

### Summary of students' performance by the end of Grade 6

#### Reasoning and problem solving

Students represent and interpret routine and non-routine mathematical problems in a range of contexts. They change from one representation to another when it would help to solve a problem. They explain their methods and reasoning, orally and in writing. They check the reasonableness of calculated results, for example, by using estimation. They search systematically for all possibilities in a given situation. They identify patterns in data or results and generalise where appropriate. They use ICT to support their mathematical work.

#### Number and algebra

Students calculate efficiently with whole numbers and decimals, without and with a calculator, and explain and justify their chosen methods. They use a range of strategies to calculate mentally. They use written column methods to add and subtract decimals and to multiply and divide them by a one- or two-digit whole number. They estimate answers to calculations and check results using inverse operations. They find and use factors and multiples of numbers, and identify prime numbers. They cancel common factors to reduce a fraction to its simplest form, and add and subtract proper fractions with different denominators. They change fractions to decimals or percentages, and vice versa, and calculate fractional or percentage parts of quantities and measurements, using a calculator where appropriate. They use simple ratios and apply proportional reasoning. Students simplify and evaluate simple algebraic expressions, and construct and solve simple linear equations. Given a rule, they generate the terms of a sequence. They use ordered coordinate pairs to plot points that follow a simple rule. They apply their skills to solving a range of routine and non-routine problems, including mathematical and real-life problems.

#### Geometry and measures

Students reflect a 2-D shape in a given mirror line and rotate a 2-D shape about one of its vertices. They recognise vertically opposite angles, angles on a straight line and around a point. They know angle sum of a triangle and use this property to find the angle sum of a quadrilateral. They use these and other properties to identify equal sides or to find the values of angles in geometric figures. They use a ruler and protractor to construct triangles, given two sides and the included angle, or two angles and the included side. They solve problems involving the area of rectangles, triangles and parallelograms, and the volume and surface area of cuboids. They find the volume of liquid in cuboid containers.

#### Data handling

Students answer questions by collecting data and representing them in tables and bar charts. They interpret and draw conclusions from bar charts and pie charts (circle graphs), including those generated by ICT. They understand and use the mean and median of discrete data, and describe characteristics of a data set using the range and the mode.

## Content and assessment weightings for Grade 6

The mathematics standards for Grades K to 9 are grouped into four strands: reasoning and problem solving; number and algebra; geometry and measures; and data handling.

The reasoning and problem solving strand cuts across the other three strands and should be integrated with them in teaching and assessments. For Grade 6, about 60% of the teaching and assessment of each of the other three strands should be devoted to reasoning and problem solving.

For Grades 1 to 6, the weightings of the three content strands relative to each other are as follows:

Number and algebra	Geometry and measures	Data handling
60%	30%	10%

The standards are numbered for easy reference. Those in shaded rectangles, e.g. 1.2, are the performance standards for all students. The national tests for mathematics will be based on these standards.

**Grade 6 teachers should review and consolidate Grade 5 standards where necessary.**

### Reasoning and problem solving

By the end of Grade 6, students represent and interpret routine and non-routine mathematical problems in a range of contexts. They change from one representation to another when it would help to solve a problem. They explain their methods and reasoning, orally and in writing. They check the reasonableness of calculated results, for example, by using estimation. They search systematically for all possibilities in a given situation. They identify patterns in data or results and generalise where appropriate. They use ICT to support their mathematical work.

#### Key standards

Key performance standards are shown in shaded rectangles, e.g. **1.2**.

#### Cross-references

Standards are referred to using the notation RP for reasoning and problem solving, NA for number and algebra, GM for geometry and measures, and DH for data handling, e.g. standard NA 2.3.

#### Examples of problems

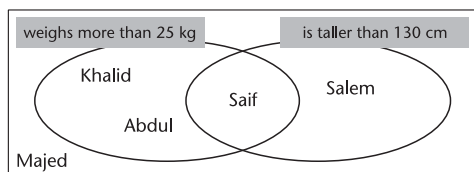
The examples of problems in italics are intended to clarify the standards, not to represent the full range of possible problems.

#### Students should:

### 1 Use mathematical reasoning to solve problems

- 1.1** Model or represent problems from a range of contexts; change from one representation to another.

*Five children sorted themselves into these sets.*

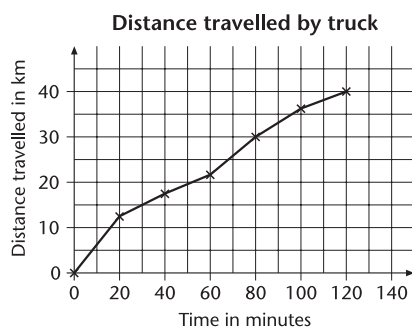


*Complete this diagram to show the same information.*

	is taller than 130 cm	is not taller than 130 cm
weighs more than 25 kg		
does not weigh more than 25 kg		

- 1.2** Explain their methods and reasoning, orally and in writing.

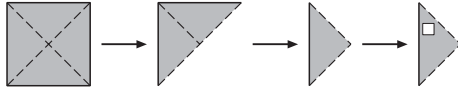
*This graph shows how far a truck had travelled through the desert at different times.*



*Adel says: 'The truck travelled further in the first hour than in the second hour'. Explain how the graph shows this.*

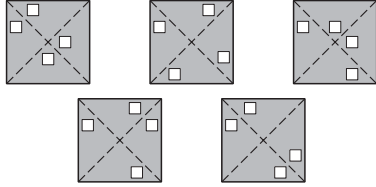
Imagine a square of paper.

Imagine folding it in half, then in half again, then cutting out one small square.



Then unfold your paper.

Circle the diagram below that shows what your paper looks like now.



Explain how you know.

Ghada thinks of a number.

She says: 'Halve my number and then add 17. The answer is 83.'

What is Ghada's number?

Explain how you worked out your answer.

Leila knows that  $65 \times 3 = 195$ .

Explain how she can use this information to find the answer to  $165 \times 3$ .

**1.3** Check the reasonableness of calculated results, for example, by estimating.

Circle the best estimate of the answer to  $32.7 \times 0.48$ .

1.2    1.6    12    16    120    160

**1.4** Search systematically for all possibilities in a given situation.

Use the digits 5, 0, 4, 7.

How many different three-digit numbers can you make?

In each number, each digit must be different.

An isosceles triangle has a perimeter of 12 cm.

One of its sides is 5 cm.

What could the length of each of the other two sides be?

Two different answers are possible.

Give both answers.

**1.5** Identify patterns in data or results, generalising where appropriate.

The rule for this sequence of numbers is 'add 3 each time'.

1    4    7    10    13    16    ...

The sequence continues in the same way.

Mary says: 'There will never be a multiple of 3 in the sequence.'

Is she correct? Circle YES or NO.

Explain how you know.

Hissa is working with whole numbers. She says: 'If you add a two-digit number to a two-digit number you cannot get a four-digit number.'

Is she correct? Circle YES or NO.

Explain why.

**1.6** Use ICT to support mathematical work.

---

# Number and algebra

By the end of Grade 6, students calculate efficiently with whole numbers and decimals, without and with a calculator, and explain and justify their chosen methods. They use a range of strategies to calculate mentally. They use written column methods to add and subtract decimals and to multiply and divide them by a one- or two-digit whole number. They estimate answers to calculations and check results using inverse operations. They find and use factors and multiples of numbers, and identify prime numbers. They cancel common factors to reduce a fraction to its simplest form, and add and subtract proper fractions with different denominators. They change fractions to decimals or percentages, and vice versa, and calculate fractional or percentage parts of quantities and measurements, using a calculator where appropriate. They use simple ratios and apply proportional reasoning. Students simplify and evaluate simple algebraic expressions, and construct and solve simple linear equations. Given a rule, they generate the terms of a sequence. They use ordered coordinate pairs to plot points that follow a simple rule. They apply their skills to solving a range of routine and non-routine problems, including mathematical and real-life problems.

## Students should:

### 2 Calculate efficiently with whole numbers and decimals and apply these skills to solve problems

- 2.1** Find and use factors and multiples of numbers, and identify prime numbers; find the prime factorisation of a number, and the highest common factor (HCF) and lowest common multiple (LCM) of two numbers.

*Write in the boxes the three prime numbers which multiply to make 231.*

$$\square \times \square \times \square = 231$$

- 2.2** Know and use tests of divisibility for 2, 3, 4, 5, 6 and 10.

- 2.3** Use and explain mental methods to multiply and divide whole numbers and decimals in special cases:

- multiply by 25 by multiplying by 100 and dividing by 4;  
*e.g.*  $48 \times 25 = 48 \times 100 \div 4 = 4800 \div 4 = 1200$
- divide by a number with one-digit factors;  
*e.g.*  $864 \div 24 = (864 \div 4) \div 6 = 216 \div 6 = 36$
- multiply by a one-digit decimal;  
*e.g.*  $23 \times 0.7 = 23 \times 7 \div 10 = 161 \div 10 = 16.1$
- divide by a one-digit decimal.  
*e.g.*  $48 \div 0.3 = 48 \times 10 \div 3 = (48 \div 3) \times 10 = 160$

- 2.4** Use and explain written column methods to add and subtract decimals.

- 2.5** Use and explain written column methods to multiply and divide:

- whole numbers with up to four digits by a two-digit number;  
*e.g.*  $2386 \times 35$ ,  $1596 \div 38$
- decimals with up to two places by a two-digit whole number.  
*e.g.*  $4.17 \times 24$ ,  $2.52 \div 42$

#### Factors and multiples

Include common factors and common multiples.

#### Mental methods

Exclude decimals with more than one decimal place.

**2.6** Know the order of operations for carrying out calculations with more than one step.

**2.7** Use calculator methods to multiply and divide by decimals (other than the special cases in standard NA 2.3 above), to convert fractions to decimals, and to calculate with numbers involving several digits. Know how to:

- use the [clear] and [clear entry] keys, all operation keys, the [=] key and decimal point, and the [ $\sqrt{\quad}$ ] key, to calculate with realistic data;
- enter a negative number;
- key in and interpret the outcome of calculations involving money;
- key in fractions, recognise the equivalent decimal form, and use this to compare and order fractions;
- read the display of, say, 0.3333333 as *point three recurring*, know that it represents one third, and that 0.6666666 represents two thirds;
- select the correct key sequence to carry out routine calculations involving more than one step: for example,  $8 \times (37 + 58)$ ;
- use the memory.

*Put a tick (✓) in the correct box for each calculation.*

*Use a calculator.*

	less than 1000	equal to 1000	more than 1000
$8.9 \times 9.9 \times 11.9$			✓
$(786 - 387) \div 0.41$			
$95.4 + (91 \times 9.95)$			
$12.5 \times (21.1 + 58.9)$			

**2.8** Check answers for accuracy by using inverse operations.

**2.9** Check answers for reasonableness by using an estimate based on approximations and by considering the context of the problem.

**2.10** Round answers to calculations to a given degree of accuracy.

**Problem solving with whole numbers and decimals**

**2.11** Solve problems with up to three steps using addition, subtraction, multiplication or division of whole numbers or decimals, with and without a calculator.

*Aisha buys a pack of 24 cans of lemon drink for QR 60.*

*She sells five of the cans for QR 4 each.*

*How much profit did she make on the five cans?*

**2.12** Solve missing-number problems involving inverse operations, with and without a calculator.

*Use a calculator to find the missing number.*

$568.1 \div \square = 24.7$

**2.13** Solve routine and non-routine problems involving whole numbers or decimals, including word problems based on real-life contexts, and problems in mathematical contexts, with and without a calculator.

**Order of operations**

Exclude brackets.

**Using a calculator**

Include:

- checking the reasonableness of an answer by estimating;
- giving a result to a specified degree of accuracy, e.g. the nearest metre;
- discussing when and when not to use a calculator.

Exclude the use of the % key (see NA 4.5).

**Word problems**

Include money and units of measurement.

### 3 Work with fractions and use them to solve problems

**3.1** Recall that the value of a fraction does not change if the numerator and denominator are multiplied or divided by the same number and use this method to find equivalent fractions:

- reduce a fraction to its simplest form by cancelling a common factor;
- given a proper fraction, and either the numerator or denominator of an equivalent fraction, write the equivalent fraction.

**3.2** Express a decimal with up to three places as a fraction, reducing it to its simplest form; know the fraction and decimal equivalents for one thousandth, one eighth, three eighths, five eighths and seven eighths.

**3.3** Convert a proper fraction or mixed number to a decimal using division:

- with a calculator;
- without a calculator.

**3.4** Recognise and use the notation for recurring decimals, e.g.  $4.\dot{3}$ , for  $4.33333\dots$  or  $4\frac{1}{3}$ , and  $0.\dot{1}8$ , for  $0.181818\dots$  or  $\frac{2}{11}$ .

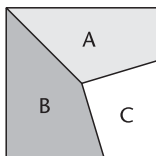
**3.5** Compare and order unrelated fractions by converting them to decimals (if necessary, with a calculator) and positioning them on a number line.

*Which one of these fractions is closest in value to  $\frac{1}{3}$ ?*

$$\frac{10}{31} \quad \frac{20}{61} \quad \frac{30}{91} \quad \frac{40}{121} \quad \frac{50}{151}$$

**3.6** Add and subtract proper fractions with different denominators by writing them with a common denominator.

*This square is divided into three parts.*



*Part A is  $\frac{1}{3}$  of the area of the square. Part B is  $\frac{2}{5}$  of the area of the square.*

*What fraction of the area of the square is part C?*

**3.7** Multiply a proper fraction by a proper fraction.

**3.8** Know that, since  $1 \div a = \frac{1}{a} = 1 \times \frac{1}{a}$ , division is equivalent to multiplication by the reciprocal, and use this principle to divide a proper fraction by a whole number.

**3.9** Solve up to two-step word problems involving fractions.

*There are 24 coloured cubes in a box.*

*Three quarters of the cubes are red, four of the cubes are blue and the rest are green.*

*How many green cubes are in the box?*

*One more blue cube is put into the box.*

*What fraction of the cubes in the box are blue now?*

### 4 Calculate and use percentages

**4.1** Change fractions and decimals to percentages, and vice versa.

**4.2** Calculate a percentage of a whole.

*Find 45% of QR 400.*

#### Converting fractions

Exclude denominators greater than 10, other than 100 and 1000.

#### Ordering fractions

Include both ascending and descending order.

#### Percentages

Exclude percentage increase/decrease and percentage profit and loss.

- 4.3** Express one quantity as a percentage of another.

*In a survey, 34 out of 40 people liked swimming.  
What percentage of people liked swimming?*

- 4.4** Find the whole, given a part and the percentage, in simple cases.

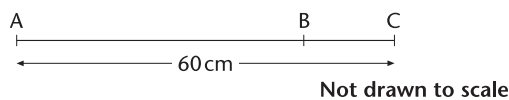
*10% of a number is 21.5.  
What is the number?*

- 4.5** With and without a calculator, solve word problems involving percentages.

*Jamal had 75 riyals.  
He gave 60 riyals to his sister.  
What percentage of his riyals did Jamal give to his sister?*

## 5 Use simple ratios and direct proportion

- 5.1** Use simple ratios to show the relative sizes of two quantities.



*The ratio of the distance from A to B to the distance from B to C is 3 : 1.  
The distance from A to C is 60 centimetres.  
Calculate the distance from A to B.*

- 5.2** Recognise equivalent ratios and reduce a ratio to its lowest terms.

- 5.3** Recognise simple cases when two quantities are in direct proportion.

*A recipe for a fruit drink for 6 people is:*

chopped oranges	300 g
lemonade	1500 ml
orange juice	750 ml

*Noor wants to make enough fruit drink for 10 people.  
How many millilitres of lemonade will she need?*

- 5.4** Without a calculator, solve simple problems involving ratios or direct proportion.

*Students voted whether they preferred the Lunar Park or the Zoo.  
The result was a ratio of 10 : 3 in favour of the Lunar Park.  
40 students voted in favour of the Lunar Park.  
How many students voted for the Zoo?*

*Samira paid 45 dollars for a present in the USA.  
1 dollar equals QR 3.2.  
What would the present cost in QR?*

## 6 Use and interpret letters to write, simplify and evaluate simple expressions and solve simple equations

- 6.1** Use a letter to represent an unknown number or variable and write a simple algebraic expression in one variable to model a given situation.

- 6.2** Simplify algebraic expressions with a single variable by collecting terms.

*Simplify: a.  $7 + 2t + 3t$     b.  $b + 7 + 2b + 10$*

- 6.3** Evaluate simple algebraic expressions and formulae by substituting numbers for words or letters.

*The formula  $c = 5n$  represents the cost in riyals of  $n$  pens at QR 5 each.  
What is the cost of 12 pens?*

### Finding the whole

Limit to parts of 25%, 50%, 75%, and multiples of 10%.

### Calculators

Exclude the use of the % key so that students understand how the calculation is carried out.

### Ratio

Include the notation  $a : b$ .  
Include simple scale drawings such as maps or plans.

### Direct proportion

Include converting riyals to US dollars (\$) or British pounds (£), and vice versa.

### ICT opportunity

Use a spreadsheet to generate conversion tables.

### Simplification

Exclude brackets.

- 6.4** Solve simple problems by constructing and solving simple linear equations with integer coefficients (unknown on one side only), using inverse operations; verify the solution by substituting in the original equation.

*The length of a photograph frame is twice its height.  
It is made with 126 cm of wood.  
What is the length of the frame?*

**Equations**

Include the forms:  
 $ax = b$   
 $ax + b = c$   
 $a - bx = c$   
 Exclude brackets.

**7 Generate sequences and plot graphs of functions**

- 7.1** Given a rule, generate a simple sequence:

- find a term from the previous term, given a rule such as ‘add 6’;
- find a term given its position in the sequence.

*This sequence follows the rule:  
‘to get the next number, add the two previous numbers’.  
Write in the next two numbers in the sequence.*

2.1 2.2 4.3 6.5 ... ..

*Each number in this sequence is double the previous number.  
Write in the missing numbers.*

... 3 6 12 24 48 ...

**Sequences**

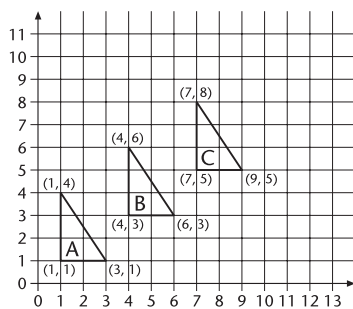
Include common integer sequences, such as odd and even numbers, square numbers.  
 Include extending sequences to negative numbers.

**ICT opportunity**

Use a spreadsheet to generate sequences.

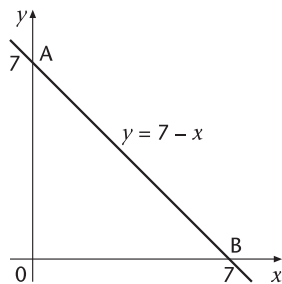
- 7.2** Use ordered coordinate pairs to plot points that follow a simple rule.

*Write the coordinates of the next triangle in the sequence.*



- 7.3** Plot the graphs of simple linear functions (y given explicitly in terms of x); use the graph to find the value of y, given the value of x, and vice versa.

*The diagram shows the graph of  $y = 7 - x$ .*



*Write the coordinates of one point on the line between A and B.*

**ICT opportunity**

Use graph plotting software.

# Geometry and measures

By the end of Grade 6, students reflect a 2-D shape in a given mirror line and rotate a 2-D shape about one of its vertices. They recognise vertically opposite angles, angles on a straight line and around a point. They know angle sum of a triangle and use this property to find the angle sum of a quadrilateral. They use these and other properties to identify equal sides or to find the values of angles in geometric figures. They use a ruler and protractor to construct triangles, given two sides and the included angle, or two angles and the included side. They solve problems involving the area of rectangles, triangles and parallelograms, and the volume and surface area of cuboids. They find the volume of liquid in cuboid containers.

**Students should:**

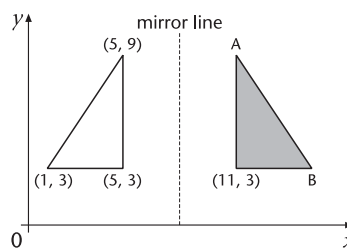
## 8 Identify properties of and relationships in geometric shapes

### Transformations

**8.1** Draw the reflection of a 2-D shape in a given mirror line.

*The shaded triangle is a reflection of the white triangle in the mirror line.*

*Write the coordinates of point A and point B.*



### Transformations

Keep to the first quadrant.

### ICT opportunity

Use a dynamic geometry system (DGS) to explore reflections and rotations.

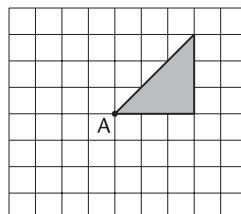
The programming language Logo can also be used to explore rotations.

**8.2** Draw the rotation of a 2-D shape about one of its vertices.

*Here is a shaded shape on a grid.*

*The shape is rotated  $90^\circ$  clockwise about point A.*

*Draw the shape in its new position on the grid.*



### Angles, shapes and geometrical reasoning

**8.3** Use the labelling conventions for angles, lines and geometric figures.

**8.4** Identify angles in a straight line, at a point and vertically opposite angles.

**8.5** Know that the angle sum of a triangle is  $180^\circ$ ; derive and use the property that the angle sum of a quadrilateral is  $360^\circ$ .

*Two of the angles in a quadrilateral add up to  $280^\circ$ .*

*The other two angles are equal.*

*What is the size of one of these other two angles?*

### Vertically opposite angles

Include a proof that vertically opposite angles are equal.

### Angle sum of a triangle

Exclude a formal proof. Include a demonstration, e.g. by tearing off the corners of a paper triangle.

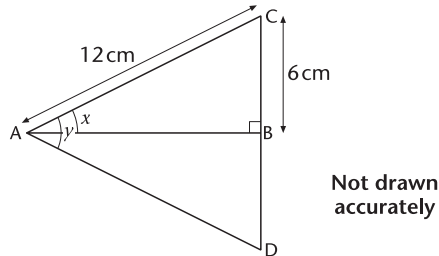
**8.6** Identify equal lengths or find unknown angles in geometric figures, involving:

- angles in a straight line, around a point or vertically opposite angles;
- the angle sum of a triangle;
- side or angle properties of an isosceles, equilateral, right-angled and scalene triangle;
- side or angle properties of a square, rectangle or parallelogram.

*Triangle ABD is the reflection of triangle ABC in the line AB.*

*Explain why ACD is an equilateral triangle.*

*What is the size of angle  $x$ ?*



### Constructions

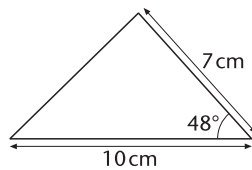
**8.7** Use ruler and protractor to construct a triangle:

- given two angles and the included side;
- given two sides and the included angle.

*Here is a sketch of a triangle.*

*It is not drawn to scale.*

*Construct the triangle using a ruler and protractor.*



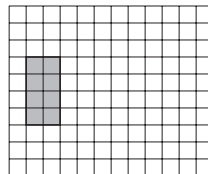
**8.8** Use ruler, protractor and set square to measure and draw angles, perpendicular and parallel lines, rectangles and squares.

**8.9** Use ICT to draw shapes such as rectangles and squares.

## 9 Solve problems involving perimeter, area and volume

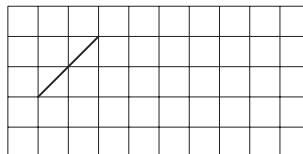
**9.1** Derive and use formulae for the area of a triangle and the area of a parallelogram.

*On the grid draw a triangle with the same area as the shaded rectangle. Use a ruler.*



*This is a centimetre grid.*

*Draw three more lines to make a parallelogram with an area of  $10\text{ cm}^2$ . Use a ruler.*



### Unknown angles

Exclude:

- properties related to diagonals of 2-D shapes;
- identifying congruent triangles;
- the need for extra construction lines.

### ICT opportunity

Use a dynamic geometry system to explore constructions.

### Angles

Include reflex angles.

### Area of triangle and parallelogram

Include identifying the base and the corresponding height.

Exclude finding the base or height given the area.

9.2

Find:

- the surface area of a cube, given the length of an edge;
- the edge of a cube, given its volume or surface area;
- one dimension of a cuboid, given its volume and the other two dimensions.

9.3

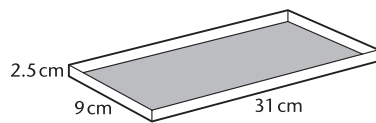
Recognise the equivalence of 1 litre or 1000 ml and 1000 cm<sup>3</sup>; know and use the formula for the volume of a cuboid to find the volume of liquid in a cuboid container.

9.4

Solve problems involving:

- the area of rectangles, triangles and parallelograms;
- the volume of cubes and cuboids and of liquids in cuboid containers.

*Boxes measure 2.5 cm wide by 4.5 cm long by 6.2 cm deep.  
A shopkeeper puts them in a tray.*



*Work out the largest number of boxes that can lie flat in the tray.*

### Volumes of cubes

Limit to cubes and cuboids with integer dimensions.

Exclude use of  $\sqrt[3]{\quad}$  sign.

### Volume of liquid

Include conversions between l, ml and cm<sup>3</sup>.

Include problems about the height of water in cuboid containers.

Link to work in science but exclude finding volume of a solid by displacing liquid.

## Data handling

By the end of Grade 6, students answer questions by collecting data and representing them in tables and bar charts. They interpret and draw conclusions from bar charts and pie charts (circle graphs), including those generated by ICT. They understand and use the mean and median of discrete data, and describe characteristics of a data set using the range and the mode.

### Students should:

## 10 Collect, process, represent and interpret data and draw conclusions

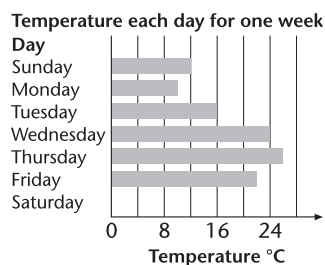
10.1

Collect data to answer a question, including from the Internet.

10.2

Represent data in tables and bar charts.

*Here is a chart of the maximum temperature each day for a week in Cairo in January.  
The temperature on Saturday was 14°C. Draw the bar for Saturday.*



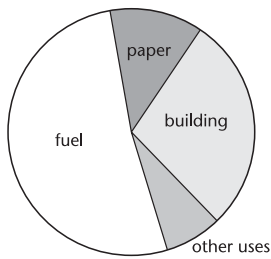
*Make a table showing the same information as on the bar chart.*

### Data handling and ICT

Data handling provides many opportunities to use spreadsheets and graph drawing packages to present tables, charts and graphs. The Internet is an excellent source of real data of interest to students.

**10.3** Read and interpret graphs and charts, including bar charts and pie charts.

*This pie chart shows the different ways that wood is used in the world.*



*Use the pie chart to estimate the percentage of wood that is used for paper.*

*54% of the wood is used for fuel.*

*Calculate the angle for the fuel sector on the pie chart.*

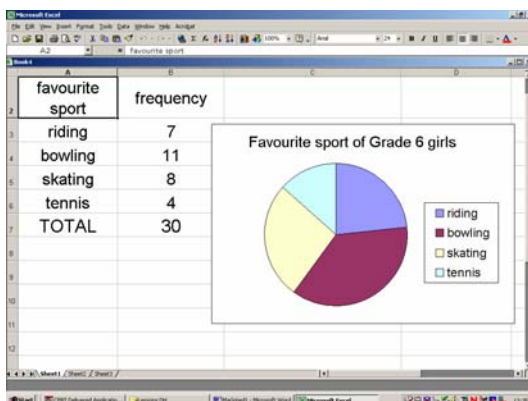
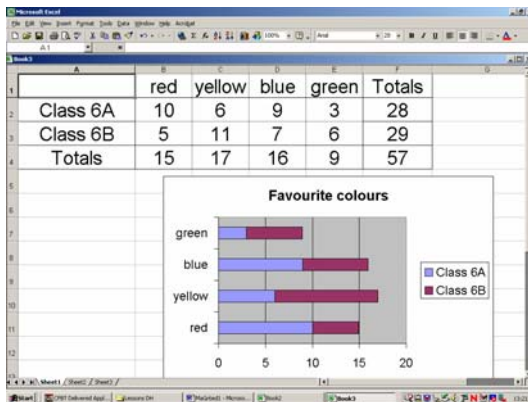
**Pie charts**

Exclude construction of pie charts, other than those generated using ICT.

**10.4** Use ICT to generate graphs, charts and tables, including bar charts and pie charts.

**ICT opportunity**

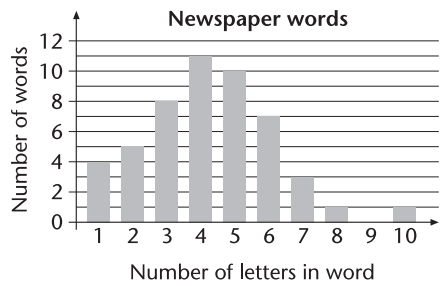
Use a spreadsheet and graph drawing package.



**10.5**

Calculate a mean and find the median of a set of data; draw conclusions about a set of data based on the shape of the graph and the mode or range.

An article from the Gulf Times has 50 words in it.  
Here is a bar chart of the number of letters in each word.



What is the range of the number of letters in the words used?  
What is the most common number of letters used in a word?

Bashir runs 100 metres ten times.  
These are his times in seconds.

13.4	13.0	13.9	13.7	13.3
13.5	14.0	14.4	13.8	14.0

What is his mean time?

Alia counts the matches in nine matchboxes.  
Here are her results for the nine boxes.

Number of matches in a box						
48	49	50	51	52	53	54
	✓	✓	✓	✓		✓
	✓	✓				✓
	✓					

What is the median number of matches in a box?  
What is the mode for the number of matches in a box?  
What is the range of the number of matches in a box?

Alia counts the matches in one more box.  
She works out that the mean number of matches in all ten boxes is 51.  
Calculate how many matches are in the tenth box.