

WALT understand probability and the chance

Success Criteria I know ...

- A probability is a number between 0 and 1. 0 means impossible and 1 means certain
- If the outcomes are equally likely, we find the probability of an event by counting the ways it can happen and dividing it by the total number of outcomes
- [Video on probability](#)

Let's start

▶ Let's start: Estimating probabilities

Try to estimate the probability of the following events, giving a number between 0 and 1. Compare your answers with other students in the class and discuss any differences.

- 1 Flipping a 'tail' on a 50-cent coin.
- 2 An albino whale is born.
- 3 Rolling three 6s in a row on a fair die.
- 4 Correctly guessing a number between 1 and 10.
- 5 Tomorrow being a rainy day.
- 6 Seeing a wombat in the Australian bush.

Are there some events for which there is more than one correct answer?

Important notes

Trial - One run of an event

Outcome- One of the possibilities from an event

Event- Collection of possible outcomes

Probability - A measure of the likelihood that an event will occur

Sample Space -The list of all the possible outcomes of an event

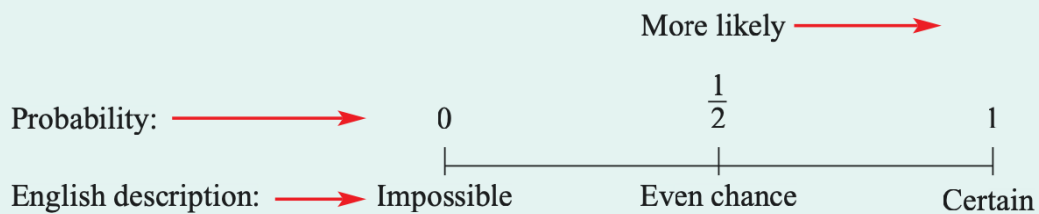
Complement - Set containing the elements that are not in a given set

Teacher discussion

- A **trial** could be flipping a coin, rolling a die or spinning a spinner.
- There are multiple **outcomes** that could occur for any trial; for example, 'rolling a 3' or 'flipping tails on the coin'.
- An **event** is a collection of outcomes.
- The **probability** of an event is a number between 0 and 1 that represents the chance that the event occurs. If all the outcomes are equally likely:

$$\text{Pr}(\text{Event}) = \frac{\text{number of outcomes where the event occurs}}{\text{total number of outcomes}}$$

- Probabilities are often written as fractions, but can also be written as decimals or percentages.



- The **sample space** is the set of possible outcomes of a trial or event. For example, the sample space for the roll of a die is 1, 2, 3, 4, 5, 6.
- The **complement** of some event E is written E' (or not E). E' is the event that E does not occur. For example, the complement of 'rolling the number 3' is 'rolling a number other than 3'.

- 1 Write the missing word from each statement.
- a An example of a _____ is flipping a coin.
 - b After rolling a die the possible _____ are 1, 2, 3, 4, 5 and 6.
 - c The set of all possible outcomes from a trial is called the _____.
 - d The _____ of an event is the opposite of that event.
 - e If an event is called A then the complement is written as _____.
- 2 Match each experiment with the set of possible outcomes.
- a Flipping a coin
 - b Choosing a number between 1 and 5
 - c Choosing a letter of the word MATHS
 - d Rolling a die
- A** 1, 2, 3, 4, 5, 6 **B** Heads, Tails **C** 1, 2, 3, 4, 5 **D** M, A, T, H, S
- 3 The following events are shown with their probabilities.
 Event A: 0 Event B: 0.9 Event C: 1 Event D: 0.5
- a Which of the four events is most likely to occur?
 - b Which of the four events is sure not to occur?
 - c Which is more likely – event B or event D?
 - d Which event is sure to occur?

Impossible events are sure not to occur.

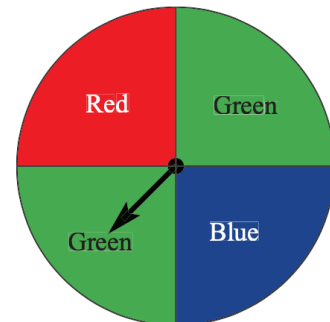


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- 4 The spinner is spun and could land with the pointer on any of the four sections.
 Answer true or false:
- a Red and blue are equally likely outcomes.
 - b Green is less likely to occur than blue.
 - c The probability of it landing orange is 0.
 - d Red is less likely to occur than green.



Working with probabilities

The letters of the word PRINCE are written onto 6 equally-sized cards and one is chosen at random.

- a State the sample space.
- b Find $\Pr(\text{the letter N is chosen})$.
- c What is the sample space of the event $V = \text{choosing a vowel}$?
- d Find $\Pr(V)$.
- e State the sample space of the complement of choosing a vowel, written V' .
- f Hence find $\Pr(V')$.

Solution

Explanation

a P, R, I, N, C, E

The sample space is all the possible outcomes when a single card is chosen. In this case each of the letters in the word.

b $\Pr(N) = \frac{1}{6}$

There are 6 equally likely cards and 1 of them has the letter N.

c I, E

The sample space V includes all the vowels in the word PRINCE.

d $\Pr(V) = \frac{2}{6}$
 $= \frac{1}{3}$

There are 2 cards with vowels, so probability = $2 \div 6$.

e V' includes P, R, N, C

The complement of V (V') is all the outcomes that are not in V , i.e. all the letters that are not vowels.

f $\Pr(V') = \frac{4}{6}$
 $= \frac{2}{3}$

There are 4 cards that do not have vowels, so $\Pr(V') = 4 \div 6$.

5 The letters of the word PIANO are written on 5 cards and then one card is drawn from a hat at random.

a List the sample space.

b Find \Pr (the letter A is chosen).

c Find \Pr (a vowel is chosen).

d Find \Pr (a consonant is drawn).

e Find \Pr (the letter chosen is not an N).

f State the sample space of the complement of choosing a vowel, written V' .

g Hence find ($\Pr(V')$)

Pr means probability.



Write probability answers as fractions.



6 A fair die is rolled.

a List the sample space.

b Find $\Pr(5)$. That is, find the probability that a 5 is rolled.

c Find \Pr (even number).

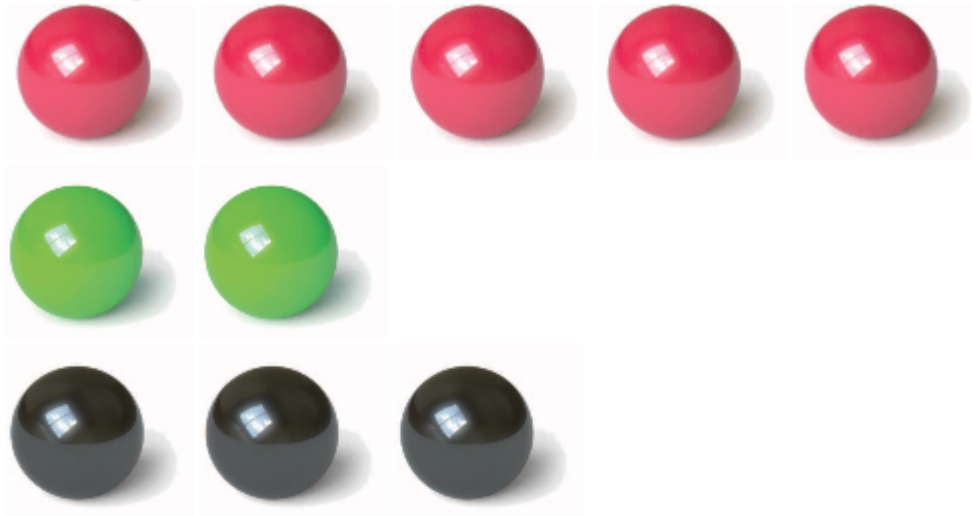
d State the sample space of the complement of 'rolling a 5'.

e State the probability that a 5 is not rolled.

f What is the probability of rolling a 14?



- 7 There are five red marbles, two green marbles and three black marbles. The 10 marbles are placed into a hat and one is picked out.



- What is $\text{Pr}(\text{red})$? That is, what is the probability that the picked marble is red?
 - Find $\text{Pr}(\text{green})$.
 - Find $\text{Pr}(\text{black})$.
 - Find $\text{Pr}(\text{a black or a red marble is drawn})$.
 - Find $\text{Pr}(\text{red}')$, that is find the probability of the complement of choosing a red marble.
 - Find $\text{Pr}(\text{black}')$.
 - Give an example of an event that has a probability of 0.
- 8 The numbers 1 to 10 are written on cards. A card is chosen at random.
- List the sample space.
 - Find the probability of choosing a 5.
 - Find $\text{Pr}(7 \text{ or } 9)$.
 - Find $\text{Pr}(\text{a multiple of } 3 \text{ is chosen})$.
 - Find $\text{Pr}(\text{prime number})$.
 - Find $\text{Pr}(\text{a factor of } 24)$.

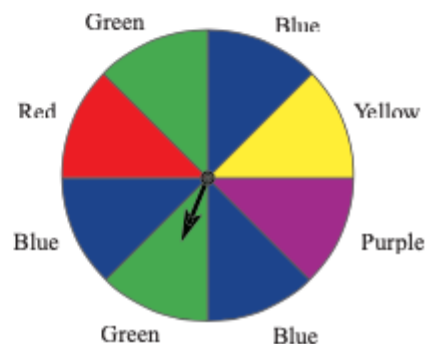
A factor of 24 divides into 24 with no remainder. A prime has 2 factors. 1 is not prime.



Problem-solving and Reasoning

- 9 A spinner has the arrangement of colours as shown.
- List the sample space when this spinner is spun.
 - Find $\text{Pr}(\text{red})$.
 - State $\text{Pr}(\text{green})$.
 - Find $\text{Pr}(\text{blue})$.
 - List the sample space of the complement of 'spinner landing on blue'.
 - What is $\text{Pr}(\text{not blue})$?
 - Find $\text{Pr}(\text{red or green or blue})$.
 - What is an event that is equally likely to 'spinning red'?
 - Give an example of an event that has a probability of 0.

List the colour as many times as it is on the spinner.



Extension

10 On a game show, a wheel is spun for a prize with the options as shown.

- Joan wants to go on a \$10 000 holiday so she is happy with the cash or the holiday. What is the probability she will get what she wants?
- What is the probability of getting a prize that is not the cash?
- What is $\Pr(\text{car or motorbike})$?
- What is the probability of winning a prize?



11 Jamie has a collection of marbles in his pocket. Four of them are blue, three are green and three are white. He chooses one at random.

- What is the probability that a green marble is chosen?
- What is the probability that he does not choose a white marble?
- He adds two more marbles and now $\Pr(\text{blue}) = \frac{1}{2}$. What colour were the marbles he added?
- If instead of adding the two marbles he removed two, is it possible for $\Pr(\text{blue})$ to become $\frac{1}{2}$? Explain your answer.

12 Six counters coloured red, purple or orange are placed in a pocket. You are told that

$$\Pr(\text{red or orange}) = \frac{1}{2} \text{ and } \Pr(\text{red or purple}) = \frac{2}{3}$$

- How many counters of each colour are there?
 - State $\Pr(\text{red})$.
 - Find $\Pr(\text{purple})$.
 - Find $\Pr(\text{orange})$.
- 13 Draw a spinner that has $\Pr(\text{red}) = \frac{1}{8}$, $\Pr(\text{blue}) = \frac{5}{8}$ and $\Pr(\text{green}) = \frac{1}{4}$.

Change the probabilities to have a common denominator.

First divide a circle into 8 equal sectors.

Changing probabilities

14 In a large bucket there are 2 red balls and 8 blue balls.

- State $\Pr(\text{red})$.
- One of each colour is added. What is the new $\Pr(\text{red})$?
- The procedure of adding a red ball and a blue ball is repeated several times. How many balls are in the bucket when $\Pr(\text{red}) = \frac{1}{3}$?
- Imagine the procedure is repeated many times. What value does $\Pr(\text{red})$ eventually approach as more balls are added? It might be helpful to imagine 1000 balls of each colour are added and use decimals.

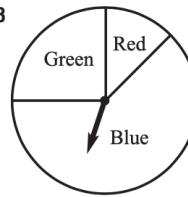
Make a table.



Check your answers

- 1 a trial b outcomes c sample space
d complement e A'
- 2 a B b C c D d A
- 3 a Event C b Event A c Event B d Event C
- 4 a true b false c true d true
- 5 a P, I, A, N, O b $\frac{1}{5}$ c $\frac{3}{5}$
d $\frac{2}{5}$ e $\frac{4}{5}$ f $V' = P, N$ g $\Pr(V') = \frac{2}{5}$
- 6 a 1, 2, 3, 4, 5, 6 b $\frac{1}{6}$ c $\frac{1}{2}$
d 1, 2, 3, 4, 6 e $\frac{5}{6}$ f 0
- 7 a $\frac{1}{2}$ b $\frac{1}{5}$ c $\frac{3}{10}$ d $\frac{4}{5}$
e $\frac{1}{2}$ f $\frac{7}{10}$ g choosing a purple marble
- 8 a 1, 2, 3, 4, 5, 6, 7, 8, 9, 10 b $\frac{1}{10}$ c $\frac{1}{5}$
d $\frac{3}{10}$ e $\frac{2}{5}$ f $\frac{3}{5}$
- 9 a red, green, blue, yellow, purple, blue, green, blue
b $\frac{1}{8}$ c $\frac{1}{4}$ d $\frac{3}{8}$
e green, green, red, yellow, purple f $\frac{5}{8}$
g $\frac{3}{4}$ h spinning purple (or spinning yellow)
i spinning orange
- 10 a $\frac{1}{3}$ b $\frac{5}{6}$ c $\frac{1}{3}$ d $\frac{5}{6}$
- 11 a $\frac{3}{10}$ b $\frac{7}{10}$ c Both were blue.
d Yes, for instance if he removed two green marbles.
- 12 a 1 red, 2 orange, 3 purple b $\frac{1}{6}$
c $\frac{1}{2}$ d $\frac{2}{3}$

13



- 14 a $\frac{1}{5}$ b $\frac{1}{4}$ c 18
d It approaches $\frac{1}{2}$ or 0.5.