Mathematics Level 4

Chapter 7 — Probability

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Contents

Ordering outcomes by likelihood; independent and dependent events

Code `VC2M4P01` (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 4; authority file `maths_4.json`): "describe possible everyday events and the possible outcomes of chance experiments and order outcomes or events based on their likelihood of occurring; identify independent or dependent events". This section draws on `VC2M4P01.E01`, `.E02`, `.E03`, `.E04`, `.E05` and `.E06`.

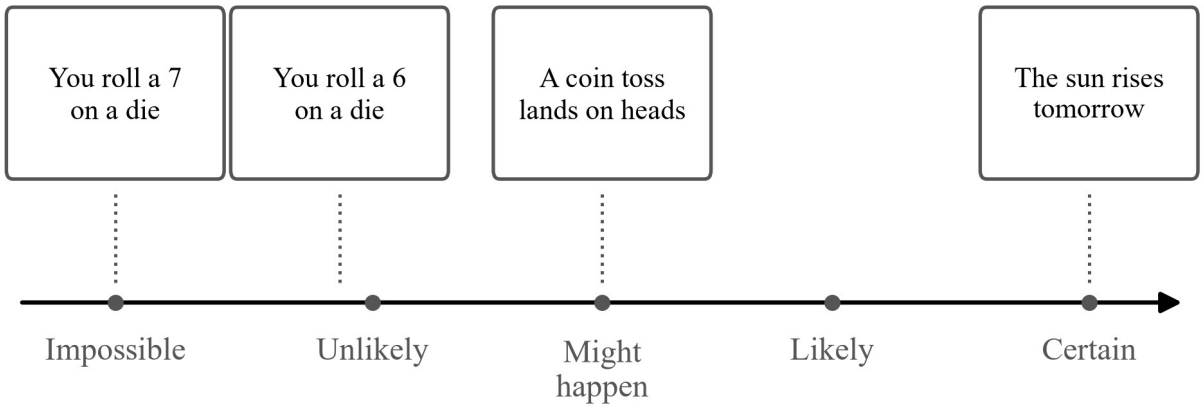
What you need to know

In Year 3 you used the chance words **impossible**, **unlikely**, **likely** and **certain**. They all come back in this section. This section has two parts. **Part (i)** is about ordering outcomes and events by how likely they are. **Part (ii)** is about independent and dependent events.

Part (i) — Ordering outcomes by likelihood

A **chance experiment** is something you do where you cannot know the result before it happens: tossing a coin, rolling a die, spinning a spinner, drawing a ball from a bag. Each thing that could happen in a chance experiment is an **outcome**. When you roll a die, the outcomes are 1, 2, 3, 4, 5 and 6.

Outcomes and everyday events can be put in order, from least likely to most likely. A good tool for the ordering is the **chance line**.

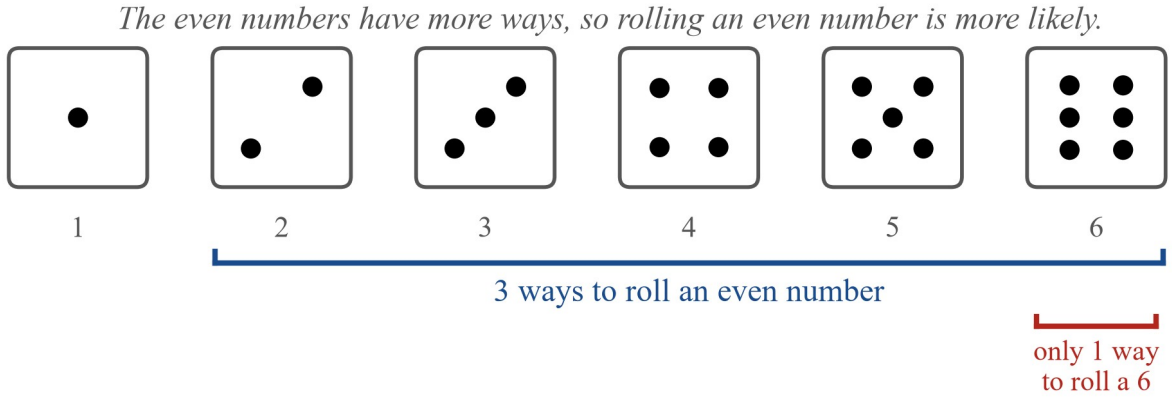


Chance gets bigger as you move to the right.

A chance line from impossible to certain. Under the line sit the words impossible, unlikely, might happen, likely and certain. Four event cards stand above the line: you roll a 7 on a die at impossible, you roll a 6 on a die at unlikely, a coin toss lands on heads at might happen, and the sun rises tomorrow at certain.

On the chance line, impossible things sit at the left end and certain things sit at the right end. Unlikely things sit near the left, likely things sit near the right, and things that might or might not happen sit in the middle. The events on the right are more likely to happen.

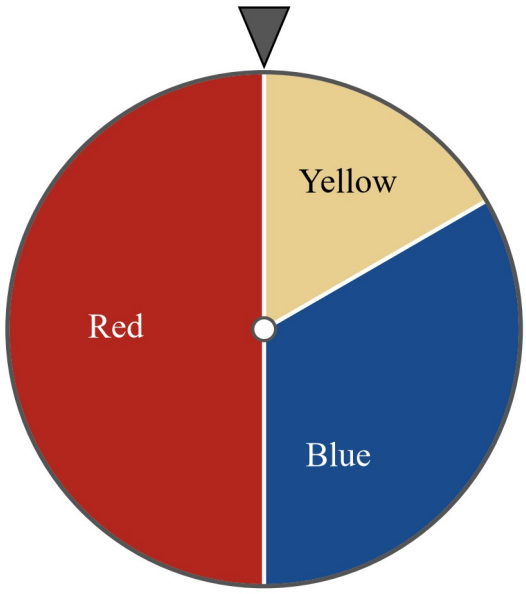
More ways means more likely.



Six die faces in a row showing 1, 2, 3, 4, 5 and 6. A blue line under the faces 2, 4 and 6 reads 3 ways to roll an even number, and a red line under the face 6 reads only 1 way to roll a 6.

A die has six faces. There are 3 ways to roll an even number (the faces 2, 4 and 6), but only 1 way to roll a 6. So rolling an even number is more likely than rolling a 6. When an outcome can happen in more ways, it is more likely.

More of the spinner means more likely.



Which colour is the spinner most likely to land on?

A spinner with a pointer at the top and three coloured sections. Red covers half of the spinner, blue about a third, and yellow the small rest.

The red part of this spinner is the biggest part, so the spinner is most likely to land on red. The yellow part is the smallest part, so the spinner is least likely to land on yellow. In order from least likely to most likely: **yellow, blue, red**.

More balls of a colour means more likely.

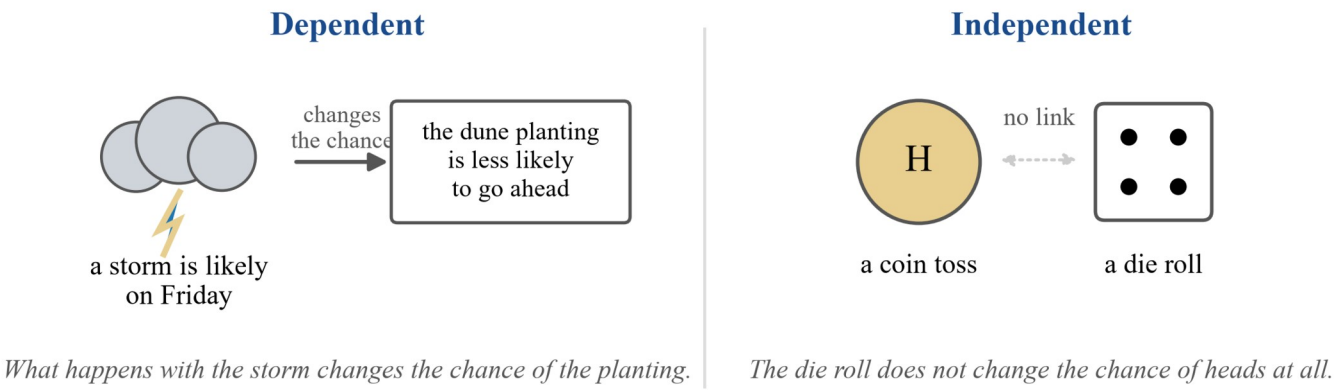
A bag holds 4 red balls and 1 white ball. Without looking, you draw one ball. There are more red balls than white balls, so drawing red is likely and drawing white is unlikely. You still cannot say for sure which ball you will get — that is what makes it a chance experiment — but red has the better chance.

A word on Year 5 and Year 6. In Year 5 you will compare chances more carefully, and in Year 6 you will even write chances as numbers. In this section, words and good reasons are the whole job.

Part (ii) — Independent and dependent events

Now we look at *pairs* of events and ask one question: *does what happens with one event change the chance of the other?*

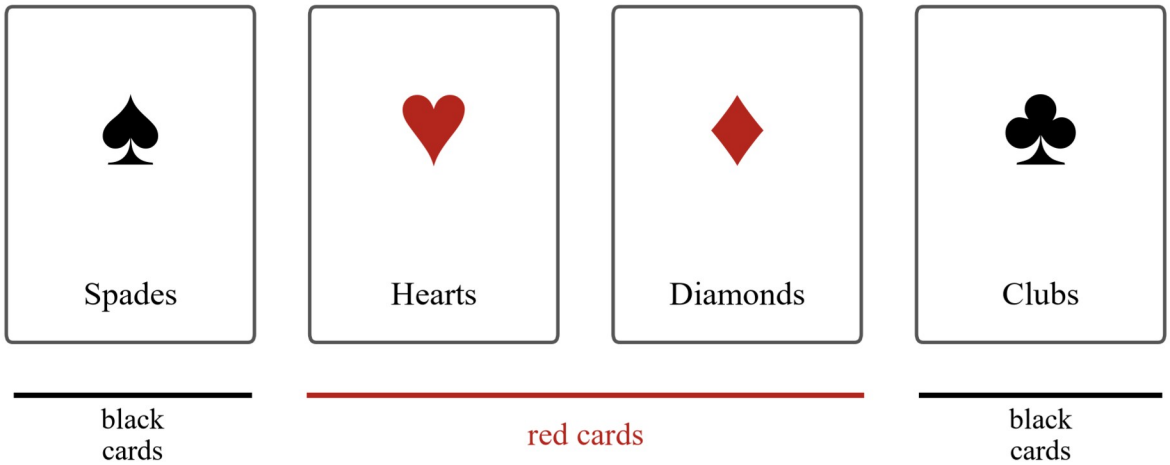
Two events are **independent** when what happens with one does not change the chance of the other. Two events are **dependent** when what happens with one does change the chance of the other.



Two panels. The left panel, labelled dependent, shows a storm cloud with an arrow to a card reading the dune planting is less likely to go ahead. The right panel, labelled independent, shows a coin and a die with a dotted line between them to show they are not joined.

On the left, the storm and the dune planting are **dependent**: if a storm is likely on Friday, the planting is less likely to go ahead. What happens with one event changes the chance of the other. On the right, the coin toss and the die roll are **independent**: the die roll does not change the chance of heads at all.

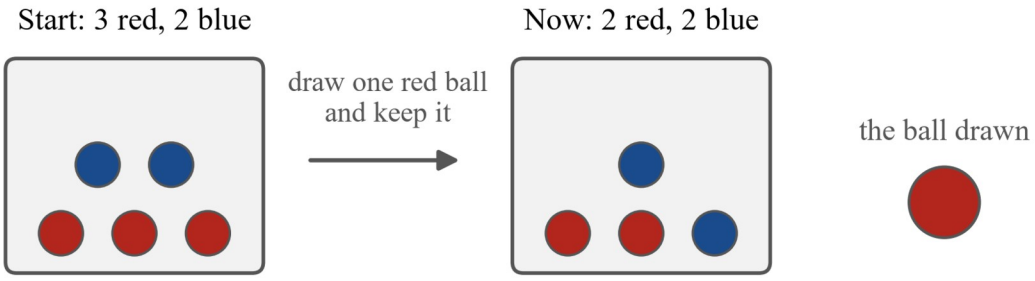
One thing can rule another out.



Four playing cards showing the four kinds: spades and clubs in black, hearts and diamonds in red. A red line joins hearts and diamonds as the red cards, and black lines mark spades and clubs as the black cards.

Sometimes, when one outcome happens, another outcome cannot happen at the same time. Draw a card from a pack and turn it over. If it is a red card, it cannot be a spade and it cannot be a club — being red rules those out. In the same way, it cannot be hot and cold at the same time.

Taking away changes the bag.



The bag has changed, so the next draw has changed too.

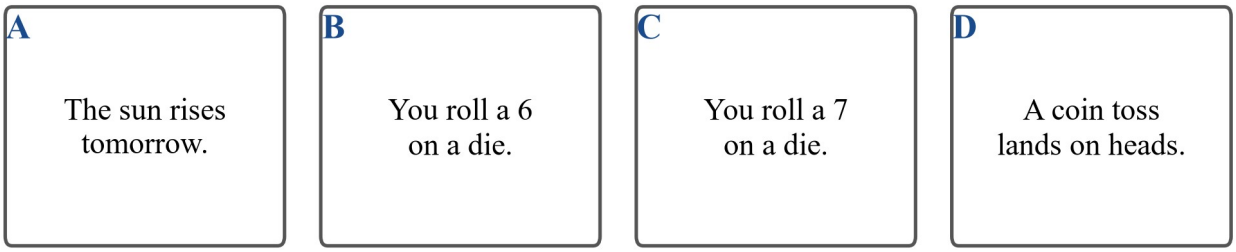
Two bags. The first bag holds 3 red and 2 blue balls. After one red ball is drawn and kept, the second bag holds 2 red and 2 blue balls, with the drawn red ball shown outside the bag.

A bag holds 3 red and 2 blue balls. You draw one ball, it is red, and you keep it. The bag now holds 2 red and 2 blue, so the chances for the next draw have changed. The two draws are **dependent** events. If you had put the red ball back, the bag would be just as it was, the next draw would have the same chances as the first, and the two draws would be **independent** events.

Worked examples

Example 1 — putting event cards in order

Put the four event cards in order, from least likely to most likely.



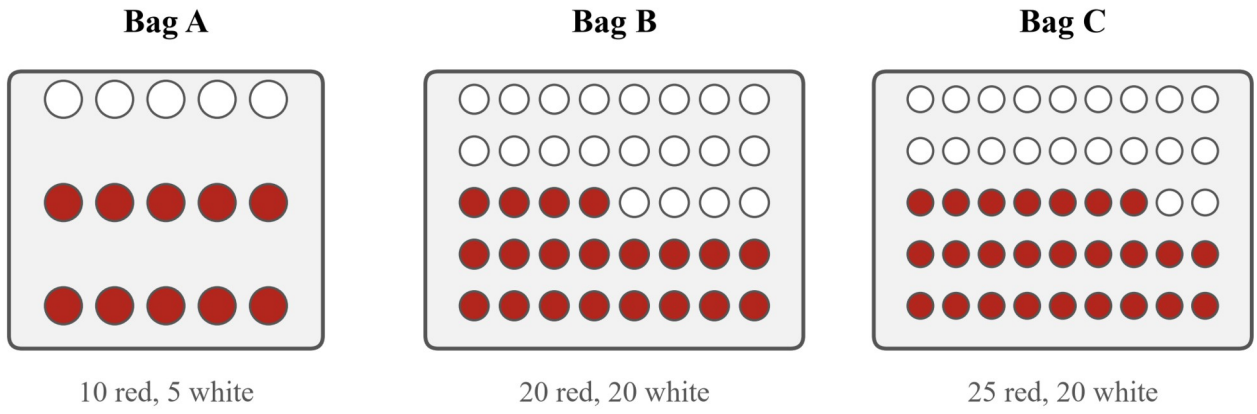
Four event cards labelled A, B, C and D. A: the sun rises tomorrow. B: you roll a 6 on a die. C: you roll a 7 on a die. D: a coin toss lands on heads.

Working	Comment
Card C comes first.	A die has no 7 face, so rolling a 7 is impossible.
Card B comes next.	Only the face 6 gives a 6, so rolling a 6 is unlikely.
Card D comes next.	Heads and tails have the same chance, so this might happen.
Card A comes last.	The sun rising tomorrow is certain.

The order, from least likely to most likely, is **C, B, D, A**.

Example 2 — which bag gives the better chance of red?

One ball is drawn from each bag, without looking. Put the bags in order from least likely to most likely to give a red ball.



One ball will be drawn from each bag, without looking.

Three bags of balls. Bag A holds 10 red and 5 white balls, Bag B holds 20 red and 20 white balls, and Bag C holds 25 red and 20 white balls.

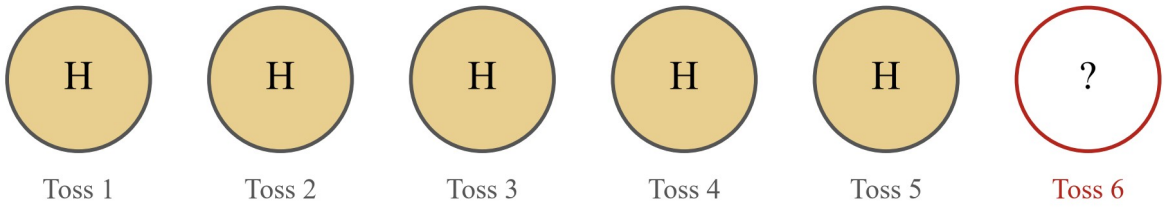
Working	Comment
Bag B: 20 red and 20 white — the same number of each.	Red and white have the same chance here, so Bag B sits in the middle of the order.
Bag C: 25 red and 20 white — 25 − 20 = 5, so 5 more red than white, out of 45 balls.	Red is ahead, but with so many balls in the bag the lead of 5 is only a small help.
Bag A: 10 red and 5 white — twice as many red as white.	Red is far ahead here, so Bag A gives the best chance of red.

The order, from least likely to most likely, is **B, C, A**. Bag A gives the best chance of a red ball.

Example 3 — five heads in a row

A coin is tossed five times and lands on heads every time. Tom says: “So many heads came up, so tails is more likely next.” Is Tom right?

Five heads in a row. What happens on toss 6?



Five coins in a row, all showing H, labelled toss 1 to toss 5, then one more coin marked with a question mark, labelled toss 6.

Working	Comment
A coin has no memory.	It cannot remember the five heads, so the heads do not make tails more likely.
Toss 6 is a new toss of the same coin.	Heads and tails have the same chance on toss 6 as they did on toss 1.
Tom is not right.	Tails is not more likely after five heads.

Toss 6 is **independent** of the first five tosses: what happened before does not change the chance of what happens next.

Example 4 — independent or dependent?

Say whether each pair of events is independent or dependent, and give a reason.

(a) Event 1: a storm is likely on Friday. Event 2: the coastal dune planting goes ahead on Friday.

(b) Event 1: you toss a coin and it lands on heads. Event 2: you roll a die and get a 4.

	Independent or dependent?	Reason
(a)	Dependent	A storm changes the chance of the planting: if the storm comes, the planting is less likely to go ahead.
(b)	Independent	The coin does not change the die, and the die does not change the coin. One does not change the chance of the other.

Practice questions

Part (i) — Questions with help

Q1. Put these chance words in order, from the smallest chance to the greatest chance: certain, unlikely, impossible, likely.

Q2. Look at the chance line picture. Which word sits under "you roll a 6 on a die"?

Q3. Look at the spinner picture. Put the three colours in order from least likely to most likely.

Q4. Look at the die picture. Is rolling an even number more likely or less likely than rolling a 6? Why?

Q5. A bag holds 4 red balls and 1 white ball. You draw one ball without looking. Which colour is more likely?

Q6. Put these in order from least likely to most likely: you fly to school tomorrow; you eat lunch today; it rains at your school tomorrow.

Part (i) — Questions on your own

Q7. Put these in order from least likely to most likely: you see a dog this week; you see a purple dog this week; you see an animal this week.

Q8. A spinner has a big green part and a small yellow part. Which colour is the spinner least likely to land on?

Q9. A bag holds 3 red, 3 blue and 3 yellow balls. You draw one ball without looking. What can you say about the chance of each colour?

Q10. Bag X holds 6 red and 2 white balls. Bag Y holds 3 red and 3 white balls. From which bag is drawing a red ball more likely? Give a reason.

Q11. You roll a die. Put these in order from least likely to most likely: rolling a 5; rolling a number less than 5; rolling a 7.

Q12. True or false, with a reason: something that is unlikely can never happen.

Q13. True or false, with a reason: if something is not certain, then it is impossible.

Q14. A card is drawn from a pack. Put these in order from least likely to most likely: the card is the queen of hearts; the card is a heart; the card is a red card.

Q15. Zoe rolls a die and gets a 6. She says: "Six is my lucky number now, so I will roll a 6 again next time." Is her thinking right? Explain.

Part (ii) — Questions with help

Q16. Fill in the blank: two events are ____ when what happens with one does not change the chance of the other.

Q17. Fill in the blank: two events are ____ when what happens with one does change the chance of the other.

Q18. You toss a coin twice. The first toss lands on heads. Does the first toss change the chance of the second toss?

Q19. Look at the playing cards picture. A card is drawn and it is red. Can it be a spade? Can it be a heart?

Q20. It cannot be hot and cold at the same time. If it is hot, what does that tell you about "it is cold"?

Q21. There is a high chance of a storm on Saturday. Is the chance that a Saturday cricket match goes ahead independent of the storm, or dependent on it?

Part (ii) — Questions on your own

Q22. Say whether each pair of events is independent or dependent. (a) You toss a coin and get heads; you toss the same coin again. (b) You draw a ball from a bag and keep it; you draw a second ball from the same bag. (c) You wear your red socks; your team wins the match.

Q23. A bag holds 5 red and 5 blue counters. You draw one counter, keep it, then draw again. Does the second draw have the same chances as the first? Why?

Q24. Mia's brother says tails is more likely after five heads. Mia says the chance is the same as before. Who is right? Why?

Q25. A card is drawn from a pack and it is a spade. Name one thing that cannot be true about the card.

Q26. A lunch bag holds 3 apple slices and 3 grapes. You take one and eat it, then take another. Are the two draws independent or dependent? Explain.

Q27. There is a high chance of rain on the school picnic day. Write one event that is dependent on the rain, and say how its chance changes.

Q28. Write your own pair of independent events.

Q29. Write your own pair of dependent events.

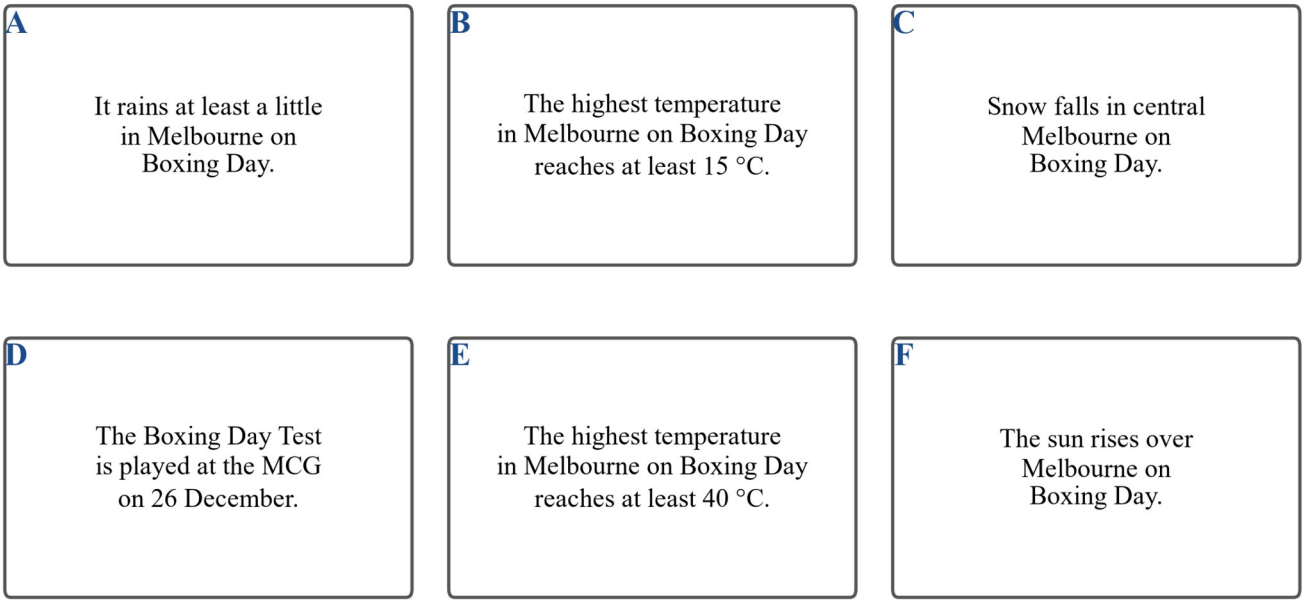
Q30. Kay says: "If two events are independent, then knowing one happened tells me nothing about the chance of the other." Is Kay right? Use a coin and a die to explain.

Applied

Q31. Boxing Day is 26 December. In Melbourne, the Boxing Day Test cricket match is played at the Melbourne Cricket Ground (MCG), and the whole city is in the middle of summer.

> Source: Wikipedia, *Boxing Day Test*, en.wikipedia.org, retrieved 2026-08-20. Source: Wikipedia, *Climate of Melbourne*, en.wikipedia.org (Bureau of Meteorology station data), retrieved 2026-08-20.

These facts come from those sources: the Test starts on Boxing Day each year, but no Test was played between 1953 and 1967, and in 1989 a different match was played instead; the average highest temperature in Melbourne in December is 24.8 °C; about 10 of the 31 days in December usually have at least a little rain; the highest temperature ever recorded in Melbourne is 46.4 °C; and there was snow in Melbourne's city centre in July 1986, but no snow has been recorded there since.



Six event cards labelled A to F about Boxing Day in Melbourne. A: it rains at least a little in Melbourne on Boxing Day. B: the highest temperature in Melbourne on Boxing Day reaches at least 15 °C. C: snow falls in central Melbourne on Boxing Day. D: the Boxing Day Test is played at the MCG on 26 December. E: the highest temperature in Melbourne on Boxing Day reaches at least 40 °C. F: the sun rises over Melbourne on Boxing Day.

(a) Which card names an event that is impossible? How do the facts show it?

(b) Put all six cards in order, from least likely to most likely.

(c) Give a reason for the place of card A and the place of card D in your order.

(d) Sam says card E is more likely than card A. Use the facts to show that Sam is wrong.

Answers

Q1. impossible, unlikely, likely, certain. **Q2.** unlikely. **Q3.** yellow, blue, red. **Q4.** More likely; there are 3 ways to roll an even number and only 1 way to roll a 6. **Q5.** red. **Q6.** you fly to school tomorrow; it rains at your school tomorrow; you eat lunch today. **Q7.** you see a purple dog this week; you see a dog this week; you see an animal this week. **Q8.** yellow. **Q9.** The three colours have the same chance, because there are 3 of each. **Q10.** Bag X; red is far ahead of white in Bag X, while red and white are level in Bag Y. **Q11.** rolling a 7; rolling a 5; rolling a number less than 5. **Q12.** False; unlikely things can happen, they just do not happen most of the time. **Q13.** False; a likely event is not certain, but it is not impossible either. **Q14.** the queen of hearts; a heart; a red card. **Q15.** No; each roll is a new roll, and a 6 is still only one face of the six. **Q16.** independent. **Q17.** dependent. **Q18.** No; the two tosses are independent. **Q19.** It cannot be a spade; it can be a heart. **Q20.** "It is cold" cannot happen; when one happens, the other cannot. **Q21.** Dependent; a storm makes the match less likely to go ahead. **Q22.** (a) independent (b) dependent (c) independent. **Q23.** No; the bag has changed, so the second draw is dependent on the first. **Q24.** Mia; the coin has no memory, so the chance is the same as before. **Q25.** It cannot be a red card (so it cannot be a heart or a diamond either). **Q26.** Dependent; after one is eaten, the lunch bag has changed. **Q27.** Answers will vary; for example: the picnic in the park is less likely to go ahead. **Q28.** Answers will vary; for example: a coin toss and a die roll. **Q29.** Answers will vary; for example: rain on Saturday and the picnic going ahead. **Q30.** Yes; the coin landing on heads does not change the chance of any die roll. **Q31.** (a) Card C; snow has not been recorded in Melbourne's city centre since July 1986, and Boxing Day is in the middle of summer. (b) C, E, A, D, B, F. (c) Card A: only about 10 of the 31 days in December have rain, so rain on one named day is unlikely. Card D: the Test has started on Boxing Day each year since 1968, except 1989, so it is very likely. (d) A 40 °C day is rare in Melbourne, while rain comes on about 10 December days each month, so card A is more likely than card E.

Worked answers

Q1. Impossible is the smallest chance and certain is the greatest: **impossible, unlikely, likely, certain**.

Q2. The card "you roll a 6 on a die" sits above the word **unlikely**, because only one face of the six gives a 6.

Q3. The yellow part is the smallest and the red part is the biggest: **yellow, blue, red**.

Q4. More likely. There are 3 ways to roll an even number (2, 4, 6) and only 1 way to roll a 6, and more ways means more likely.

Q5. Red. There are 4 red balls and only 1 white ball, so red has the better chance.

Q6. Flying to school by yourself is impossible, rain tomorrow might or might not happen, and eating lunch today is certain: **fly to school, rain at your school, eat lunch**.

Q7. A purple dog is impossible (dogs are never purple), seeing a dog is likely, and seeing an animal of some kind is almost certain: **purple dog, dog, animal**.

Q8. Yellow. The yellow part is the small part, so the spinner is least likely to land on yellow.

Q9. There are 3 balls of each colour, so **the three colours have the same chance**.

Q10. Bag X. In Bag X, red is far ahead of white (6 to 2). In Bag Y, red and white are level (3 to 3). So red has the better chance from Bag X.

Q11. Rolling a 7 is impossible; rolling a 5 has one way; rolling a number less than 5 has four ways (1, 2, 3, 4): **rolling a 7, rolling a 5, rolling a number less than 5**.

Q12. False. Unlikely things can happen — rolling a 6 on a die is unlikely, but it happens. Unlikely only means it does not happen most of the time.

Q13. False. Tossing a coin and getting heads is not certain, but it is not impossible either. Not certain does not mean impossible.

Q14. There is only 1 queen of hearts, there are 13 hearts, and there are 26 red cards. More ways means more likely, so the order is **the queen of hearts, a heart, a red card**.

Q15. No. The die has no memory any more than a coin does. Each roll is a new roll, and 6 is still only 1 face of the six, so a 6 is not more likely next time.

Q16. independent — what happens with one does not change the chance of the other.

Q17. dependent — what happens with one does change the chance of the other.

Q18. No. The coin has no memory. Heads and tails have the same chance on the second toss as on the first, so the two tosses are independent.

Q19. A red card **cannot be a spade** (spades are black), and it **can be a heart** (hearts are red).

Q20. It tells you that **"it is cold" cannot happen**. When one of the two happens, the other cannot happen at the same time.

Q21. Dependent. If a storm is likely on Saturday, the match is less likely to go ahead, so the storm changes the chance of the match.

Q22. (a) **Independent** — the first toss does not change the second. (b) **Dependent** — keeping the first ball changes what is left in the bag. (c) **Independent** — socks do not change the chance of winning; wearing them does not change anything.

Q23. No. After one counter is kept, the bag holds 4 of one colour and 5 of the other, so the chances have changed. The second draw is dependent on the first.

Q24. Mia. A coin has no memory, and toss 6 is a new toss of the same coin, so the chance is the same as before. Five heads do not make tails more likely.

Q25. The card **cannot be a red card** — spades are black. (So it also cannot be a heart or a diamond.)

Q26. Dependent. After one is eaten, it is not put back, so the lunch bag has changed and the chances for the second draw have changed too.

Q27. Answers will vary. For example: "the picnic is played in the park" is dependent on the rain — if the rain comes, the picnic in the park is less likely to go ahead.

Q28. Answers will vary. For example: tossing a coin and getting heads, and rolling a die and getting a 4 — the coin does not change the die, so they are independent.

Q29. Answers will vary. For example: rain on Saturday and the school picnic going ahead — the rain changes the chance of the picnic, so they are dependent.

Q30. Yes. If the coin lands on heads, the die still has its six faces, and the chance of each die roll is just as it was. Knowing one happened tells you nothing about the chance of the other — that is what independent means.

Q31. (a) **Card C.** There was snow in Melbourne's city centre in July 1986, and no snow has been recorded there since. Boxing Day is in the middle of summer, so snow on Boxing Day is impossible. (b) **C, E, A, D, B, F.** (c) Card A sits low because only about 10 of the 31 days in December usually have rain, so rain on one named day is unlikely. Card D sits high because the Test has started on Boxing Day each year since 1968 (with 1989 the exception), so it is very likely. (d) The highest temperature ever recorded in Melbourne is 46.4 °C, and a day of 40 °C or more is rare. Rain comes on about 10 December days each month. So card A (rain) is more likely than card E (40 °C), and Sam is wrong.

Repeated chance experiments and the variation in results

Code VC2M4P02 (Victorian Curriculum F–10 Version 2.0, Mathematics, Level 4; authority file `maths_4.json`): "conduct repeated chance experiments to observe relationships between outcomes in games and other chance situations, and identify and describe the variation in results". This section draws on elaborations `VC2M4P02.E01`, `.E02`, `.E03` and `.E04`.

What you need to know

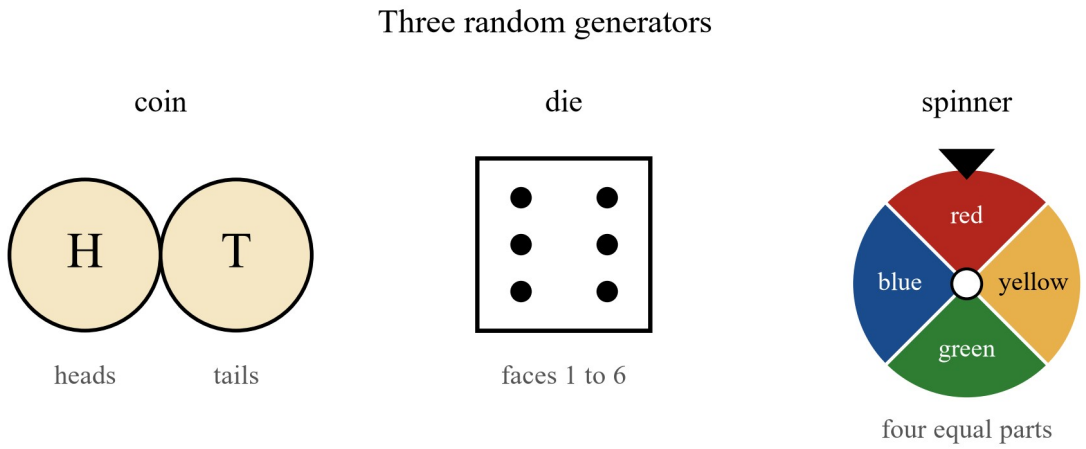
In Year 3 you used chance words like *likely*, *unlikely*, *certain* and *impossible*. In 7A you ordered chance outcomes by how likely they are. In this section you **do** the chance work yourself: you run chance experiments, you repeat them, and you watch what the results do.

Chance experiments. A **chance experiment** is a test where you cannot know the result before it happens. Tossing a coin is a chance experiment. Rolling a die is a chance experiment. Spinning a spinner is a chance experiment.

Random generators. The things you use to get the results are called **random generators**.

> In this section, *random generators* means coins, dice, spinners and other things that give one result from a set of possible results, where you cannot know in advance which one it will be.

A coin, a die and a spinner are random generators you can hold in your hand. Computer programs that toss a coin or shuffle cards on the screen are random generators too — those are **virtual** ones, and the ones you can hold are **physical**.



Three random generators. A coin shows a heads side and a tails side. A die shows faces numbered 1 to 6. A spinner has four equal parts coloured red, blue, green and yellow, with a pointer in the middle.

Outcomes. Each possible result of a chance experiment is called an **outcome**.

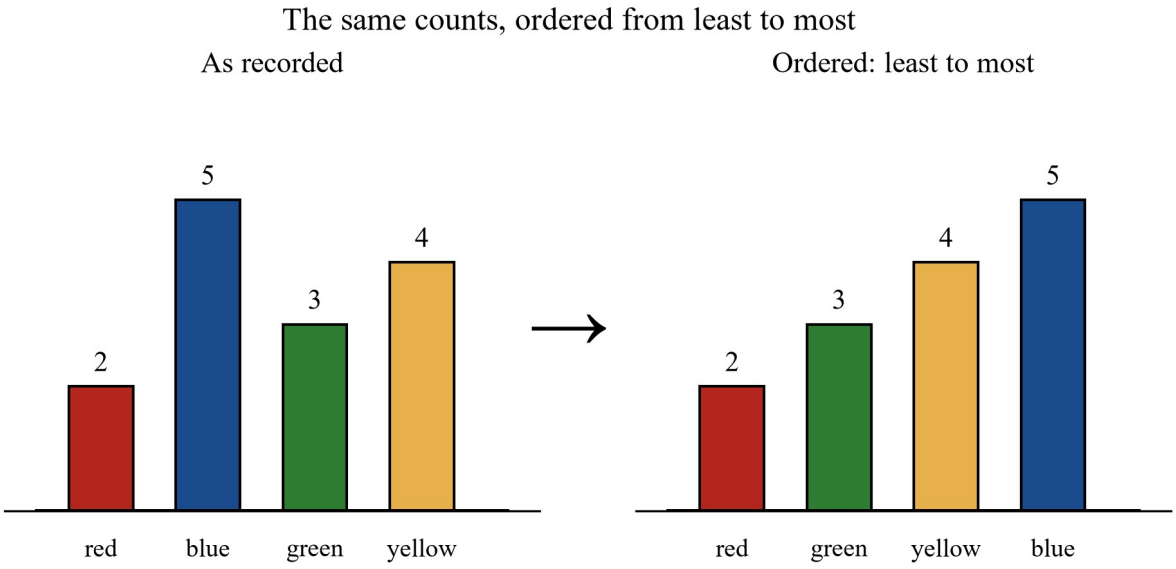
- Toss a coin: the outcomes are **heads** and **tails**.
- Roll a die: the outcomes are **1, 2, 3, 4, 5** and **6**.
- Spin a four-colour spinner: the outcomes are **red**, **blue**, **green** and **yellow**.

Repeat, repeat, repeat. One toss tells you very little. To find out more, you **repeat** the experiment: you do it again and again, and you record every result. Tally marks are a quick way to record — each result gets one mark, and the fifth mark goes across the group of four, like this: `IIII/`.

Variation — the big idea. Here is what this section is about. Repeat the same chance experiment, and the results are not always the same. Toss a coin 10 times and you might get 7 heads. Toss it 10 more times and you might get only 4 heads. The way the results change from run to run is called the **variation** in the results.

> In this section, *variation* means the way the results change when you repeat the same experiment.

Ordering the outcomes. When you finish, count how many times each outcome happened. Then you can **order** the outcomes — from the one that happened least to the one that happened most, or the other way around. Here are the counts from one run of a spinner experiment, as recorded and then ordered from least to most.



Two column graphs side by side. The left graph is labelled as recorded, with columns red 2, blue 5, green 3 and yellow 4. The right graph is labelled ordered from least to most, with the same columns sorted: red 2, green 3, yellow 4 and blue 5. An arrow joins the two graphs.

Guesses. Before an experiment, you can make a **guess** about what will happen. After the experiment, compare your guess with the real results. Your guess is not always right — the results can surprise you.

Games. You can also repeat a whole game. Play a chance game many times, record who wins each game, and then look at the results. Does it make a difference who goes first? Does one side win more games? You will try this in Activity 1 below.

Where this section stops. In this section you describe chance in words, and you compare what happened by counting results. You do not write chance as a number — that work comes in later years.

Worked examples

Example 1 — step by step: toss a coin 20 times

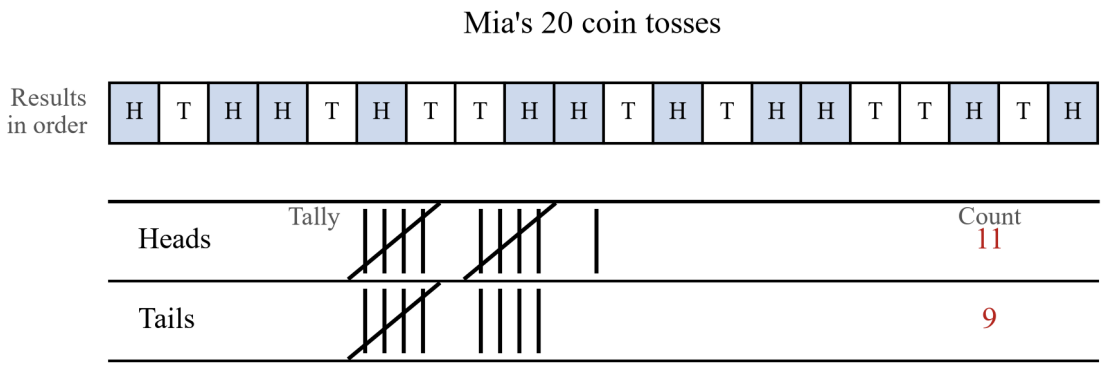
Mia tosses a coin 20 times. She records every result, then counts the heads and the tails.

Her results, in order, are:

H, T, H, H, T, H, T, T, H, H, T, H, T, H, H, T, T, H, T, H

Working	Comment
H = heads, T = tails. Write every result in order.	Record every toss, even when the same result comes up again and again.
Heads: 𝍸 𝍸 I = 11	Count the heads with tally marks.
Tails: 𝍸 IIII = 9	Count the tails with tally marks.
Check: 11 + 9 = 20	There were 20 tosses, so the counts must add to 20.
Heads came up more than tails: 11 times, against 9 times.	Compare the counts.

Describe the variation: *"The results were not all the same. In my 20 tosses, heads came up 11 times and tails came up 9 times."*



Check: 11 + 9 = 20 tosses. Heads came up more than tails.

A record of 20 coin tosses. The top row shows the 20 results in order, H and T. Below it, a tally table shows heads with 11 tally marks and tails with 9 tally marks, and the counts add to 20.

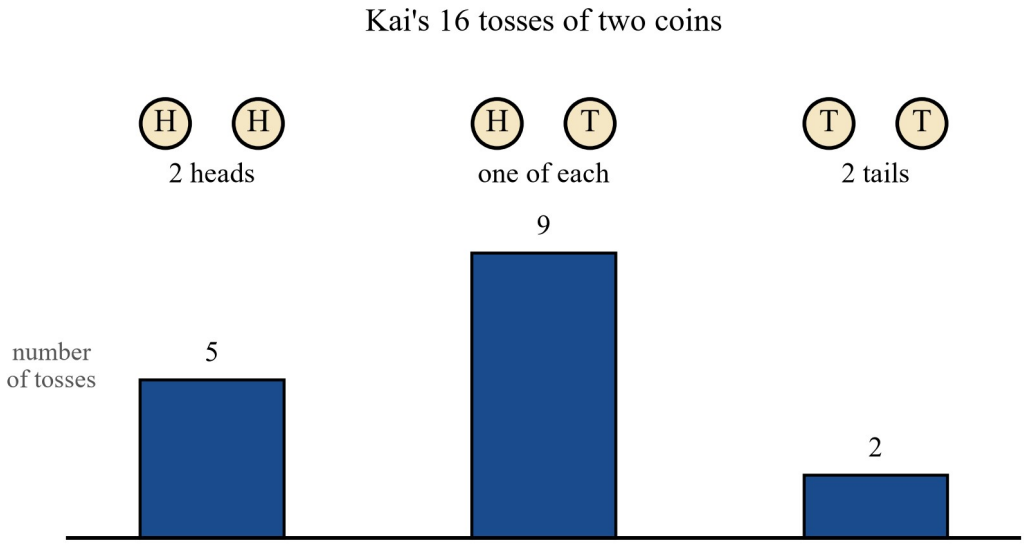
Example 2 — step by step: toss two coins at the same time

Kai tosses **two** coins at the same time, 16 times. Each toss gives one of three results: **2 heads**, **one of each** (one head and one tail), or **2 tails**.

Kai's counts are: 2 heads — 5 times; one of each — 9 times; 2 tails — 2 times.

Working	Comment
Three result types: 2 heads, one of each, 2 tails.	HT and TH are both "one of each".
2 heads: 𝍸 = 5	Count each type.
One of each: 𝍸 𝍸 = 9	This type came up most often.
2 tails: 𝍷 = 2	This type came up least often.
Check: 5 + 9 + 2 = 16	There were 16 tosses.

Describe the results: *"In my 16 tosses, one of each came up most often and 2 tails came up least often. Another student doing the same experiment 16 times could get different counts."*



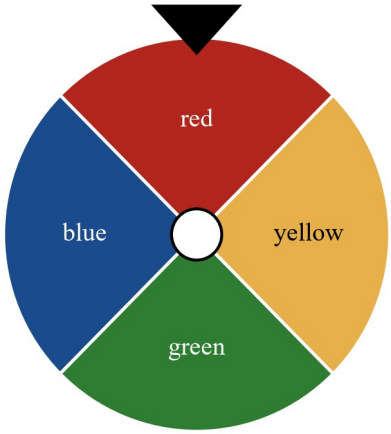
One of each came up most often (9). 2 tails came up least often (2).

Three result types for tossing two coins, shown as pairs of coins labelled 2 heads, one of each and 2 tails. A column graph shows Kai's 16 tosses: 2 heads came up 5 times, one of each came up 9 times and 2 tails came up 2 times.

Example 3 — step by step: the same spinner, two different groups

A spinner has four equal parts: red, blue, green and yellow. Group A spins it 12 times. Group B spins the **same** spinner 12 times.

A four-colour spinner

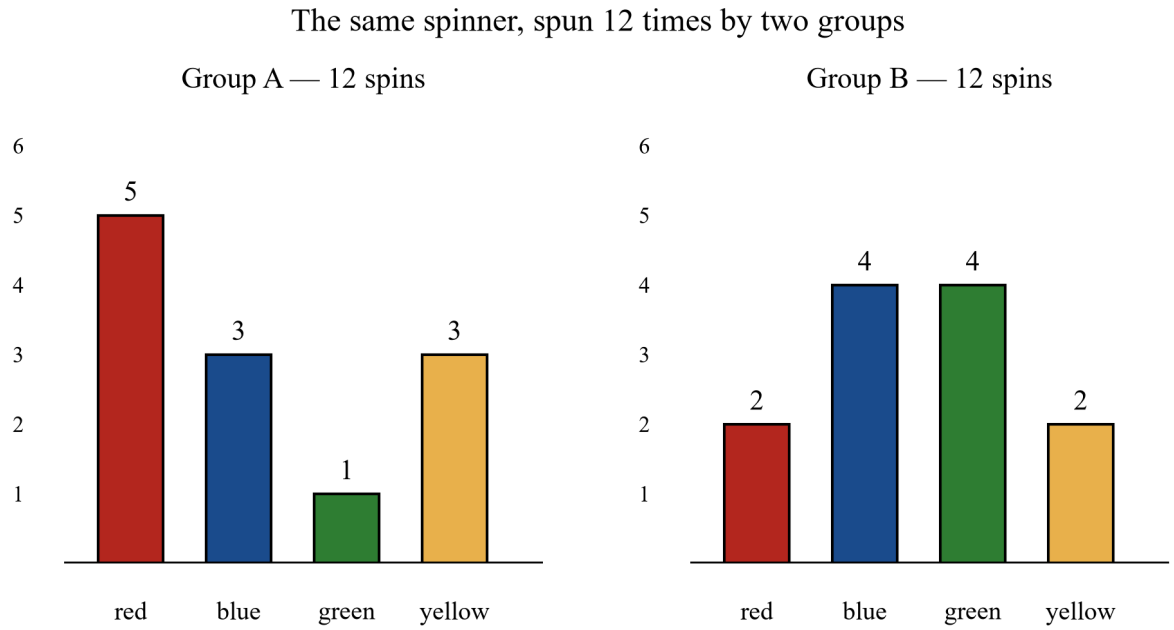


A spinner with four equal parts coloured red, blue, green and yellow, and a pointer in the middle.

Group A's results: red 5, blue 3, green 1, yellow 3. Group B's results: red 2, blue 4, green 4, yellow 2.

Working	Comment
Group A: check 5 + 3 + 1 + 3 = 12.	Group A spun 12 times.
Group B: check 2 + 4 + 4 + 2 = 12.	Group B spun 12 times.
Group A order: red (5) most, then blue and yellow (3), then green (1) least.	Order Group A's outcomes by count.
Group B order: blue and green (4) most, then red and yellow (2) least.	Order Group B's outcomes by count.
The two orders are different.	Same spinner, same number of spins — different results.

Describe the variation: *"Both groups used the same spinner and spun it 12 times, but the results were different. Both groups did nothing wrong — that is variation."*



Two column graphs side by side for the same spinner. Group A spun 12 times and got red 5, blue 3, green 1 and yellow 3. Group B spun 12 times and got red 2, blue 4, green 4 and yellow 2.

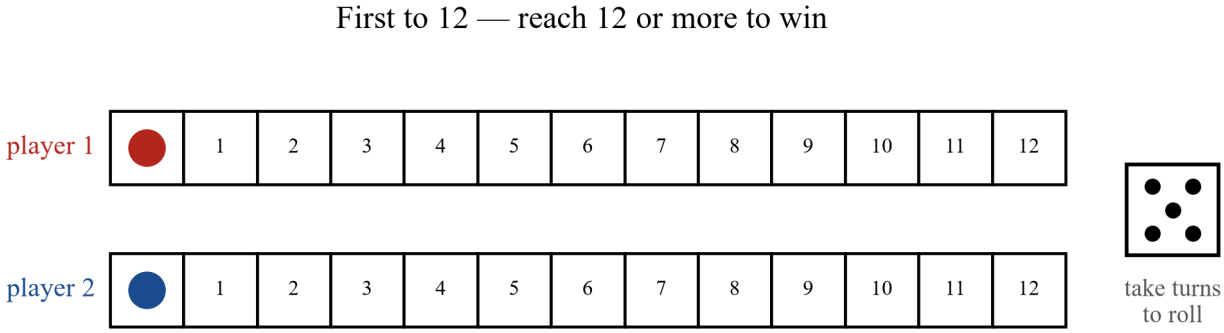
Experiment activity — your turn to run one

Activity 1 — First to 12

You need: one die, one First to 12 track for each player, one counter for each player.

Rules.

1. Two players take turns to roll the die.
2. On your turn, add the number you roll to your total, and move your counter that many squares along your track.
3. The first player to reach 12 or more wins the game.



A First to 12 game track. Two tracks are labelled player 1 and player 2, each with squares numbered 0 to 12, and a counter on square 0 of each track. A die sits beside the tracks.

Play 10 games. After each game, record who went first and who won. Then look at your results:

- How many games did the player going first win? How many did the player going second win?
- Does it make a difference who goes first? How do you know?

Activity 2 — your own repeated experiment

Now run your own chance experiment, step by step.

1. **Choose** one from this list of random generators and write down its name: a coin, a die, a spinner, or a set of shuffled cards.
2. **List** the possible outcomes.
3. **Guess** which outcome will happen most often.
4. **Repeat** the experiment at least 15 times. Record every result on the sheet below, using tally marks.
5. **Count** the results, and order the outcomes from least often to most often.
6. **Write** two sentences: what happened, and how the results varied.

My repeated chance experiment

Random generator: _____

Possible outcomes: _____

My guess: _____

My results

Trial	Result
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

My counts

Outcome	Tally	Count

What happened? _____

How did the results vary? _____

A blank recording sheet for a chance experiment. It has a space to write which random generators you could use, a space for the possible outcomes and a guess, a table with 15 numbered rows for results, and a space to write what happened.

Your teacher may use Activity 2 for the practical task K4 — a repeated chance experiment with named random generators.

Practice questions

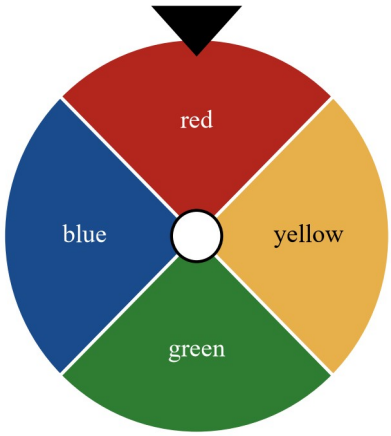
Questions with help

Q1. Which of these are random generators? A coin, a ruler, a die, a spinner, a pencil.

Q2. List all the possible outcomes for each experiment.

(a) Toss a coin.
(b) Roll a die.
(c) Spin the spinner below.

A four-colour spinner



A spinner with four equal parts coloured red, blue, green and yellow, and a pointer in the middle.

Q3. A class tosses a coin 15 times and records the results with tally marks.

Outcome	Tally
Heads	𝍸 III
Tails	𝍸 II

(a) How many times did heads come up?
(b) How many times did tails come up?
(c) How many tosses were there altogether?

Q4. Ava rolls a die 12 times. Her counts are: 1 came up 3 times, 2 came up 1 time, 3 came up 4 times, 4 came up 2 times, 5 came up 0 times, and 6 came up 2 times. Order the outcomes from the one that happened least to the one that happened most.

Q5. Priya spins the spinner from Q2 10 times. Her results are: red 4, blue 2, green 3, yellow 1.

(a) Which colour came up most often?
(b) Which colour came up least often?
(c) Priya spins one more time. Can you say for certain which colour will come up? Explain.

Q6. Kai tosses two coins 8 times. His results are:

HH, HT, TH, TT, HT, HH, TH, HT

(The first letter is coin 1, and the second letter is coin 2. H = heads, T = tails.)

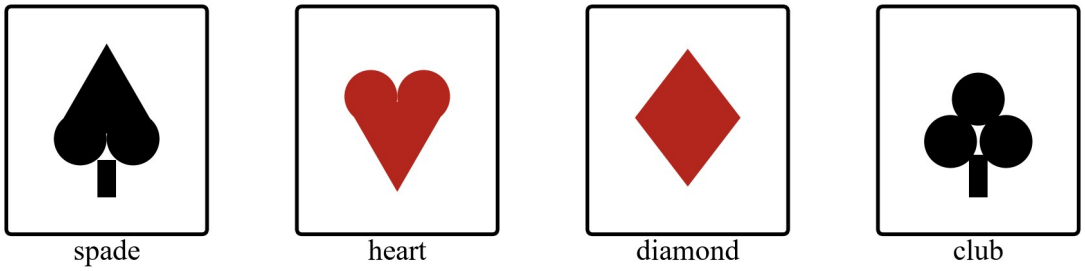
Copy and complete the table.

Result	Tally	Count
2 heads (HH)		
One of each (HT or TH)		
2 tails (TT)		

Q7. Ruby shuffles four cards — one spade, one heart, one diamond and one club. She draws one card, records the suit, puts the card back, and shuffles again. She repeats this 12 times. Her results are:

spade, heart, spade, club, diamond, spade, heart, heart, spade, club, spade, diamond

The four suits



Four cards in a row showing the four suits: a spade, a heart, a diamond and a club.

(a) Draw a tally table for the four suits.
(b) Which suit came up most often?

Q8. Say whether each statement is true or false. Give a reason for each answer.

(a) If you toss a coin 10 times, heads must come up exactly 5 times.
(b) Two groups can do the same spinner experiment and get different results.
(c) When you repeat a chance experiment, the results can be different each time.

Questions on your own

Q9. List all the possible outcomes for each experiment.

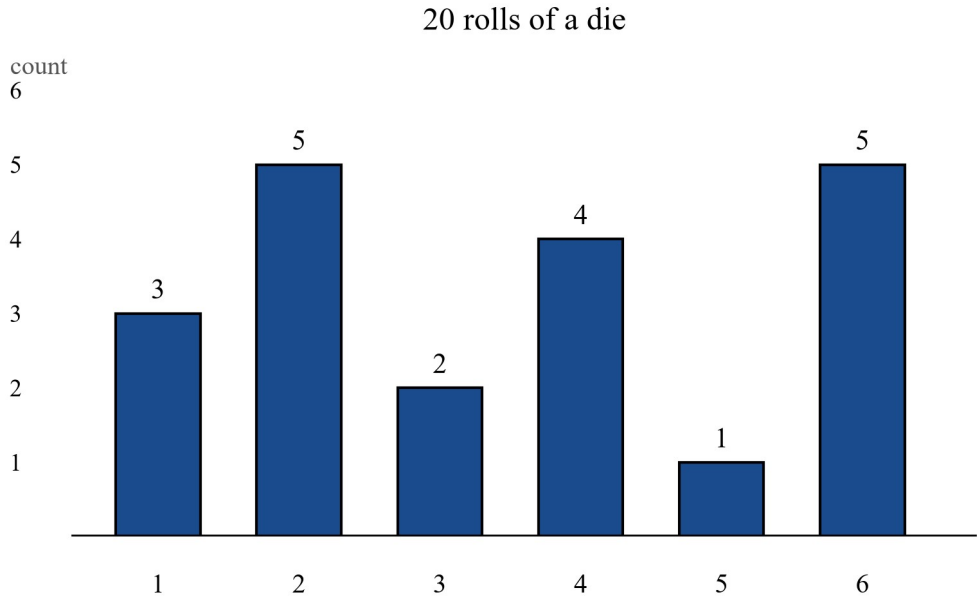
(a) Spin a spinner with three equal parts numbered 1, 2 and 3.
(b) Draw one marble from a bag with 2 red marbles and 3 blue marbles.

Q10. Mia tosses a coin 10 times. Heads comes up 8 times.

(a) Mia tosses the coin 10 more times. Is it possible that heads comes up 8 times again?
(b) Explain your answer using the word *variation*.

Q11. The table shows the results of 20 rolls of a die.

Number rolled	1	2	3	4	5	6
Count	3	5	2	4	1	5



A column graph of 20 die rolls. The columns show the counts for each number: 1 came up 3 times, 2 came up 5 times, 3 came up 2 times, 4 came up 4 times, 5 came up 1 time and 6 came up 5 times.

(a) Which numbers came up most often?

(b) Which number came up least often?

(c) Order the outcomes from least often to most often.

(d) Leo says: “The next roll must be a 5, because 5 came up least.” Is Leo right? Explain.

Q12. Two groups each spin the same spinner 12 times. In Group A’s results, red comes up 5 times. In Group B’s results, red comes up 2 times. Group B thinks their spinner must be different from Group A’s spinner. The teacher says both groups used the same spinner. Can both results be true? Explain.

Q13. A class plays First to 12. They play 10 games. The player who goes first wins 7 games, and the player who goes second wins 3 games.

(a) Who won more games — the player going first, or the player going second?

(b) Does going first seem to make a difference in this game? Explain how you know.

Q14. Noah shuffles a pack of cards. He draws one card, records whether it is a picture card (jack, queen or king) or a number card, puts the card back, and shuffles again. He repeats this 20 times. He gets 6 picture cards and 14 number cards.

(a) Copy and complete the table.

Kind of card	Tally	Count
Picture card		
Number card		

(b) Which kind of card came up more often?

(c) Noah draws one more card. Can you say for certain what kind it will be? Explain.

Q15. Before spinning a four-colour spinner 12 times, Zoe makes a guess: “Blue will come up most often.” The real results are: red 4, blue 2, green 3, yellow 3.

(a) Was Zoe’s guess right? Explain.

(b) What does this tell you about guesses?

Q16. Zoe tosses a coin 5 times. It comes up heads all 5 times. She says: “The next toss must be tails.” Is Zoe right? Explain.

Q17. Two classes each toss two coins 20 times. Their results are:

Result	Class A	Class B
2 heads	6	3
One of each	10	12
2 tails	4	5

(a) In each class, which result came up most often?

(b) Are the two classes’ results exactly the same? What is the word for the way results change from one run of an experiment to another?

Q18. Here are the results of 15 spins of the four-colour spinner:

green, red, blue, green, green, yellow, red, blue, green, red, green, blue, yellow, green, red

(a) Draw a tally table for the four colours.

(b) Order the colours from the one that came up most to the one that came up least.

(c) Which colour came up least often?

Q19. Explain why tossing a coin 30 times tells you more about the results than tossing it 3 times.

Q20. Design your own chance experiment.

(a) Choose from the random generators (a coin, a die, a spinner or cards) and write down the name of the one you choose.
(b) List the possible outcomes.
(c) Write down how many times you will repeat the experiment.
(d) Draw a table you could use to record the results.

Applied

Q21. Before every AFL match, the umpire tosses a coin, and one captain calls heads or tails before the coin lands.

Source: Australian Football League, *Laws of Australian Football* (13 February 2026), retrieved 2026-08-20.

(a) What are the possible outcomes of the coin toss?
(b) In one season, a captain calls heads in 6 matches. The toss comes up: heads, tails, tails, heads, heads, tails. Draw a tally table for the 6 tosses.
(c) Before the next match, the captain says: "I won the toss last time, so I will definitely win it this time." Can the captain be certain? Explain.
(d) Is it possible for a captain to win the toss 6 times in a row? Explain.

Answers

Q1. A coin, a die and a spinner. **Q2.** (a) heads, tails; (b) 1, 2, 3, 4, 5, 6; (c) red, blue, green, yellow. **Q3.** (a) 8; (b) 7; (c) 15. **Q4.** 5 (0 times), 2 (1 time), 4 and 6 (2 times each), 1 (3 times), 3 (4 times). **Q5.** (a) red; (b) yellow; (c) no — the next spin could land on any of the four colours. **Q6.** 2 heads: 2; one of each: 5; 2 tails: 1. **Q7.** (a) spade 5, heart 3, diamond 2, club 2; (b) spade. **Q8.** (a) false; (b) true; (c) true. See worked answers for reasons. **Q9.** (a) 1, 2, 3; (b) red, blue. **Q10.** (a) yes; (b) see worked answer. **Q11.** (a) 2 and 6; (b) 5; (c) 5, 3, 1, 4, 2 and 6; (d) no — see worked answer. **Q12.** Yes — see worked answer. **Q13.** (a) the player going first; (b) yes — see worked answer. **Q14.** (a) picture card 6, number card 14; (b) number card; (c) no — see worked answer. **Q15.** (a) no; (b) see worked answer. **Q16.** No — see worked answer. **Q17.** (a) Class A: one of each; Class B: one of each; (b) no — variation. **Q18.** (a) green 6, red 4, blue 3, yellow 2; (b) green, red, blue, yellow; (c) yellow. **Q19.** See worked answer. **Q20.** Answers will vary — see worked answer for what a full answer needs. **Q21.** (a) heads, tails; (b) heads 3, tails 3; (c) no; (d) yes. See worked answers.

Worked answers

Q1. Random generators give results you cannot know in advance. A **coin** (heads or tails), a **die** (1 to 6) and a **spinner** are random generators. A ruler and a pencil are not — you cannot get a chance result from them.

Q2. (a) A coin has two possible outcomes: **heads** and **tails**. (b) A die has six possible outcomes: **1, 2, 3, 4, 5 and 6**. (c) The spinner has four possible outcomes: **red, blue, green and yellow**.

Q3. Count the tally marks. A group of five is four marks with one across: IIII/ III = 5 + 3 = **8 heads**; IIII/ II = 5 + 2 = **7 tails**. Check: 8 + 7 = **15 tosses** altogether. ✓

Q4. Look at the counts and put the smallest first: 5 came up 0 times, 2 came up 1 time, 4 and 6 came up 2 times each, 1 came up 3 times, and 3 came up 4 times. The order from least to most is **5, 2, 4 and 6, 1, 3**.

Q5. (a) Red came up 4 times — more than any other colour — so **red** came up most often. (b) Yellow came up only 1 time, so **yellow** came up least often. (c) **No.** The next spin is a chance result — it could land on red, blue, green or yellow, and you cannot know in advance which one it will be.

Q6. Go through the list one toss at a time. HH appears at tosses 1 and 6 (2 times). HT appears at tosses 2, 5 and 8, and TH appears at tosses 3 and 7 — that is 5 tosses that are one of each. TT appears at toss 4 (1 time).

Result	Tally	Count
2 heads (HH)	II	2
One of each (HT or TH)	IIII/	5
2 tails (TT)	I	1

Check: 2 + 5 + 1 = 8 tosses. ✓

Q7. (a) Go through Ruby's list one draw at a time:

Suit	Tally	Count
Spade	IIII/	5
Heart	III	3
Diamond	II	2
Club	II	2

Check: 5 + 3 + 2 + 2 = 12 draws. ✓ (b) **Spade** came up most often (5 times).

Q8. (a) **False.** A coin toss is a chance result. In 10 tosses you might get 5 heads, but you might get 6, or 3, or another count — the results vary. (b) **True.** Same spinner, same number of spins — but the results can still be different. That is variation. (c) **True.** Repeating a chance experiment can give different results each time.

Q9. (a) The spinner has three equal parts numbered 1, 2 and 3, so the possible outcomes are **1, 2 and 3**. (b) The bag has red and blue marbles only, so the possible outcomes are **red and blue**.

Q10. (a) **Yes**, it is possible. (b) A coin toss is a chance result, and the results **vary** from run to run. The first 10 tosses gave 8 heads; the next 10 tosses could give 8 heads again, or a different count. What happened last time does not fix what happens next time.

Q11. (a) 2 came up 5 times and 6 came up 5 times — more than the others — so **2 and 6** came up most often. (b) 5 came up only 1 time, so **5** came up least often. (c) From least to most: **5** (1 time), **3** (2 times), **1** (3 times), **4** (4 times), **2 and 6** (5 times each). (d) **No.** Each roll is a chance result. The next roll could be 1, 2, 3, 4, 5 or 6 — you cannot know in advance, and 5 is not more sure to come up just because it came up least before.

Q12. Yes, both results can be true. Both groups used the same spinner and spun it the same number of times, but chance results **vary** from run to run. Getting red 5 times in one run and 2 times in another run is variation, not a mistake — and it does not mean the spinners were different.

Q13. (a) The player going first won **7 games**, and the player going second won 3 games, so **the player going first won more games**. (b) **Yes — in this game, going first seems to make a difference.** The player going first won most of the 10 games. Playing more games would help you be more sure.

Q14. (a)

Kind of card	Tally	Count
Picture card	𝍸 I	6
Number card	𝍸 𝍸 IIII	14

Check: 6 + 14 = 20 draws. ✓ (b) **Number cards** came up more often (14 times against 6). (c) **No.** The next draw is a chance result — it could be a picture card or a number card, and you cannot know in advance which one it will be.

Q15. (a) **No.** Zoe guessed blue would come up most often, but blue came up only 2 times. Red came up most often (4 times). (b) A guess is not always right. The real results can be different from what you guessed — that is part of variation.

Q16. No. Each toss is a chance result. The coin can still land heads or tails — 5 heads in a row does not make tails sure next time. Zoe cannot know the next result in advance.

Q17. (a) Class A: one of each came up 10 times — more than 2 heads (6) or 2 tails (4) — so **one of each** came up most often. Class B: one of each came up 12 times — more than 2 heads (3) or 2 tails (5) — so **one of each** came up most often there too. (b) **No.** The counts are different: Class A got 6, 10 and 4, and Class B got 3, 12 and 5. The word for the way results change from one run of an experiment to another is **variation**.

Q18. (a) Go through the list one spin at a time:

Colour	Tally	Count
Green	𝍸 I	6
Red	IIII	4
Blue	III	3
Yellow	II	2

Check: 6 + 4 + 3 + 2 = 15 spins. ✓ (b) From most to least: **green (6), red (4), blue (3), yellow (2)**. (c) **Yellow** came up least often (2 times).

Q19. With only 3 tosses, one lucky run can make the results look strange — you might get 3 heads and think heads always comes up. With 30 tosses, there are more results to look at, so you can see the way the results vary even better. Repeating an experiment more times tells you more.

Q20. Answers will vary. A full answer needs: (a) a named pick from the random generators, for example a die; (b) its possible outcomes, for example 1, 2, 3, 4, 5 and 6; (c) a number of repeats, for example 15 times; (d) a table with a row for each outcome and columns for tally marks and counts.

Q21. (a) The coin has two possible outcomes: **heads** and **tails**. (b) The toss came up heads, tails, tails, heads, heads, tails:

Outcome	Tally	Count
Heads	𝙸𝙸𝙸	3
Tails	𝙸𝙸𝙸	3

(c) **No, the captain cannot be certain.** The toss is a chance result — it can come up heads or tails, and winning the toss last time does not fix the next one.

(d) **Yes, it is possible.** Every toss can come up heads, so 6 heads in a row can happen. It would not happen every time — but it is possible.

Test

Test T7 · Chapter 7 — Probability

Mathematics Level 4 (Year 4) · Victorian Curriculum 2.0

Codes assessed: VC2M4P01 · VC2M4P02

Name: _____ Date: _____

Total marks	12
Guidance duration	20 minutes
Timing	This is a classroom check, not an exam. There is no strict time limit. Your teacher will let you finish.
Equipment	You will need a pencil. All the results in this test are already recorded — you do not toss, roll or spin anything in the test itself.
Calculators	The content descriptions VC2M4P01 and VC2M4P02 do not say "without a calculator", so a calculator is allowed. You do not need one for any question in this test.

Attempt every question. Show your working where the question asks for it.

Question 1 — Ordering outcomes by likelihood (4 marks)

(a) You roll one die. Which outcome is **least** likely? (1 mark)

A. Rolling a 2

B. Rolling an even number

C. Rolling a number greater than 6

D. Rolling a number less than 6

(b) You roll one die. Put these outcomes in order, from least likely to most likely: rolling a 1; rolling an even number; rolling a number less than 5. (1 mark)

(c) Bag A holds 5 red balls and 1 white ball. Bag B holds 4 red balls and 4 white balls. One ball is drawn from each bag, without looking.

```
Bag A:  red ● ● ● ● ●     white ●
Bag B:  red ● ● ● ●       white ● ● ● ●
```

From which bag is drawing a red ball more likely? Give a reason. (2 marks)

Question 2 — Independent or dependent events (4 marks)

Two events are **independent** when what happens with one does not change the chance of the other. Two events are **dependent** when what happens with one does change the chance of the other.

Before every AFL match, the umpire tosses a coin, and one captain calls heads or tails before the coin lands.

Source: Australian Football League, *Laws of Australian Football* (13 February 2026), retrieved 2026-08-20.

(a) A captain wins the toss in round 1. Is winning the toss in round 2 independent of round 1, or dependent on round 1? Give a reason. (2 marks)

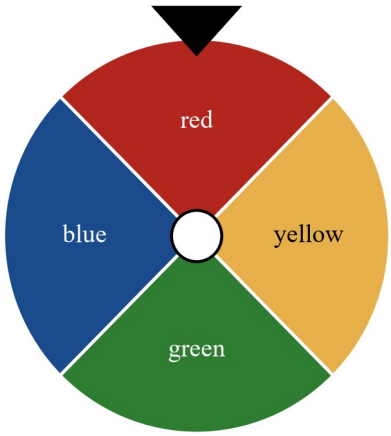
(b) There is a high chance of a storm on Saturday. An AFL match is played outdoors on Saturday. Is the match going ahead independent of the storm, or dependent on the storm? (1 mark)

(c) A captain wins the coin toss five matches in a row. He says: "I have won so many tosses in a row, so I am sure to lose the next toss." Is the captain right? Give a reason. (1 mark)

Question 3 — A repeated chance experiment (4 marks)

Ava makes a spinner with four equal parts: red, blue, green and yellow.

A four-colour spinner



A spinner with four equal parts coloured red, blue, green and yellow, and a pointer in the middle.

She spins the spinner 12 times and records every result. Her completed tally table is shown. The way the results change from run to run is called the **variation** in the results.

Colour	Tally	Count
Red	𝍸	4
Blue	II	2
Green	𝍸/	5
Yellow	I	1

(a) Which colour came up most often? Which colour came up least often? (1 mark)

(b) Put the colours in order, from the one that came up least often to the one that came up most often. (1 mark)

(c) Liam spins the same spinner 12 times. His counts are not the same as Ava's counts. Liam says: "My results are different, so I must have made a mistake." Is Liam right? Use the word *variation* in your answer. (2 marks)

Total: 12 marks

Solutions

Teacher-facing. Test T7 is a classroom check, not an exam: untimed in principle with a 20-minute guidance duration, and calculator status follows D7 — VC2M4P01 and VC2M4P02 are silent on calculators, so neither CD is calculator-free and no question needs one. Chance is described in words throughout this paper: probabilities as fractions, decimals or percentages are Level 6 (VC2M6P01) and "equally likely" as a technical comparison of outcomes is Level 5 (VC2M5P01), so neither is required or expected — award full marks for correct reasoning in words. The verb in VC2M4P02 is *conduct*: students carry out repeated chance experiments in Task K4 (§7), and Question 3 is the written evidence for VC2M4P02 — reading a completed tally table — so a student absent for the task is not left with an unassessed CD.

Coverage and mark map

CD	Subtopic	Questions	Marks
VC2M4P01	7A Ordering outcomes by likelihood; independent and dependent events	Q1, Q2	8
VC2M4P02	7B Repeated chance experiments and the variation in results	Q3	4
	Total		**12**

Every CD owned by Chapter 7 contributes at least one separately scored item, as §7 requires. Multiple choice is used sparingly: 1 mark of 12 (about 8%), inside the one-quarter cap — Q1(a), four options A–D.

The marking language follows each CD's achievement-standard extract from the authority file: for VC2M4P01, *Students order events or the outcomes of chance experiments in terms of likelihood and identify whether events are independent or dependent*; for VC2M4P02, *They conduct repeated chance experiments and describe the variation in results*.

Answer key

Q	Part	Answer	Marks
1	(a)	C (rolling a number greater than 6)	1
1	(b)	Rolling a 1; rolling an even number; rolling a number less than 5	1
1	(c)	Bag A; red is ahead of white in Bag A, but level in Bag B	2
2	(a)	Independent; the round 1 toss does not change round 2	2
2	(b)	Dependent	1
2	(c)	No; each toss is a new toss	1
3	(a)	Green came up most often; yellow came up least often	1
3	(b)	Yellow, blue, red, green	1
3	(c)	No; results change from run to run — that is variation	2

Worked solutions

Q1. (a) A die shows only 1, 2, 3, 4, 5 and 6. Rolling a 2 has one way. Rolling an even number has three ways (the faces 2, 4 and 6). Rolling a number greater than 6 has no ways — a die has no such face, so it is impossible. Rolling a number less than 6 has five ways (the faces 1, 2, 3, 4 and 5). Impossible is the smallest chance of all, so the answer is **C**.

(b) Rolling a 1 has only one way. Rolling an even number has three ways (the faces 2, 4 and 6). Rolling a number less than 5 has four ways (the faces 1, 2, 3 and 4). When an outcome can happen in more ways, it is more likely, so the order from least likely to most likely is **rolling a 1, rolling an even number, rolling a number less than 5**.

Marks: 1 for the correct order in the direction asked. Do not award the mark for the reverse order.

(c) In Bag A, red is far ahead of white — 5 red against 1 white. In Bag B, red and white are level — 4 of each — so red and white have the same chance in Bag B. **Drawing a red ball is more likely from Bag A.**

Marks: 1 for Bag A; 1 for a reason that refers to the counts (red ahead of white in Bag A, level in Bag B). Accept any correct wording of the reason. Fractions or decimals for chance are not expected at this level and are not needed for full marks.

Q2. (a) **Independent.** Each toss of the coin is a new toss. The coin has no memory of round 1, so winning the toss in round 1 does not change the chance of winning the toss in round 2.

Marks: 1 for "independent"; 1 for a reason that says the round 1 toss does not change round 2, or that the coin has no memory.

(b) **Dependent.** If the storm comes, the match is less likely to go ahead, so the storm changes the chance of the match.

Marks: 1 for "dependent". A reason is not required, but accept one if given.

(c) **The captain is not right.** Each toss is a new toss of the same coin. Five wins in a row do not change the next toss — the captain can still win it or lose it, so losing the next toss is not sure.

Marks: 1 for the judgment "no" with a reason that says each toss is new, or that the earlier tosses do not change the next toss.

Q3. (a) Green came up 5 times — more than any other colour — so **green** came up most often. Yellow came up only 1 time, so **yellow** came up least often.

Marks: 1 for both parts correct.

(b) From least often to most often: **yellow (1), blue (2), red (4), green (5)**.

Marks: 1 for the correct order in the direction asked.

(c) **Liam is not right.** Both children used the same spinner and spun it the same number of times, but chance results change from run to run. Different results are **variation**, not a mistake.

Marks: 1 for the judgment "no"; 1 for an explanation that says the results change from run to run, using or naming the word variation.