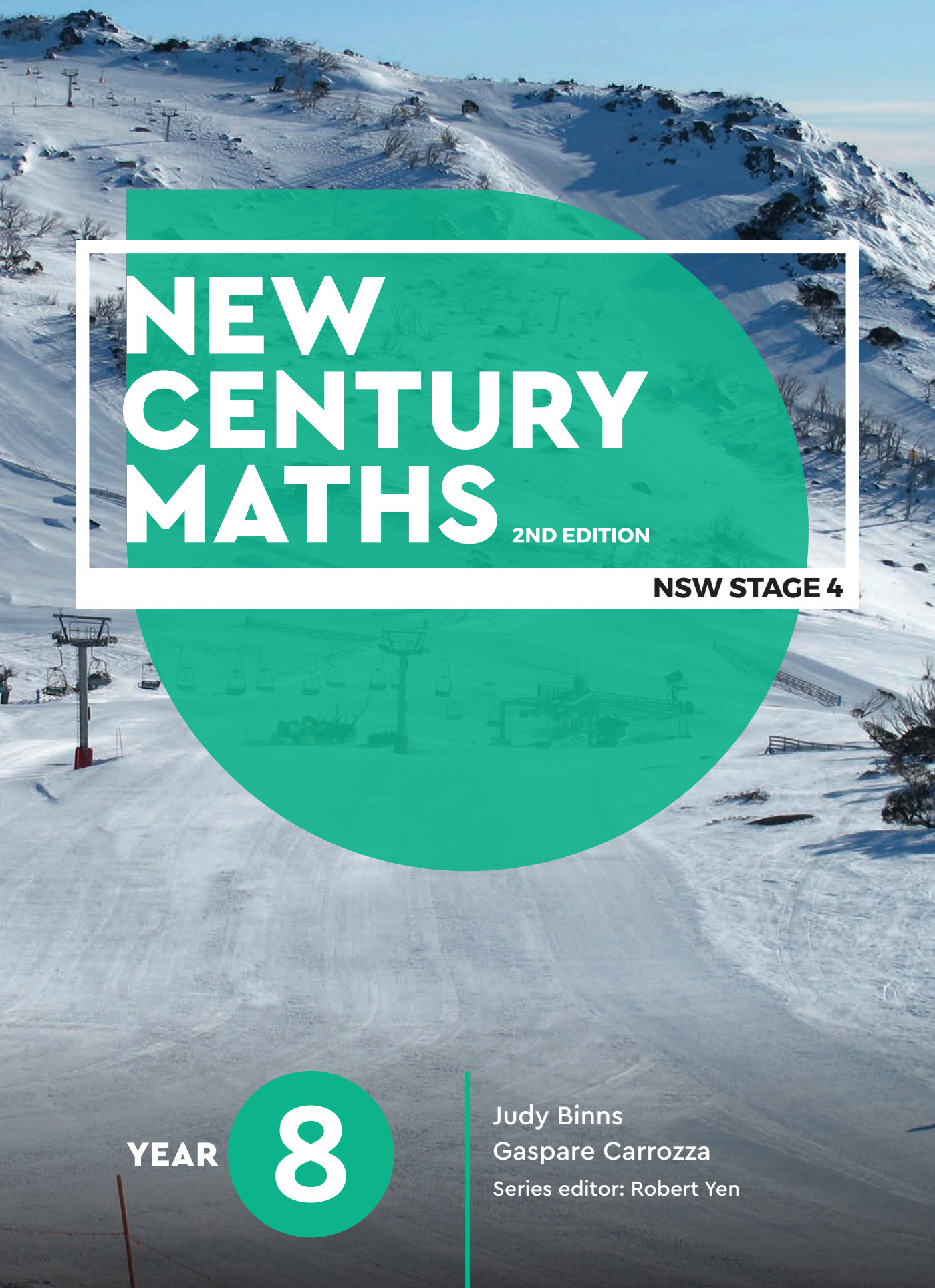

# NEW CENTURY MATHS 2ND EDITION

## NSW STAGE 4

YEAR 8

Judy Binns
Gaspare Carrozza
Series editor: Robert Yen

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# PREFACE

Teachers, it's time to start teaching maths again. You asked and we listened.

*New Century Maths 7-10* has been refreshed for the 2020s classroom, focusing on core skills to discourage 'teaching by syllabus dot points', featuring explicit grading and labelling of exercise questions, more 'flipped classroom' video tutorials, more applications and problem-solving questions, and worked solutions to every question.

In schools for over 25 years, *New Century Maths* is carefully mapped to the NSW syllabus and built on solid pedagogical foundations that integrate into every chapter practical classroom activities, engaging investigations, problem-solving, reasoning, communicating, reflecting, summarising, extension, revision, mental calculation, technology, numeracy and literacy.

This book, *New Century Maths 8,* has been designed for Year 8 students progressing along the Stage 4 continuum, but includes Year 7 revision and Year 9 extension work.

The *NelsonNet* student and teacher websites contain worksheets, video tutorials, topic tests, worked solutions and much more. We have provided an abundance of resources for teachers to plan and teach for a variety of pathways. *New Century Maths* is clear, concise, fresh and smart. We have designed this series to be user-friendly and uncomplicated so that teachers and students everywhere can pick it up and use straight away. So let's get started.

## About the authors

**Judy Binns** was head teacher of mathematics at Mulwaree High School in Goulburn and has taught at Homebush Boys High School. She has an interest in motivating students with learning difficulties and wide expereince in teaching senior practical mathematics courses. Judy also co-wrote *New Century Maths 11–12 Mathematics Standard 1.*

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Series editor **Robert Yen** taught at Hurlstone Agricultural High School. He co-wrote *New Century Maths 11–12 Mathematics Standard 2*, co-edited *Reflections,* the MANSW journal, and works for Cengage as the mathematics publisher.

**Contributing authors**

**Sarah Hamper** wrote the technology sections.

**Kuldip Khehra, Judy Binns, Gaspare Carrozza** and **Robert Yen** wrote many of the *NelsonNet* worksheets and topic tests.

**John Drake, Katie Jackson, Joanne Magner, Scott Smith** and **Robert Yen** created the video tutorials.

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* = EXTENSION
# = NSW ONLY, NOT AUSTRALIAN CURRICULUM

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# SYLLABUS GRIDS

## NSW syllabus

| Strand and substrand | *New Century Maths 7* chapter | | *New Century Maths 8* chapter | |
|---|---|---|---|---|
| **NUMBER AND ALGEBRA** | | | | |
| Computation with integers | 1 | Integers | 2 | Working with numbers |
| | 3 | Whole numbers | | |
| Fractions, decimals and percentages | 4 | Fractions and percentages | 2 | Working with numbers |
| | 7 | Decimals | 6 | Fractions and percentages |
| Financial mathematics | 12 | Ratios, rates and time | 6 | Fractions and percentages |
| | | | 11 | Ratios, rates and time |
| Ratios and rates | 12 | Ratios, rates and time | 11 | Ratios, rates and time |
| Algebraic techniques 1 | 5 | Algebra and equations | 3 | Algebra |
| Algebraic techniques 2 | 5 | Algebra and equations | 3 | Algebra |
| | | | 12 | Graphing linear equations |
| Indices | 3 | Whole numbers | 2 | Working with numbers |
| | | | 3 | Algebra |
| Equations | 5 | Algebra and equations | 10 | Equations |
| Linear relationships | 9 | The number plane | 12 | Graphing linear equations |
| **MEASUREMENT AND GEOMETRY** | | | | |
| Length | | | 5 | Area and volume |
| Area | 8 | Area and volume | 5 | Area and volume |
| Volume | 8 | Area and volume | 5 | Area and volume |
| Time | 11 | Ratios, rates and time | 11 | Ratios, rates and time |
| Right-angled triangles (Pythagoras) | | | 1 | Pythagoras' theorem |
| Angle relationships | 2 | Angles | 4 | Geometry |
| Properties of geometrical figures 1 | 6 | Geometrical figures | 4 | Geometry |
| Properties of geometrical figures 2 | | | 8 | Congruent figures |
| **STATISTICS AND PROBABILITY** | | | | |
| Data collection and representation | 10 | Analysing data | 7 | Investigating data |
| Single variable data analysis | 10 | Analysing data | 7 | Investigating data |
| Probability 1 | 11 | Probability | 9 | Probability |
| Probability 2 | | | 9 | Probability |

## Australian curriculum

Australian CURRICULUM

| Strand and substrand | *New Century Maths 7* chapter | | *New Century Maths 8* chapter | |
|---|---|---|---|---|
| **NUMBER AND ALGEBRA** | | | | |
| Number and place value | 1 | Integers | 2 | Working with numbers |
| | 3 | Whole numbers | | |
| | 5 | Algebra and equations | | |
| Real numbers | 4 | Fractions and percentages | 2 | Working with numbers |
| | 7 | Decimals | 6 | Fractions and percentages |
| | 12 | Ratios, rates and time | 11 | Ratios, rates and time |
| Money and financial mathematics | 12 | Ratios, rates and time | 6 | Fractions and percentages |
| | | | 11 | Ratios, rates and time |
| Patterns and algebra | 5 | Algebra and equations | 3 | Algebra |
| Linear and non-linear relationships | 5 | Algebra and equations | 10 | Equations |
| | 9 | The number plane | 11 | Ratios, rates and time |
| | 12 | Ratios, rates and time | 12 | Graphing linear equations |
| **MEASUREMENT AND GEOMETRY** | | | | |
| Using units of measurement | 8 | Area and volume | 5 | Area and volume |
| | 12 | Ratios, rates and time | 11 | Ratios, rates and time |
| Shape | 8 | Area and volume | | |
| Location and transformation | 6 | Geometrical figures | 4 | Geometry |
| | 9 | The number plane | 8 | Congruent figures |
| Geometric reasoning | 2 | Angles | 4 | Geometry |
| | 6 | Geometrical figures | 8 | Congruent figures |
| Pythagoras and trigonometry | | | 1 | Pythagoras' theorem |
| **STATISTICS AND PROBABILITY** | | | | |
| Chance | 11 | Probability | 9 | Probability |
| Data representation and interpretation | 10 | Analysing data | 7 | Investigating data |

## Year 8 content descriptions

Australian Curriculum descriptions (© ACARA 2012).

| Content description | New Century Maths 8 chapter | |
|---|---|---|
| **NUMBER AND ALGEBRA** | | |
| **Number and place value** | | |
| **ACMNA182:** Use index notation with numbers to establish the index laws with positive integral indices and the zero index | 2 | Working with numbers |
| **ACMNA183:** Carry out the four operations with integers, using efficient mental and written strategies and appropriate digital technologies | 2 | Working with numbers |
| **Real numbers** | | |
| **ACMNA152:** Compare fractions using equivalence. Locate and represent fractions and mixed numerals on a number line | 4 | Fractions and percentages |
| **ACMNA153:** Solve problems involving addition and subtraction of fractions, including those with unrelated denominators | 4 | Fractions and percentages |
| **ACMNA154:** Multiply and divide fractions and decimals using efficient written strategies and digital technologies | 4 | Fractions and percentages |
| | 7 | Decimals |
| **ACMNA155:** Express one quantity as a fraction of another, with and without the use of digital technologies | 4 | Fractions and percentages |
| **ACMNA156:** Round decimals to a specified number of decimal places | 7 | Decimals |
| **ACMNA184:** Investigate terminating and recurring decimals | 2 | Working with numbers |
| **ACMNA186:** Investigate the concept of irrational numbers, including $\pi$ | 1 | Pythagoras' theorem |
| | 5 | Area and volume |
| **ACMNA187:** Solve problems including the use of percentages, including percentage increases and decreases, with and without digital technologies | 6 | Fractions and percentages |
| **ACMNA188:** Solve a range of problems involving rates and ratios, with and without digital technologies | 11 | Ratios, rates and time |
| **Money and financial mathematics** | | |
| **ACMNA189:** Solve problems involving profit and loss, with and without digital technologies | 6 | Fractions and percentages |
| **Patterns and algebra** | | |
| **ACMNA190:** Extend and apply the distributive law to the expansion of algebraic expressions | 3 | Algebra |
| **ACMNA191:** Factorise algebraic expressions by identifying numerical factors | 3 | Algebra |
| **ACMNA192:** Simplify algebraic expressions involving the four operations | 3 | Algebra |
| **Linear and non-linear relationships** | | |
| **ACMNA193:** Plot linear relationships on the Cartesian plane with and without the use of digital technologies | 12 | Linear equations |
| **ACMNA194:** Solve linear equations using algebraic and graphical techniques. Verify solutions by substitution. | 8 | Equations |
| | 12 | Linear equations |

| Content description | New Century Maths 8 chapter | |
|---|---|---|
| **MEASUREMENT AND GEOMETRY** | | |
| **Using units of measurement** | | |
| **ACMMG195:** Choose appropriate units of measurement for area and volume and convert from one unit to another | 5 | Area and volume |
| **ACMMG196:** Find perimeters and areas of parallelograms, rhombuses and kites | 5 | Area and volume |
| **ACMMG197:** Investigate the relationship between the features of circles such as circumference, area, radius and diameter. Use formulas to solve problems involving circumference and area. | 5 | Area and volume |
| **ACMMG198:** Develop the formulas for volumes of rectangular and triangular prisms and prisms in general. Use formulas to solve problems involving volume. | 5 | Area and volume |
| **ACMMG199:** Solve problems involving duration, including using 12- and 24-hour time within a single time zone | 11 | Ratios, rates and time |
| **Geometric reasoning** | | |
| **ACMMG200:** Define congruence of plane shapes using transformations | 8 | Congruent figures |
| **ACMMG201:** Develop the conditions for congruence of triangles | 8 | Congruent figures |
| **ACMMG202:** Establish properties of quadrilaterals using congruent triangles and angle properties, and solve related problems using reasoning. | 4 | Geometry |
| | 8 | Congruent figures |
| **Pythagoras and trigonometry** | | |
| **YEAR 9 ACMMG222:** Investigate Pythagoras' theorem and its application to solving simple problems involving right-angled triangles | 1 | Pythagoras' theorem |
| **STATISTICS AND PROBABILITY** | | |
| **Chance** | | |
| **ACMSP204:** Identify complementary events and use the sum of probabilities to solve problems | 9 | Probability |
| **ACMSP205:** Describe events using language of 'at least', exclusive 'or' (A or B but not both), inclusive 'or' (A or B or both) and 'and' | 9 | Probability |
| **ACMSP292:** Represent such events in two-way tables and Venn diagrams and solve related problems | 9 | Probability |
| **Data representation and interpretation** | | |
| **ACMSP206:** Explore the practicalities and implications of obtaining representative data using a variety of investigative processes | 7 | Investigating data |
| **ACMSP207:** Investigate the effect of individual data values, including outliers, on the mean and median | 7 | Investigating data |
| **ACMSP293:** Explore the variation of means and proportions in representative data | 7 | Investigating data |

# ABOUT THIS BOOK

## Coverage of the syllabus

- *New Century Maths 8* covers both the NSW syllabus and the Australian curriculum, as shown by the table of contents and syllabus grids on the previous pages.
- This book contains Stage 4 content. It also contains revision of some Stage 3 content, and some Year 9 or extension work marked by *.
- Each chapter begins with a **chapter outline** that includes the Working Mathematically proficiencies covered in each section.

**Chapter outline**

| | | Working mathematically | | | | |
|---|---|---|---|---|---|---|
| **10.01** | One-step equations | U | F | | R | C |
| **10.02** | Two-step equations | U | F | | R | C |
| **10.03** | Equations with variables on both sides | U | F | | R | C |
| **10.04** | Equations with brackets | U | F | | R | C |
| **10.05** | Simple quadratic equations $x^2 = c^\#$ | U | F | | R | C |
| **10.06** | Equation problems | U | F | PS | R | C |
| **10.07** | Extension: Formulas and equations* | U | F | PS | R | C |

**U = UNDERSTANDING**

**Understanding** is 'knowing and relating' maths. It is more than just learning facts. It's deep understanding, seeing how mathematical content is interconnected, knowing 'why' as well as 'how'.

**F = FLUENCY**

**Fluency** is 'applying' maths. It is being able to use mathematics competently and effectively. When you are fluent in a language, you have mastered it so that you can improvise and confidently use the correct word or phrase. Fluency in maths is choosing an appropriate skill, method or formula to use at the right place and time.

**PS = PROBLEM SOLVING**

**Problem solving** is 'modelling and investigating' with maths. It involves interpreting a rich, elaborate problem, selecting an appropriate strategy or model, solving the problem, then evaluating, communicating and justifying the solution.

**R = REASONING**

**Reasoning** is 'generalising and proving' with maths, using higher-order thinking to connect specific facts to general principles, using algebra, logic, proof and justification.

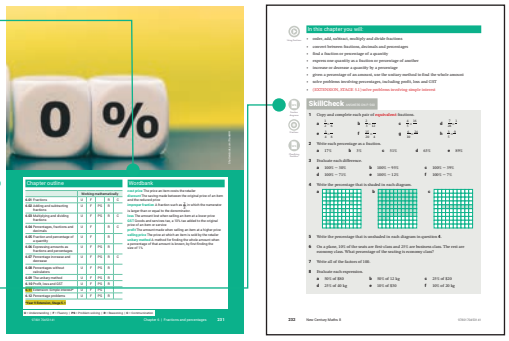
**C = COMMUNICATING**

**Communicating** is 'describing and explaining' maths, representing mathematical theory and solutions in words, algebraic symbols, special notations, diagrams, graphs and tables.

- **Understanding** and **Fluency** can be found in every exercise and activity, while **Problem solving**, **Reasoning** and **Communicating** are found in the **Investigations**, **Technology**, **Mental skills**, **Language of Maths** and **Topic summary** activities, and explicitly labelled in every exercise (see 'In each chapter' next page).

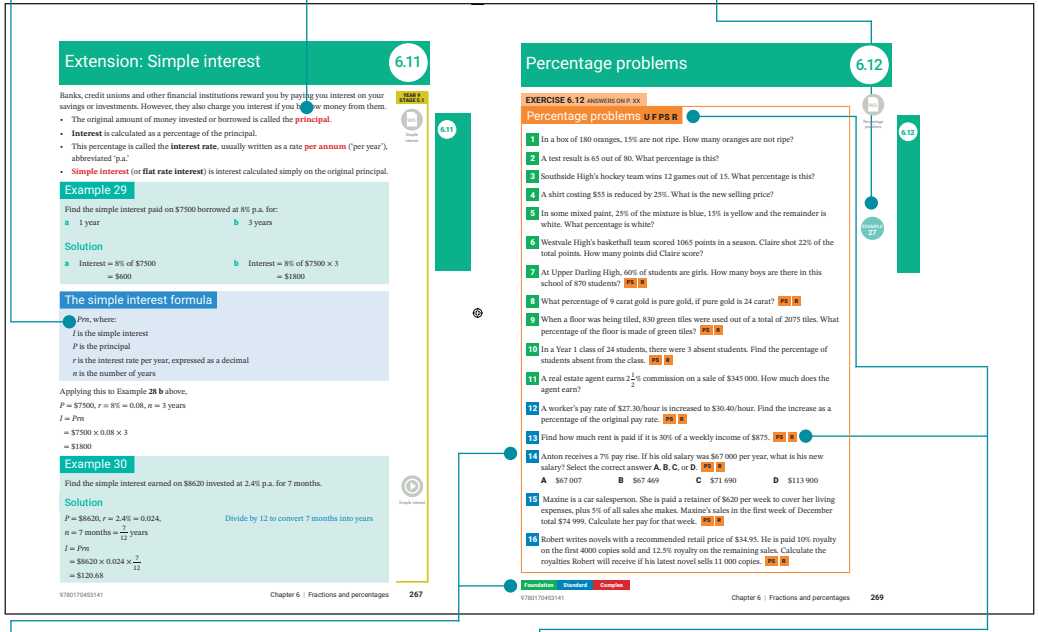
## At the beginning of each chapter

- A **Chapter outline** and a **Wordbank** chapter glossary (a full glossary appears at the back of the book)
- **SkillCheck** reviews prerequisite skills and knowledge for the chapter

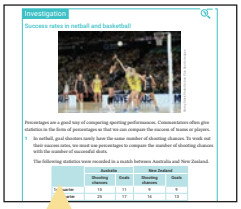



## In each chapter

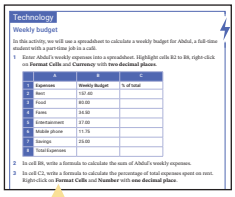
- Important facts and formulas are highlighted in a shaded box.
- Glossary terms are printed in **red**.
- Graded exercises are linked to worked examples and include multiple-choice questions, exam-style problems and realistic applications.



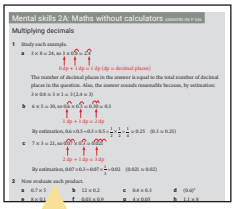

- The exercise questions are colour-coded for level of difficulty:
  **Foundation** **Standard** **Complex**
- Specific questions are also labelled **PS** for **Problem solving**, **R** for **Reasoning** and **C** for **Communicating**.



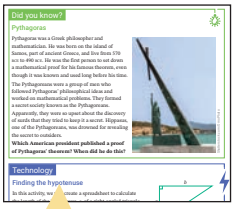

**Investigations** explore the syllabus in more detail, through group work, discovery and modelling activities.




**Technology** includes spreadsheets, dynamic geometry software and the Internet.




**Mental skills** reinforce mental calculation strategies ('calculator-free maths')




**Did you know?** contains interesting facts and applications of the mathematics learned in the chapter.

## At the end of each chapter

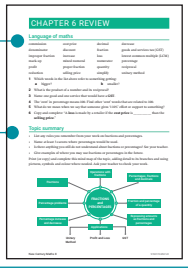
**Power plus** is an extension/challenge exercise.

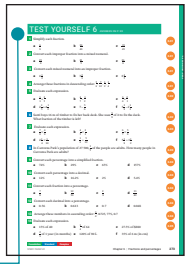
**Language of maths** has a chapter word list and literacy questions.

**Topic summary** has a mind map activity with downloadable solutions.

**Test Yourself** contains chapter revision linked to the relevant exercise set.

**Practice sets** after every 3 chapters.



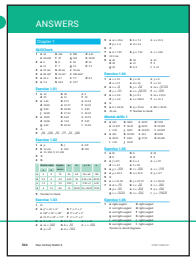




## At the end of the book

**General practice** exercise

**Answers** (worked solutions are on the teacher website).

**Glossary and index**





## NelsonNet student website

Visit the *NelsonNet* student website, **www.nelsonnet.com.au** to access 300+ worksheets, 100+ videos and more:

**Worksheets** and **puzzle sheets**


**Skillsheets** of examples and exercises


**Video tutorials:** worked examples explained by 'flipped classroom' teachers


**Technology worksheets**


**Chapter quizzes:** interactive and self-marking

## NelsonNet teacher website

Teachers can access the *NelsonNet* teacher website, also at **www.nelsonnet.com.au**, for:

- A **teaching program**
- **Topic tests**
- **Worked solutions** to every question
- **Quiz generator and questionbank (Cognero)**
- **Chapter PDFs**

*Note:* Complimentary access to these resources is only available to teachers who use this book as a core educational resource in their classroom. Contact your Cengage Education Consultant for information about access codes and conditions.

## NelsonNetBook

**NelsonNetBook** is the web-based interactive version of this book found on *NelsonNet*.

- To each page of NelsonNetBook you can add notes, voice and sound bites, highlighting, weblinks and bookmarks
- **Zoom** and **Search** functions
- Chapters can be customised for different groups of students

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# MATHEMATICAL VERBS

## A glossary of 'doing words' commonly found in mathematics problems

**analyse:** study in detail the parts of a situation

**bisect:** cut in half

**calculate:** *see* **evaluate**

**classify, identify:** state the type, category or feature of an item or situation

**comment:** express an observation or opinion about a result

**complete:** fill in detail to make a statement, diagram or table correct or finished

**compare:** show how 2 or more things are similar or different

**construct:** draw an accurate diagram

**convert:** change from one form to another, for example, from a fraction to a decimal, or from kilograms to grams

**decrease:** make smaller

**describe:** state the features of a situation

**estimate:** make an educated guess for a number, measurement or solution, to find roughly or approximately.

**evaluate, calculate:** find the value of a numerical expression, for example, $3 \times 8^2$ or $4x + 1$ when $x = 5$

**expand:** remove brackets in an algebraic expression by multiplying, for example, expanding $3(2y + 1)$ gives $6y + 3$

**explain:** describe why or how

**factorise:** take out the highest common factor (HCF) of an expression and insert brackets, for example, factorising $5x - 20$ gives $5(x - 4)$. The opposite of **expand**.

**give reasons:** show the rules or thinking used when solving a problem. See also **justify**.

**graph:** display on a number line, number plane or statistical graph.

**hence find/prove:** find an answer or prove a result using previous answers or information supplied

**identify:** *see* **classify**.

**increase:** make larger

**interpret:** find meaning in an answer or result

**justify:** give reasons or evidence to support your argument or conclusion. See also **give reasons**.

**measure:** use an instrument to find the size of something, for example, use a ruler to determine the length of a pen.

**prove that:** *see* **show that**

**recall:** remember and state.

**reduce (a fraction) to its lowest terms:** see **simplify (a fraction)**.

**round (a number):** find the nearest approximation of a number. For example, 4.3 rounded to the nearest whole number is 4, \$12.9598 rounded to the nearest cent is \$12.96, 0.166 66 rounded to 3 decimal places is 0.167.

**show that, prove that:** (in questions where the answer is given) use calculation, procedure or reasoning to prove that an answer or result is true

**show working:** show the steps you used to find the answer

**simplify:** give a result in its most basic, shortest, neatest form, for example, simplifying a ratio or algebraic expression

**simplify (a fraction):** reduce the numerator and denominator of a fraction by dividing by their highest common factor (HCF), for example, $\frac{16}{20}$ simplified is $\frac{4}{5}$.

**simplify (a ratio or rate):** reduce the terms or units of a ratio or rate by dividing by their highest common factor (HCF), for example, 10 : 4 simplified is 5 : 2.

**sketch:** draw a rough diagram that shows the general shape or idea, less accurate than **construct**

**solve:** find the value(s) of an unknown variable in an equation or inequality

**state:** *see* **write**.

**substitute:** replace a variable by a number and evaluate

**verify:** check that a solution or result is correct, usually by substituting back into the equation or referring back to the problem

**write correct to:** See **round (a number)**.

**write, state:** give the answer, formula or result without showing any working or explanation (this usually means that the answer can be found mentally, or in one step)

# SYMBOLS AND ABBREVIATIONS

| | | | |
|---|---|---|---|
| $=$ | is equal to | $\triangle ABC$ | triangle $ABC$ |
| $\neq$ | is not equal to | $\parallel$ | is parallel to |
| $\approx$ | is approximately equal to | $\perp$ | is perpendicular to |
| $<$ | is less than | $\equiv$ | is congruent to |
| $>$ | is greater than | $\therefore$ | therefore |
| $\leq$ | is less than or equal to | $x^2$ | $x$ squared, $x \times x$ |
| $\geq$ | is greater than or equal to | $x^3$ | $x$ cubed, $x \times x \times x$ |
| ( ) | parentheses, round brackets | $\sqrt{\ }$ | square root, radical sign |
| [ ] | (square) brackets | $\sqrt[3]{\ }$ | cube root |
| { } | braces | $P(E)$ | the probability of event $E$ |
| $\pm$ | plus or minus | LHS | left-hand side |
| $-3$ | negative 3 | RHS | right-hand side |
| $\pi$ | pi = 3.14159... | % | percentage |
| $0.\dot{1}5\dot{2}$ | the recurring decimal 0.152152 ... | p.a. | per annum (per year) |
| $^\circ$ | degree | $\overline{x}$ | the mean (average) |
| $\angle A$ | angle $A$ | $\mu$ | micro-, mu |