Vertex Academy

Year 8 Maths workbook

10 worksheets · answers at the back

Contents

1. Powers of ten, in both directions
2. Comparing money plans, and taking a discount off
3. Equations, and what the letter is doing
4. Volume, capacity and converting units
5. The parts of a circle
6. Mean, median, mode and range
7. Choosing a graph, and spotting outliers
8. Reading a graph properly: shape, centre and spread
9. Experimental probability and the Law of Large Numbers
10. Probability as a fraction, a decimal and a percentage

Year 8 · Number: Powers, Primes & Proportions

Name: _____ Date: _____

Kia ora! This sheet gives your brain a good workout across place value, powers, order of operations, fractions, percentages and ratios. Take your time, show your steps, and check that each answer looks reasonable.

Warm-up

1. Write 5.83 in expanded form using powers of 10.

2. Evaluate $\sqrt{64}$ and $\sqrt[3]{125}$.

3. Write 72 as a product of its prime factors, using exponents.

4. Calculate $-6 + 10$ and $4 + -9$.

Practice

5. Order these numbers from smallest to largest: −3.4, −3, 0.5, −0.5, 2.1.

6. Use the order of operations (GEMA) to evaluate $3 + 4 \times 2^2 - 5$.

7. Work out 2.3×45. Use estimation to check your answer is reasonable.

8. Multiply the fractions and give your answer in simplest form: $\frac{2}{3} \times \frac{3}{4}$.

9. A netball club in Avondale has 40 registered players. $\frac{3}{5}$ of them are juniors. How many juniors are there?

10. Mere and Tane share $56 from their lemonade stall in the ratio 3 : 5. How much does each person get?

Challenge

11. At Avondale Intermediate, 18 students in one Year 8 class walk or bike to school. This is 45% of the whole class. How many students are in the class altogether?

12. Evaluate $5 \times (-3) + 2^3 - \sqrt{49}$, using the order of operations.

Year 8 · Number: Smart with Money

Name: _____ Date: _____

Hi! This sheet helps you work with New Zealand dollars, compare saving and payment plans, and take percentages off prices. Remember to round money answers to two decimal places, and cash payments to the nearest 10 cents.

Warm-up

1. Find 10% of $45.

2. A shirt costs $32. It has a 25% discount. How much is taken off?

3. Round a cash payment of $18.67 to the nearest 10 cents.

4. Aroha saves $6 each week. How much does she save in 8 weeks?

Practice

5. A pair of sneakers at The Warehouse is $120 with a 35% discount. What is the new price?

6. A jacket is priced at $89.99 with a 20% discount. Work out the sale price, rounded to two decimal places.

7. Liam wants to save $312 for a bike. He plans to save $12 each week. How many weeks will it take?

8. Phone Plan A costs $25 per month. Phone Plan B costs $6 per week. Over one year (52 weeks, 12 months), which plan is cheaper and by how much?

9. Mia buys a $240 tablet using a 'buy now, pay later' plan of 6 equal fortnightly payments. There is a $9 setup fee added to the total. What is each payment?

10. At the dairy, Sione's groceries come to $23.44. He pays with cash. What amount does he actually pay after rounding to the nearest 10 cents?

Challenge

11. A $150 speaker has a 30% discount. After the discount, GST is already included in the price. Emma pays cash. First find the discounted price, then round the cash payment to the nearest 10 cents.

12. Ana compares two saving plans for a $520 holiday. Plan 1: save $20 per week. Plan 2: save $85 per month. Using 4 weeks per month, work out how many weeks each plan takes to reach $520, and state which is faster.

Year 8 · Algebra: Solving Equations and Spotting Patterns

Name: _____ Date: _____

Kia ora! This sheet helps you get confident forming and solving equations, simplifying expressions, and finding the rules behind number patterns. Take your time and check each answer by substituting back in.

Warm-up

1. Solve: $x + 8 = 15$

2. Simplify: $4a + 3a - a$

3. If $w = 5$, find the value of $w + 12$.

4. Solve: $3s = 18$

Practice

5. Solve: $5s + 9 = -6$

6. Solve: $t + 7 = 6.5$

7. Expand and simplify: $2(x + 3) + 1$

8. Factorise fully: $5x - 35$

9. Aroha buys 4 identical smoothies at the Avondale market and pays with a $20 note. She gets $3.20 change. Write and solve an equation to find the price of one smoothie.

10. To hire a kayak on the Whau River costs a $12 booking fee plus $9 for each hour. The cost C in dollars for h hours is $C = 9h + 12$. (a) Find the cost for 4 hours. (b) Tane paid $75. Solve for how many hours he hired the kayak.

Challenge

11. Solve the inequality $t - 3 \geq -5$ and show the solution on a number line.

12. A tiling pattern grows so that shape 1 uses 5 tiles, shape 2 uses 8 tiles, shape 3 uses 11 tiles. (a) Write a rule for the number of tiles t in terms of the shape number n. (b) How many tiles are in shape 10? (c) Which shape uses 62 tiles?

Year 8 · Measurement: Volumes, Areas & Time

Name: _____ Date: _____

Hi! This sheet lets you practise converting units, finding areas of parallelograms and trapeziums, working out volumes of prisms, and reading timetables. Take your time and show your working.

Warm-up

1. Convert 5 m² into cm².

2. Find the area of a parallelogram with base 8 cm and height 5 cm.

3. Convert 2.5 L into cm³.

4. Convert 2 hours 45 minutes into minutes.

Practice

5. Find the area of a trapezium with parallel sides a = 6 cm and b = 10 cm, and height h = 4 cm.

6. A triangular prism has a triangular cross-section with base 6 cm and height 4 cm, and a length of 10 cm. Find its volume.

7. A parallelogram has an area of 60 cm² and a height of 5 cm. Find the length of its base.

8. Mereana fills a fish tank shaped like a rectangular prism that is 50 cm long, 30 cm wide and 40 cm high. How many litres of water does it hold when full?

9. The train from New Lynn departs at 7:52 am and arrives at Britomart at 8:29 am. How long is the trip, in minutes?

10. A solid is made of two rectangular prisms. The bottom prism is 10 cm × 6 cm × 4 cm and the top prism is 4 cm × 4 cm × 5 cm. Find the total volume.

Challenge

11. A barn-shaped storage shed is a composite prism 10 m long. The lower part is a rectangular prism 4 m wide and 3 m high. On top sits a triangular prism (the roof) with base 4 m and height 2 m. Find the total volume, then write it in litres.

12. A rainwater tank is a rectangular prism 1.2 m long, 0.8 m wide and 1.5 m high. A pump fills it at 15 L per minute. Starting empty, how long will it take to fill completely? Give your answer in hours and minutes.

Year 8 · Geometry: Getting to Know Circles

Name: _____ Date: _____

Hi there! This sheet is all about the special parts of a circle, the radius, the diameter, and the circumference. Take your time, sketch the circles if it helps, and enjoy!

Warm-up

1. What is the name for the distance from the centre of a circle to its edge?

2. What is the name for the distance all the way around a circle?

3. A line goes straight through the centre of a circle and touches opposite edges. What is this line called?

4. A circle has a radius of 5 cm. What is its diameter?

Practice

5. A circle has a diameter of 18 cm. What is its radius?

6. A circle has a radius of 12 mm. What is its diameter?

7. Aroha draws a circle with a diameter of 30 cm. She then draws a radius. How long is the radius?

8. Which part of a circle is longer: the radius or the diameter? Explain why.

9. Tane is decorating a round pizza with a ribbon of chocolate sauce along its circumference. The pizza has a radius of 14 cm. What is the diameter of the pizza?

10. At Avondale Primary, a round trampoline has a diameter of 3.6 m. What is the radius of the trampoline?

Challenge

11. A circular garden pond has a radius of 1.5 m. A path goes straight across the middle of the pond (the diameter), and then Mere walks halfway around the edge from one end of the path to the other. Which is the distance across the pond (the diameter), and by roughly how much would the distance around half the edge be longer? (Use 3 as a rough value for how many diameters fit around a circle.)

12. Two circles are drawn. The smaller circle has a diameter equal to the radius of the larger circle. If the larger circle has a radius of 20 cm, what is the diameter and the radius of the smaller circle?

Year 8 · Statistics: Making Sense of Data

Name: _____ Date: _____

Kia ora! This sheet helps you sort out the different types of variables and work out the mean, median, mode and range. Take your time and sort your numbers carefully before you start.

Warm-up

1. Decide whether each variable is categorical, discrete numerical, or continuous numerical: (a) favourite ice cream flavour, (b) number of pets in a house, (c) the height of a student in centimetres.

2. Find the mean of these test scores: 6, 8, 7, 9, 10.

3. Find the median of: 12, 5, 9, 3, 7.

4. Find the range of these temperatures (°C): 14, 21, 18, 9, 25.

Practice

5. Find the mode of these shoe sizes recorded at Vertex Academy: 7, 8, 8, 6, 9, 8, 7, 10.

6. For the data set 4, 11, 6, 4, 9, 8, find (a) the mean, (b) the median, (c) the range.

7. Mila measured the length of everyone's right foot in her whānau (in cm): 22, 24, 24, 26, 29. Her statistical question is 'Are our feet the same length?' Find the median foot length and the range, then answer her question.

8. At a Saturday market in Avondale, a stall sold these numbers of pies each hour: 15, 22, 18, 22, 13. Find the mean number of pies sold per hour and the mode.

9. Tane wants to answer 'How long do students take to walk to school?' He records these times in minutes: 8, 15, 10, 12, 20, 15. (a) Is walking time a discrete or continuous variable? (b) Find the mean and (c) the range.

10. A netball team scored these goals over 7 games: 24, 30, 28, 24, 35, 24, 31. Find the mean, median, mode and range.

Challenge

11. A group of 5 students has a mean age of 12 years. A sixth student joins and the new mean becomes 12.5 years. How old is the sixth student?

12. A data set of five whole numbers has a mode of 6, a median of 6, a mean of 7, and a range of 8. Find a possible set of five numbers.

Year 8 · Statistics: Picture the Data

Name: _____ Date: _____

This sheet helps you choose the best graph for different kinds of data, read what graphs are telling you, and spot the odd data points we call outliers. Have a ruler handy for the graphs!

Warm-up

1. Name the type of graph that is best for showing how a single number changes over time (for example, daily temperature in Avondale over one week).

2. A class recorded their favourite lunch: 8 chose pies, 5 chose sushi, 4 chose sandwiches, 3 chose salad. Is this data categorical or numerical?

3. Look at this dot plot of goals scored by a netball team in 6 games: 2, 3, 3, 4, 4, 12. Which value looks like an outlier?

4. True or false: an outlier pulls the mean towards itself but has little effect on the median. Explain in one sentence.

Practice

5. Mele surveyed 20 students at Vertex Academy about how they travel to the centre: Walk 7, Bus 6, Car 5, Bike 2. Describe how you would draw a bar graph for this, including what each axis shows.

6. A shop tracked ice-cream sales (in dollars) each month from January to June: $900, $760, $540, $420, $300, $250. What graph should you use, and what trend does it show?

7. Year 8 students were asked their favourite sport, split by boys and girls. Boys: Rugby 10, Football 6, Netball 2. Girls: Rugby 4, Football 5, Netball 9. What kind of graph best compares the two groups, and why?

8. Here are the heights (cm) of 9 plants in a school garden: 22, 24, 25, 25, 26, 27, 28, 29, 61. (a) Find the median. (b) Find the mean. (c) Explain what the outlier does to each.

9. Aroha made a time-series graph of her weekly savings and noticed one week jumped from about $15 up to $140, then went back to normal. Give one sensible reason this is NOT an error, and say whether she should delete it.

10. A café owner has this data and wants ONE graph: the number of customers each hour from 8am to 12pm (8am: 12, 9am: 20, 10am: 35, 11am: 18, 12pm: 40). What graph type fits best, and what does the pattern suggest?

Challenge

11. A class tracked recycling collected (kg) over 5 weeks for two rooms. Room A: 8, 9, 10, 11, 12. Room B: 2, 3, 4, 5, 46. (a) Which room has an outlier and what is it? (b) Compare the medians of the two rooms. (c) Which room truly recycles more consistently, and why can the mean be misleading here?

12. A student wants to show, in ONE graph, how many students in each of Years 7, 8 and 9 answered 'Yes' or 'No' to using the school bus. Data, Year 7: Yes 30, No 10; Year 8: Yes 20, No 20; Year 9: Yes 15, No 25. (a) Name a suitable graph and explain your choice. (b) Describe what a stacked bar graph would show that a clustered one might not. (c) State one clear pattern in the data.

Year 8 · Statistics: Making Sense of Data

Name: _____ Date: _____

Hi! This sheet helps you read graphs and tables like a real statistician, finding the middle, the spread, the shape, and spotting when a graph is trying to trick you. Take your time and show your thinking.

Warm-up

1. Find the median of these scores: 4, 7, 9, 2, 6.

2. Find the range of these heights (cm): 12, 18, 5, 22, 9.

3. A dot plot has a long tail stretching to the right and most dots bunched on the left. Is it positively or negatively skewed?

4. Find the median of this even-sized set: 3, 8, 10, 15.

Practice

5. Ten students recorded how many minutes they read one night: 20, 25, 30, 15, 40, 35, 25, 30, 45, 20. Find the median and the range.

6. Aroha's netball team scored these goals over 7 games: 12, 15, 9, 14, 11, 13, 10. Find the median number of goals and the range, then write one sentence describing the team's scoring.

7. A newspaper histogram shows house sale prices in Avondale. Most bars are tall on the left (lower prices) and a few short bars stretch far to the right (very expensive houses). Describe the shape of the data and say where the middle of the data lies compared with the highest prices.

8. Weekly water use (litres) for 7 households was: 22, 24, 23, 25, 21, 24, 78. Identify the outlier by eye, then find the range with and without it. Which range better describes the typical spread?

9. A social media post shows a bar graph titled 'Best Sports at Our School' but the vertical axis has no numbers or label. Explain why this graph cannot be interpreted accurately, and name one thing that should be added.

10. Mele records daily coffee sales at her Avondale café over one week: Mon 40, Tue 42, Wed 45, Thu 48, Fri 60, Sat 75, Sun 30. Describe the trend across the week and identify the most and least popular days.

Challenge

11. Two classes sat the same test (out of 75). Class A: 55, 60, 62, 65, 68, 70, 72. Class B: 40, 63, 64, 66, 67, 69, 71. Find the median and range for each class. Identify any outlier, and explain which class performed more consistently once the outlier is considered.

12. A company advert shows a bar graph of 'Customer Satisfaction' where Brand X's bar looks about twice as tall as Brand Y's. On closer look, the vertical axis starts at 90% (not 0%): Brand X = 96% and Brand Y = 94%. Explain how the graph is misleading and how it should be drawn to be fair.

Year 8 · Probability: Testing Your Luck: Experimental Probability

Name: _____ Date: _____

Hi! This sheet is all about doing chance experiments and working out probabilities from your results. You'll see how experimental probability compares to what should happen in theory, and why doing MORE trials usually gets you closer to the truth.

Warm-up

1. Ava flips a coin 40 times and gets 22 heads. What is the experimental probability of getting heads? Give your answer as a fraction and a decimal.

2. A spinner is spun 50 times and lands on red 15 times. What is the experimental probability of landing on red?

3. A die is rolled 60 times and a six comes up 8 times. What is the experimental probability of rolling a six? Give a fraction and a rounded decimal.

4. What is the theoretical probability of rolling a 4 on a fair six-sided die?

Practice

5. Sione rolls a fair die 30 times and records: 1 → 4 times, 2 → 6 times, 3 → 3 times, 4 → 7 times, 5 → 5 times, 6 → 5 times. Calculate the experimental probability of each outcome.

6. Using Sione's results above, compare his experimental probability of rolling a 4 to the theoretical probability. Why are they different?

7. At the Avondale School gala, Mereana runs a stall with a bag holding coloured cubes. She pulls one out, records the colour, and puts it back, doing this 100 times. Results: green 46, yellow 34, purple 20. Find the experimental probability of each colour.

8. Mereana's bag actually contains 10 cubes: 5 green, 3 yellow, 2 purple. Work out the theoretical probability of each colour and compare it with her experimental results.

9. Two students both roll the same fair die. Tama rolls it 20 times and gets 5 sixes (P = 0.25). Kiri rolls it 120 times and gets 22 sixes (P ≈ 0.18). Whose experimental probability is a better estimate of the true value of 1/6 ≈ 0.17, and why?

10. Explain, in your own words, what the Law of Large Numbers tells us about a chance experiment.

Challenge

11. Ropata suspects one of his dice is weighted. He rolls it 200 times and gets a six 60 times. (a) Find the experimental probability of a six. (b) What would you expect the count of sixes to be for a fair die over 200 rolls? (c) Do you think the die is weighted? Explain using the Law of Large Numbers.

12. A spinner has 4 unequal sections: A, B, C, D. In 50 spins the results are A 8, B 22, C 14, D 6. (a) Find the experimental probability of each section. (b) The spinner is then spun 500 times, giving A 60, B 250, C 130, D 60. Find the new experimental probabilities. (c) The true (theoretical) probabilities are A 0.12, B 0.50, C 0.26, D 0.12. Which set of trials gave estimates closer to the true values, and what does this show?

Year 8 · Probability: Working Out the Chances

Name: _____ Date: _____

Hi! This sheet helps you practise theoretical probability, working out how likely something is when all outcomes are equally likely. You'll write answers as fractions, decimals and percentages, compare events, and use complements. Have your working handy!

Warm-up

1. A fair six-sided dice is rolled once. What is the probability of rolling a 4? Give your answer as a fraction.

2. A spinner has 5 equal sections coloured red, blue, blue, green and yellow. What is the probability of landing on blue? Give your answer as a fraction and a decimal.

3. A single card is drawn from a standard 52-card deck. What is the probability it is a heart? Give your answer as a fraction.

4. The probability that it rains on Saturday in Avondale is 0.35. What is the probability that it does NOT rain?

Practice

5. A bag holds 20 marbles: 8 red, 7 blue and 5 green. One marble is taken at random. Find P(red) as a fraction, a decimal and a percentage.

6. Using the same bag of 20 marbles (8 red, 7 blue, 5 green), which is more likely: drawing a blue marble or drawing a green marble? Explain using probabilities.

7. A dice is rolled once. Find the probability of rolling a number greater than 4. Then find the probability of NOT rolling a number greater than 4.

8. Mereana spins a spinner with 8 equal sections numbered 1 to 8. What is the probability she spins an even number? Give your answer as a fraction and a percentage.

9. At the Avondale market, a raffle has 200 tickets. Tama buys 15 tickets. If one winning ticket is drawn at random, what is the probability Tama wins? Give your answer as a fraction and a decimal.

10. A pencil case contains 12 pens: 3 black, 4 blue, 2 red and 3 green. Aroha takes one pen without looking. Find P(black or red). Then find the probability she picks a pen that is neither black nor red.

Challenge

11. Two fair coins are tossed together. List all possible outcomes, then find the probability of getting exactly one head. Give your answer as a fraction and a percentage.

12. Two fair six-sided dice are rolled and the numbers are added. Use a table of all 36 outcomes to find the probability the total is 7. Then find the probability the total is NOT 7.

Answer key (for parents and tutors)

1. Write 5.83 in expanded form using powers of 10.
   $5.83 = 5 \times 10^0 + 8 \times 10^{-1} + 3 \times 10^{-2}$. ($10^0 = 1$, $10^{-1} = 1/10 = 0.1$, $10^{-2} = 1/100 = 0.01$, so $5 + 0.8 + 0.03 = 5.83$.)

2. Evaluate $\sqrt{64}$ and $\sqrt[3]{125}$.
   $\sqrt{64} = 8$, because $8 \times 8 = 64$. $\sqrt[3]{125} = 5$, because $5 \times 5 \times 5 = 125$.

3. Write 72 as a product of its prime factors, using exponents.
   $72 = 2 \times 36 = 2 \times 2 \times 18 = 2 \times 2 \times 2 \times 9 = 2 \times 2 \times 2 \times 3 \times 3$. Summarised with exponents: $72 = 2^3 \times 3^2$. (Check: $8 \times 9 = 72$.)

4. Calculate $-6 + 10$ and $4 + -9$.
   $-6 + 10 = 4$ (move 10 to the right of -6 on the number line). $4 + -9 = -5$ (adding -9 is the same as subtracting 9: $4 - 9 = -5$).

5. Order these numbers from smallest to largest: -3.4, -3, 0.5, -0.5, 2.1.
   Picture a number line. Negatives sit to the left of zero, and -3.4 is further left than -3. Order: $-3.4 < -3 < -0.5 < 0.5 < 2.1$.

6. Use the order of operations (GEMA) to evaluate $3 + 4 \times 2^2 - 5$.
   Exponents first: $2^2 = 4$, giving $3 + 4 \times 4 - 5$. Then multiply: $4 \times 4 = 16$, giving $3 + 16 - 5$. Then add and subtract left to right: $3 + 16 = 19$, $19 - 5 = 14$. Answer: 14.

7. Work out 2.3×45. Use estimation to check your answer is reasonable.
   Estimate first: $2 \times 45 = 90$ and $3 \times 45 = 135$, so the answer should be between 90 and 135. Now calculate: $23 \times 45 = 1035$, and since 2.3 has one decimal place, $2.3 \times 45 = 103.5$. This sits between 90 and 135, so it is reasonable.

8. Multiply the fractions and give your answer in simplest form: $\frac{2}{3} \times \frac{3}{4}$.
   Multiply numerators and denominators: $(2 \times 3)/(3 \times 4) = 6/12$. Simplify by dividing top and bottom by 6: $6/12 = \frac{1}{2}$. Answer: $\frac{1}{2}$.

9. A netball club in Avondale has 40 registered players. $\frac{3}{5}$ of them are juniors. How many juniors are there?
   $\frac{3}{5}$ of 40 = $\frac{3}{5} \times 40 = (3 \times 40)/5 = 120/5 = 24$. There are 24 junior players. (Check: $\frac{1}{5}$ of 40 = 8, and $3 \times 8 = 24$.)

10. Mere and Tane share $56 from their lemonade stall in the ratio 3 : 5. How much does each person get?
    Total parts = $3 + 5 = 8$. Value of one part = $56 \div 8 = $7. Mere gets $3 \times $7 = $21; Tane gets $5 \times $7 = $35. Check: $21 + $35 = $56. ✓

11. At Avondale Intermediate, 18 students in one Year 8 class walk or bike to school. This is 45% of the whole class. How many students are in the class altogether?
    If 45% = 18, then 1% = $18 \div 45 = 0.4$ students. The whole class is 100%, so $100 \times 0.4 = 40$ students. Check: 45% of $40 = 0.45 \times 40 = 18$. ✓ The class has 40 students.

12. Evaluate $5 \times (-3) + 2^3 - \sqrt{49}$, using the order of operations.
    Exponents and roots first: $2^3 = 8$ and $\sqrt{49} = 7$, giving $5 \times (-3) + 8 - 7$. Then multiply: $5 \times (-3) = -15$, giving $-15 + 8 - 7$. Then work left to right: $-15 + 8 = -7$, and $-7 - 7 = -14$. Answer: -14.

Answer key (for parents and tutors)

1. Find 10% of $45.
   10% means 0.10. 0.10 × $45 = $4.50. Answer: $4.50
2. A shirt costs $32. It has a 25% discount. How much is taken off?
   25% = 0.25. 0.25 × $32 = $8.00. Answer: $8.00 is taken off.
3. Round a cash payment of $18.67 to the nearest 10 cents.
   $18.67 is between $18.60 and $18.70. The last digit is 7, so round up to $18.70. Answer: $18.70
4. Aroha saves $6 each week. How much does she save in 8 weeks?
   $6 × 8 = $48. Answer: $48.00
5. A pair of sneakers at The Warehouse is $120 with a 35% discount. What is the new price?
   Discount = 0.35 × $120 = $42.00. New price = $120 − $42.00 = $78.00. Answer: $78.00
6. A jacket is priced at $89.99 with a 20% discount. Work out the sale price, rounded to two decimal places.
   Discount = 0.20 × $89.99 = $17.998 = $18.00 (to 2 dp). Sale price = $89.99 − $18.00 = $71.99. Answer: $71.99
7. Liam wants to save $312 for a bike. He plans to save $12 each week. How many weeks will it take?
   $312 ÷ $12 = 26. Answer: 26 weeks.
8. Phone Plan A costs $25 per month. Phone Plan B costs $6 per week. Over one year (52 weeks, 12 months), which plan is cheaper and by how much?
   Plan A: $25 × 12 = $300.00 per year. Plan B: $6 × 52 = $312.00 per year. Plan A is cheaper by $312 − $300 = $12.00. Answer: Plan A, by $12.00 per year.
9. Mia buys a $240 tablet using a 'buy now, pay later' plan of 6 equal fortnightly payments. There is a $9 setup fee added to the total. What is each payment?
   Total to pay = $240 + $9 = $249.00. Each payment = $249 ÷ 6 = $41.50. Answer: $41.50 per fortnight.
10. At the dairy, Sione's groceries come to $23.44. He pays with cash. What amount does he actually pay after rounding to the nearest 10 cents?
    $23.44 is between $23.40 and $23.50. The last digit is 4, so round down to $23.40. Answer: $23.40
11. A $150 speaker has a 30% discount. After the discount, GST is already included in the price. Emma pays cash. First find the discounted price, then round the cash payment to the nearest 10 cents.
    Discount = 0.30 × $150 = $45.00. Discounted price = $150 − $45.00 = $105.00. This is already a multiple of 10 cents, so the cash payment stays $105.00. Answer: $105.00
12. Ana compares two saving plans for a $520 holiday. Plan 1: save $20 per week. Plan 2: save $85 per month. Using 4 weeks per month, work out how many weeks each plan takes to reach $520, and state which is faster.
    Plan 1: $520 ÷ $20 = 26 weeks. Plan 2: $520 ÷ $85 = 6.12 months, so she needs 7 months to have enough. 7 months × 4 weeks = 28 weeks. Comparing: Plan 1 takes 26 weeks, Plan 2 takes about 28 weeks. Answer: Plan 1 (weekly saving) is faster, by about 2 weeks.

Answer key (for parents and tutors)

1. Solve: $x + 8 = 15$
   Subtract 8 from both sides: $x = 15 - 8 = 7$. Check: $7 + 8 = 15$. ✓ So $x = 7$.

2. Simplify: $4a + 3a - a$
   Collect like terms: $4a + 3a = 7a$, then $7a - a = 6a$. Answer: $6a$.

3. If $w = 5$, find the value of $w + 12$.
   Substitute $w = 5$: $5 + 12 = 17$. Answer: 17.

4. Solve: $3s = 18$
   Divide both sides by 3: $s = 18 \div 3 = 6$. Check: $3 \times 6 = 18$. ✓ So $s = 6$.

5. Solve: $5s + 9 = -6$
   Subtract 9 from both sides: $5s = -6 - 9 = -15$. Divide by 5: $s = -15 \div 5 = -3$. Check: $5 \times (-3) + 9 = -15 + 9 = -6$. ✓ So $s = -3$.

6. Solve: $t + 7 = 6.5$
   Subtract 7 from both sides: $t = 6.5 - 7 = -0.5$. Check: $-0.5 + 7 = 6.5$. ✓ So $t = -0.5$.

7. Expand and simplify: $2(x + 3) + 1$
   Expand the bracket: $2 \times x + 2 \times 3 = 2x + 6$. Then add 1: $2x + 6 + 1 = 2x + 7$. Answer: $2x + 7$.

8. Factorise fully: $5x - 35$
   The common factor of $5x$ and 35 is 5. Take it out: $5x - 35 = 5(x - 7)$. Check by expanding: $5 \times x - 5 \times 7 = 5x - 35$. ✓

9. Aroha buys 4 identical smoothies at the Avondale market and pays with a $20 note. She gets $3.20 change. Write and solve an equation to find the price of one smoothie.
   Let p be the price of one smoothie. Total spent = $20 - 3.20 = $16.80. Equation: $4p = 16.80$. Divide by 4: $p = 16.80 \div 4 = 4.20$. Each smoothie costs $4.20. Check: $4 \times 4.20 = 16.80$, and $20 - 16.80 = 3.20$. ✓

10. To hire a kayak on the Whau River costs a $12 booking fee plus $9 for each hour. The cost C in dollars for h hours is $C = 9h + 12$. (a) Find the cost for 4 hours. (b) Tane paid $75. Solve for how many hours he hired the kayak.
    (a) Substitute $h = 4$: $C = 9 \times 4 + 12 = 36 + 12 = 48. (b) Set $C = 75$: $9h + 12 = 75$. Subtract 12: $9h = 63$. Divide by 9: $h = 7$. Tane hired it for 7 hours. Check: $9 \times 7 + 12 = 63 + 12 = 75$. ✓

11. Solve the inequality $t - 3 \geq -5$ and show the solution on a number line.
    Add 3 to both sides: $t \geq -5 + 3$, so $t \geq -2$. On a number line, draw a filled (closed) circle at -2 (because $\geq$ includes -2) and shade the arrow to the right, covering all values greater than -2. Check with $t = 0$: $0 - 3 = -3$, and $-3 \geq -5$ is true. ✓

12. A tiling pattern grows so that shape 1 uses 5 tiles, shape 2 uses 8 tiles, shape 3 uses 11 tiles. (a) Write a rule for the number of tiles t in terms of the shape number n. (b) How many tiles are in shape 10? (c) Which shape uses 62 tiles?
    (a) The tiles increase by 3 each time, so the pattern is $t = 3n + d$. Using shape 1 ($n = 1$, $t = 5$): $5 = 3 \times 1 + d$, so $d = 2$. Rule: $t = 3n + 2$. (b) Substitute $n = 10$: $t = 3 \times 10 + 2 = 32$ tiles. (c) Set $t = 62$: $3n + 2 = 62$, so $3n = 60$, $n = 20$. Shape 20 uses 62 tiles. Check: $3 \times 20 + 2 = 62$. ✓

Answer key (for parents and tutors)

1. Convert 5 m^2 into cm^2.
   1 m^2 = 100 cm × 100 cm = 10 000 cm^2. So 5 m^2 = 5 × 10 000 = 50 000 cm^2.

2. Find the area of a parallelogram with base 8 cm and height 5 cm.
   A = bh = 8 × 5 = 40 cm^2.

3. Convert 2.5 L into cm^3.
   1 L = 1000 cm^3. So 2.5 L = 2.5 × 1000 = 2500 cm^3.

4. Convert 2 hours 45 minutes into minutes.
   2 hours = 2 × 60 = 120 minutes. 120 + 45 = 165 minutes.

5. Find the area of a trapezium with parallel sides a = 6 cm and b = 10 cm, and height h = 4 cm.
   A = ½(a + b)h = ½ × (6 + 10) × 4 = ½ × 16 × 4 = ½ × 64 = 32 cm^2.

6. A triangular prism has a triangular cross-section with base 6 cm and height 4 cm, and a length of 10 cm. Find its volume.
   V = ½bhl = ½ × 6 × 4 × 10 = ½ × 240 = 120 cm^3.

7. A parallelogram has an area of 60 cm^2 and a height of 5 cm. Find the length of its base.
   A = bh, so 60 = b × 5. Divide both sides by 5: b = 60 ÷ 5 = 12 cm.

8. Mereana fills a fish tank shaped like a rectangular prism that is 50 cm long, 30 cm wide and 40 cm high. How many litres of water does it hold when full?
   Volume = length × width × height = 50 × 30 × 40 = 60 000 cm^3. Since 1 L = 1000 cm^3, capacity = 60 000 ÷ 1000 = 60 L.

9. The train from New Lynn departs at 7:52 am and arrives at Britomart at 8:29 am. How long is the trip, in minutes?
   From 7:52 am to 8:52 am would be 60 minutes, but arrival is at 8:29 am. From 7:52 to 8:00 is 8 minutes; from 8:00 to 8:29 is 29 minutes. 8 + 29 = 37 minutes.

10. A solid is made of two rectangular prisms. The bottom prism is 10 cm × 6 cm × 4 cm and the top prism is 4 cm × 4 cm × 5 cm. Find the total volume.
    Bottom prism: 10 × 6 × 4 = 240 cm^3. Top prism: 4 × 4 × 5 = 80 cm^3. Total volume = 240 + 80 = 320 cm^3.

11. A barn-shaped storage shed is a composite prism 10 m long. The lower part is a rectangular prism 4 m wide and 3 m high. On top sits a triangular prism (the roof) with base 4 m and height 2 m. Find the total volume, then write it in litres.
    Rectangular part: V = 4 × 3 × 10 = 120 m^3. Triangular roof: V = ½bhl = ½ × 4 × 2 × 10 = 40 m^3. Total = 120 + 40 = 160 m^3. Since 1 m^3 = 1000 L, volume = 160 × 1000 = 160 000 L.

12. A rainwater tank is a rectangular prism 1.2 m long, 0.8 m wide and 1.5 m high. A pump fills it at 15 L per minute. Starting empty, how long will it take to fill completely? Give your answer in hours and minutes.
    Volume = 1.2 × 0.8 × 1.5 = 1.44 m^3. Convert to litres: 1.44 × 1000 = 1440 L. Time = 1440 ÷ 15 = 96 minutes. 96 minutes = 60 + 36 = 1 hour 36 minutes.

Answer key (for parents and tutors)

1. What is the name for the distance from the centre of a circle to its edge?
   The radius. It runs from the centre point out to any point on the circle's edge.
2. What is the name for the distance all the way around a circle?
   The circumference. It is the total distance around the outside of the circle.
3. A line goes straight through the centre of a circle and touches opposite edges. What is this line called?
   The diameter. It passes through the centre and joins two opposite points on the edge.
4. A circle has a radius of 5 cm. What is its diameter?
   The diameter is twice the radius. 5 cm × 2 = 10 cm.
5. A circle has a diameter of 18 cm. What is its radius?
   The radius is half the diameter. 18 cm ÷ 2 = 9 cm.
6. A circle has a radius of 12 mm. What is its diameter?
   The diameter is twice the radius. 12 mm × 2 = 24 mm.
7. Aroha draws a circle with a diameter of 30 cm. She then draws a radius. How long is the radius?
   The radius is half the diameter. 30 cm ÷ 2 = 15 cm.
8. Which part of a circle is longer: the radius or the diameter? Explain why.
   The diameter is longer. The diameter goes all the way across through the centre, while the radius only goes from the centre to the edge, half the distance. The diameter is exactly twice the radius.
9. Tane is decorating a round pizza with a ribbon of chocolate sauce along its circumference. The pizza has a radius of 14 cm. What is the diameter of the pizza?
   The diameter is twice the radius. 14 cm × 2 = 28 cm. (The ribbon of sauce follows the circumference, the distance around the pizza.)
10. At Avondale Primary, a round trampoline has a diameter of 3.6 m. What is the radius of the trampoline?
    The radius is half the diameter. 3.6 m ÷ 2 = 1.8 m.
11. A circular garden pond has a radius of 1.5 m. A path goes straight across the middle of the pond (the diameter), and then Mere walks halfway around the edge from one end of the path to the other. Which is the distance across the pond (the diameter), and by roughly how much would the distance around half the edge be longer? (Use 3 as a rough value for how many diameters fit around a circle.)
    First find the diameter: 1.5 m × 2 = 3 m. The full circumference is about 3 × the diameter = 3 × 3 m = 9 m, so halfway around the edge is about 9 m ÷ 2 = 4.5 m. The straight path across is 3 m, so walking around half the edge (4.5 m) is about 4.5 − 3 = 1.5 m longer than walking straight across.
12. Two circles are drawn. The smaller circle has a diameter equal to the radius of the larger circle. If the larger circle has a radius of 20 cm, what is the diameter and the radius of the smaller circle?
    The smaller circle's diameter equals the larger circle's radius, so the smaller diameter = 20 cm. The smaller circle's radius is half of its own diameter: 20 cm ÷ 2 = 10 cm. So the smaller circle has a diameter of 20 cm and a radius of 10 cm.

Answer key (for parents and tutors)

1. Decide whether each variable is categorical, discrete numerical, or continuous numerical: (a) favourite ice cream flavour, (b) number of pets in a house, (c) the height of a student in centimetres.
   (a) Favourite flavour puts people into groups, so it is categorical. (b) You count whole pets, so it is discrete numerical. (c) Height is measured and can take any value, so it is continuous numerical.

2. Find the mean of these test scores: 6, 8, 7, 9, 10.
   Add them: 6 + 8 + 7 + 9 + 10 = 40. Divide by how many values (5): 40 ÷ 5 = 8. The mean is 8.

3. Find the median of: 12, 5, 9, 3, 7.
   Sort the values: 3, 5, 7, 9, 12. The middle value is the third one, which is 7. The median is 7.

4. Find the range of these temperatures (°C): 14, 21, 18, 9, 25.
   Highest value is 25, lowest value is 9. Range = 25 − 9 = 16°C.

5. Find the mode of these shoe sizes recorded at Vertex Academy: 7, 8, 8, 6, 9, 8, 7, 10.
   Count how often each size appears: size 7 appears 2 times, size 8 appears 3 times, sizes 6, 9 and 10 appear once each. The size with the highest frequency is 8, so the mode is size 8.

6. For the data set 4, 11, 6, 4, 9, 8, find (a) the mean, (b) the median, (c) the range.
   (a) Mean: 4 + 11 + 6 + 4 + 9 + 8 = 42, then 42 ÷ 6 = 7. (b) Median: sort them 4, 4, 6, 8, 9, 11. With 6 values the median is the average of the two middle numbers (6 and 8): (6 + 8) ÷ 2 = 7. (c) Range: 11 − 4 = 7.

7. Mila measured the length of everyone's right foot in her whānau (in cm): 22, 24, 24, 26, 29. Her statistical question is 'Are our feet the same length?' Find the median foot length and the range, then answer her question.
   The data is already sorted: 22, 24, 24, 26, 29. The middle value (third of five) is the median = 24 cm. Range = 29 − 22 = 7 cm. Because the range is 7 cm, the feet are not all the same length, they vary by up to 7 cm.

8. At a Saturday market in Avondale, a stall sold these numbers of pies each hour: 15, 22, 18, 22, 13. Find the mean number of pies sold per hour and the mode.
   Mean: 15 + 22 + 18 + 22 + 13 = 90, then 90 ÷ 5 = 18 pies per hour. Mode: the value 22 appears twice (more than any other), so the mode is 22 pies.

9. Tane wants to answer 'How long do students take to walk to school?' He records these times in minutes: 8, 15, 10, 12, 20, 15. (a) Is walking time a discrete or continuous variable? (b) Find the mean and (c) the range.
   (a) Time is measured, so walking time is a continuous numerical variable. (b) Mean: 8 + 15 + 10 + 12 + 20 + 15 = 80, then 80 ÷ 6 = 13.33 minutes (about 13.3 minutes). (c) Range: 20 − 8 = 12 minutes.

10. A netball team scored these goals over 7 games: 24, 30, 28, 24, 35, 24, 31. Find the mean, median, mode and range.
    Mean: 24 + 30 + 28 + 24 + 35 + 24 + 31 = 196, then 196 ÷ 7 = 28. Median: sort them 24, 24, 24, 28, 30, 31, 35; the middle value (fourth of seven) is 28. Mode: 24 appears three times, so the mode is 24. Range: 35 − 24 = 11.

11. A group of 5 students has a mean age of 12 years. A sixth student joins and the new mean becomes 12.5 years. How old is the sixth student?
    The total age of the first 5 students = mean × count = 12 × 5 = 60 years. With 6 students the new total = 12.5 × 6 = 75 years. The sixth student's age = 75 − 60 = 15 years.

12. A data set of five whole numbers has a mode of 6, a median of 6, a mean of 7, and a range of 8. Find a possible set of five numbers.
    List positions as a, b, c, d, e in order. The median (middle value) is 6, so c = 6. The mode is 6, so 6 must appear most often, make b = 6 as well. The mean is 7, so the total = 7 × 5 = 35. So far a + 6 + 6 + d + e = 35, meaning a + d + e = 23. The range is 8, so e − a = 8. Try a = 4, then e = 12, giving d = 23 − 4 − 12 = 7. Check order: 4, 6, 6, 7, 12 (sorted correctly). Mode = 6 (appears twice, most often), median = 6, mean = (4+6+6+7+12) ÷ 5 = 35 ÷ 5 = 7, range = 12 − 4 = 8. A possible set is 4, 6, 6, 7, 12.

Answer key (for parents and tutors)

1. Name the type of graph that is best for showing how a single number changes over time (for example, daily temperature in Avondale over one week).
   A time-series graph. It plots time along the bottom (horizontal) axis and the numerical variable up the side, joining the points to show the trend.

2. A class recorded their favourite lunch: 8 chose pies, 5 chose sushi, 4 chose sandwiches, 3 chose salad. Is this data categorical or numerical?
   Categorical. The values are named groups (pies, sushi, sandwiches, salad), not measurements or counts of a quantity on each person.

3. Look at this dot plot of goals scored by a netball team in 6 games: 2, 3, 3, 4, 4, 12. Which value looks like an outlier?
   12 is the outlier. Five of the values sit between 2 and 4, but 12 is far larger than all of them.

4. True or false: an outlier pulls the mean towards itself but has little effect on the median. Explain in one sentence.
   True. The mean uses the actual size of every value, so a very large or small value drags it across, while the median is just the middle-ordered value and barely moves.

5. Mele surveyed 20 students at Vertex Academy about how they travel to the centre: Walk 7, Bus 6, Car 5, Bike 2. Describe how you would draw a bar graph for this, including what each axis shows.
   Put the four travel types (Walk, Bus, Car, Bike) along the horizontal axis, spaced apart with gaps between the bars because the data is categorical. The vertical axis shows frequency (number of students) from 0 to at least 7, marked in 1s. Draw a bar of height 7 for Walk, 6 for Bus, 5 for Car and 2 for Bike. Give the graph a title such as 'How 20 Vertex students travel to the centre'.

6. A shop tracked ice-cream sales (in dollars) each month from January to June: $900, $760, $540, $420, $300, $250. What graph should you use, and what trend does it show?
   Use a time-series graph, because the data is a numerical variable measured over time. Plot months Jan–Jun along the horizontal axis and sales ($) up the vertical axis, then join the points. The trend is a steady decrease in sales from summer into winter, dropping from $900 in January to $250 in June.

7. Year 8 students were asked their favourite sport, split by boys and girls. Boys: Rugby 10, Football 6, Netball 2. Girls: Rugby 4, Football 5, Netball 9. What kind of graph best compares the two groups, and why?
   A clustered (side-by-side) bar graph or a stacked bar graph, because there are two categorical variables: sport and gender. A clustered bar graph works well here: for each sport, draw a pair of bars (one for boys, one for girls) next to each other, using a key/legend. This lets you compare boys and girls directly for each sport, for example, more boys chose rugby while more girls chose netball.

8. Here are the heights (cm) of 9 plants in a school garden: 22, 24, 25, 25, 26, 27, 28, 29, 61. (a) Find the median. (b) Find the mean. (c) Explain what the outlier does to each.
   (a) Order the data (already ordered). With 9 values the median is the 5th value = 26 cm. (b) Mean = (22+24+25+25+26+27+28+29+61) ÷ 9 = 267 ÷ 9 = 29.67 cm (2 d.p.). (c) The outlier is 61 cm. It pulls the mean up to about 29.7 cm, higher than 8 of the 9 plants, so the mean is misleading. The median stays at 26 cm, close to most plants, so the median describes this data better.

9. Aroha made a time-series graph of her weekly savings and noticed one week jumped from about $15 up to $140, then went back to normal. Give one sensible reason this is NOT an error, and say whether she should delete it.
   A one-off event could explain it, for example she received a birthday gift or a pay-out that week. This is a genuine rare event, not a mistake, so she should keep it in her data, but she can note it so anyone reading the graph understands the spike.

10. A café owner has this data and wants ONE graph: the number of customers each hour from 8am to 12pm (8am: 12, 9am: 20, 10am: 35, 11am: 18, 12pm: 40). What graph type fits best, and what does the pattern suggest?
    A time-series graph, since it is a numerical count recorded across time (each hour). Plot the hours on the horizontal axis and customers on the vertical axis, then join the points. The pattern shows a busy mid-morning peak at 10am (35 customers) and a lunchtime rise to 40 at 12pm, with a quieter dip at 11am (18). The owner could add extra staff around 10am and midday.

11. A class tracked recycling collected (kg) over 5 weeks for two rooms. Room A: 8, 9, 10, 11, 12. Room B: 2, 3, 4, 5, 46. (a) Which room has an outlier and what is it? (b) Compare the medians of the two rooms. (c) Which room truly recycles more consistently, and why can the mean be misleading here?
(a) Room B has an outlier: 46 kg, far larger than its other values (2–5 kg). (b) Room A median = 3rd value = 10 kg. Room B median = 3rd value = 4 kg. So Room A's median is much higher. (c) Room A recycles more consistently, its values are all close together (8–12 kg). Room B's mean = (2+3+4+5+46) ÷ 5 = 60 ÷ 5 = 12 kg, which looks equal to Room A, but that mean is inflated by the single 46 kg week. The median (4 kg) shows Room B usually recycles very little, so the mean is misleading.

12. A student wants to show, in ONE graph, how many students in each of Years 7, 8 and 9 answered 'Yes' or 'No' to using the school bus. Data, Year 7: Yes 30, No 10; Year 8: Yes 20, No 20; Year 9: Yes 15, No 25. (a) Name a suitable graph and explain your choice. (b) Describe what a stacked bar graph would show that a clustered one might not. (c) State one clear pattern in the data.
(a) A clustered or stacked bar graph is suitable because there are two categorical variables: year level and bus use (Yes/No). Put Year 7, 8, 9 on the horizontal axis with a key for Yes/No. (b) A stacked bar graph stacks Yes on top of No so each bar's total height shows the class size (40 students each), making it easy to compare proportions within each year, for example the Yes portion shrinks as year level rises. A clustered graph makes it easier to compare exact Yes and No counts side by side but does not show the total as clearly. (c) Clear pattern: bus use decreases with age, 'Yes' falls from 30 (Year 7) to 20 (Year 8) to 15 (Year 9), while 'No' rises the opposite way.

Answer key (for parents and tutors)

1. Find the median of these scores: 4, 7, 9, 2, 6.
   Put them in order: 2, 4, 6, 7, 9. There are 5 values, so the middle one is the 3rd value. Median = 6.

2. Find the range of these heights (cm): 12, 18, 5, 22, 9.
   Range = largest − smallest = 22 − 5 = 17 cm.

3. A dot plot has a long tail stretching to the right and most dots bunched on the left. Is it positively or negatively skewed?
   The right tail tapers more slowly (stretches out), so the data is positively skewed.

4. Find the median of this even-sized set: 3, 8, 10, 15.
   Already in order. With 4 values, the median is the mean of the middle two (8 and 10). Median = (8 + 10) ÷ 2 = 9.

5. Ten students recorded how many minutes they read one night: 20, 25, 30, 15, 40, 35, 25, 30, 45, 20. Find the median and the range.
   Order the data: 15, 20, 20, 25, 25, 30, 30, 35, 40, 45. There are 10 values, so the median is the mean of the 5th and 6th values (25 and 30). Median = (25 + 30) ÷ 2 = 27.5 minutes. Range = 45 − 15 = 30 minutes.

6. Aroha's netball team scored these goals over 7 games: 12, 15, 9, 14, 11, 13, 10. Find the median number of goals and the range, then write one sentence describing the team's scoring.
   Order the data: 9, 10, 11, 12, 13, 14, 15. There are 7 values, so the median is the 4th value = 12 goals. Range = 15 − 9 = 6 goals. Sample sentence: The team typically scored about 12 goals per game, and their scores were fairly consistent, only varying by 6 goals across the season.

7. A newspaper histogram shows house sale prices in Avondale. Most bars are tall on the left (lower prices) and a few short bars stretch far to the right (very expensive houses). Describe the shape of the data and say where the middle of the data lies compared with the highest prices.
   The shape is positively skewed (right-skewed): the right tail tapers more slowly because of a few very expensive houses. The middle of the data (the median) sits toward the left, among the more common lower prices, well below the few high prices in the long right tail.

8. Weekly water use (litres) for 7 households was: 22, 24, 23, 25, 21, 24, 78. Identify the outlier by eye, then find the range with and without it. Which range better describes the typical spread?
   By eye, 78 is an outlier, it is far larger than the cluster of values around 21–25. Range with the outlier = 78 − 21 = 57 litres. Range without it = 25 − 21 = 4 litres. The range without the outlier (4 litres) better describes the typical spread, because 57 is heavily inflated by one unusual value.

9. A social media post shows a bar graph titled 'Best Sports at Our School' but the vertical axis has no numbers or label. Explain why this graph cannot be interpreted accurately, and name one thing that should be added.
   Without a labelled and numbered vertical axis, you cannot tell how many students each bar represents or what the values actually are, you can only compare bar heights roughly, and even that may be misleading. It could be hiding how small the real differences are. To fix it, add a numbered scale and a label on the vertical axis (for example 'Number of students'), and check that the scale starts at 0.

10. Mele records daily coffee sales at her Avondale café over one week: Mon 40, Tue 42, Wed 45, Thu 48, Fri 60, Sat 75, Sun 30. Describe the trend across the week and identify the most and least popular days.
    Sales rise steadily from Monday to Saturday, peaking at 75 on Saturday, then drop sharply to 30 on Sunday. The most popular day is Saturday (75 coffees) and the least popular is Sunday (30 coffees). Trend: sales build up through the week toward the weekend, then fall away on Sunday.

11. Two classes sat the same test (out of 75). Class A: 55, 60, 62, 65, 68, 70, 72. Class B: 40, 63, 64, 66, 67, 69, 71. Find the median and range for each class. Identify any outlier, and explain which class performed more consistently once the outlier is considered.
    Class A (already ordered): 7 values, median = 4th value = 65. Range = 72 − 55 = 17. Class B (already ordered): 7 values, median = 4th value = 66. Range = 71 − 40 = 31. Class B has an outlier of 40, which is much lower than the rest of its scores (63–71). This outlier makes Class B's range look large. Without the 40, Class B's range = 71 − 63 = 8,

which is smaller than Class A's range of 17. So although Class B looks more spread out, once the outlier is taken into account Class B was actually the more consistent class, and both classes had very similar medians (65 and 66).

12. A company advert shows a bar graph of 'Customer Satisfaction' where Brand X's bar looks about twice as tall as Brand Y's. On closer look, the vertical axis starts at 90% (not 0%): Brand X = 96% and Brand Y = 94%. Explain how the graph is misleading and how it should be drawn to be fair.
By starting the vertical axis at 90% instead of 0%, the graph exaggerates a tiny difference. The real gap is only 96% – 94% = 2 percentage points, but the truncated axis makes Brand X's bar appear roughly twice the height of Brand Y's, suggesting a much bigger difference than actually exists. To be fair, the axis should start at 0%, which would show both bars nearly the same height, correctly reflecting that the two brands are very close in satisfaction. The starting value of the axis should also be clearly labelled.

Answer key (for parents and tutors)

1. Ava flips a coin 40 times and gets 22 heads. What is the experimental probability of getting heads? Give your answer as a fraction and a decimal.
   Experimental probability = (times it happened) ÷ (total trials) = 22 ÷ 40 = 22/40 = 11/20 = 0.55.
2. A spinner is spun 50 times and lands on red 15 times. What is the experimental probability of landing on red?
   15 ÷ 50 = 15/50 = 3/10 = 0.30.
3. A die is rolled 60 times and a six comes up 8 times. What is the experimental probability of rolling a six? Give a fraction and a rounded decimal.
   8 ÷ 60 = 8/60 = 2/15 ≈ 0.13 (rounded to 2 decimal places).
4. What is the theoretical probability of rolling a 4 on a fair six-sided die?
   A fair die has 6 equally likely outcomes, and only one is a 4, so the theoretical probability = 1/6 ≈ 0.17.
5. Sione rolls a fair die 30 times and records: 1 → 4 times, 2 → 6 times, 3 → 3 times, 4 → 7 times, 5 → 5 times, 6 → 5 times. Calculate the experimental probability of each outcome.
   Total trials = 4+6+3+7+5+5 = 30 (correct). Divide each count by 30: P(1)=4/30=2/15≈0.13; P(2)=6/30=1/5=0.20; P(3)=3/30=1/10=0.10; P(4)=7/30≈0.23; P(5)=5/30=1/6≈0.17; P(6)=5/30=1/6≈0.17. (The probabilities add to 1.)
6. Using Sione's results above, compare his experimental probability of rolling a 4 to the theoretical probability. Why are they different?
   Experimental P(4) = 7/30 ≈ 0.23. Theoretical P(4) = 1/6 ≈ 0.17. They differ because 30 trials is a small number, so random chance means some outcomes come up more often than expected just by luck. Doing many more rolls would usually bring the experimental value closer to 0.17.
7. At the Avondale School gala, Mereana runs a stall with a bag holding coloured cubes. She pulls one out, records the colour, and puts it back, doing this 100 times. Results: green 46, yellow 34, purple 20. Find the experimental probability of each colour.
   Total = 46+34+20 = 100. P(green)=46/100=0.46; P(yellow)=34/100=0.34; P(purple)=20/100=0.20. (These add to 1.00.)
8. Mereana's bag actually contains 10 cubes: 5 green, 3 yellow, 2 purple. Work out the theoretical probability of each colour and compare it with her experimental results.
   Theoretical: P(green)=5/10=0.50; P(yellow)=3/10=0.30; P(purple)=2/10=0.20. Compared with experiment (0.46, 0.34, 0.20): purple matches exactly, while green and yellow are a little off due to random variation. The values are close because she did 100 trials, a large number of trials.
9. Two students both roll the same fair die. Tama rolls it 20 times and gets 5 sixes (P = 0.25). Kiri rolls it 120 times and gets 22 sixes (P ≈ 0.18). Whose experimental probability is a better estimate of the true value of 1/6 ≈ 0.17, and why?
   Kiri's estimate (≈0.18) is better because it is closer to 0.17 and, more importantly, it is based on 120 trials. According to the Law of Large Numbers, more trials give an experimental probability closer to the theoretical probability. Tama's 20 trials are easily affected by luck.
10. Explain, in your own words, what the Law of Large Numbers tells us about a chance experiment.
    Sample answer: The Law of Large Numbers says that as you do more and more trials of the same experiment, the experimental probability of each outcome gets closer and closer to its theoretical probability. A small number of trials can be far off due to random luck, but a large number of trials usually 'settles down' near the true value.
11. Ropata suspects one of his dice is weighted. He rolls it 200 times and gets a six 60 times. (a) Find the experimental probability of a six. (b) What would you expect the count of sixes to be for a fair die over 200 rolls? (c) Do you think the die is weighted? Explain using the Law of Large Numbers.
    (a) P(six) = 60/200 = 0.30. (b) For a fair die, expected sixes = 200 × 1/6 ≈ 33 (about 33 sixes). (c) The experimental probability 0.30 is much higher than the theoretical 0.17, and 60 sixes is nearly double the expected 33. Because 200 is a large number of trials, the Law of Large Numbers says the result should be close to 1/6 if the die were fair. Since it is so far off, it is strong evidence the die is weighted towards six.

12. A spinner has 4 unequal sections: A, B, C, D. In 50 spins the results are A 8, B 22, C 14, D 6. (a) Find the experimental probability of each section. (b) The spinner is then spun 500 times, giving A 60, B 250, C 130, D 60. Find the new experimental probabilities. (c) The true (theoretical) probabilities are A 0.12, B 0.50, C 0.26, D 0.12. Which set of trials gave estimates closer to the true values, and what does this show?
(a) 50 spins: P(A)=8/50=0.16; P(B)=22/50=0.44; P(C)=14/50=0.28; P(D)=6/50=0.12. (b) 500 spins: P(A)=60/500=0.12; P(B)=250/500=0.50; P(C)=130/500=0.26; P(D)=60/500=0.12. (c) The 500-spin results match the true values almost exactly (0.12, 0.50, 0.26, 0.12), while the 50-spin results were more spread out (especially A and B). This demonstrates the Law of Large Numbers: increasing the number of trials from 50 to 500 made the experimental probabilities settle very close to the theoretical probabilities.

Answer key (for parents and tutors)

1. A fair six-sided dice is rolled once. What is the probability of rolling a 4? Give your answer as a fraction.
   There is 1 way to roll a 4 and 6 possible outcomes. P(4) = 1/6.

2. A spinner has 5 equal sections coloured red, blue, blue, green and yellow. What is the probability of landing on blue? Give your answer as a fraction and a decimal.
   There are 2 blue sections out of 5. P(blue) = 2/5 = 0.4.

3. A single card is drawn from a standard 52-card deck. What is the probability it is a heart? Give your answer as a fraction.
   There are 13 hearts out of 52 cards. P(heart) = 13/52 = 1/4.

4. The probability that it rains on Saturday in Avondale is 0.35. What is the probability that it does NOT rain?
   An event and its complement add to 1. P(no rain) = 1 − 0.35 = 0.65.

5. A bag holds 20 marbles: 8 red, 7 blue and 5 green. One marble is taken at random. Find P(red) as a fraction, a decimal and a percentage.
   There are 8 red out of 20 marbles. P(red) = 8/20 = 2/5 = 0.4 = 40%.

6. Using the same bag of 20 marbles (8 red, 7 blue, 5 green), which is more likely: drawing a blue marble or drawing a green marble? Explain using probabilities.
   P(blue) = 7/20 = 0.35 and P(green) = 5/20 = 1/4 = 0.25. Since 0.35 > 0.25, drawing a blue marble is more likely.

7. A dice is rolled once. Find the probability of rolling a number greater than 4. Then find the probability of NOT rolling a number greater than 4.
   Numbers greater than 4 are 5 and 6, so 2 outcomes out of 6. P(>4) = 2/6 = 1/3. The complement: P(not >4) = 1 − 1/3 = 2/3.

8. Mereana spins a spinner with 8 equal sections numbered 1 to 8. What is the probability she spins an even number? Give your answer as a fraction and a percentage.
   Even numbers are 2, 4, 6, 8, that's 4 out of 8. P(even) = 4/8 = 1/2 = 50%.

9. At the Avondale market, a raffle has 200 tickets. Tama buys 15 tickets. If one winning ticket is drawn at random, what is the probability Tama wins? Give your answer as a fraction and a decimal.
   Tama holds 15 tickets out of 200. P(win) = 15/200 = 3/40 = 0.075.

10. A pencil case contains 12 pens: 3 black, 4 blue, 2 red and 3 green. Aroha takes one pen without looking. Find P(black or red). Then find the probability she picks a pen that is neither black nor red.
    Black or red pens: 3 + 2 = 5 out of 12. P(black or red) = 5/12. The complement is neither black nor red: P = 1 − 5/12 = 7/12. (Check: blue + green = 4 + 3 = 7, so 7/12. ✓)

11. Two fair coins are tossed together. List all possible outcomes, then find the probability of getting exactly one head. Give your answer as a fraction and a percentage.
    List all outcomes: HH, HT, TH, TT, that's 4 equally likely outcomes. Exactly one head happens in HT and TH, so 2 outcomes. P(exactly one head) = 2/4 = 1/2 = 50%.

12. Two fair six-sided dice are rolled and the numbers are added. Use a table of all 36 outcomes to find the probability the total is 7. Then find the probability the total is NOT 7.
    There are 6 × 6 = 36 equally likely outcomes. Totals of 7 come from: (1,6), (2,5), (3,4), (4,3), (5,2), (6,1), that's 6 ways. P(total = 7) = 6/36 = 1/6. The complement: P(not 7) = 1 − 1/6 = 5/6.