

Probability: Starters

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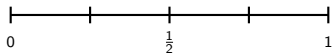
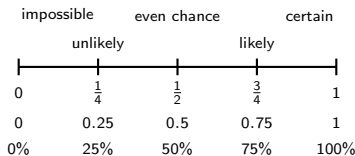
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Starter 1

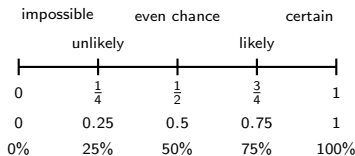


- A** a fair coin lands on heads
B a day chosen at random is a Saturday
C an ordinary dice is rolled and shows a number less than 7
D a counter taken from a bag of 3 red and 1 blue counters is red

- Write 0.25 as a fraction in its simplest form.
- Write $\frac{3}{5}$ as a decimal and as a percentage.
- Every probability is a number from ____ to ____.
- Mark events **A**, **B**, **C** and **D** on the empty scale.
- Complete the table.

Description	Probability
impossible	0
unlikely	between 0 and ____
even chance	between ____ and 1
likely	between ____ and 1
certain	1
- Write a probability that is unlikely but not impossible, as a fraction, a decimal and a percentage.
- Ravi says "the probability that it rains tomorrow is 1.4". Explain why he is wrong.

Starter 1



- A** a fair coin lands on heads
B a day chosen at random is a Saturday
C an ordinary dice is rolled and shows a number less than 7
D a counter taken from a bag of 3 red and 1 blue counters is red

- Write 0.25 as a fraction in its simplest form. $\frac{1}{4}$
- Write $\frac{3}{5}$ as a decimal and as a percentage.
 $0.6 = 60\%$
- Every probability is a number from 0 to 1.
- Mark events **A**, **B**, **C** and **D** on the empty scale.
- Complete the table.

Description	Probability
impossible	0
unlikely	between 0 and 0.5
even chance	0.5
likely	between 0.5 and 1
certain	1
- Write a probability that is unlikely but not impossible, as a fraction, a decimal and a percentage. Between 0 and 0.5, such as $\frac{1}{10} = 0.1 = 10\%$.
- Ravi says "the probability that it rains tomorrow is 1.4". Explain why he is wrong.
No probability is greater than 1; a probability of 1 means certain.

Worked Solution: Starter 1, Question 1

Question: Write 0.25 as a fraction in its simplest form.

Worked Solution: Starter 1, Question 1

Question: Write 0.25 as a fraction in its simplest form.

Solution: $0.25 = \frac{25}{100}$. Divide numerator and denominator by 25: $\frac{25}{100} = \frac{1}{4}$.

Worked Solution: Starter 1, Question 2

Question: Write $\frac{3}{5}$ as a decimal and as a percentage.

Worked Solution: Starter 1, Question 2

Question: Write $\frac{3}{5}$ as a decimal and as a percentage.

Solution: $\frac{3}{5} = \frac{6}{10} = 0.6$. To make a percentage, multiply by 100:
 $0.6 \times 100 = 60\%$.

Worked Solution: Starter 1, Question 3

Question: Every probability is a number from _____ to _____.

Worked Solution: Starter 1, Question 3

Question: Every probability is a number from _____ to _____.

Solution: Every probability is at least 0 and at most 1. So the gaps are 0 and 1: a probability is a number from 0 to 1.

Worked Solution: Starter 1, Question 4

Question: Mark events **A**, **B**, **C** and **D** on the empty scale.

Worked Solution: Starter 1, Question 4

Question: Mark events **A**, **B**, **C** and **D** on the empty scale.

Solution: $P(A) = \frac{1}{2} = 0.5$, so A is at 0.5. $P(B) = \frac{1}{7} \approx 0.143$, so B is near 0. $P(C) = 1$, so C is at 1. $P(D) = \frac{3}{4} = 0.75$, so D is at 0.75. In order from left to right: B, A, D, C.

Worked Solution: Starter 1, Question 5

Question: Complete the table.

Worked Solution: Starter 1, Question 5

Question: Complete the table.

Solution: The completed table is: impossible: 0; unlikely: between 0 and 0.5; even chance: 0.5; likely: between 0.5 and 1; certain: 1.

Worked Solution: Starter 1, Question 6

Question: Write a probability that is unlikely but not impossible, as a fraction, a decimal and a percentage.

Worked Solution: Starter 1, Question 6

Question: Write a probability that is unlikely but not impossible, as a fraction, a decimal and a percentage.

Solution: Any probability strictly between 0 and 0.5 works. For example, $\frac{1}{10} = 0.1 = 10\%$. This is unlikely because it is less than 0.5, but not impossible because it is greater than 0.

Worked Solution: Starter 1, Question 7

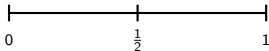
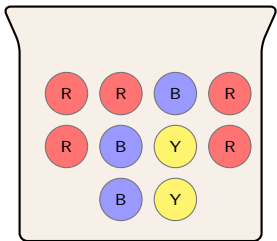
Question: Ravi says “the probability that it rains tomorrow is 1.4”. Explain why he is wrong.

Worked Solution: Starter 1, Question 7

Question: Ravi says “the probability that it rains tomorrow is 1.4”. Explain why he is wrong.

Solution: A probability cannot be greater than 1. $1.4 > 1$, so it is not a possible probability. A probability of 1 would mean rain is certain; 1.4 would be more than certain, which is impossible.

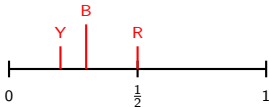
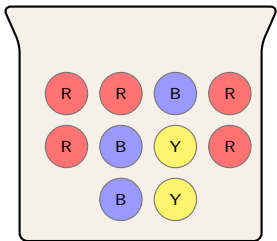
Starter 2



One counter is taken from the bag at random. The probability that the counter is red is written $P(\text{red})$.

1. Write $\frac{1}{2}$ as a decimal and as a percentage.
2. Write 30% as a fraction in its simplest form.
3. How many counters are in the bag altogether?
4. Write $P(\text{red})$ as a fraction in its simplest form.
5. Write $P(\text{blue})$ as a fraction, a decimal and a percentage.
6. Mark $P(\text{red})$, $P(\text{blue})$ and $P(\text{yellow})$ on the probability scale.
7. Write $P(\text{not red})$ as a fraction in its simplest form.
8. What does $P(\text{red}) + P(\text{blue}) + P(\text{yellow})$ come to, and why?
9. Only red counters are added to the bag, until $P(\text{red})$ is $\frac{3}{4}$. How many red counters are added?

Starter 2



One counter is taken from the bag at random. The probability that the counter is red is written $P(\text{red})$.

1. Write $\frac{1}{2}$ as a decimal and as a percentage.
 $0.5 = 50\%$
2. Write 30% as a fraction in its simplest form. $\frac{30}{100} = \frac{3}{10}$
3. How many counters are in the bag altogether? 10
4. Write $P(\text{red})$ as a fraction in its simplest form. $\frac{5}{10} = \frac{1}{2}$
5. Write $P(\text{blue})$ as a fraction, a decimal and a percentage.
 $\frac{3}{10} = 0.3 = 30\%$
6. Mark $P(\text{red})$, $P(\text{blue})$ and $P(\text{yellow})$ on the probability scale.
8. What does $P(\text{red}) + P(\text{blue}) + P(\text{yellow})$ come to, and why? 1; the counter is certain to be one of the three colours.
9. Only red counters are added to the bag, until $P(\text{red})$ is $\frac{3}{4}$. How many red counters are added? 10, giving 15 red counters out of 20, and $\frac{15}{20} = \frac{3}{4}$.

Worked Solution: Starter 2, Question 1

Question: Write $\frac{1}{2}$ as a decimal and as a percentage.

Worked Solution: Starter 2, Question 1

Question: Write $\frac{1}{2}$ as a decimal and as a percentage.

Solution: $\frac{1}{2} = 1 \div 2 = 0.5$. As a percentage: $0.5 \times 100 = 50\%$.

Worked Solution: Starter 2, Question 2

Question: Write 30% as a fraction in its simplest form.

Worked Solution: Starter 2, Question 2

Question: Write 30% as a fraction in its simplest form.

Solution: $30\% = \frac{30}{100}$. Divide by 10: $\frac{30}{100} = \frac{3}{10}$.

Worked Solution: Starter 2, Question 3

Question: How many counters are in the bag altogether?

Worked Solution: Starter 2, Question 3

Question: How many counters are in the bag altogether?

Solution: Count them by colour: 5 red, 3 blue and 2 yellow.
 $5 + 3 + 2 = 10$, so there are 10 counters altogether.

Worked Solution: Starter 2, Question 4

Question: Write $P(\text{red})$ as a fraction in its simplest form.

Worked Solution: Starter 2, Question 4

Question: Write $P(\text{red})$ as a fraction in its simplest form.

Solution: There are 5 red counters out of 10 counters in total.

$$P(\text{red}) = \frac{5}{10} = \frac{1}{2}.$$

Worked Solution: Starter 2, Question 5

Question: Write $P(\text{blue})$ as a fraction, a decimal and a percentage.

Worked Solution: Starter 2, Question 5

Question: Write $P(\text{blue})$ as a fraction, a decimal and a percentage.

Solution: There are 3 blue counters out of 10. $P(\text{blue}) = \frac{3}{10} = 0.3 = 30\%$.

Worked Solution: Starter 2, Question 6

Question: Mark $P(\text{red})$, $P(\text{blue})$ and $P(\text{yellow})$ on the probability scale.

Worked Solution: Starter 2, Question 6

Question: Mark $P(\text{red})$, $P(\text{blue})$ and $P(\text{yellow})$ on the probability scale.

Solution: $P(\text{yellow}) = \frac{2}{10} = 0.2$, $P(\text{blue}) = \frac{3}{10} = 0.3$, and $P(\text{red}) = \frac{5}{10} = 0.5$. On a scale from 0 to 1, mark Y at 0.2, B at 0.3, and R at 0.5. So from left to right the marks are Y, B, R.

Worked Solution: Starter 2, Question 7

Question: Write $P(\text{not red})$ as a fraction in its simplest form.

Worked Solution: Starter 2, Question 7

Question: Write $P(\text{not red})$ as a fraction in its simplest form.

Solution: $P(\text{not red}) = 1 - P(\text{red}) = 1 - \frac{1}{2} = \frac{1}{2}$. Alternatively, the non-red counters are 3 blue and 2 yellow, so $\frac{5}{10} = \frac{1}{2}$.

Worked Solution: Starter 2, Question 8

Question: What does $P(\text{red}) + P(\text{blue}) + P(\text{yellow})$ come to, and why?

Worked Solution: Starter 2, Question 8

Question: What does $P(\text{red}) + P(\text{blue}) + P(\text{yellow})$ come to, and why?

Solution: $P(\text{red}) + P(\text{blue}) + P(\text{yellow}) = \frac{5}{10} + \frac{3}{10} + \frac{2}{10} = \frac{10}{10} = 1$. This is 1 because every counter is red, blue or yellow, so one of these three colours is certain to be taken.

Worked Solution: Starter 2, Question 9

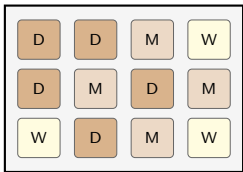
Question: Only red counters are added to the bag, until $P(\text{red})$ is $\frac{3}{4}$. How many red counters are added?

Worked Solution: Starter 2, Question 9

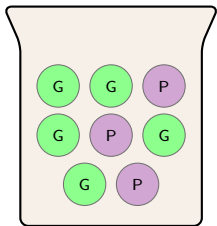
Question: Only red counters are added to the bag, until $P(\text{red})$ is $\frac{3}{4}$. How many red counters are added?

Solution: Let x be the number of red counters added. There were 5 red counters and 10 counters in total. After adding x red counters, red = $5 + x$ and total = $10 + x$. We need $\frac{5+x}{10+x} = \frac{3}{4}$. Cross-multiply: $4(5 + x) = 3(10 + x)$, so $20 + 4x = 30 + 3x$. Thus $x = 10$. Check: 15 red out of 20 is $\frac{15}{20} = \frac{3}{4}$. So 10 red counters are added.

Starter 3



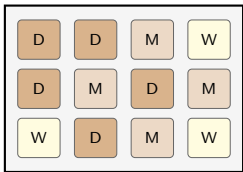
a box of dark, milk and white chocolates



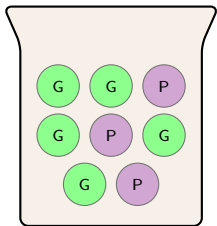
a bag of green and purple counters

1. Write $\frac{3}{4}$ as a decimal and as a percentage.
2. Write 0.08 as a percentage and as a fraction in its simplest form.
3. One chocolate is taken at random. Write $P(\text{white})$ in its simplest form.
4. Write $P(\text{not milk})$ in its simplest form.
5. Write $P(\text{green})$ for the bag as a fraction, a decimal and a percentage.
6. Which is more likely: a dark chocolate, or a purple counter? Show your working.
7. A counter is taken from the bag at random and then replaced. This is done 200 times. How many green counters would you expect?
8. Another bag holds only red and blue counters. It holds 12 red counters, and $P(\text{red}) = 0.4$. How many counters are in it?

Starter 3



a box of dark, milk and white chocolates



a bag of green and purple counters

1. Write $\frac{3}{4}$ as a decimal and as a percentage.
 $0.75 = 75\%$
2. Write 0.08 as a percentage and as a fraction in its simplest form.
 $8\% = \frac{8}{100} = \frac{2}{25}$
3. One chocolate is taken at random. Write $P(\text{white})$ in its simplest form.
 $\frac{3}{12} = \frac{1}{4}$
4. Write $P(\text{not milk})$ in its simplest form.
 $\frac{8}{12} = \frac{2}{3}$
5. Write $P(\text{green})$ for the bag as a fraction, a decimal and a percentage.
 $\frac{5}{8} = 0.625 = 62.5\%$
6. Which is more likely: a dark chocolate, or a purple counter? Show your working.
 $\frac{5}{12} = \frac{10}{24}$ and $\frac{3}{8} = \frac{9}{24}$, so the dark chocolate.
7. A counter is taken from the bag at random and then replaced. This is done 200 times. How many green counters would you expect?
 $\frac{5}{8} \times 200 = 125$
8. Another bag holds only red and blue counters. It holds 12 red counters, and $P(\text{red}) = 0.4$. How many counters are in it? $12 \div 0.4 = 30$

Worked Solution: Starter 3, Question 1

Question: Write $\frac{3}{4}$ as a decimal and as a percentage.

Worked Solution: Starter 3, Question 1

Question: Write $\frac{3}{4}$ as a decimal and as a percentage.

Solution: $\frac{3}{4} = 3 \div 4 = 0.75$. As a percentage: $0.75 \times 100 = 75\%$.

Worked Solution: Starter 3, Question 2

Question: Write 0.08 as a percentage and as a fraction in its simplest form.

Worked Solution: Starter 3, Question 2

Question: Write 0.08 as a percentage and as a fraction in its simplest form.

Solution: $0.08 = 8\%$. As a fraction, $0.08 = \frac{8}{100}$. Divide by 4: $\frac{8}{100} = \frac{2}{25}$.

Worked Solution: Starter 3, Question 3

Question: One chocolate is taken at random. Write $P(\text{white})$ in its simplest form.

Worked Solution: Starter 3, Question 3

Question: One chocolate is taken at random. Write $P(\text{white})$ in its simplest form.

Solution: There are 3 white chocolates. The total is $5 + 4 + 3 = 12$ chocolates. $P(\text{white}) = \frac{3}{12} = \frac{1}{4}$.

Worked Solution: Starter 3, Question 4

Question: Write $P(\text{not milk})$ in its simplest form.

Worked Solution: Starter 3, Question 4

Question: Write $P(\text{not milk})$ in its simplest form.

Solution: There are 4 milk chocolates out of 12, so $P(\text{milk}) = \frac{4}{12} = \frac{1}{3}$.
Therefore $P(\text{not milk}) = 1 - \frac{1}{3} = \frac{2}{3}$. Alternatively, the non-milk chocolates are 5 dark and 3 white, so $\frac{8}{12} = \frac{2}{3}$.

Worked Solution: Starter 3, Question 5

Question: Write $P(\text{green})$ for the bag as a fraction, a decimal and a percentage.

Worked Solution: Starter 3, Question 5

Question: Write $P(\text{green})$ for the bag as a fraction, a decimal and a percentage.

Solution: The bag has 5 green and 3 purple counters, so 8 counters in total. $P(\text{green}) = \frac{5}{8} = 0.625 = 62.5\%$.

Worked Solution: Starter 3, Question 6

Question: Which is more likely: a dark chocolate, or a purple counter?
Show your working.

Worked Solution: Starter 3, Question 6

Question: Which is more likely: a dark chocolate, or a purple counter?
Show your working.

Solution: $P(\text{dark}) = \frac{5}{12}$, because there are 5 dark chocolates out of 12.
 $P(\text{purple}) = \frac{3}{8}$, because there are 3 purple counters out of 8. Compare with a common denominator: $\frac{5}{12} = \frac{10}{24}$ and $\frac{3}{8} = \frac{9}{24}$. Since $\frac{10}{24} > \frac{9}{24}$, a dark chocolate is more likely.

Worked Solution: Starter 3, Question 7

Question: A counter is taken from the bag at random and then replaced. This is done 200 times. How many green counters would you expect?

Worked Solution: Starter 3, Question 7

Question: A counter is taken from the bag at random and then replaced. This is done 200 times. How many green counters would you expect?

Solution: $P(\text{green}) = \frac{5}{8}$. Expected number
 $= P(\text{green}) \times 200 = \frac{5}{8} \times 200 = 125$. So we would expect about 125 green counters.

Worked Solution: Starter 3, Question 8

Question: Another bag holds only red and blue counters. It holds 12 red counters, and $P(\text{red}) = 0.4$. How many counters are in it?

Worked Solution: Starter 3, Question 8

Question: Another bag holds only red and blue counters. It holds 12 red counters, and $P(\text{red}) = 0.4$. How many counters are in it?

Solution: Let the total number of counters be N . Then $P(\text{red}) = \frac{12}{N} = 0.4$. So $12 = 0.4N$, and $N = 12 \div 0.4 = 30$. There are 30 counters in the bag.

Starter 4

Choose a sandwich



C cheese H ham T tuna

and a drink



W water J juice

	W	J
C		
H		
T		

1. Write $\frac{2}{5}$ as a decimal and as a percentage.
2. Write 65% as a fraction in its simplest form.
3. A spinner lands on red, blue or green only.
 $P(\text{red}) = 0.35$,
 $P(\text{blue}) = 0.4$. Write $P(\text{green})$.
4. Complete the table to list every lunch deal.
5. How many different lunch deals are there?
6. A deal is chosen at random. Write $P(\text{juice})$ in its simplest form.
7. Write $P(\text{cheese with water})$.
8. A third drink is added. How many deals are there now?
9. Two fair coins are flipped. List all the outcomes systematically, then write $P(\text{one head and one tail})$.

Starter 4

Choose a sandwich



C cheese H ham T tuna

and a drink



W water J juice

	W	J
C	CW	CJ
H	HW	HJ
T	TW	TJ

- Write $\frac{2}{5}$ as a decimal and as a percentage.
 $0.4 = 40\%$
- Write 65% as a fraction in its simplest form.
 $\frac{65}{100} = \frac{13}{20}$
- A spinner lands on red, blue or green only.
 $P(\text{red}) = 0.35$,
 $P(\text{blue}) = 0.4$. Write $P(\text{green})$.
 $1 - 0.35 - 0.4 = 0.25$
- How many different lunch deals are there? 6
- A deal is chosen at random. Write $P(\text{juice})$ in its simplest form.
 $\frac{3}{6} = \frac{1}{2}$
- Write $P(\text{cheese with water})$. $\frac{1}{6}$
- A third drink is added. How many deals are there now? $3 \times 3 = 9$
- Two fair coins are flipped. List all the outcomes systematically, then write $P(\text{one head and one tail})$.
HH, HT, TH, TT, so $\frac{2}{4} = \frac{1}{2}$

Worked Solution: Starter 4, Question 1

Question: Write $\frac{2}{5}$ as a decimal and as a percentage.

Worked Solution: Starter 4, Question 1

Question: Write $\frac{2}{5}$ as a decimal and as a percentage.

Solution: $\frac{2}{5} = \frac{4}{10} = 0.4$. As a percentage: $0.4 \times 100 = 40\%$.

Worked Solution: Starter 4, Question 2

Question: Write 65% as a fraction in its simplest form.

Worked Solution: Starter 4, Question 2

Question: Write 65% as a fraction in its simplest form.

Solution: $65\% = \frac{65}{100}$. Divide numerator and denominator by 5: $\frac{65}{100} = \frac{13}{20}$.

Worked Solution: Starter 4, Question 3

Question: A spinner lands on red, blue or green only. $P(\text{red}) = 0.35$, $P(\text{blue}) = 0.4$. Write $P(\text{green})$.

Worked Solution: Starter 4, Question 3

Question: A spinner lands on red, blue or green only. $P(\text{red}) = 0.35$, $P(\text{blue}) = 0.4$. Write $P(\text{green})$.

Solution: The probabilities of all possible outcomes add to 1.
 $P(\text{green}) = 1 - 0.35 - 0.4 = 0.25$.

Worked Solution: Starter 4, Question 4

Question: Complete the table to list every lunch deal.

Worked Solution: Starter 4, Question 4

Question: Complete the table to list every lunch deal.

Solution: There are 3 sandwiches: C, H, T. There are 2 drinks: W, J. Systematically pair each sandwich with each drink: CW, CJ, HW, HJ, TW, TJ. These are the six entries in the table.

Worked Solution: Starter 4, Question 5

Question: How many different lunch deals are there?

Worked Solution: Starter 4, Question 5

Question: How many different lunch deals are there?

Solution: 3 choices of sandwich and 2 choices of drink, so $3 \times 2 = 6$ different deals.

Worked Solution: Starter 4, Question 6

Question: A deal is chosen at random. Write $P(\text{juice})$ in its simplest form.

Worked Solution: Starter 4, Question 6

Question: A deal is chosen at random. Write $P(\text{juice})$ in its simplest form.

Solution: Each of the 6 deals is equally likely. Three of them include juice: CJ, HJ, TJ. So $P(\text{juice}) = \frac{3}{6} = \frac{1}{2}$.

Worked Solution: Starter 4, Question 7

Question: Write $P(\text{cheese with water})$.

Worked Solution: Starter 4, Question 7

Question: Write $P(\text{cheese with water})$.

Solution: There is only one deal that is cheese with water: CW. Out of 6 equally likely deals, $P(\text{cheese with water}) = \frac{1}{6}$.

Worked Solution: Starter 4, Question 8

Question: A third drink is added. How many deals are there now?

Worked Solution: Starter 4, Question 8

Question: A third drink is added. How many deals are there now?

Solution: There are still 3 sandwiches, but now 3 drinks. Number of deals
 $= 3 \times 3 = 9$.

Worked Solution: Starter 4, Question 9

Question: Two fair coins are flipped. List all the outcomes systematically, then write $P(\text{one head and one tail})$.

Worked Solution: Starter 4, Question 9

Question: Two fair coins are flipped. List all the outcomes systematically, then write $P(\text{one head and one tail})$.

Solution: List the first coin then the second: HH, HT, TH, TT. There are 4 equally likely outcomes. The outcomes with one head and one tail are HT and TH, so there are 2 of them. $P(\text{one head and one tail}) = \frac{2}{4} = \frac{1}{2}$.

Starter 5

Two fair, ordinary dice are rolled, and the two numbers on them are added together.

		second dice					
first dice	+	1	2	3	4	5	6
	1	2	3	4	5	6	
	2	3	4	5	6	7	
	3	4	5	6	7	8	
	4	5	6	7	8	9	
	5	6	7	8	9	10	
	6						
the sum of the two dice							

1. Write $\frac{1}{3}$ as a decimal and as a percentage.
2. Write 0.36 as a fraction in its simplest form.
3. Write the missing sums in the table.
4. How many outcomes are there altogether?
5. Write $P(\text{the sum is } 7)$ in its simplest form.
6. Write the probability that the sum is more than 10, in its simplest form.
7. Which sum is the most likely? Use its probability as a percentage to decide whether that sum is likely or unlikely.
8. The two dice are rolled 180 times. How many times would you expect a sum of 5?

Starter 5

Two fair, ordinary dice are rolled, and the two numbers on them are added together.

		second dice					
first dice	+	1	2	3	4	5	6
	1	2	3	4	5	6	7
	2	3	4	5	6	7	8
	3	4	5	6	7	8	9
	4	5	6	7	8	9	10
	5	6	7	8	9	10	11
	6	7	8	9	10	11	12
the sum of the two dice							

- Write $\frac{1}{3}$ as a decimal and as a percentage.
 $0.\dot{3} = 33.\dot{3}\%$
- Write 0.36 as a fraction in its simplest form. $\frac{36}{100} = \frac{9}{25}$
- Write the missing sums in the table.
- How many outcomes are there altogether?
 $6 \times 6 = 36$
- Write $P(\text{the sum is 7})$ in its simplest form.
 $\frac{6}{36} = \frac{1}{6}$
- Write the probability that the sum is more than 10, in its simplest form. $\frac{3}{36} = \frac{1}{12}$
- Which sum is the most likely? Use its probability as a percentage to decide whether that sum is likely or unlikely. **7 is the most likely sum, but $\frac{1}{6} = 16.\dot{6}\%$, which is below 50%, so a sum of 7 is still unlikely.**
- The two dice are rolled 180 times. How many times would you expect a sum of 5? $\frac{4}{36} = \frac{1}{9}$, and $\frac{1}{9} \times 180 = 20$ times

Worked Solution: Starter 5, Question 1

Question: Write $\frac{1}{3}$ as a decimal and as a percentage.

Worked Solution: Starter 5, Question 1

Question: Write $\frac{1}{3}$ as a decimal and as a percentage.

Solution: $\frac{1}{3} = 0.333\dots = 0.\dot{3}$. As a percentage: $0.\dot{3} \times 100 = 33.\dot{3}\%$.

Worked Solution: Starter 5, Question 2

Question: Write 0.36 as a fraction in its simplest form.

Worked Solution: Starter 5, Question 2

Question: Write 0.36 as a fraction in its simplest form.

Solution: $0.36 = \frac{36}{100}$. Divide numerator and denominator by 4: $\frac{36}{100} = \frac{9}{25}$.

Worked Solution: Starter 5, Question 3

Question: Write the missing sums in the table.

Worked Solution: Starter 5, Question 3

Question: Write the missing sums in the table.

Solution: The table shows the sum of the two dice. For the last row, the first die is 6, so the sums are $6 + 1 = 7$, $6 + 2 = 8$, $6 + 3 = 9$, $6 + 4 = 10$, $6 + 5 = 11$, $6 + 6 = 12$. For the last column, the second die is 6, so the remaining missing sums are $1 + 6 = 7$, $2 + 6 = 8$, $3 + 6 = 9$, $4 + 6 = 10$, $5 + 6 = 11$. Thus the missing entries are 7, 8, 9, 10, 11, 12 along the bottom row and 7, 8, 9, 10, 11 down the right column.

Worked Solution: Starter 5, Question 4

Question: How many outcomes are there altogether?

Worked Solution: Starter 5, Question 4

Question: How many outcomes are there altogether?

Solution: There are 6 outcomes for the first die and 6 for the second die.
Total outcomes $= 6 \times 6 = 36$.

Worked Solution: Starter 5, Question 5

Question: Write P (the sum is 7) in its simplest form.

Worked Solution: Starter 5, Question 5

Question: Write $P(\text{the sum is } 7)$ in its simplest form.

Solution: The pairs giving a sum of 7 are

$(1, 6), (2, 5), (3, 4), (4, 3), (5, 2), (6, 1)$, so 6 outcomes.

$$P(\text{sum } 7) = \frac{6}{36} = \frac{1}{6}.$$

Worked Solution: Starter 5, Question 6

Question: Write the probability that the sum is more than 10, in its simplest form.

Worked Solution: Starter 5, Question 6

Question: Write the probability that the sum is more than 10, in its simplest form.

Solution: Sums more than 10 are 11 and 12. Sum 11: (5, 6), (6, 5), two outcomes. Sum 12: (6, 6), one outcome. Total 3 outcomes.

$$P(\text{sum} > 10) = \frac{3}{36} = \frac{1}{12}.$$

Worked Solution: Starter 5, Question 7

Question: Which sum is the most likely? Use its probability as a percentage to decide whether that sum is likely or unlikely.

Worked Solution: Starter 5, Question 7

Question: Which sum is the most likely? Use its probability as a percentage to decide whether that sum is likely or unlikely.

Solution: The sum 7 is the most likely, because it has the most outcomes: 6 out of 36. $P(\text{sum } 7) = \frac{6}{36} = \frac{1}{6} = 16.\dot{6}\%$. Since $16.\dot{6}\%$ is less than 50%, a sum of 7 is still unlikely, even though it is the most likely single sum.

Worked Solution: Starter 5, Question 8

Question: The two dice are rolled 180 times. How many times would you expect a sum of 5?

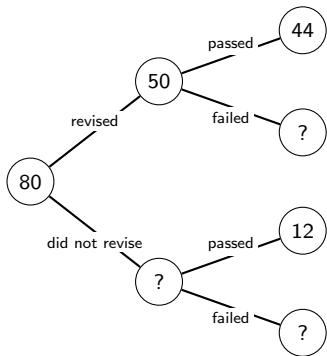
Worked Solution: Starter 5, Question 8

Question: The two dice are rolled 180 times. How many times would you expect a sum of 5?

Solution: The pairs giving a sum of 5 are (1, 4), (2, 3), (3, 2), (4, 1), so 4 outcomes. $P(\text{sum } 5) = \frac{4}{36} = \frac{1}{9}$. Expected number = $\frac{1}{9} \times 180 = 20$. So expect 20 times.

Starter 6

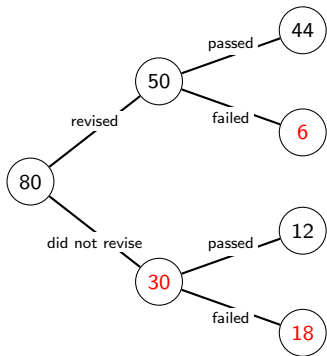
80 pupils sat a test. 50 of them revised. Of the pupils who revised, 44 passed. Of the pupils who did not revise, 12 passed. One of the 80 pupils is then chosen at random.



1. Write $\frac{3}{8}$ as a decimal and as a percentage.
2. A bag holds 9 red and 1 blue counter. Is taking a red counter likely? Give $P(\text{red})$ as a percentage.
3. Complete the frequency tree.
4. How many pupils passed the test altogether?
5. Write $P(\text{revised})$ in its simplest form.
6. Write $P(\text{revised and failed})$ in its simplest form.
7. Write $P(\text{passed})$ as a fraction, a decimal and a percentage.
8. Is a pupil who revised more likely to pass than a pupil who did not revise? Use probabilities to explain your answer.

Starter 6

80 pupils sat a test. 50 of them revised. Of the pupils who revised, 44 passed. Of the pupils who did not revise, 12 passed. One of the 80 pupils is then chosen at random.



1. Write $\frac{3}{8}$ as a decimal and as a percentage.
 $0.375 = 37.5\%$
2. A bag holds 9 red and 1 blue counter. Is taking a red counter likely? Give $P(\text{red})$ as a percentage.
 $\frac{9}{10} = 90\%$, so likely.
3. Complete the frequency tree.
4. How many pupils passed the test altogether?
 $44 + 12 = 56$
5. Write $P(\text{revised})$ in its simplest form.
 $\frac{50}{80} = \frac{5}{8}$
6. Write $P(\text{revised and failed})$ in its simplest form.
 $\frac{6}{80} = \frac{3}{40}$
7. Write $P(\text{passed})$ as a fraction, a decimal and a percentage.
 $\frac{56}{80} = \frac{7}{10} = 0.7 = 70\%$
8. Is a pupil who revised more likely to pass than a pupil who did not revise? Use probabilities to explain your answer. Yes: $\frac{44}{50} = 88\%$ of those who revised passed, against $\frac{12}{30} = 40\%$ of those who did not.

Worked Solution: Starter 6, Question 1

Question: Write $\frac{3}{8}$ as a decimal and as a percentage.

Worked Solution: Starter 6, Question 1

Question: Write $\frac{3}{8}$ as a decimal and as a percentage.

Solution: $\frac{3}{8} = 3 \div 8 = 0.375$. As a percentage: $0.375 \times 100 = 37.5\%$.

Worked Solution: Starter 6, Question 2

Question: A bag holds 9 red and 1 blue counter. Is taking a red counter likely? Give $P(\text{red})$ as a percentage.

Worked Solution: Starter 6, Question 2

Question: A bag holds 9 red and 1 blue counter. Is taking a red counter likely? Give $P(\text{red})$ as a percentage.

Solution: There are 9 red counters out of 10 counters in total.

$P(\text{red}) = \frac{9}{10} = 0.9 = 90\%$. Since 90% is greater than 50%, taking a red counter is likely.

Worked Solution: Starter 6, Question 3

Question: Complete the frequency tree.

Worked Solution: Starter 6, Question 3

Question: Complete the frequency tree.

Solution: The total is 80. 50 revised, so $80 - 50 = 30$ did not revise. Of the 50 who revised, 44 passed, so $50 - 44 = 6$ failed. Of the 30 who did not revise, 12 passed, so $30 - 12 = 18$ failed. The missing numbers are 30, 6, 18 in the positions shown.

Worked Solution: Starter 6, Question 4

Question: How many pupils passed the test altogether?

Worked Solution: Starter 6, Question 4

Question: How many pupils passed the test altogether?

Solution: Add the two passed groups: 44 who revised and passed plus 12 who did not revise and passed. $44 + 12 = 56$. So 56 pupils passed.

Worked Solution: Starter 6, Question 5

Question: Write $P(\text{revised})$ in its simplest form.

Worked Solution: Starter 6, Question 5

Question: Write $P(\text{revised})$ in its simplest form.

Solution: 50 pupils revised out of 80 pupils in total. $P(\text{revised}) = \frac{50}{80} = \frac{5}{8}$.

Worked Solution: Starter 6, Question 6

Question: Write P (revised and failed) in its simplest form.

Worked Solution: Starter 6, Question 6

Question: Write $P(\text{revised and failed})$ in its simplest form.

Solution: 6 pupils revised and failed. Out of 80 pupils,

$$P(\text{revised and failed}) = \frac{6}{80} = \frac{3}{40}.$$

Worked Solution: Starter 6, Question 7

Question: Write $P(\text{passed})$ as a fraction, a decimal and a percentage.

Worked Solution: Starter 6, Question 7

Question: Write $P(\text{passed})$ as a fraction, a decimal and a percentage.

Solution: 56 pupils passed out of 80. $P(\text{passed}) = \frac{56}{80} = \frac{7}{10} = 0.7 = 70\%$.

Worked Solution: Starter 6, Question 8

Question: Is a pupil who revised more likely to pass than a pupil who did not revise? Use probabilities to explain your answer.

Worked Solution: Starter 6, Question 8

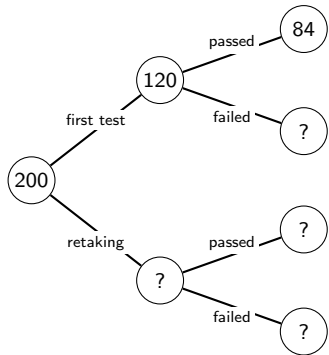
Question: Is a pupil who revised more likely to pass than a pupil who did not revise? Use probabilities to explain your answer.

Solution: Among those who revised, 44 out of 50 passed:

$\frac{44}{50} = 0.88 = 88\%$. Among those who did not revise, 12 out of 30 passed:
 $\frac{12}{30} = 0.4 = 40\%$. Since $88\% > 40\%$, a pupil who revised was more likely to pass.

Starter 7

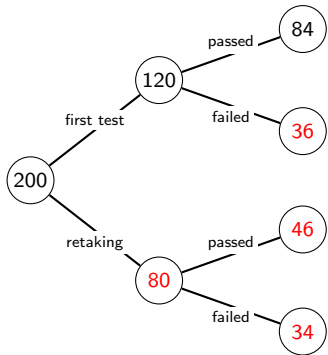
200 people took a driving test. 120 of them were taking it for the first time, and 84 of those passed. Altogether 130 people passed.



1. Write 0.65 as a fraction in its simplest form.
2. Write $\frac{7}{8}$ as a percentage.
3. A bag holds 7 green and 3 red counters. Write $P(\text{green})$ as a percentage.
4. Complete the frequency tree.
5. Write $P(\text{passed})$ in its simplest form and as a percentage.
6. Write the probability that a person took the test for the first time and passed.
7. What percentage passed on a first test, and what percentage passed on a retake?
8. Jo says "people are more likely to pass a retake, because they have had more practice". Do these figures support Jo?

Starter 7

200 people took a driving test. 120 of them were taking it for the first time, and 84 of those passed. Altogether 130 people passed.



1. Write 0.65 as a fraction in its simplest form.
 $\frac{65}{100} = \frac{13}{20}$
2. Write $\frac{7}{8}$ as a percentage. **87.5%**
3. A bag holds 7 green and 3 red counters. Write $P(\text{green})$ as a percentage.
 $\frac{7}{10} = 70\%$
4. Complete the frequency tree.
5. Write $P(\text{passed})$ in its simplest form and as a percentage.
 $\frac{130}{200} = \frac{13}{20} = 65\%$
6. Write the probability that a person took the test for the first time and passed.
 $\frac{84}{200} = \frac{21}{50}$
7. What percentage passed on a first test, and what percentage passed on a retake?
 $\frac{84}{120} = 70\%$ and $\frac{46}{80} = 57.5\%$
8. Jo says "people are more likely to pass a retake, because they have had more practice". Do these figures support Jo? **No: 70% passed on a first test, but only 57.5% on a retake.**

Worked Solution: Starter 7, Question 1

Question: Write 0.65 as a fraction in its simplest form.

Worked Solution: Starter 7, Question 1

Question: Write 0.65 as a fraction in its simplest form.

Solution: $0.65 = \frac{65}{100}$. Divide numerator and denominator by 5: $\frac{65}{100} = \frac{13}{20}$.

Worked Solution: Starter 7, Question 2

Question: Write $\frac{7}{8}$ as a percentage.

Worked Solution: Starter 7, Question 2

Question: Write $\frac{7}{8}$ as a percentage.

Solution: $\frac{7}{8} = 7 \div 8 = 0.875$. As a percentage: $0.875 \times 100 = 87.5\%$.

Worked Solution: Starter 7, Question 3

Question: A bag holds 7 green and 3 red counters. Write $P(\text{green})$ as a percentage.

Worked Solution: Starter 7, Question 3

Question: A bag holds 7 green and 3 red counters. Write $P(\text{green})$ as a percentage.

Solution: There are 7 green counters out of 10 counters in total.

$$P(\text{green}) = \frac{7}{10} = 0.7 = 70\%.$$

Worked Solution: Starter 7, Question 4

Question: Complete the frequency tree.

Worked Solution: Starter 7, Question 4

Question: Complete the frequency tree.

Solution: The total is 200. 120 were taking the test for the first time, so $200 - 120 = 80$ were retaking it. Of the 120 first-timers, 84 passed, so $120 - 84 = 36$ failed. Altogether 130 passed, so the number of retakers who passed is $130 - 84 = 46$. Therefore the number of retakers who failed is $80 - 46 = 34$. The missing numbers are 80, 36, 46, 34.

Worked Solution: Starter 7, Question 5

Question: Write $P(\text{passed})$ in its simplest form and as a percentage.

Worked Solution: Starter 7, Question 5

Question: Write $P(\text{passed})$ in its simplest form and as a percentage.

Solution: 130 people passed out of 200.

$$P(\text{passed}) = \frac{130}{200} = \frac{13}{20} = 0.65 = 65\%.$$

Worked Solution: Starter 7, Question 6

Question: Write the probability that a person took the test for the first time and passed.

Worked Solution: Starter 7, Question 6

Question: Write the probability that a person took the test for the first time and passed.

Solution: 84 people took the test for the first time and passed. Out of 200 people, $P(\text{first time and passed}) = \frac{84}{200} = \frac{21}{50}$.

Worked Solution: Starter 7, Question 7

Question: What percentage passed on a first test, and what percentage passed on a retake?

Worked Solution: Starter 7, Question 7

Question: What percentage passed on a first test, and what percentage passed on a retake?

Solution: First test: 84 passed out of 120, so $\frac{84}{120} = 0.7 = 70\%$. Retake: 46 passed out of 80, so $\frac{46}{80} = 0.575 = 57.5\%$.

Worked Solution: Starter 7, Question 8

Question: Jo says “people are more likely to pass a retake, because they have had more practice”. Do these figures support Jo?

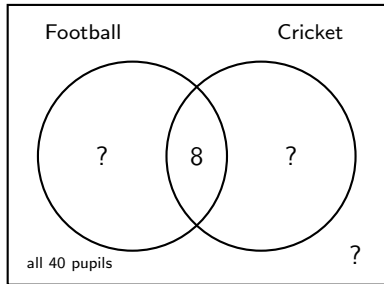
Worked Solution: Starter 7, Question 8

Question: Jo says “people are more likely to pass a retake, because they have had more practice”. Do these figures support Jo?

Solution: No. The pass rate for a first test was 70%, but the pass rate for a retake was 57.5%. Since $70\% > 57.5\%$, people were actually less likely to pass on a retake in these figures.

Starter 8

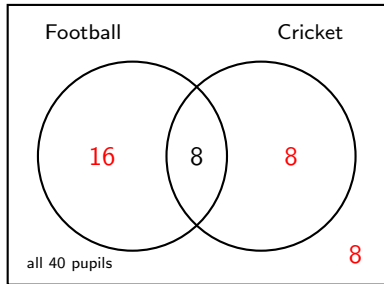
40 pupils were asked which sports they play. 24 play football, 16 play cricket, and 8 play both. One pupil is then chosen at random.



1. Write 0.2 as a fraction in its simplest form and as a percentage.
2. A café sells 4 sandwiches and 3 drinks. How many deals of one sandwich and one drink are there?
3. How many pupils play football but not cricket?
4. Complete the Venn diagram.
5. Write $P(\text{cricket})$ in its simplest form and as a percentage.
6. Write $P(\text{neither sport})$ in its simplest form.
7. Write $P(\text{football or cricket})$ in its simplest form and as a percentage.
8. $P(\text{football}) + P(\text{cricket}) = \frac{3}{5} + \frac{2}{5} = 1$, but $P(\text{football or cricket}) = \frac{4}{5}$. Explain why these are different.

Starter 8

40 pupils were asked which sports they play. 24 play football, 16 play cricket, and 8 play both. One pupil is then chosen at random.



1. Write 0.2 as a fraction in its simplest form and as a percentage.
 $\frac{1}{5} = 20\%$
2. A café sells 4 sandwiches and 3 drinks. How many deals of one sandwich and one drink are there?
 $4 \times 3 = 12$
3. How many pupils play football but not cricket?
 $24 - 8 = 16$
4. Complete the Venn diagram.
5. Write $P(\text{cricket})$ in its simplest form and as a percentage.
 $\frac{16}{40} = \frac{2}{5} = 40\%$
6. Write $P(\text{neither sport})$ in its simplest form.
 $\frac{8}{40} = \frac{1}{5}$
7. Write $P(\text{football or cricket})$ in its simplest form and as a percentage.
 $\frac{32}{40} = \frac{4}{5} = 80\%$
8. $P(\text{football}) + P(\text{cricket}) = \frac{3}{5} + \frac{2}{5} = 1$, but $P(\text{football or cricket}) = \frac{4}{5}$. Explain why these are different. The 8 who play both are in both circles, so they are counted twice.

Worked Solution: Starter 8, Question 1

Question: Write 0.2 as a fraction in its simplest form and as a percentage.

Worked Solution: Starter 8, Question 1

Question: Write 0.2 as a fraction in its simplest form and as a percentage.

Solution: $0.2 = \frac{2}{10} = \frac{1}{5}$. As a percentage: $0.2 \times 100 = 20\%$.

Worked Solution: Starter 8, Question 2

Question: A café sells 4 sandwiches and 3 drinks. How many deals of one sandwich and one drink are there?

Worked Solution: Starter 8, Question 2

Question: A café sells 4 sandwiches and 3 drinks. How many deals of one sandwich and one drink are there?

Solution: For each of the 4 sandwiches there are 3 drink choices. Number of deals $= 4 \times 3 = 12$.

Worked Solution: Starter 8, Question 3

Question: How many pupils play football but not cricket?

Worked Solution: Starter 8, Question 3

Question: How many pupils play football but not cricket?

Solution: 24 pupils play football, but 8 of them also play cricket. So
football but not cricket = $24 - 8 = 16$.

Worked Solution: Starter 8, Question 4

Question: Complete the Venn diagram.

Worked Solution: Starter 8, Question 4

Question: Complete the Venn diagram.

Solution: Football only: $24 - 8 = 16$. Both: 8. Cricket only: $16 - 8 = 8$.
The number who play at least one sport is $16 + 8 + 8 = 32$. Since there are 40 pupils, neither sport is $40 - 32 = 8$. So the regions are 16, 8, 8, and 8 outside.

Worked Solution: Starter 8, Question 5

Question: Write $P(\text{cricket})$ in its simplest form and as a percentage.

Worked Solution: Starter 8, Question 5

Question: Write $P(\text{cricket})$ in its simplest form and as a percentage.

Solution: 16 pupils play cricket out of 40.

$$P(\text{cricket}) = \frac{16}{40} = \frac{2}{5} = 0.4 = 40\%.$$

Worked Solution: Starter 8, Question 6

Question: Write $P(\text{neither sport})$ in its simplest form.

Worked Solution: Starter 8, Question 6

Question: Write $P(\text{neither sport})$ in its simplest form.

Solution: 8 pupils play neither sport out of 40. $P(\text{neither}) = \frac{8}{40} = \frac{1}{5}$.

Worked Solution: Starter 8, Question 7

Question: Write $P(\text{football or cricket})$ in its simplest form and as a percentage.

Worked Solution: Starter 8, Question 7

Question: Write $P(\text{football or cricket})$ in its simplest form and as a percentage.

Solution: The number who play football or cricket is $16 + 8 + 8 = 32$. So

$$P(\text{football or cricket}) = \frac{32}{40} = \frac{4}{5} = 0.8 = 80\%.$$

Worked Solution: Starter 8, Question 8

Question: $P(\text{football}) + P(\text{cricket}) = \frac{3}{5} + \frac{2}{5} = 1$, but $P(\text{football or cricket}) = \frac{4}{5}$. Explain why these are different.

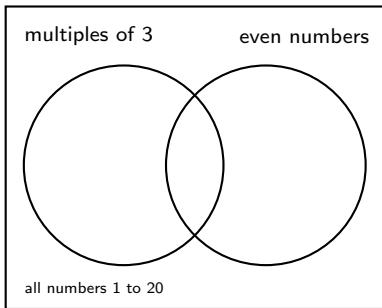
Worked Solution: Starter 8, Question 8

Question: $P(\text{football}) + P(\text{cricket}) = \frac{3}{5} + \frac{2}{5} = 1$, but $P(\text{football or cricket}) = \frac{4}{5}$. Explain why these are different.

Solution: Adding $P(\text{football})$ and $P(\text{cricket})$ counts the 8 pupils who play both sports twice. So $\frac{3}{5} + \frac{2}{5}$ counts those pupils twice and gives 1. To find $P(\text{football or cricket})$, we must count each pupil only once, so we subtract the overlap: $\frac{3}{5} + \frac{2}{5} - \frac{8}{40} = 1 - \frac{1}{5} = \frac{4}{5}$.

Starter 9

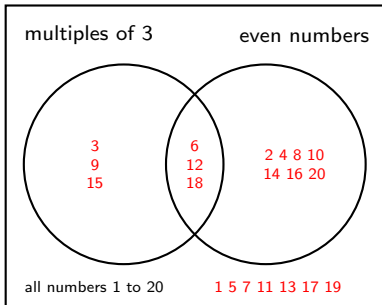
One of the numbers from 1 to 20 is chosen at random.



1. Write $\frac{3}{20}$ as a decimal and as a percentage.
2. Write 35% as a fraction in its simplest form.
3. Write each number from 1 to 20 in the correct region.
4. A number goes in the overlap when it is a multiple of ____.
5. Write $P(\text{multiple of 3})$ in its simplest form.
6. Write the probability that the number is neither even nor a multiple of 3.
7. Is the number likely or unlikely to be a multiple of 3? Use its probability as a percentage to explain.
8. Choose two new labels for the circles so that the overlap must be empty, and explain why.

Starter 9

One of the numbers from 1 to 20 is chosen at random.



1. Write $\frac{3}{20}$ as a decimal and as a percentage.
 $0.15 = 15\%$
2. Write 35% as a fraction in its simplest form.
 $\frac{35}{100} = \frac{7}{20}$
3. Write each number from 1 to 20 in the correct region.
4. A number goes in the overlap when it is a multiple of 6.
5. Write $P(\text{multiple of 3})$ in its simplest form.
 $\frac{6}{20} = \frac{3}{10}$
6. Write the probability that the number is neither even nor a multiple of 3. $\frac{7}{20}$
7. Is the number likely or unlikely to be a multiple of 3? Use its probability as a percentage to explain. $\frac{3}{10} = 30\%$, which is below 50%, so unlikely.
8. Choose two new labels for the circles so that the overlap must be empty, and explain why.
For example "odd" and "even": no number is both odd and even.

Worked Solution: Starter 9, Question 1

Question: Write $\frac{3}{20}$ as a decimal and as a percentage.

Worked Solution: Starter 9, Question 1

Question: Write $\frac{3}{20}$ as a decimal and as a percentage.

Solution: $\frac{3}{20} = \frac{15}{100} = 0.15$. As a percentage: $0.15 \times 100 = 15\%$.

Worked Solution: Starter 9, Question 2

Question: Write 35% as a fraction in its simplest form.

Worked Solution: Starter 9, Question 2

Question: Write 35% as a fraction in its simplest form.

Solution: $35\% = \frac{35}{100}$. Divide numerator and denominator by 5: $\frac{35}{100} = \frac{7}{20}$.

Worked Solution: Starter 9, Question 3

Question: Write each number from 1 to 20 in the correct region.

Worked Solution: Starter 9, Question 3

Question: Write each number from 1 to 20 in the correct region.

Solution: Multiples of 3: 3, 6, 9, 12, 15, 18. Even numbers: 2, 4, 6, 8, 10, 12, 14, 16, 18, 20. The overlap (both even and a multiple of 3) is the multiples of 6: 6, 12, 18. Multiples of 3 only: 3, 9, 15. Even only: 2, 4, 8, 10, 14, 16, 20. Neither: 1, 5, 7, 11, 13, 17, 19.

Worked Solution: Starter 9, Question 4

Question: A number goes in the overlap when it is a multiple of _____.

Worked Solution: Starter 9, Question 4

Question: A number goes in the overlap when it is a multiple of _____.

Solution: The overlap is for numbers that are both even and multiples of 3. Such numbers are multiples of 6. So the blank is 6.

Worked Solution: Starter 9, Question 5

Question: Write P (multiple of 3) in its simplest form.

Worked Solution: Starter 9, Question 5

Question: Write $P(\text{multiple of } 3)$ in its simplest form.

Solution: There are 6 multiples of 3 from 1 to 20: 3, 6, 9, 12, 15, 18.

$$P(\text{multiple of } 3) = \frac{6}{20} = \frac{3}{10}.$$

Worked Solution: Starter 9, Question 6

Question: Write the probability that the number is neither even nor a multiple of 3.

Worked Solution: Starter 9, Question 6

Question: Write the probability that the number is neither even nor a multiple of 3.

Solution: The numbers that are neither even nor a multiple of 3 are 1, 5, 7, 11, 13, 17, 19, which is 7 numbers. $P(\text{neither}) = \frac{7}{20}$.

Worked Solution: Starter 9, Question 7

Question: Is the number likely or unlikely to be a multiple of 3? Use its probability as a percentage to explain.

Worked Solution: Starter 9, Question 7

Question: Is the number likely or unlikely to be a multiple of 3? Use its probability as a percentage to explain.

Solution: $P(\text{multiple of } 3) = \frac{3}{10} = 0.3 = 30\%$. Since 30% is less than 50%, it is unlikely to be a multiple of 3.

Worked Solution: Starter 9, Question 8

Question: Choose two new labels for the circles so that the overlap must be empty, and explain why.

Worked Solution: Starter 9, Question 8

Question: Choose two new labels for the circles so that the overlap must be empty, and explain why.

Solution: For example, label one circle “odd numbers” and the other “even numbers”. No number from 1 to 20 can be both odd and even, so the overlap must be empty.