other.

For the event “pull out red”, the 2 red counters are the favourable outcomes, so $P(\text{red}) = \frac{2}{5} = 0.4 = 40\%$. For the event

“pull out not red”, the 3 blue counters are favourable, so $P(\text{not red}) = \frac{3}{5} = 0.6$.

Equally likely or not? The fraction above only works when the outcomes are equally likely. A fair coin and a fair die are equally likely all the way through. A spinner, though, can be built with unequal sections, and then the chance of a colour is the **share of the spinner** that colour covers:

A spinner with unequal sections



The sections are NOT equal:
red covers half the spinner; blue and yellow cover a quarter each.

Made-up spinner, drawn for this book.

On this spinner red covers half, so $P(\text{red}) = \frac{1}{2}$, while blue and yellow cover a quarter each, so $P(\text{blue}) = \frac{1}{4}$ and $P(\text{yellow}) = \frac{1}{4}$. Two special cases are worth locking in: an event with **no** favourable outcomes has probability 0 and is **impossible** (this spinner can never land on purple), and an event that covers **every** outcome has probability 1 and is **certain** (this spinner must land on red, blue or yellow). As you saw in 4A, 0, $\frac{1}{2}$ and 1 sit on the chance scale at impossible, even chance and certain.

Refresher — simplest form, and fractions, decimals, percentages. Before you compare two probabilities, get them into the same form. To simplify a fraction, divide the top and the bottom by the same number (4B teaches this in full): $\frac{4}{10} = \frac{2}{5}$. To turn a fraction into a decimal, divide the top by the bottom; to turn a decimal into a percentage, multiply by 100. These five are worth knowing cold:

Fraction	Decimal	Percentage
$\frac{1}{2}$	0.5	50%
$\frac{1}{4}$	0.25	25%
$\frac{1}{5}$	0.2	20%
$\frac{1}{10}$	0.1	10%
$\frac{3}{4}$	0.75	75%

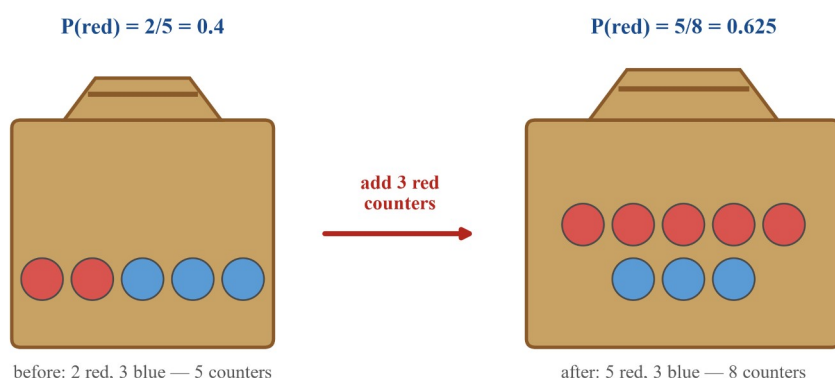
Simple inference — reading a likelihood and acting on it. A likelihood estimate is worth acting on. If a forecast says there is an 80% chance of rain tomorrow, then rain is more likely than not, so the sensible call is to take a raincoat or plan an indoor option. That step — from “how likely” to “so what should I do” — is **inference**. It works

the same way when you choose between options: if one bag holds 1 red counter in 2 and another holds 1 red in 5, and you want red, the first bag gives you the better chance ($\frac{1}{2}$ against $\frac{1}{5}$), so you choose the first bag.

Changing the likelihood. You can make an event more likely or less likely by changing the set-up. Take the bag from the refresher above: 2 red and 3 blue counters, so $P(\text{red}) = \frac{2}{5} = 0.4$.

- Add 3 red counters: the bag now holds 5 red of 8 counters, so $P(\text{red}) = \frac{5}{8} = 0.625$ — red became **more likely**.
- Add 3 blue counters instead: the bag now holds 2 red of 8 counters, so $P(\text{red}) = \frac{2}{8} = \frac{1}{4} = 0.25$ — red became **less likely**.

Increasing the likelihood of red



Adding red counters made red MORE likely: 0.4 went up to 0.625.

Made-up bags, drawn for this book.

Adding to one side of a bag, taking counters out, or repainting a spinner section are all moves like these: they change the count of favourable outcomes, the count of all outcomes, or both, and the probability moves with them.

Refresher — comparing fractions. To say which of two probabilities is bigger, put them in the same form. As decimals: $\frac{2}{5} = 0.4$ and $\frac{3}{10} = 0.3$, and 0.4 is bigger than 0.3, so $\frac{2}{5}$ is the bigger chance. (Common denominators work just as well: $\frac{2}{5} = \frac{4}{10}$, and 4 tenths beats 3 tenths.)

Technology. A calculator or a spreadsheet will turn a fraction into a decimal or a percentage for you — typing $2 \div 5$ gives 0.4, and 0.4×100 gives 40 — which is a handy way to check your own working. Every number in this section is small enough to do by hand, so technology is never needed here.

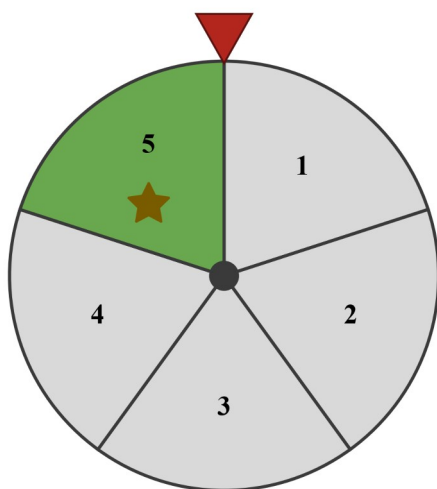
Units 3 & 4 preview. In Units 3 and 4 probability moves on to conditional probability and tools such as two-way tables and Venn diagrams; this book stops at simple one-object probability like the kind above.

Worked examples

Example 1 — scaffolded

Cooper spins the spinner below once. It has 5 equal sections, numbered 1 to 5. (a) Write down the sample space. (b) What is the probability of spinning a 2? (c) Write that probability as a decimal and as a percentage.

Cooper's spinner at the fete



5 equal sections — landing on 5 wins a prize

Made-up spinner, drawn for this book.

Working

Comment

The spinner can land on 1, 2, 3, 4 or 5.

(a) sample space {1, 2, 3, 4, 5}

The 5 sections are equal, so there are 5 equally likely outcomes.

Equal sections, equal chances.

Exactly one section shows a 2, so there is 1 favourable outcome: $P(2) = \frac{1}{5}$.

(b) favourable $\div$ all outcomes

$1 \div 5 = 0.2$, and $0.2 \times 100 = 20$.

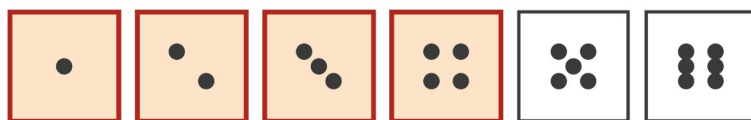
(c) 0.2, or 20%

Cooper's sample space is {1, 2, 3, 4, 5}, and $P(2) = \frac{1}{5} = 0.2 = 20\%$.

Example 2 — scaffolded

Dev rolls a fair die once. He scores a point if the die shows 1, 2, 3 or 4. (a) Write down the sample space. (b) How many outcomes are favourable? (c) What is the probability that Dev scores? Is scoring likely?

Dev's die — the scoring faces



Dev scores if the die shows 1, 2, 3 or 4 (highlighted).

Made-up die faces, drawn for this book.

Working

Comment

A fair die can show 1, 2, 3, 4, 5 or 6.

(a) sample space {1, 2, 3, 4, 5, 6}

The scoring faces are 1, 2, 3 and 4.

(b) 4 favourable outcomes



$$P(\text{scores}) = \frac{4}{6} = \frac{2}{3}.$$

$\frac{2}{3}$ is bigger than $\frac{1}{2}$.

(c) Divide top and bottom by 2.

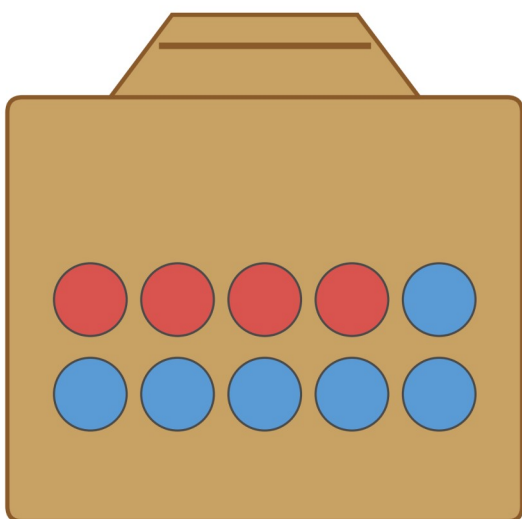
More likely than not, so: likely.

Dev scores with probability $\frac{2}{3}$, which is more than a half, so scoring is likely rather than unlikely.

Example 3 — unscaffolded

Elly's bag holds 4 red and 6 blue counters. They all feel the same, so every counter is as likely as every other. Elly may add some red counters to the bag (and nothing else). How many red counters must she add so that $P(\text{red}) = \frac{1}{2}$?

Elly's bag of counters



4 red and 6 blue counters — they all feel the same

Made-up bag, drawn for this book.

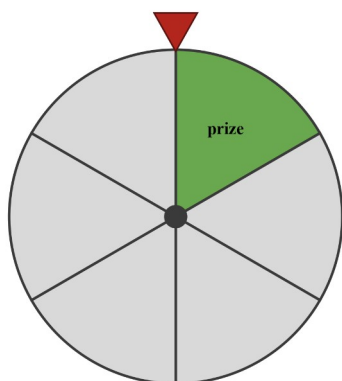
To start, the bag holds 4 red of 10 counters, so $P(\text{red}) = \frac{4}{10} = \frac{2}{5}$. Adding red counters changes both counts at once — the reds go up and the total goes up — so try a small number and check. Adding 2 red gives 6 red of 12 counters:

$$\frac{6}{12} = \frac{1}{2}$$

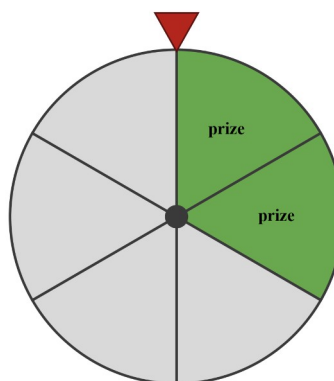
$\therefore$ Elly must add 2 red counters; the bag then holds 6 red and 6 blue, and $P(\text{red}) = \frac{1}{2}$.

Example 4 — unscaffolded

Marcus wants to win a prize at the fete, and he may spin once on either spinner below. Spinner A has 6 equal sections with 1 prize section. Spinner B has 6 equal sections with 2 prize sections. Which spinner gives Marcus the better chance of a prize?



Spinner A: 6 equal sections,
1 prize section



Spinner B: 6 equal sections,
2 prize sections

Made-up spinners, drawn for this book.

On spinner A, 1 of the 6 equal sections is a prize section, so $P(\text{prize}) = \frac{1}{6}$. On spinner B, 2 of the 6 equal sections are prize sections, so $P(\text{prize}) = \frac{2}{6} = \frac{1}{3}$. Comparing the two, $\frac{1}{3} = \frac{2}{6}$, which is bigger than $\frac{1}{6}$.

$\therefore$ Marcus should choose spinner B, where $P(\text{prize}) = \frac{1}{3}$ — double the $\frac{1}{6}$ he would get on spinner A.

Practice questions

Scaffolded

Q1. A fair coin is tossed once.

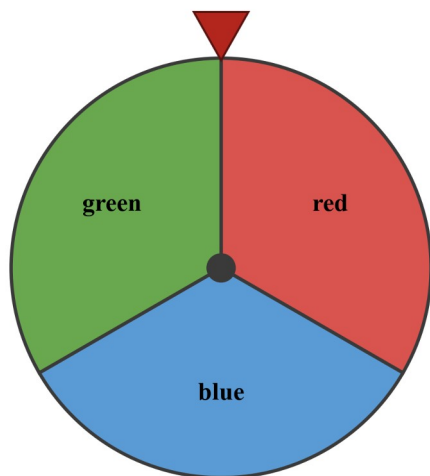
- Write down the sample space.
- How many outcomes are in the sample space?
- What is the probability of tossing heads?

Q2. A fair die is rolled once.

- Write down the sample space.
- List the favourable outcomes for the event “roll a number less than 4”.
- What is the probability of that event, in simplest form?

Q3. The games-night spinner below has 3 equal sections.

The games-night spinner



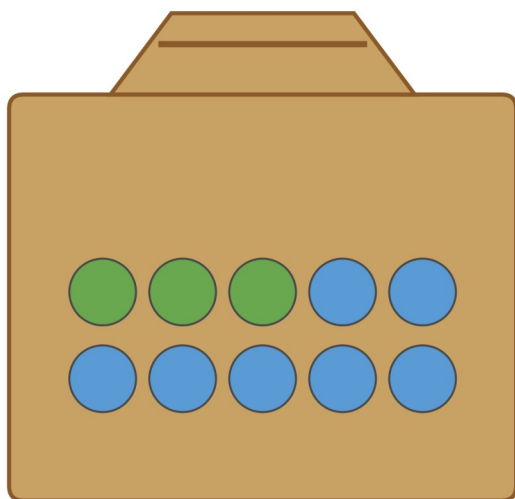
3 equal sections

Made-up spinner, drawn for this book.

- (a) Write down the sample space.
- (b) What is the probability of spinning blue?
- (c) What is the probability of spinning purple?

Q4. The lucky-dip bag below holds 3 green and 7 blue counters that all feel the same.

The lucky-dip bag



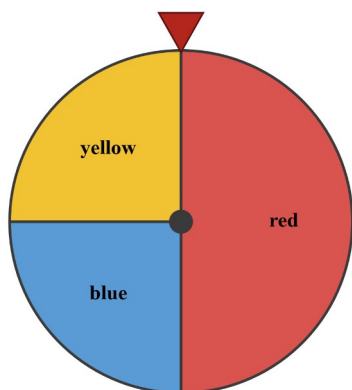
3 green and 7 blue counters — they all feel the same

Made-up bag, drawn for this book.

- (a) How many counters are in the bag?
- (b) What is the probability of pulling out a green counter?
- (c) Write that probability as a decimal and as a percentage.

Q5. The spinner below has unequal sections: red covers half the spinner, and blue and yellow cover a quarter each.

A spinner with unequal sections



The sections are NOT equal:

red covers half the spinner; blue and yellow cover a quarter each.

Made-up spinner, drawn for this book.

- (a) Which colour is the spinner most likely to land on?
- (b) What is the probability of red?
- (c) What is the probability of yellow?

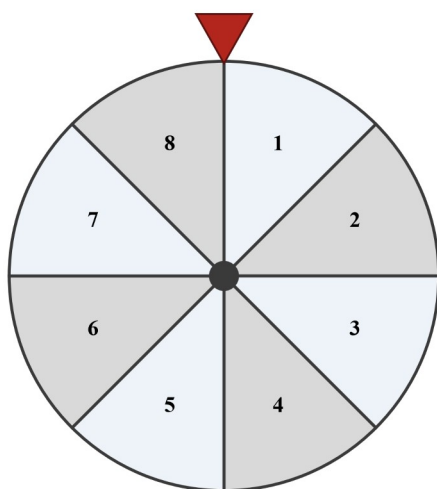
Q6. A jar holds 4 red and 4 yellow lollies. Wren adds 2 yellow lollies to the jar and shakes it.

- (a) Before the extra lollies are added, what is the probability of picking a red lolly?
- (b) How many lollies are in the jar after they are added?
- (c) What is the probability of picking a red lolly now? Is picking red more likely, less likely, or just as likely as it was before?

Unscaffolded

Q7. The fete spinner below has 8 equal sections, numbered 1 to 8.

The fete spinner



8 equal sections, numbered 1 to 8

Made-up spinner, drawn for this book.

- (a) What is the probability of spinning a 7?
- (b) What is the probability of spinning an even number?
- (c) What is the probability of spinning a number greater than 6?

Q8. A raffle has 10 tickets, numbered 1 to 10. One ticket is drawn at random.

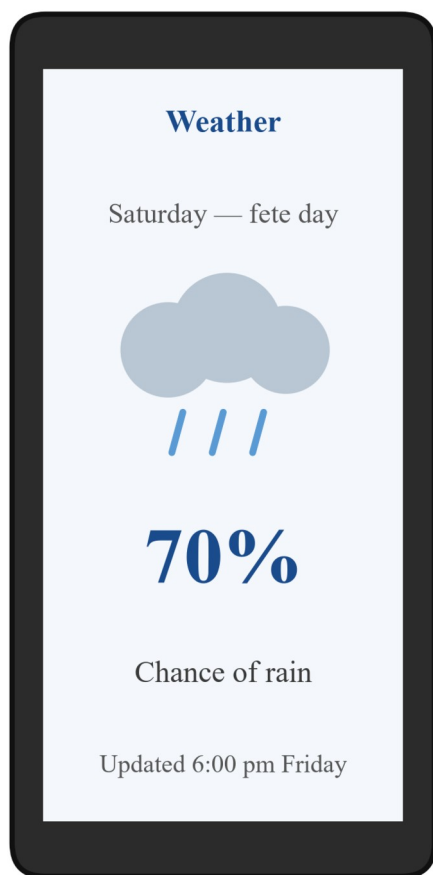
- (a) How many equally likely outcomes are there?
- (b) Your ticket is number 7. What is the probability it is the ticket drawn? Give your answer as a fraction, a decimal and a percentage.
- (c) What is the probability the number drawn is a multiple of 5?

Q9. Tia and Marcus play a game with one fair die. Tia scores a point if the die shows 1. Marcus scores a point if the die shows 2, 3, 4, 5 or 6.

- (a) What is the probability that Tia scores?
- (b) What is the probability that Marcus scores?
- (c) Is this game fair? Who has the better chance of scoring?

Q10. A weather app shows a 70% chance of rain for the day of the Saturday market.

The weather app on Friday night

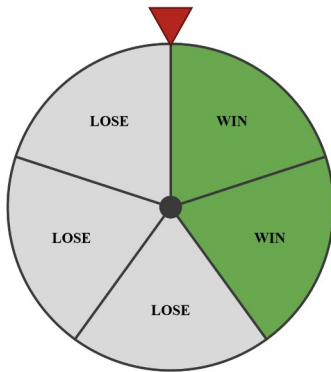


Made-up app screen, drawn for this book.

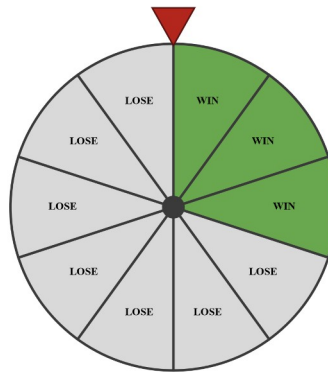
- (a) Write the chance of rain as a decimal.
- (b) What is the chance of no rain, as a percentage? Which is more likely: rain or no rain?
- (c) The market has a covered area and an open area. Which area would you choose for a stall? Give a reason.

Q11. Two stalls at the fete run prize spinners, shown below. Stall A's spinner has 5 equal sections with 2 prize sections. Stall B's spinner has 10 equal sections with 3 prize sections.

Two game stalls at the fete



Stall A: 5 equal sections,
2 WIN and 3 LOSE



Stall B: 10 equal sections,
3 WIN and 7 LOSE

Made-up spinners, drawn for this book.

- What is the probability of a prize on stall A's spinner? Give your answer as a decimal.
- What is the probability of a prize on stall B's spinner? Give your answer as a decimal.
- Which stall gives you the better chance of a prize?

Q12. A bag holds 1 red and 4 white counters that all feel the same.

- What is the probability of pulling out the red counter?
- How many red counters must be added (and nothing else) so that $P(\text{red}) = \frac{1}{2}$?
- Check your answer by writing down the new probability of red.

Q13. A game spinner has 3 equal sections: 2 say PRIZE and 1 says BLANK.

- What is the probability of spinning PRIZE?
- The game manager repaints one PRIZE section so that it says BLANK. What is the probability of spinning PRIZE now?
- Did the repaint increase or reduce the likelihood of a prize?

Q14. Use the unequal spinner from Q5, where red covers half the spinner and blue and yellow cover a quarter each.

- What is the probability of red?
- What is the probability of not red?
- A friend says the game "red wins, not red loses" is fair on this spinner. Are they right? Give a reason.

Q15. A lucky dip holds 20 counters, and 5 of them are winners.

- What is the probability of pulling out a winner, in simplest form?
- Write that probability as a percentage.
- The shop adds 5 blank counters to the dip. What is the probability of pulling out a winner now, and what has happened to the likelihood?

Q16. The canteen fridge holds 5 identical cartons of flavoured milk, one of each flavour: chocolate, strawberry, vanilla, banana and mango. Fay picks one carton at random.

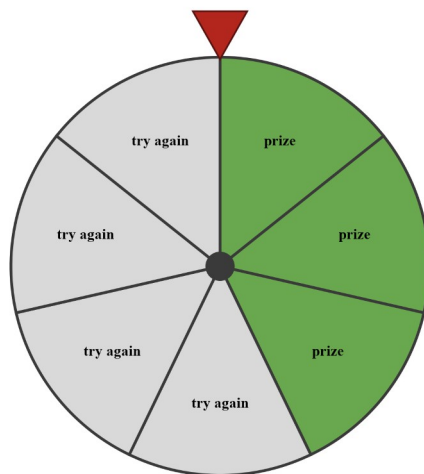
- (a) Write down the sample space.
- (b) What is the probability Fay picks banana? Give your answer as a fraction and as a percentage.
- (c) Fay does not like chocolate. What is the probability she picks a flavour that is not chocolate?

Q17. A show wheel has 10 equal sections: 4 are labelled WIN and the rest are labelled TRY AGAIN.

- (a) What is the probability of WIN, as a fraction in simplest form and as a percentage?
- (b) How many sections are labelled TRY AGAIN?
- (c) The show repaints one TRY AGAIN section so that it says WIN. How many WIN sections are there now, and what is the probability of WIN as a decimal?

Q18. The prize wheel below has 7 equal sections: 3 say prize and 4 say try again.

The fete wheel



7 equal sections: 3 prize, 4 try again

Made-up wheel, drawn for this book.

- (a) What is the probability of landing on prize?
- (b) Write that probability as a decimal, rounded to two decimal places.
- (c) Is landing on prize more likely or less likely than landing on try again?

Answers

Q1. (a) {heads, tails}. (b) 2. (c) $\frac{1}{2}$.

Q2. (a) {1, 2, 3, 4, 5, 6}. (b) {1, 2, 3}. (c) $\frac{1}{2}$.

Q3. (a) {red, blue, green}. (b) $\frac{1}{3}$. (c) 0 — the spinner has no purple section, so purple is impossible.

Q4. (a) 10. (b) $\frac{3}{10}$. (c) 0.3, or 30%.

Q5. (a) red. (b) $\frac{1}{2}$. (c) $\frac{1}{4}$.

Q6. (a) $\frac{1}{2}$. (b) 10. (c) $\frac{2}{5}$ — less likely than before.

Q7. (a) $\frac{1}{8}$. (b) $\frac{1}{2}$. (c) $\frac{1}{4}$.

Q8. (a) 10. (b) $\frac{1}{10}$, 0.1, 10%. (c) $\frac{1}{5}$.

Q9. (a) $\frac{1}{6}$. (b) $\frac{5}{6}$. (c) Not fair — Marcus has the better chance.

Q10. (a) 0.7. (b) 30%; rain is more likely. (c) The covered area — rain is more likely than not.

Q11. (a) 0.4. (b) 0.3. (c) stall A.

Q12. (a) $\frac{1}{5}$. (b) 3. (c) $\frac{4}{8} = \frac{1}{2}$.

Q13. (a) $\frac{2}{3}$. (b) $\frac{1}{3}$. (c) reduced.

Q14. (a) $\frac{1}{2}$. (b) $\frac{1}{2}$. (c) yes — red and not red are each $\frac{1}{2}$, so both sides are equally likely.

Q15. (a) $\frac{1}{4}$. (b) 25%. (c) $\frac{1}{5}$ — the likelihood went down.

Q16. (a) {chocolate, strawberry, vanilla, banana, mango}. (b) $\frac{1}{5}$, 20%. (c) $\frac{4}{5}$.

Q17. (a) $\frac{2}{5}$, 40%. (b) 6. (c) 5 WIN sections; 0.5.

Q18. (a) $\frac{3}{7}$. (b) 0.43 (to two decimal places). (c) less likely.

Fully-worked solutions

Q1. (a) A tossed coin lands heads or tails, so the sample space is {heads, tails}. (b) That is 2 outcomes. (c) Heads is 1 of the 2 equally likely outcomes: $P(\text{heads}) = \frac{1}{2}$.

Q2. (a) A fair die shows 1 to 6: {1, 2, 3, 4, 5, 6}. (b) The numbers less than 4 are 1, 2 and 3, so the favourable outcomes are {1, 2, 3}. (c) 3 favourable outcomes out of 6: $\frac{3}{6} = \frac{1}{2}$.

Q3. (a) The spinner has three sections: {red, blue, green}. (b) The sections are equal and one of the three is blue: $\frac{1}{3}$.

(c) There is no purple section, so there are 0 favourable outcomes: $P(\text{purple}) = \frac{0}{3} = 0$ — impossible.

Q4. (a) $3 + 7 = 10$ counters. (b) 3 of the 10 equally likely counters are green: $\frac{3}{10}$. (c) $3 \div 10 = 0.3$, and $0.3 \times 100 = 30$, so 0.3 or 30%.

Q5. (a) Red covers the biggest share of the spinner (half of it), so red is the colour the spinner is most likely to land on. (b) Red covers half: $\frac{1}{2}$. (c) Yellow covers a quarter: $\frac{1}{4}$.

Q6. (a) 4 red of 8 lollies: $\frac{4}{8} = \frac{1}{2}$. (b) $8 + 2 = 10$ lollies. (c) Still 4 red, now out of 10: $\frac{4}{10} = \frac{2}{5}$. Since $\frac{2}{5}$ is less than $\frac{1}{2}$, picking red is less likely than it was before.

Q7. (a) One of the 8 equal sections shows a 7: $\frac{1}{8}$. (b) The even numbers are 2, 4, 6 and 8 — 4 sections of 8: $\frac{4}{8} = \frac{1}{2}$. (c) The numbers greater than 6 are 7 and 8 — 2 sections of 8: $\frac{2}{8} = \frac{1}{4}$.

Q8. (a) Any one of the 10 tickets can be drawn, so there are 10 equally likely outcomes. (b) Your ticket is 1 of those 10: $\frac{1}{10}$, which is 0.1 or 10%. (c) The multiples of 5 between 1 and 10 are 5 and 10 — 2 tickets of 10: $\frac{2}{10} = \frac{1}{5}$.

Q9. (a) One face of the 6 shows a 1: $\frac{1}{6}$. (b) Five faces of the 6 score for Marcus: $\frac{5}{6}$. (c) Not fair: $\frac{5}{6}$ is much bigger than $\frac{1}{6}$, so Marcus has the better chance of scoring. (The two chances add to 1, because exactly one of them scores on every roll.)

Q10. (a) 70% means 70 out of 100: $\frac{70}{100} = 0.7$. (b) Rain and no rain share the whole 100%, so no rain is $100 - 70 = 30$ out of 100, or 30%; 70% is bigger than 30%, so rain is more likely. (c) The covered area. With a 70% chance of rain, rain is more likely than not, so sheltering the stall is the sensible inference from the forecast.

Q11. (a) 2 prize sections of 5 equal sections: $\frac{2}{5} = 0.4$. (b) 3 prize sections of 10 equal sections: $\frac{3}{10} = 0.3$. (c) 0.4 is bigger than 0.3, so stall A gives the better chance of a prize — even though stall B has more prize sections, they are a smaller share of its spinner.

Q12. (a) 1 red of 5 equally likely counters: $\frac{1}{5}$. (b) Add 3 red counters: the bag then holds 4 red and 4 white, so 8 counters with half of them red. 3 is the smallest number of added reds that gets there. (c) Check: $\frac{1+3}{5+3} = \frac{4}{8} = \frac{1}{2}$, as required.

Q13. (a) 2 of the 3 equal sections say PRIZE: $\frac{2}{3}$. (b) After the repaint, 1 of the 3 equal sections says PRIZE: $\frac{1}{3}$. (c) $\frac{1}{3}$ is less than $\frac{2}{3}$, so the repaint reduced the likelihood of a prize.

Q14. (a) Red covers half the spinner: $\frac{1}{2}$. (b) Not red means blue or yellow: $\frac{1}{4} + \frac{1}{4} = \frac{1}{2}$. (c) Yes, your friend is right: red and not red each have probability $\frac{1}{2}$, so the two sides of the game are equally likely and the game is fair — even though the spinner's sections are unequal.

Q15. (a) 5 winners of 20 counters: $\frac{5}{20} = \frac{1}{4}$. (b) $\frac{1}{4} = 0.25$, and $0.25 \times 100 = 25$, so 25%. (c) With 5 blank counters added there are 5 winners of 25 counters: $\frac{5}{25} = \frac{1}{5}$. Since $\frac{1}{5}$ is less than $\frac{1}{4}$, the likelihood of a winner went down.

Q16. (a) One carton of each flavour: {chocolate, strawberry, vanilla, banana, mango}. (b) Banana is 1 of the 5 equally likely cartons: $\frac{1}{5}$, which is 20%. (c) Four of the five flavours are not chocolate: $\frac{4}{5}$.

Q17. (a) 4 WIN sections of 10 equal sections: $\frac{4}{10} = \frac{2}{5}$, which is 40%. (b) $10 - 4 = 6$ sections are labelled TRY AGAIN. (c) $4 + 1 = 5$ WIN sections of 10: $P(\text{WIN}) = \frac{5}{10} = \frac{1}{2}$, which is 0.5 as a decimal.

Q18. (a) 3 of the 7 equal sections say prize: $\frac{3}{7}$. (b) $3 \div 7 = 0.428571\dots$, which rounds to 0.43 to two decimal places. (c) Try again covers $\frac{4}{7}$ of the wheel, and $\frac{3}{7}$ is less than $\frac{4}{7}$, so landing on prize is less likely than landing on try again.

Chapter 04 — Test A (multiple choice)

Chapter 4 Uncertainty (Sections 4A–4C). Allowed materials: pen, paper and a basic calculator. Section A: 12 questions (12 marks). Time: about 20 minutes.

About the data in this test. Every name, place, game, app reading and number in this test is **made up** (not real). They are built for this book so you can practise the mathematics from Chapter 4. Nothing here is real data about a real person, business or place.

Section A — Multiple-choice questions

Choose the response that is correct for the question.

Question 1

Cooper's game spinner has 4 equal sections, numbered 1, 2, 3 and 4. Cooper spins the spinner once. Which chance word describes the event 'the spinner lands on 6'?

- A. impossible
- B. unlikely
- C. even chance
- D. certain

Question 2

The Cobble Creek weather app puts the chance of rain on market day at 0.7. Which chance word describes rain on market day?

- A. unlikely
- B. even chance
- C. certain
- D. likely

Question 3

Rory says the Cobble Creek Wombats have a good chance of winning on Saturday. On the chance scale from 0 to 1, where does a good chance sit?

- A. exactly 0.5
- B. between 0 and 0.5
- C. between 0.5 and 1
- D. exactly 1

Question 4

Mabel says the Wombats winning on Saturday is likely. Which chance word describes the event 'the Wombats do NOT win'?

- A. impossible
- B. unlikely
- C. even chance
- D. certain

Question 5

The chance $\frac{3}{4}$ written as a decimal and as a percentage is

- A. 0.34 and 34 %
- B. 0.75 and 75 %
- C. 0.25 and 25 %
- D. 1.33 and 133 %

Question 6

A bag holds 7 green marbles and 5 white marbles. The marbles are all the same size. One marble is picked without looking. The probability $P(\text{green})$ is

- A. $\frac{5}{12}$
- B. $\frac{1}{7}$
- C. $\frac{7}{5}$
- D. $\frac{7}{12}$

Question 7

The fete guessing game has a barrel of 9 identical balls. 5 of the balls have a star painted on them, and the rest are blank. One ball is drawn at random. The probability that the ball drawn has a star, as a decimal correct to 2 decimal places, is

- A. 0.56
- B. 0.55
- C. 0.44
- D. 1.8

Question 8

The weather app shows a 35 % chance of rain on fete day. The chance that it does NOT rain on fete day, as a percentage, is

- A. 35 %
- B. 65 %
- C. 50 %
- D. 75 %

Question 9

A box of scratch cards at the fete says '1 in 4 cards wins a prize'. This chance written as a fraction and as a percentage is

- A. $\frac{1}{4}$ and 4 %
- B. $\frac{3}{4}$ and 75 %
- C. $\frac{1}{5}$ and 20 %
- D. $\frac{1}{4}$ and 25 %

Question 10

Tia's game uses one fair die. Tia scores a point when the die shows an odd number. The list of ALL the favourable outcomes for the event 'Tia scores' is

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

Question 11

Marcus can spin once on either of two prize spinners at the fete. Spinner A has 10 equal sections, and 4 of them are prize sections. Spinner B has 5 equal sections, and 3 of them are prize sections. Which spinner gives Marcus the better chance of a prize, and why?

- A. Spinner A, because 4 prize sections is more than 3 prize sections
- B. Spinner A, because $\frac{4}{10}$ is bigger than $\frac{3}{5}$
- C. Spinner B, because $\frac{3}{5} = 0.6$ and $\frac{4}{10} = 0.4$, and 0.6 is bigger than 0.4
- D. Both spinners give the same chance of a prize

Question 12

Elly's bag holds 4 green counters and 4 white counters that all feel the same. Elly adds 2 green counters to the bag, and nothing else. The probability $P(\text{green})$ now is

- A. $\frac{1}{2}$
- B. $\frac{3}{4}$
- C. $\frac{2}{5}$
- D. $\frac{3}{5}$

End of Section A

Test A — Answers

Que stio n	1	2	3	4	5	6	7	8	9	10	11	12
Ans wer	A	D	C	B	B	D	A	B	D	A	C	D

Test A — Fully-worked solutions

Question	Answer	Working
1	A	The spinner only shows the numbers 1, 2, 3 and 4, so a 6 can never come up. An event that cannot happen at all is impossible, with value 0. Option B is for an event that could happen but probably will not; option C is for an event as likely as not; option D is for an event that cannot fail.
2	D	The value 0.7 sits between 0.5 and 1, so rain is likely. Option A fits values between 0 and 0.5; option B is exactly 0.5; option C is exactly 1, and 0.7 is less than 1.
3	C	A good chance means the event will probably happen, so its value sits between 0.5 and 1. Exactly 0.5 (option A) is fifty-fifty; between 0 and 0.5 (option B) is a slim chance; exactly 1 (option D) is a sure thing.
4	B	Thinking about the event NOT happening flips the word across the scale: likely flips to unlikely. Impossible (option A) and certain (option D) are the two ends of the scale, and even chance (option C) only flips to itself.
5	B	Divide top by bottom: $3 \div 4 = 0.75$. Multiply by 100: $0.75 \times 100 = 75$. So $\frac{3}{4} = 0.75 = 75\%$. Option A reads the digits 3 and 4 straight across as 0.34; option C is $1 - \frac{3}{4}$, the chance of NOT happening; option D divides 4 by 3 instead.
6	D	Total marbles: $7 + 5 = 12$. Favourable outcomes: the 7 green marbles. So $P(\text{green}) = \frac{7}{12}$. Option A is $P(\text{white})$; option B is the chance of one particular marble; option C puts green over white, which is a ratio, not a probability.
7	A	Favourable outcomes: the 5 star balls. Total: 9 balls. So $P(\text{star}) = \frac{5}{9}$. Divide: $5 \div 9 = 0.5555\dots$ The third decimal

Question	Answer	Working
		digit is 5, so round the second digit up: 0.56 correct to 2 decimal places. Option B cuts the digits off instead of rounding; option C is $P(\text{blank}) = \frac{4}{9}, \text{ which rounds to } 0.44;$ option D divides 9 by 5.
8	B	Rain and no rain share the whole 100%: $100 - 35 = 65$. So the chance of no rain is 65%. Option A leaves the chance unchanged; option C is the fifty-fifty answer, but 35% and 65% are not equal; option D is a subtraction slip.
9	D	'1 in 4 cards wins' means 1 favourable card out of 4: $\frac{1}{4}$. Divide: $1 \div 4 = 0.25$. Multiply by 100: $0.25 \times 100 = 25$. So the chance is $\frac{1}{4} = 25\%$. Option A turns the 4 into 4%; option B is the chance a card does NOT win; option C is the '1 in 5' chance.
10	A	A fair die shows 1, 2, 3, 4, 5 or 6. The odd numbers are 1, 3 and 5, so the favourable outcomes are {1, 3, 5}. Option B lists the even numbers, where Tia does NOT score; option C is the whole sample space, not just the favourable outcomes; option D misses out 5.
11	C	Spinner A: $P(\text{prize}) = \frac{4}{10} = 0.4$. Spinner B: $P(\text{prize}) = \frac{3}{5} = 0.6$. Since $0.6 > 0.4$, spinner B gives the better chance. Option A counts prize sections instead of comparing shares — spinner A's 10 sections make each share smaller; option B compares the fractions the wrong way round, since $\frac{4}{10} = 0.4$ is less than $\frac{3}{5} = 0.6$; option D treats $\frac{4}{10}$ and $\frac{3}{5}$ as equal, and they are not.
12	D	The bag now holds $4 + 2 = 6$ green counters out of $4 + 4 + 2 = 10$ counters in total, so

$P(\text{green}) = \frac{6}{10}$. Divide top and bottom by 2: $\frac{3}{5}$. Option A is the old chance, $\frac{4}{8} = \frac{1}{2}$, before the extra greens; option B adds the 2 greens to the top only, $\frac{6}{8} = \frac{3}{4}$; option C is $P(\text{white})$ now, $\frac{4}{10} = \frac{2}{5}$.

Chapter 04 — Test B (written response)

Chapter 4 Uncertainty (Sections 4A–4C). Allowed materials: pen, paper and a basic calculator. Section B: 7 questions (34 marks). Time: about 35 minutes. Show your working for every part. Only round where the question tells you to, and give each rounded answer at the precision asked for.

About the data in this test. Every name, place, game, app reading and number in this test is **made up** (not real). They are built for this book so you can practise the mathematics from Chapter 4. Nothing here is real data about a real person, business or place.

Section B — Written-response questions

Question 1 (4 marks)

Darcy reads the chance of rain for four days off the Cobble Creek weather app.

Day	Chance of rain
Monday	5 %
Tuesday	0.9
Wednesday	50 %
Thursday	0

Made-up data: the app readings in this table are made up for this test.

a. Tuesday's chance is 0.9. Write it as a percentage. 1 mark

b. Give the chance word for rain on Thursday. 1 mark

c. Give the chance word for rain on Monday. 1 mark

d. Put the four days in order from least likely to most likely rain. 1 mark

Question 2 (4 marks)

Tess says, 'Either it rains at the market on Saturday or it doesn't, so the chance of rain is 50%.' The weather app actually shows a 15 % chance of rain for Saturday.

a. Is Tess right? Answer yes or no. 1 mark

b. Give the chance word for rain on Saturday. 1 mark

c. Write the chance that it does NOT rain on Saturday as a percentage. 1 mark

d. Say in one sentence why 'it rains or it doesn't' does not make the chance of rain 50%. 1 mark

Question 3 (5 marks)

The fete lucky-dip barrel holds 15 identical plastic ducks. 6 of the ducks have a star painted on them, and the rest are blank. One duck is pulled out at random.

a. How many ducks are blank? 1 mark

b. Write $P(star)$ as a fraction in simplest form. 1 mark

c. Write $P(star)$ as a decimal, and then as a percentage. 2 marks

d. Write $P(blank)$ as a fraction in simplest form. 1 mark

Question 4 (5 marks)

The Cobble Creek fete raffle prints 100 tickets. The raffle organiser says 20 % of the tickets are winner tickets. One ticket is bought at random.

a. How many winner tickets are there? 1 mark

b. Write the chance that the ticket bought is a winner as a fraction in simplest form. 1 mark

c. Write this chance as a decimal, and then as a percentage. 2 marks

d. Write the chance that the ticket bought is NOT a winner as a percentage. 1 mark

Question 5 (5 marks)

Wen's party game has a bag of 10 identical counters, numbered 1 to 10. One counter is pulled out without looking.

a. How many outcomes are in the sample space? 1 mark

b. List ALL the favourable outcomes for the event 'the number is a multiple of 3'. 1 mark

c. Write $P(\text{multiple of } 3)$ as a fraction, and then as a decimal and as a percentage. 2 marks

d. What is the probability of pulling the counter numbered 11? Give the chance word for this event too. 1 mark

Question 6 (5 marks)

The fete game spinner has unequal sections: WIN covers three-quarters of the spinner, and LOSE covers one-quarter of it.

a. Write $P(WIN)$ as a fraction. 1 mark

b. Write $P(LOSE)$ as a percentage. 1 mark

c. Is this game fair? Say why in one sentence. 2 marks

d. The game manager repaints the spinner so that WIN covers half of it and LOSE covers half of it. Write the new $P(WIN)$ as a percentage. 1 mark

Question 7 (6 marks)

The Cobble Creek fete has two lucky-dip bags. Bag P holds 1 prize counter and 3 blank counters. Bag Q holds 3 prize counters and 5 blank counters. All the counters feel the same, so every counter is as likely as every other. You win a prize if you pull out a prize counter.

a. Write $P(\textit{prize})$ for Bag P as a fraction in simplest form.

1 mark

b. Write $P(\textit{prize})$ for Bag Q as a fraction, and then as a decimal.

2 marks

c. Which bag gives the better chance of a prize at the start?

1 mark

d. The fete adds 2 prize counters to Bag P, and nothing else. Write the new $P(\textit{prize})$ for Bag P as a fraction in simplest form, and say which bag now gives the better chance of a prize.

2 marks

End of Section B

Test B — Answers

Q1. (a) 90 %. (b) impossible. (c) unlikely. (d) Thursday, Monday, Wednesday, Tuesday.

Q2. (a) No. (b) unlikely. (c) 85 %. (d) The two outcomes are not equally likely.

Q3. (a) 9. (b) $\frac{2}{5}$. (c) 0.4, 40 %. (d) $\frac{3}{5}$.

Q4. (a) 20. (b) $\frac{1}{5}$. (c) 0.2, 20 %. (d) 80 %.

Q5. (a) 10. (b) {3, 6, 9}. (c) $\frac{3}{10}$, 0.3, 30 %. (d) 0, impossible.

Q6. (a) $\frac{3}{4}$. (b) 25 %. (c) No — WIN and LOSE are not equally likely. (d) 50 %.

Q7. (a) $\frac{1}{4}$. (b) $\frac{3}{8}$, 0.375. (c) Bag Q. (d) $\frac{1}{2}$, Bag P.

Test B — Fully-worked solutions

Question 1.

- a. Multiply by 100: $0.9 \times 100 = 90$. So Tuesday's chance of rain is 90 %.
- b. Thursday's chance is 0. The value 0 means the event cannot happen at all: impossible.
- c. Monday's chance is 5 %. This sits between 0 % and 50 %, close to 0 %, so rain on Monday is unlikely.
- d. Write all four chances in the same form: 0, 5 %, 50 %, 90 %. In size order, $0 < 5 \% < 50 \% < 90 \%$. So the order from least likely to most likely is Thursday, Monday, Wednesday, Tuesday.

Question 2.

- a. No. The app says 15 %, and 15 % is not 50 %.
- b. 15 % sits between 0 % and 50 %, so rain on Saturday is unlikely.
- c. Rain and no rain share the whole 100 %: $100 - 15 = 85$. So the chance of no rain is 85 %.
- d. 'It rains or it doesn't' gives two outcomes, but the two outcomes are not equally likely. At 15 %, no rain (85 %) is much more likely than rain, so the chance of rain is not 50 %.

Question 3.

- a. $15 - 6 = 9$. There are 9 blank ducks.
- b. Favourable outcomes: the 6 star ducks. Total outcomes: 15 ducks. So $P(star) = \frac{6}{15}$. Divide top and bottom by 3: $\frac{2}{5}$.
- c. Divide top by bottom: $2 \div 5 = 0.4$. Multiply by 100: $0.4 \times 100 = 40$. So $P(star) = 0.4 = 40 \%$.
- d. Favourable outcomes: the 9 blank ducks. So $P(blank) = \frac{9}{15}$. Divide top and bottom by 3: $\frac{3}{5}$. Check: $\frac{2}{5} + \frac{3}{5} = 1$, so the two chances share the whole 1.

Question 4.

- a. 20 % of 100: write 20 % as 0.2, then $0.2 \times 100 = 20$. There are 20 winner tickets.
- b. Favourable outcomes: the 20 winner tickets. Total outcomes: 100 tickets. So the chance is $\frac{20}{100}$. Divide top and bottom by 20: $\frac{1}{5}$.
- c. Divide top by bottom: $1 \div 5 = 0.2$. Multiply by 100: $0.2 \times 100 = 20$. So the chance is $0.2 = 20 \%$.
- d. Winner and not winner share the whole 100 %: $100 - 20 = 80$. So the chance of NOT winning is 80 %.

Question 5.

- a. The bag holds 10 counters, so the sample space has 10 outcomes: $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$.
- b. The multiples of 3 in the bag are 3, 6 and 9, so the favourable outcomes are $\{3, 6, 9\}$.
- c. Favourable outcomes: 3. Total outcomes: 10. So $P(\text{multiple of } 3) = \frac{3}{10}$. Divide: $3 \div 10 = 0.3$. Multiply by 100: $0.3 \times 100 = 30$. So the chance is $\frac{3}{10} = 0.3 = 30\%$.
- d. No counter is numbered 11, so there are 0 favourable outcomes: the probability is 0. The value 0 means impossible.

Question 6.

- a. WIN covers three-quarters of the spinner, so $P(WIN) = \frac{3}{4}$.
- b. LOSE covers one-quarter, so $P(LOSE) = \frac{1}{4}$. Divide: $1 \div 4 = 0.25$. Multiply by 100: $0.25 \times 100 = 25$. So $P(LOSE) = 25\%$.
- c. No. A fair game needs both sides equally likely. Here $P(WIN) = \frac{3}{4}$ and $P(LOSE) = \frac{1}{4}$, and $\frac{3}{4}$ is bigger than $\frac{1}{4}$, so the game is not fair.
- d. Half means $\frac{1}{2}$, and $\frac{1}{2} \times 100 = 50$. So the new $P(WIN)$ is 50%. The game is fair now, because both sides are $\frac{1}{2}$.

Question 7.

- a. Bag P holds $1 + 3 = 4$ counters, and 1 of them is a prize counter. So $P(\text{prize}) = \frac{1}{4}$, which is already in simplest form.
- b. Bag Q holds $3 + 5 = 8$ counters, and 3 of them are prize counters. So $P(\text{prize}) = \frac{3}{8}$. Divide: $3 \div 8 = 0.375$.
- c. $\frac{1}{4} = 0.25$ and $\frac{3}{8} = 0.375$. Since 0.375 is bigger than 0.25, Bag Q gives the better chance of a prize.
- d. Bag P now holds $1 + 2 = 3$ prize counters out of $4 + 2 = 6$ counters in total. So the new $P(\text{prize}) = \frac{3}{6}$. Divide top and bottom by 3: $\frac{1}{2}$. Now $\frac{1}{2} = 0.5$, and 0.5 is bigger than 0.375, so Bag P now gives the better chance of a prize.