numicon

Pupil Book 4 Answers

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www.oxfordprimary.co.uk/numicon

About Numicon

Numicon is a distinctive multi-sensory approach to children's mathematical learning that emphasizes three key aspects of doing mathematics: communicating mathematically, exploring relationships and generalizing.

Numicon was founded in the daily experience of intelligent children having real difficulty with maths, the frequent underestimation of the complexity of the ideas that young children are asked to face when doing maths and recognition of the importance of maths to them and to society as a whole.

Numicon aims to facilitate children's understanding and enjoyment of maths by using structured imagery that plays to children's strong sense of pattern. This is done through research-based, multi-sensory teaching activities.

Numicon takes into account the complexity of abstract number ideas and seeks to foster the self-belief necessary to achieve in the face of challenge or difficulty.

Through the combination of communicating mathematically (being active, talking and illustrating), exploring relationships and generalizing, children are given the support to structure their experiences: a vital skill for both their mathematical and their overall development.

A multi-sensory approach, particularly one that makes use of structured imagery, provides learners with the opportunity to play to their strengths, thereby releasing their potential to enjoy, understand and achieve in maths. By watching and listening to what children do and say, this enjoyment in achievement is also shared by teachers and parents.

Numicon strives to support teachers' subject knowledge and pedagogy by providing teaching materials, Professional Development and on-going support that will help develop a better understanding of how to encourage all learners in the vital early stages of their own mathematical journey.

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Written by Jayne Campling, Adella Osborne,
Peter Warwick and Dr Tony Wing

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Using Numicon Pupil Books

Introduction

The Numicon Pupil Books have been created to help children develop mastery of the mathematics set out in Numicon Teaching Resource Handbook (TRH) activities. The questions in the Pupil Books extend children's experiences of live TRH activities, giving them the opportunity to reason and apply what they have learned, deepen their understanding, take on challenges and develop greater fluency.

Just like the teaching activities, all Pupil Book pages are designed to stimulate discussion, reasoning and rich mathematical communicating. The Numicon approach to teaching mathematics is about dialogue. It is about encouraging children to communicate mathematically using the full range of mathematical imagery, terminology, conventions and symbols.

All questions in the Pupil Books relate to specific Numicon TRH activities. At the top of each Pupil Book page you can find details of the Activity Group the page relates to (for example, Calculating 1). The number after the decimal point tells you which focus activities the page accompanies (so Calculating 1·2 goes with focus activity 2). It is crucial to teach the relevant focus activities before children work on the questions. The Pupil Book questions are designed for children who are succeeding with specific TRH activities, and will invite them to think more deeply about a topic. If you find that children are struggling with a focus activity, details are given in the Teaching Resource Handbooks of other live activities, provided earlier in the progression, which you can work through together to support them until they are ready to move on.

There's a recommended order to teach the Activity Groups in and the Pupil Book materials follow this order of progression too, as you'll see from the contents page. You can use this order to help children see how their ideas and understanding build upon what they have learned before.

These Pupil Book questions have been developed as a large bank that you can select from to best meet the changing needs of the children in your class. You can decide which questions are suitable for which children at which time, and no child is expected to find every question useful. How you choose to use the questions might also vary; for example, you may find that particular questions are useful to discuss and work through together as a class.

Intelligent practice

The 'Practice' sections target two areas. Routine practice is used to promote fluency with particular aspects or techniques. Non-routine practice questions offer challenges in varied ways designed both to improve fluency and to deepen and extend understanding. Practice for simple fluency usually comes first and the questions on each page become progressively more challenging.

Going deeper

'Going deeper' questions are designed to develop children's growing mastery of an area, challenging their understanding beyond routine exercises. In these sections, children are commonly asked to check, explain and justify their strategies and thinking. Trying to explain something clearly helps promote, and is a key indicator, of developing mastery.

Using the Pupil Books

Doing mathematics involves much more than logic, and children's emotions are crucially important. Thoughtful progress is more likely to happen through encouraging curiosity and good humour, and engaging with children in a polite and calm way. This is why the phrasing and tone of Numicon Pupil Book questions are deliberately different to many mathematical textbooks. For example, we often begin questions for children with, "Can you … ?" If any child says simply 'yes' or 'no' in response, we'd suggest replying with, "Can you show me how … ?" or "That's interesting, can you say anything about why not?" These invitations are effective beginnings to the kinds of open conversation and discussions that are at the heart of the Numicon approach.

Some Pupil Book questions have a pair work symbol to signal that these require specific work with a partner, and help with classroom management. These are not the only questions where working with a partner is likely to be beneficial, however. All Pupil Book questions should be seen as opportunities for rich mathematical communicating between anyone and everyone in the classroom at all times, and this should be actively encouraged wherever you think appropriate. The Numicon approach is crucially about dialogue – action, imagery and conversation.

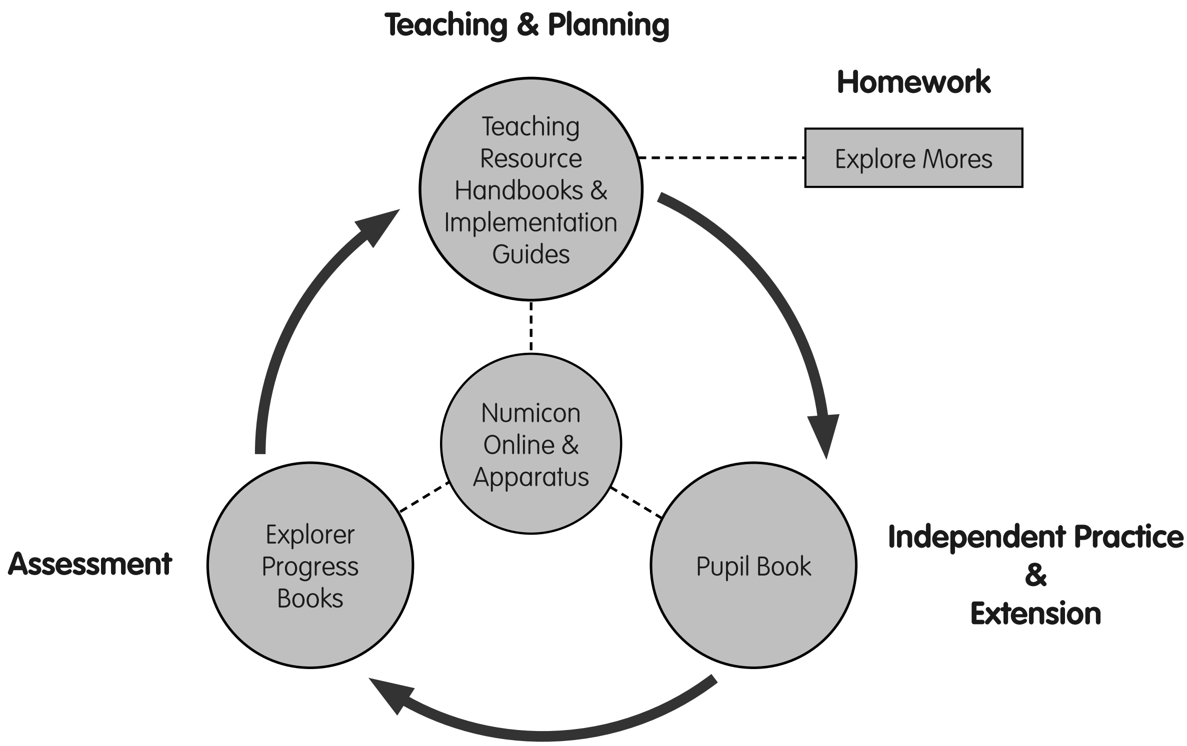
Finally, the Pupil Book questions are there to be enjoyed. Children who are supported, and who are succeeding, generally relish challenge and further difficulty. We hope you as teachers will also enjoy the journeys and pathways that these books will take children and their teachers jointly along.

Dr Tony Wing

A guide to the Numicon teaching resources

Numicon Pupil Books fit with the other resources shown here to fully support your teaching. You can also find additional resources, including an electronic copy of this answer book, on Numicon Online. This is available on the Oxford Owl website (www.oxfordowl.co.uk).

Numicon resources



Teaching Resource Handbooks

There is a Number, Pattern and Calculating and a Geometry, Measurement and Statistics Teaching Resource Handbook for each year group. The teaching in these handbooks is carried out through activities. You will find detailed support for planning and assessment here, along with vocabulary lists, the key mathematical ideas covered and photocopy masters.

Implementation Guides

Each Teaching Resource Handbook comes with an Implementation Guide. These provide guidance on the Numicon approach, how to implement this in the classroom and valuable information to support subject knowledge, including explanations of the key mathematical ideas covered and a glossary of mathematical terms used.

Explore More Copymasters

The Explore More Copymasters provide homework that enables children to practise what they are learning in school. For Geometry, Measurement and Statistics these are given in the back of the Teaching Resource Handbook. For Number, Pattern and Calculating these are provided in a separate book.

A homework activity is included for every Activity Group. Each one includes information for the parent or carer on the mathematics that has been learned in class beforehand and how to use the work together. These activities can also be used in school to provide extra practice.

Explorer Progress Books

There are four Explorer Progress Books for each year group (one for Geometry, Measurement and Statistics and three for Number, Pattern and Calculating). There are two pages in the Explorer Progress Books for each Activity Group which can be used to assess children's progress, either immediately after the Pupil Book questions or at a later point to find out what learning has been retained. These Progress Books give children the opportunity to apply what they have learned to a new situation.

Apparatus

Physical apparatus

Apparatus on the Interactive Whiteboard Software

A wide range of apparatus and structured imagery is used in Numicon to enable children to explore abstract mathematical ideas. You can find digital versions of this apparatus in the Interactive Whiteboard Software available through Numicon Online. Here you can manipulate the apparatus from the front of the class and save anything you have set up for future use.

Numicon Online for planning and assessment support

Many other resources are provided on Numicon Online to support your planning, teaching and assessment. There are editable planning documents, photocopy masters and videos to support teaching. Assessment resources here include assessment grids for the Explorer Progress Books and milestone tracking charts to monitor children's progress throughout the year. You can access all these resources, along with the Interactive Whiteboard Software, through the Oxford Owl website (www.oxfordowl.co.uk).

Planning chart

The chart below shows you how the Activity Groups in the Teaching Resource Handbooks and the Pupil Book pages fit together and the key learning that is covered. The order follows the recommended teaching progression.

Key to abbreviations used on the chart
NPC: *Number, Pattern and Calculating Teaching Resource Handbook*
GMS: *Geometry, Measurement and Statistics Teaching Resource Handbook*

NNS: Numbers and the Number System
Geo: Geometry
Calc: Calculating
PA: Pattern and Algebra
Mea: Measurement

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
Calc 1: Using adding and subtracting facts and understanding inverse relationships (Number, Pattern and Calculating 4, pages 142–148)	p2–5	**NPC Milestone 1** • To know and use patterns in adding and subtracting facts for any multiple of 10 • To have fluent recall of adding and subtracting facts to 10 to derive adding and subtracting facts to 100 • To use the inverse relationship between adding and subtracting to check totals are correct
NNS 1: Understanding place value in 4-digit numbers (Number, Pattern and Calculating 4, pages 90–95)	p6–9	**NPC Milestone 1** • To give a sensible estimate of amounts of more than 100 objects • To read, write and build 4-digit numbers with apparatus and say the value of each digit
PA 1: Exploring sequences and number patterns (Number, Pattern and Calculating 4, pages 44–49)	p10–13	**NPC Milestone 1** • To recognize and count forwards and backwards in sequences of multiples of all numbers to 12 • To notice patterns in sequences of multiples, explain the rule for the sequence and use this to find missing numbers • To use the idea of constant difference to find missing numbers in sequences
NNS 2: Ordering and comparing numbers to 1000 and beyond (Number, Pattern and Calculating 4, pages 96–100)	p14–17	**NPC Milestone 1** • To count aloud across multiples of 100 and multiples of 1000 to 10 000 • To order and compare numbers to 1000
Calc 2: Strategies for bridging when adding and subtracting (Number, Pattern and Calculating 4, pages 149–154)	p18–21	**NPC Milestone 1** • To recall adding and subtracting facts to add and subtract single digit numbers to/from any number to 1000

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
NNS 3: Estimating and rounding (Number, Pattern and Calculating 4, pages 101–106)	**p22–25**	**NPC Milestone 2** • To give a rounded estimate of amounts to 1000 • To round any number to the nearest 10, 100 or 1000 • To connect estimation and rounding numbers to the use of measuring instruments • To use the strategy of rounding numbers and adjusting to make calculations easier
Geo 1: Classifying triangles and quadrilaterals (Geometry, Measurement and Statistics 4, pages 28–36)	**p26–29**	**GMS Milestone 1** • Make or draw different triangles, using properties of sides and angles to name them, e.g. scalene, right-angled • Make or draw different quadrilaterals, using properties of sides and angles to name them, e.g. oblong, trapezium, kite • Explain how polygons are classified within umbrella categories, e.g. square, rectangle, parallelogram, quadrilateral, polygon • Use sorting diagrams to categorize collections of shapes according to chosen criteria
Calc 3: Developing fluency with mental adding strategies (Number, Pattern and Calculating 4, page 155–161)	**p30–33**	**NPC Milestone 2** • To use the strategy of partitioning in different ways to simplify adding and subtracting calculations • To use the strategy of adding or subtracting multiples of 10 in mental calculating
Calc 4: Developing fluency with mental subtracting strategies (Number, Pattern and Calculating 4, pages 162–168)	**p34–37**	**NPC Milestone 2** • To use compensating as a non-computational strategy for adding and subtracting • To know that it is important to look carefully at the numbers involved in a calculation before deciding which strategy to use
Calc 5: Developing fluency with multiplying facts to 12 × 12 (Number, Pattern and Calculating 4, pages 169–175)	**p38–41**	**NPC Milestone 2** • To recall multiplying and dividing facts for multiplication tables up to 12 × 12 • To generalize and explain the effects of multiplying by 0 and by 1
Calc 6: Developing fluency with dividing facts to 12 × 12 (Number, Pattern and Calculating 4, pages 176–182)	**p42–45**	**NPC Milestone 2** • To use the commutative property of multiplying and the inverse relationship between dividing and multiplying to speed up fluent recall of multiplying and dividing facts
PA 2: Exploring inverse relationships (Number, Pattern and Calculating 4, pages 50–56)	**p46–49**	**NPC Milestone 3** • To use inverse relationships between multiplying and dividing to record number trios and find solutions to different problems including missing number problems • To be able to explain how to use inverse operations to check answers to a calculation

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
Calc 7: Mental strategies for multiplying and dividing by 10 and 100 (Number, Pattern and Calculating 4, pages 183–189)	**p50–53**	**NPC Milestone 3** • To explain a general rule for multiplying and dividing by 10 and 100
Geo 2: Understanding reflective symmetry (Geometry, Measurement and Statistics 4, pages 37–44)	**p54–57**	**GMS Milestone 1** • Complete given symmetrical patterns, or create their own, with one vertical, horizontal or diagonal line of symmetry • Use a mirror, folded paper shape or drawing, to show the lines of symmetry in 2D shapes when presented in different orientations • Explain why all regular polygons have the same number of lines of symmetry as the number of sides or vertices
NNS 4: Introducing negative numbers (Number, Pattern and Calculating 4, pages 107–112)	**p58–61**	**NPC Milestone 3** • To count backwards through zero to include negative numbers • To read, write and order positive and negative numbers within a range of $^{-}20$ to 20
NNS 5: Fractions and recognizing part-whole relationships (Number, Pattern and Calculating 4, pages 113–119)	**p62–65**	**NPC Milestone 3** • To know that, when comparing fractions with a common denominator, the larger numerator represents the larger fraction • To make connections between fractions of a shape or fractions of one whole and fractions of a length or of a set of objects
Calc 8: Developing fluency with the column method of adding (Number, Pattern and Calculating 4, pages 190–194)	**p66–69**	**NPC Milestone 3** • To know that columns are added from right to left • To complete column calculations, recording the carrying or redistributed digit in the correct column and referring to this as the given number of tens or hundreds to carry
Calc 9: Developing fluency with the column method of subtracting (Number, Pattern and Calculating 4, pages 195–200)	**p70–73**	**NPC Milestone 3** • To review numbers involved in an adding calculation to make reliable estimates and decide whether the written column method is the most efficient
Geo 3: Investigating angles in shapes (Geometry, Measurement and Statistics 4, pages 45–50)	**p74–77**	**GMS Milestone 1** • Name polygons according to the number of sides or vertices • Test, or recognize, angles in polygons, saying if they are acute, right-angled or obtuse
NNS 6: Introducing decimal fractions (Number, Pattern and Calculating 4, pages 120–126)	**p78–81**	**NPC Milestone 4** • To know that the decimal point serves to separate the whole numbers and the fractional part of a mixed number • To express tenths as common fractions and decimal fractions • To use place value understanding to compare and order decimal fractions with one decimal place

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
PA 3: Exploring 'equals' in balancing number sentences (Number, Pattern and Calculating 4, pages 57–62)	**p82–85**	**NPC Milestone 4** • To know that three numbers can be multiplied together in any order and the product will be the same • To find missing numbers in balancing number calculations involving adding, subtracting and multiplying • To know that brackets are used to show the order in which calculations are carried out • To develop strategies for comparing and adjusting calculations • To review numbers involved in a subtracting calculation to make a reliable estimate and decide whether a written column method is the most efficient • To know that using the inverse relationship between adding and subtracting is useful when checking calculations
Calc 10: Exploring the distributive property and developing written methods of multiplying (Number, Pattern and Calculating 4, pages 201–205)	**p86–89**	**NPC Milestone 4** • To use known multiplying facts and the distributive property to derive and record other multiplying facts • To use a doubling strategy and understanding of the distributive property to derive unfamiliar multiplying facts
Calc 11: Using multiplying facts to solve dividing problems (Number, Pattern and Calculating 4, pages 206–211)	**p90–93**	**NPC Milestone 5** • To understand that known multiplying facts and the distributive property can be used to work out dividing facts • To use multiplying and dividing facts to find fractions of amounts • To understand that the way a remainder is expressed depends on the context of the problem
PA 4: Exploring multiples and factors (Number, Pattern and Calculating 4, pages 63–69)	**p94–97**	**NPC Milestone 5** • To understand that the factors of a number are those numbers that can be divided into it without leaving a remainder • To find pairs of factors • To find common multiples for two or more sequences • To make and use connections between multiplying number trios, multiples and factors
Calc 12: Developing fluency with the short written method of multiplying (Number, Pattern and Calculating 4, pages 212–216)	**p98–101**	**NPC Milestone 5** • To apply understanding of arrays to use the short written method for multiplying calculations
Calc 13: Developing fluency with the short written method of dividing (Number, Pattern and Calculating 4, pages 217–221)	**p102–105**	**NPC Milestone 5** • To use the short written method for dividing • To use multiplying facts to check short written dividing calculations

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
Calc 14: Solving problems involving more than one step (Number, Pattern and Calculating 4, pages 222–227)	**p106–109**	**NPC Milestone 5** • To select appropriate calculating operations, strategies and methods in a variety of situations involving more than one step
Mea 1: **Finding times and durations, and using the 24-hour clock** (Geometry, Measurement and Statistics 4, pages 60–68)	**p110–113**	**GMS Milestone 2** • Convert 12-hour clock times from digital to analogue, and vice versa • Calculate times earlier or later than a given time, including when bridging an hour, e.g. 37 minutes later than twenty to ten • Use a digital stopwatch to measure the duration of an activity, reading the display as hours : minutes : seconds • Interpret information shown on a simple timetable and use this to work out time durations • Draw timelines to solve problems involving times and durations • Recall equivalences between units of time: seconds, minutes, hours, days, weeks, and choose appropriate conversions to solve problems • Read and say 24-hour clock times, e.g. 17:00 as "seventeen hundred hours" • Write a given 12-hour clock time as a 24-hour clock time, and vice versa
PA 5: Looking for growing patterns in problem solving (Number, Pattern and Calculating 4, pages 70–75)	**p114–117**	**NPC Milestone 6** • To recognize and deduce rules for growing patterns including doubling sequences
Geo 4: Reading and plotting positions using coordinates (Geometry, Measurement and Statistics 4, pages 51–58)	**p118–121**	**GMS Milestone 3** • Label coordinate axes accurately and understand that coordinates show positions on the intersections of the gridlines • Locate and plot coordinates, given as (x, y), in the first quadrant, including coordinates that describe the vertices of a polygon • Translate a counter or object on a grid, describing the movements in units, e.g. down 4, right 3
NNS 7: Exploring equivalence in fractions and introducing proportion (Number, Pattern and Calculating 4, pages 127–132)	**p122–125**	**NPC Milestone 6** • To recognize and show, using diagrams, families of common equivalent fractions • To add and subtract fractions with the same denominator

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
NNS 8: Introducing decimal fractions with two places (Number, Pattern and Calculating 4, pages 133–139)	**p126–129**	**NPC Milestone 6** • To recognize and write decimal equivalents to $\frac{1}{4}, \frac{1}{2}, \frac{3}{4}$ • To recognize and write decimal equivalents of any number of tenths or hundredths • To recognize that hundredths arise when dividing an object by a hundred and dividing tenths by ten • To use place value understanding to compare and order decimal fractions with two decimal places
Mea 2: Calculating with money amounts (Geometry, Measurement and Statistics 4, pages 69–76)	**p130–133**	**GMS Milestone 3** • Convert money amounts between pounds and pence, recognizing that 1p is 1 hundredth of £1, e.g. 175p and £1·75 • Use decimal notation to write, and say, the total value of a collection of notes and coins, e.g. write £2·46 and say, "Two pounds forty-six." • Round money amounts to the nearest pound, and give real-life examples of when this skill could be useful • Present money data in a table and use this to solve problems, e.g. a sponsorship form showing how much more is needed to reach a target
Mea 3: Understanding and using units of length and distance (Geometry, Measurement and Statistics 4, pages 77–83)	**p134–137**	**GMS Milestone 3** • Give reasonable estimates of length or distance, considering the unit and instrument most appropriate for the measurement task • Use decimal notation to write, and say, lengths in m, e.g. write 3 m 85 cm as 3·85 m and say, "three point eight five metres" • Convert lengths measurements between different metric units, knowing equivalences between mm and cm, cm and m, m and km • Record length data in a table, and construct a simple bar chart to find totals and differences
Mea 4: Understanding and using units of mass (Geometry, Measurement and Statistics 4, pages 84–90)	**p138–141**	**GMS Milestone 4** • Weigh items using digital scales and present results in a conversion table, e.g. 3·45 kg, 3 kg 450 g, 3450 g • Round a list of masses and estimate the total, giving real-life examples of when this skill could be useful • Solve problems involving mass, including finding the mass of multiples of an item and the difference between the mass and a target total

Activity group title and pages in the Teaching Resource Handbook	Accompanying Pupil Book pages	Milestone statements covered
Mea 5: Understanding and using units of capacity and volume (Geometry, Measurement and Statistics 4, pages 91–97)	**p142–145**	**GMS Milestone 4** • Estimate the volume held within, or the capacity of, everyday containers, and describe the difference between these terms • Measure out a volume of liquid, when the capacity of the jug is smaller than the total volume required, e.g. 1·5 ℓ volume using a 300 ml jug • Convert between millilitres and litres, e.g. 1500 ml, 1 ℓ 500 ml, 1·5 ℓ, choosing the most appropriate units to use when solving problems
PA 6: Solving problems and puzzles systematically (Number, Pattern and Calculating 4, pages 76–80)	**p146–149**	**NPC Milestone 6** • To plan how to organize an investigation and keep systematic records of possibilities tried and tested • To begin to use their repertoire of number facts to predict the number of possibilities in a problem
Mea 6: Understanding perimeter and area (Geometry, Measurement and Statistics 4, pages 98–104)	**p150–153**	**GMS Milestone 4** • Devise methods for calculating the perimeter of regular polygons, e.g. multiplying the side length of an equilateral triangle by 3 • Draw, or use equipment to make, different polygons that have the same perimeter • Use their own words to explain and show the difference between the terms ‘perimeter’ and ‘area’ • Find the area of rectilinear shapes and shapes with diagonal sides, by counting whole squares and/or adding fractions of squares
PA 7: Exploring general rules, reasoning and logic (Number, Pattern and Calculating 4, pages 81–87)	**p154–157**	**NPC Milestone 6** • To notice patterns and predict from them to arrive at a general rule and explain their reasoning logically

Cover and Pages 2 to 5

Cover

Practice

The winning cabbage weighs 2·7 kg. This can also be written as 2700 g or 2 kg 700 g.

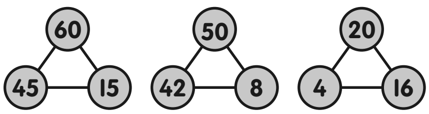
Going deeper

Both the 2nd and 3rd place cabbages must weigh less than the winning cabbage which is 2·7 kg.
To round down to 2 kg, the 2nd place cabbage must weigh less than 2·5 kg. (If it weighs 2·5 kg or more it would round up to 3 kg.) For example it could weigh 2·1 kg, 2·2 kg, 2·3 kg or 2·4 kg.
To round up to 2 kg, the 3rd place cabbage must weigh at least 1·5 kg (If it weighed less than 1·5 kg it would round down to 1 kg). For example it could weigh 1.5 kg, 1·6 kg, 1·7 kg, 1·8 kg or 1·9 kg.

Page 2: Using adding and subtracting facts (Calc 1·1 & 1·2)

Practice

1 **a**



i Any two numbers that total 60, e.g. 45 and 15.

ii Examples might include: 8 and 50, 18 and 60, 28 and 70 …

iii Examples might include: 4 and 20, 14 and 30, 24 and 40 …

b Example for above

i 45 + 15 = 60

15 + 45 = 60

60 – 15 = 45

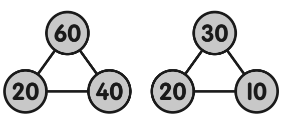
60 – 45 = 15

c Answers will vary as above.

2 48

Going deeper

1 Answers will vary, but examples could be:



2

+	37	17
23	60	40
13	50	20

+	19	33
37	56	70
42	61	75

Page 3: Number trios for 100 (Calc 1·3 & 1·4)

Guidance: Encourage children to use a baseboard to help them see the complement to 100.

Practice

1 53p. You can count the remaining spots on the baseboard (53), or complete the following calculation: £1 = 100p; 100p – 47p = 53p.

2 £2 = 200p; 200p – 68p = 132p or £1.32; 132p + 68p = 200p or £2

Going deeper

1 Answers will vary. Any two amounts that total £2·99. Examples might include:

£1 and £1·99, £1·50 and £1·49, 99p and £2

2 £10

Page 4: Using number facts for measurement problems (Calc 1·5 & 1·6)

Practice

1 **a** 750 ml

b 920 g

2 960 g flour left; 875 ml milk left

3 **a** 545 g

b 715 ml

c 112 ml

Going deeper

1 2272 ml – 750 ml = 1522 ml or 1·522 litres

2 400 ml orange, 600 ml pineapple

Page 5: Problem solving using number facts to 1000 (Calc 1·7)

Practice

1 **a** Answers will vary. Example could be: 40 + 50 + 60 = 150

b Answers will vary. Example could be: 8 + 62 + 80

2 It is not possible because 150 is an even number and three odd numbers added together always equal an odd number.

3 Answers will vary.

Going deeper

1 Example for above: 50 + 60 + 70 = 180 (adding 10 to each)

2 **a** Example responses might include: one even number and two odd numbers.

b Another possible response is: one of the numbers is the other in reverse, e.g. 36, 63.

c Answers could include: 50 + 61 + 69 and 57 + 75 + 48.

NPC Milestone 1

- To know and use patterns in adding and subtracting facts for any multiple of 10.
- To have fluent recall of adding and subtracting facts to 10 to derive adding and subtracting facts to 100.
- To use the inverse relationship between adding and subtracting to check totals are correct.

Page 6: Estimating numbers of things (NNS 1·1)

Practice

1 Children's estimations will vary. They may notice that there are 90 seeds on one A4 sheet and multiply this by the number of sheets they think will cover the table.

2 Answers will vary.

Going deeper

1 Estimations and strategies will vary. Children may estimate the number of triangles on the page, or choose to estimate one section of a page or one line. They may divide the sheets into different shapes, e.g. hexagons.

2 Answers will vary. Some children will suggest that they need to measure or estimate how many counters balance with one 10-shape and then multiply this by 10.

Page 7: Representing larger numbers in different ways (NNS 1·2 & 1·3)

Practice

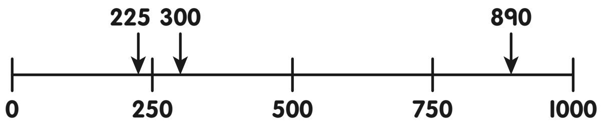
1 Ten 10-shapes on ten baseboards is one way to illustrate 1000.

2 Ten

3 Answers will vary. A good estimate of this weight is a loaf of bread.

Going deeper

1 Look for children dividing the number line into sections to help them position these numbers. Drawing half and quarter points is a helpful start; so is marking hundreds.



2 Answers will vary. Some suggestions might include base-ten apparatus, a number line, drawing small pictures of baseboards and Numicon Shapes. They may also use numerals: '670', or words: 'six hundred and seventy'.

3 Instructions will vary. Children can measure a piece of A4 paper with a ruler and try drawing the line first. They will find that the paper is just less than 30 cm and may draw a line with ten intervals of slightly less than 3 cm each.

Page 8: Column values and quantities (NNS 1·4 & 1·5)

Practice

1 3300, 3030, 3003

2 2000 + 300 + 70 + 6 = 2376

4000 + 500 + 30 + 6 = 4536

3000 + 400 + 60 + 7 = 3467

Going deeper

1 Answers will vary. Examples might include:

1 red, 6 blue, 7 green and 4 yellow

16 blue, 7 green, 4 yellow

16 blue, 74 yellow

167 green, 4 yellow

1674 yellow

2 There could be 3 red, 3 blue, 5 green, 2 yellow which is 3352 or 3 red, 3 blue, 6 green, 1 yellow which is 3361. One strategy is to draw 13 counters and label 7 green or yellow. The remaining 6 can be coloured half red and half blue. Next colour 5 or 6 green and the rest yellow.

3 Answers will vary. Dev's counters total 2733 points so one possibility is that Harriet has 2 red, 7 blue, 33 yellow. Another possibility is 27 blue, 2 green, 13 yellow.

Page 9: Calculating with larger numbers (NNS 1·6 & 1·7)

Practice

1 **a** 4312 g **b** 4512 g

2 3000 g

3 The parcels weigh the same. Children might explain that 4 kg is 4000 g which is 40 hundred grams.

Going deeper

1 54 + 23 = 77 (LXXVII)

2 212 – 131 = 81 (nnnnnnnnı)

NPC Milestone 1

- To give a sensible estimate of amounts of more than 100 objects.
- To read, write and build 4-digit numbers with apparatus and say the value of each digit.

Page 10: Sequences and patterns of multiples (P&A 1·1 & 1·2)

Practice

1 The sequence is 16, 24, 32, 40, 48, 56, 64, 72.

2 Answers will vary. Some might explain a method where they halve the difference between two given terms to find the one in between that is missing, e.g. there is a difference of 16 between the terms 24 and 40 and so the missing term is 8 more than 24 or 8 less than 40 because 8 is half the difference. The other terms can also be found by adding steps of 8. Other children will explain that they recognize that this sequence is multiples of 8.

3 The sequence is 84, 72, 60, 48, 36, 24, 12.

Going deeper

1 3: 3, 6, 9, 2, 5, 8, 1, 4, 7, 0

4: 4, 8, 2, 6, 0

5: 5, 0

6: 6, 2, 8, 4, 0

7: 7, 4, 1, 8, 5, 2, 9, 6, 3, 0

8: 8, 6, 4, 2, 0

9: 9, 8, 7, 6, 5, 4, 3, 2, 1, 0

10: 0

2 Multiples of 1, 3, 7 and 9 use all the keys.

Multiples of 2, 4, 6 and 8 use five keys.

3 Answers will vary. Some will notice that multiples of even numbers 2 to 8 use the same five keys and multiples of the odd numbers (apart from 5) use all ten keys. Others will explain connections between the multiples, e.g. multiples of 4 are also multiples of 2 and therefore use the same keys.

Page 11: More sequences and patterns of multiples (P&A 1·3 & 1·4)

Practice

1 Answers will vary. They might notice that the ones digits are the same in both multiple sequences. Another connection is that each term in the second sequence is 6 times larger than the same term in the first, e.g. 60 is 6 times more than 10.

2 The last digit of both the 4th terms is 0, the second sequence is 40 more or 3 times more.

The last digit of both the 7th terms is 5, the second sequence is 70 more or 3 times more.

Going deeper

1 Answers will vary. Some might explain that the ones digit is the same in both sequences. Some might show how the Numicon 3-shapes in both sequences combine in the same way regardless of the tens involved.

2 Answers will vary. Some will suggest that 4 and 14 have the same sequence of unit digits. Others will list different possibilities, e.g. 24, 34, 44.

3 The ones digit will be 2. Answers will vary. Some will notice the ones digit sequence is 4, 8, 2, 6, 0 and repeat this up to the 13th term. Others will explain that because there are five digits in this sequence, the 5th and 10th terms are 0 and so the 13th term is the 3rd one in the list.

Page 12: Other sequences (P&A 1·5)

Practice

1 The sequence would continue 19, 24, 27, 32, 35, 40 …

2 The rule for the sequence is add 3, add 5.

3 Answers will vary. One suggestion might be to look at the alternate terms in sequence. The 2nd term is 1 × 8, the 4th term is 2 × 8 and the 6th term is 3 × 8 so continuing this pattern would mean the 12th term is the 6th multiple of 8 which is 48. Others might predict that the 6th term is 24 so the 12th is double this.

Going deeper

1 Answers will vary. The sequence is 2, 9, 11, 18, 20, 27, 29 and the 17th term is 74. Some might explain that the sequence increases alternately in steps of 2 and 7 and the alternate steps increase by 9. This means that following the pattern that the 2nd term is 1 × 9 and the 4th term is 2 × 9 so the 16th term will be 72 (8 × 9). The 17th term is 2 more than this.

2 72, 117 will occur in the sequence because they are multiples of 9. 92 will also appear as it is 2 more than a multiple of 9. 85 will not occur in this sequence.

3 Answers will vary. Some may suggest that because 108, 126 and 54 are all multiples of 9 they would use three number rods that make 9, e.g. 5, 3 and 1.

Page 13: Constant differences (P&A 1·6 & 1·7)

Practice

1 Both sequences increase in steps of 3 but they have different starting numbers. The first is a multiple of 3 sequence because the first term is 3 and the step size is 3.

2 Answers will vary. Some may notice that they can use 3-rods to make the first sequence but they need one 5-rod and some 3-rods to make the second sequence.

3 Both sequences decrease in steps of 4. The first is a decreasing multiple of 4 sequence because the first term is a multiple of 4 and the step size is 4.

Going deeper

1 The hamster food will run out on day 7. If the bag is started on Sunday, it will last 7 days from Sunday through to Saturday. S14, M28, T42, W56, T70, F84, S98

2 The sequence is 3, 9, 15, 21, 27. It increases in steps of 6.

3 Answers will vary. Some might explain that the difference between the first and last terms is 25 and then explain that they need to divide this equally to make steps of a constant size. 25 divides into 5, so this can be the step size. The sequence is then 7, 12, 17, 22, 27, 32.

NPC Milestone 1

- To recognize and count forwards and backwards in sequences of multiples of all numbers to 12.
- To notice patterns in sequences of multiples, explain the rule for the sequence and use this to find missing numbers.
- To use the idea of constant difference to find missing numbers in sequences.

Page 14: Counting on and back (NNS 2·1)

Practice

1 475, 474, 473, 472,471, 470 … 460, 459, 458, 457

2 Answers will vary. The sequence is 42, 47, 52, 57, 62, 67, 72, 77, 82, 87, 92, 97, 102. Some will notice the repeating digits pattern with 2 and 7 and use this to help them.

3 764, 759, 754, 749, 744, 739, 734, 729, 724, 719, 714, 709, 704, 699

4 2250, 2275, 2300, 2325, 2350, 2375, 2400

Going deeper

1 Answers will vary. Some may explain that counting in 25s or 50s is easy when the starting number is a multiple of 25, others will make reference to other familiar patterns and observations, e.g. counting on or back in 10s doesn't change the ones digit, counting in 5s is easier if the start number is a multiple of 5.

2 Answers will vary according to their preferences.

3 235, 244, 253, 262, 271, 280, 289, 298, 307, 316, 325. Some children may notice that in this count sequence the ones digits are decreasing by 1 and the tens digits are increasing by 1 each time. They might explain to a friend how this can be useful to know when counting forward in 9s.

4 824, 815, 806, 797, 788, 779, 770 … Some children may suggest that a good strategy for counting backwards in 9s is to increase the ones digits by 1 and decrease the tens digits by 1 each time.

Page 15: Ordering numbers (NNS 2·2 & 2·3)

Practice

1 4304, 4340

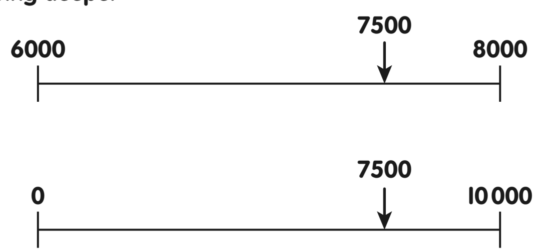
2 Answers will vary. Examples include 2357 < 3527, 2357 < 2537, 3257 < 3275

3 7523 < 7532. The smallest difference is 9. To find the smallest difference, the thousands and hundreds digits need to be the same and the closest pair of digits, e.g. 2 and 3, need to be in the tens and ones places.

4 Answers will vary; examples include 3212, 3122, 3221, 2132.

Going deeper

1



7500 is three-quarters of the way between 6000 and 8000, and also three-quarters of the way between 0 and 10 000. This is represented on the number lines.

2 1388 is roughly 1400, which is left of the centre if the number line is labelled 1000 and 2000 at either end.

Page 16: Number games (NNS 2·4)

Practice

1 **a** The smallest difference is 18, made from 2653 and 2635 or from 6253 and 6235.

b The largest difference is 3618, made from 6253 and 2635.

2 **a** The smallest difference is 2 but answers will vary on the numbers used, for example it can be made with 2243 and 2245.

b The largest difference is 4121 and it can be made with 5443 and 1322.

Going deeper

1 There are six possible numbers that Lara could have made: 5431, 5413, 4531, 4513, 4331 and 4313.

2 The smallest possible difference between 2-digit numbers on dominoes is 1, e.g. 21 and 22, so you can use these for the tens and ones, and any other domino for the thousands and hundreds, using the same domino in both 4-digit numbers, e.g. 4621 and 4622. There are many possible answers here, since the difference can be made using any two adjacent numbers for tens and ones, and any other domino to make up the 4 digits.

Page 17: Finding numbers within a range (NNS 2·5 & 2·6)

Practice

1 **a** Answers will vary but will attempt to narrow down the range. One strategy is to use the halfway point, e.g. 3250, and choose whether to ask if the number is smaller or bigger than this.

b Answers will vary and will depend on the question chosen in Practice 1. If the question was: "Is it bigger than 3250?", a ‘no’ answer means the biggest number it could be is 3250 and the smallest is 3001.

2 Answers will vary. Some examples include: "Is it bigger than 7500? Is it smaller than 6000? Is it bigger than 6500? Is it smaller than 7000?"

Going deeper

1 **a** Answers will vary. Some examples include: 4050, 4041, 3502, 5123.

b Answers will vary. Some examples include: 2431, 2415, 1403, 1033, 2003.

2 The smallest number could be 3500 and the largest could be 3600. A good strategy is to look for the highest first number in all the ranges and the lowest second number.

NPC Milestone 1

- To count aloud across multiples of 100 and multiples of 1000 to 10 000.
- To order and compare numbers to 1000.

Page 18: Bridging multiples of 10 when adding (Calc 2·1 & 2·3)

Practice

1 **a** Tia – 34 (3 full pages)

Ben – 26 (2 full pages)

b Tia – 51

Ben – 43

2 **a** 35 + 7 = **42** **b** 27 + 15 = **42**

c 48 + 16 = **64** **d** 34 + 28 = **62**

Going deeper

1 Explanations will vary but all except **a** and **d** make sense to use bridging/compensating, e.g.

- 18 + 26, take 2 off the 26 to make 18 into 20, then add.
- 32 + 19, make 19 into 20 and take 1 off 32.
- 137 + 48, make 48 into 50 and take two off 137.

2 18 + 26 = 20 + 24

32 + 19 = 31 + 20

137 + 48 = 135 + 50

Page 19: Bridging multiples of 10 when subtracting (Calc 2·2 & 2·4)

Practice

1 16

2 8

3 You would bridge to get to those marked in bold.

50, 43, **36**, **29**, 22, **15**, **8**, 1

4 **a** 67 – 28 = **39** **b** 46 – 19 = **27**

c 155 – 38 = **117** **d** 172 – 26 = **146**

Going deeper

1 Answers will vary. For example, 54 – 17 = 37, 54 – 36 = 18.

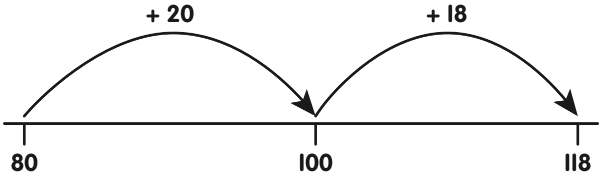
2 Explanations should recognize that when the ones digit is larger in the number they are subtracting than the ones digit in the number they are starting with, it is always easier to bridge, e.g. 56 – 28.

Page 20: Bridging through 100 when adding (Calc 2·5)

Practice

1 70 + 45 = 100 + 15

2 a 80 + 38 = 118



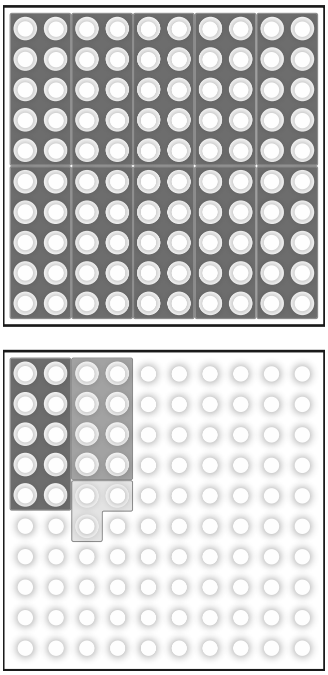
b 160 + 56 = 216

c 77 + 64 = 141

d 185 + 49 = 234

Going deeper

1 a 73 + 48 = 100 + 21



Move the 3-shape off the first board onto the second board and move three 10-shapes from the second board onto the first board, to make a complete board. This leaves one 10-shape, an 8-shape and a 3-shape on the second board, which is 21.

b Another way would be to fill the second board (by first removing the 8-shape and then moving six 10-shapes onto it) leaving a 1-shape, 8-shape and 3-shape on the first board.

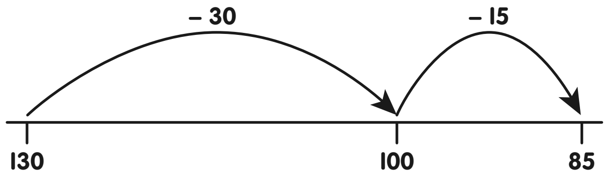
2 Explanations will vary but should discuss that bridging is helpful when the tens digits combine to over 100.

Page 21: Bridging through 100 when subtracting (Calc 2·6)

Practice

1 Explanations will vary but are likely to explain that she will have 85 balloons left because if she subtracts 30 from 45, it leaves her with 15 to take away from 100.

2 130 – 45 = **100 – 15**



3 a 150 – 78 = **72**

b 342 – 55 = **287**

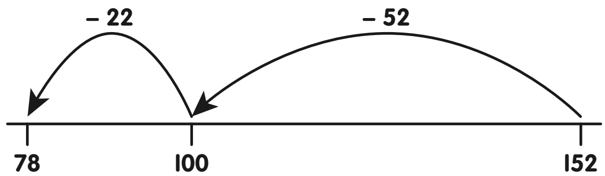
c 265 – 187 = **78**

Going deeper

1 50 + 15 = 65, then 130 – 65 = 65

130 ÷ 2 = 65, then 130 – 65 = 65

2 152 – 74 = 78



3 Examples will vary but they should recognise that those for which bridging is suitable is where the tens digit is larger in the number being taken away, e.g. 342 – 171 or 454 – 278 as opposed to: 435 – 112 or 348 – 123.

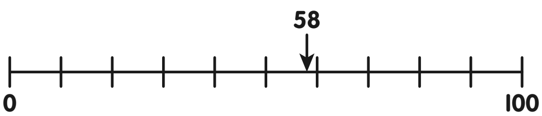
NPC Milestone 1

- To recall adding and subtracting facts to add and subtract single digit numbers to/from any number to 1000.

Page 22: Estimating and rounding (NNS 3·1 & 3·2)

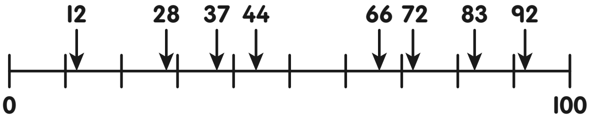
Practice

1 a



b Answers will vary. One strategy is to locate the nearest multiples of 10, e.g. for 37 this would be 30 and 40. Then place 37 about a 7th of the way between these.

2



Going deeper

1 Answers will vary. One strategy is to find the halfway point (50) and then half the distance between this point and the end of the line. Other suggestions could be to locate the multiples of 10 and position 75 halfway between 70 and 80 or divide the line into quarters and mark 75 at the three-quarter point.

2 The end points could be 50 and 100 or 0 and 200. Explanations will vary, some will use the halfway points or other tens markers in their estimations, others may use fractions, e.g. the number is about $\frac{2}{6}$ of the way along the line.

Page 23: Rounding to the nearest 100 (NNS 3·3 & 3·4)

Practice

1 336 cm is 3 m to the nearest metre.

2 An estimation to the nearest metre is 3 m, as 162 cm is only 12 more than 150 cm.

3 Children's own explanations will probably note that two revolutions of the wheel will be 450 cm and recognize that this is exactly halfway between 4 and 5 metres. Following this, they might explain that we round up halfway points so 450 cm to the nearest metre is 5 m.

Going deeper

1 Explanations may vary; one example might be to use a known fact, e.g. 85 + 25 = 100, to explain that 4685 cm is 25 cm away from the nearest metre. Some children may use a number line.

2 Explanations will vary. Some will explain how they rounded the wheel revolution of 225 cm to 200 cm and then used known facts (e.g. 5 × 200 cm is equal to 1 metre and 50 × 200 cm is equal to 10 metres) to help them estimate that the bike has made 50 revolutions to the nearest metre. Lastly, they might check with the exact calculation (225 cm × 50 = 11 250 cm). Other acceptable answers are 51, 49, 48, 47 revolutions, with 49 being the closest to 11 metres.

3 If a number is 600 rounded to the nearest 100, it has to be between 550 and 649, and if it is 560 rounded to the nearest 10, it has to be between 555 and 564.

Page 24: Rounding to the nearest 1000 (NNS 3·5 & 3·6)

Practice

1 a Annapurna 2: 7937 m rounded to the nearest 1000 metres is 8000 m

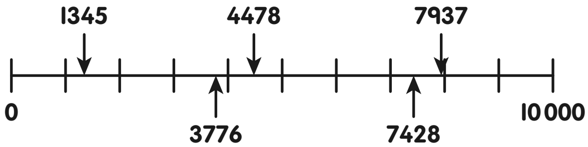
K12: 7428 m rounded to the nearest 1000 metres is 7000 m

Matterhorn: 4478 m rounded to the nearest 1000 metres is 4000 m

Mount Fuji: 3776 m rounded to the nearest 1000 metres is 4000 m

Ben Nevis: 1345 m rounded to the nearest 1000 metres is 1000 m

b



2 The lowest number that rounds to 6000 as the nearest 1000 is 5500 and the highest is 6499.

Going deeper

1 The lowest number is 3547 and the highest is 4397.

2 There are 498 pairs of numbers, starting with 4501 and 5499 and ending with 4999 and 5001.

Page 25: Rounding calculations (NNS 3·7)

Practice

1 Rounding 4230 kg to 4200 kg and 375 kg to 400 kg, we can work out that the campervan weighs roughly 3800 kg to the nearest 100 kg.

2 Estimates may vary. Examples might include:

a 250 + 40 = 290 **b** 180 − 60 = 120

c 20 × 5 = 100 **d** 60 ÷ 20 = 3

3 Answers will vary depending on their estimates. Examples might include:

a The exact calculation will be less than the estimation because both numbers were rounded up.

b The exact calculation will be more because the first number in the subtraction is more and the amount subtracted is less.

c The exact calculation will be more because multiplying by 6 makes a much bigger number than multiplying a slightly bigger number by 5.

d The exact calculation will be the same because the first number has increased by 3 making 20 groups of 3 rather than 19.

Going deeper

1 Answers will vary. Examples might include: 187 + 54, 335 − 96, 3 × 81, 2390 ÷ 10.

2 Numbers in the range of 2995 to 3004 will round to 3000 as the nearest 10, 100 and 1000. Numbers less than 2995 will round down to 2990 as the nearest 10 and numbers more than 3004 will round up to 3010 as the nearest 10.

NPC Milestone 2

- To give a rounded estimate of amounts to 1000.
- To round any number to the nearest 10, 100 or 1000.
- To connect estimation and rounding numbers to the use of measuring instruments.
- To use the strategy of rounding numbers and adjusting to make calculations easier.

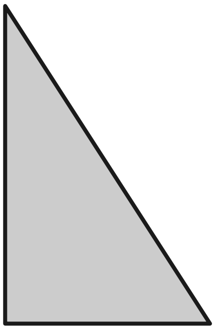
Page 26: Types of triangles (Geo 1·1)

Practice

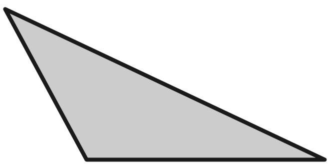
1 **a** The two isosceles triangles: A and D.

b They both have 2 equal sides and 2 equal angles.

2 **a** Any right-angle triangle, e.g.



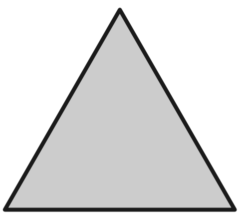
b Any scalene triangle, e.g.



3 Ravi's is a right-angle triangle (one of the angles is a right-angle).

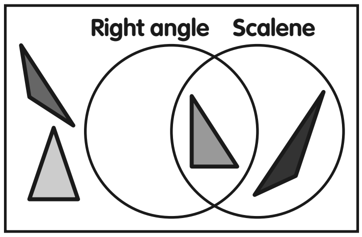
Tia's is a scalene triangle (it has 3 different side lengths and angles).

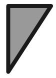
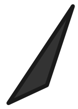
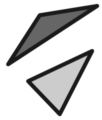
4 An equilateral triangle is regular.



Going deeper

1 Children's diagrams will differ as will their criteria. An example might be:



	Right angle	**No right angle**
Scalene		
Not scalene		

2 It is NOT possible as two obtuse angles alone would total more than 180° and the triangle would not be a closed shape.

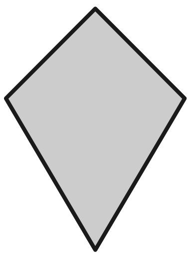
Page 27: Classifying quadrilaterals (Geo 1·2)

Practice

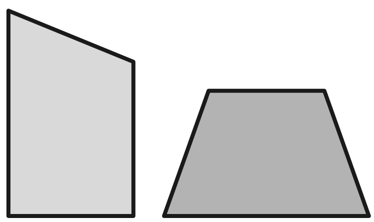
1 **a** Possible responses might include: square, rectangle, parallelogram, trapezium.

b Diagrams will vary.

2 Kite

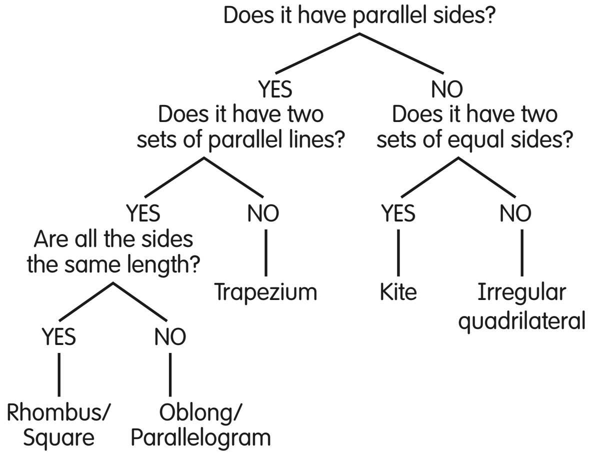


3 Drawings will vary but all should have one set of parallel lines, e.g.



Going deeper

1



2 **a** and **b** Shapes will vary.

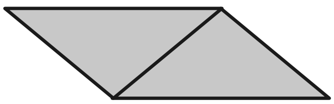
3 **a** A rectangle has 4 right angles and opposite sides are equal. A square fits this description but is special as all its sides are equal.

b A parallelogram is any shape with 2 pairs of parallel sides. Opposite sides and angles are equal. A rhombus fits this description but is special as all its sides are equal length.

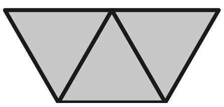
Page 28: Making shapes with triangles (Geo 1·3)

Practice

1 Yes, except a congruent parallelogram facing the other way.

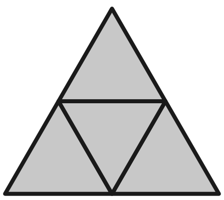


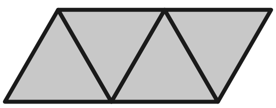
2 A trapezium in different orientations.



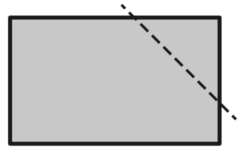
Going deeper

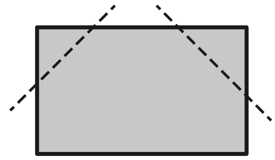
1 It is only possible to make a parallelogram or a larger equilateral triangle.





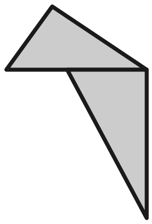
2 **a** They should be left with a pentagon and a right-angled triangle and then a hexagon and a right-angled triangle.



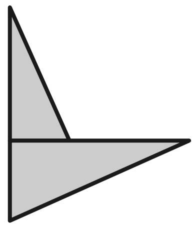


b Shapes will vary depending on how they put them together and what size triangles they cut off. Examples are:

Pentagon



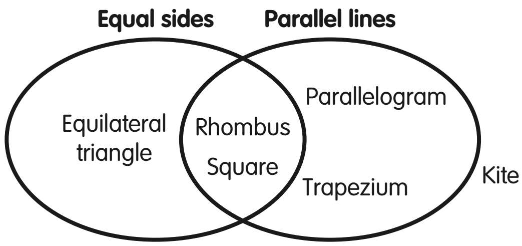
Quadrilateral



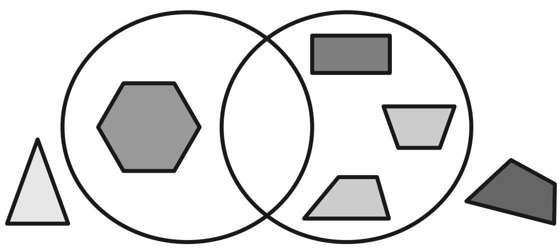
Page 29: Sorting and classifying triangles and quadrilaterals (Geo 1·4)

Practice

1



2 Responses may vary but check against the criteria. Examples are:

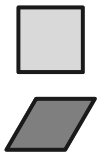
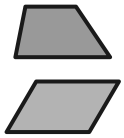
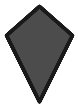


3 Diagrams will vary.

Going deeper

1 Responses will vary.

2

	Equal sides	Not equal sides
Parallel lines		
No parallel lines		

3 Responses will vary.

GMS Milestone 1

- Make or draw different triangles, using properties of sides and angles to name them, e.g. scalene, right-angled.
- Make or draw different quadrilaterals, using properties of sides and angles to name them, e.g. oblong, trapezium, kite
- Explain how polygons are classified within umbrella categories, e.g. square, rectangle, parallelogram, quadrilateral, polygon.
- Use sorting diagrams to categorize collections of shapes according to chosen criteria.

Page 30: Exploring adding problems (Calc 3·1 & 3·2)

Practice

1 **a** £2·85

b Strategies will vary.

c Strategies will vary.

2 **a** £1·87 **b** £3·39 **c** £3·90

Strategies for above will vary.

Going deeper

1 Example response:

50p, 20p, 5p, 10p, 2p, 2p, 1p

50p, 20p, 20p, 5p, 5p, 5p, 5p

2 50p, 50p, 20p, 20p, 10p

£1, 20p, 20p, 5p, 5p

£1, 20p, 10p, 10p, 10p

Page 31: Adding by rounding and adjusting (Calc 3·3)

Practice

1 **a** 61, rounding 29 to 30 and taking 1 off the 32

b 32 + 29 = 31 + 30

2 **a** 49 + 79 = 50 + 78 (128)

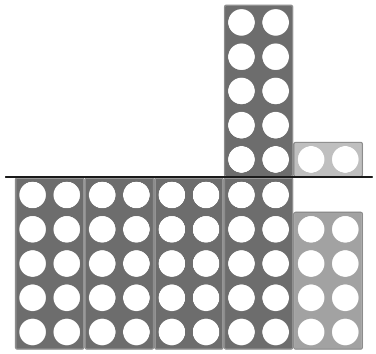
b 78 + 53 = 80 + 51 (131)

c 102 + 219 = 101 + 220 (321)

Going deeper

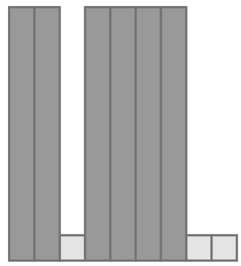
1 **a** 48 + 12 = 50 + 10 (60)

Children may model in different ways. An example could be using Numicon Shapes showing 12 and 48 and how the 2 can move down leaving 50 and 10.



b 21 + 42 = 20 + 43 (63)

Using number rods you could move the 1 from the 21 to the 42.



2 **a** 54 + 72 = 56 + 70 (rounding and adjusting to give 126)

b 39 + 63 = 40 + 62 (rounding and adjusting to give 102)

c 18 + 26 = 20 + 24 (rounding and adjusting to give 44)

d 65 + 45 (110 – add the tens and then the ones)

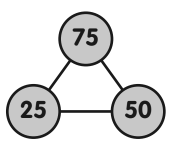
Generalize that where the ones digit is greater or less than 5, it is easiest to round and adjust.

Page 32: Reasoning skills (Calc 3·4)

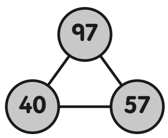
Practice

1 Adjustments could vary. Example response:

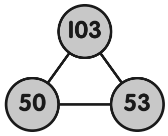
a Change 51 to 50 and adjust the 24 to 25.



b Change 39 to 40 and adjust the 58 to 57.



c Change 47 to 50 and adjust 56 to 53.



2 **a** 48 + 74 = 50 + 72 (122) **b** 97 + 46 = 100 + 43 (143)

Going deeper

1 Children may adjust differently. Example response:

a 50 + 25 = 75 **b** 50 + 47 = 97 **c** 50 + 53 = 103

2 A range of possible responses.

Two examples are shown below.

60 + 30 = 62 + 28

60 + 30 = 56 + 34

Page 33: Choosing strategies to solve problems (Calc 3·5 & 3·6)

Practice

1 **a** 18 + 18 + 19 = 55

b 14 + 14 + 17 + 17 = 62

c Strategies will vary. Look for those who round and adjust, use doubling.

2 **a** 55 + 13 = 68

b 62 + 15 = 77

Going deeper

1 **a** 12 or double 6 or triple 4

b 3

2 Responses will vary but looking for a total of 62, e.g. double 19 and triple 8.

Double 20 and double 11.

3 smallest – 6 darts all landing on 1 = 6

largest – 6 darts all landing on triple 20 = 60 × 6 = 360

NPC Milestone 2

- To use the strategy of partitioning in different ways to simplify adding and subtracting calculations.
- To use the strategy of adding or subtracting multiples of 10 in mental calculating.

Page 34: Exploring subtracting problems (Calc 4·1 & 4·2)

Practice

1 **a** £5·20 – £3·30 = £1·90 **b** £2·50 – £1·80 = 70p

c £8·50 – £4·80 = £3·70

2 £3·30 + £1·90 = £5·20

£1·80 + £0·70 = £2·50

£4·80 + £3·70 = £8·50

Going deeper

1 **a** Ravi and Tia, £5·20 – £2·50 = £2·70

b Molly and Ravi, £5·20 – £4·80 = 40p

2 Responses will vary. Example: 68 – 28 = 40

70 – 30 = 40

Page 35: Using rounding and adjusting to subtract (Calc 4·3 & 4·4)

Practice

1 120 – 51 = 69

69 – 38 = 31

31 – 19 = **12**

2 120 – 38 = 82

82 – 29 = 53

53 – **42** = 11

She turned over **D**.

3 **a** 124 – 36 = 120 – **32** **b** 52 – **27** = 50 – 25

Going deeper

1 A, B and E

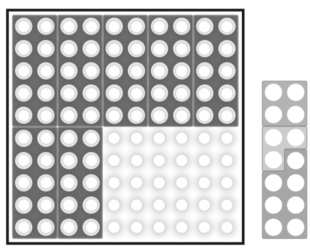
2 B, C and D because the total of the three numbers is 131 (greater than 120)

A, B, D – total 122

Page 36: Using partitioning to subtract (Calc 4·5)

Practice

1 Using the method of first taking away the tens and then the ones, Molly would do: 84 – 30 = 54, and then 54 – 7 = 47.



If you partition 84 into 70 + 14, then you can take away the 7 easily from the 14 leaving 7, and then take away the 30 from the 70, giving 47 as the answer.

2 **a** 54 – 26

40 + 14 –

20 + 6

20 + 8 = 28

b 103 – 68

90 + 13 –

60 + 8

30 + 5 = 35

c 152 – 75

140 + 12 –

70 + 5

70 + 7 = 77

Going deeper

1 84 – 37 = 47

Explanations will vary.

i Take away 40, add 3 back on

ii Partition 84 into 70 + 14 and then take away 30 and 7

iii 80 – 33 (take 4 away from each number)

2 Examples could be:

34 – 8 = 26

42 – 16 = 26

50 – 24 = 26

58 – 32 = 26

Pattern continues.

3 **a** and **b** Children's strategies will vary.

107 – 84 = 100 – 77 (23: rounding and adjusting)

72 – 36 (partitioning or just doubling knowledge)

60 + 12 –

30 + 6

30 + 6 = 36

135 – 18 = 137 – 20 (117: rounding and adjusting)

93 – 25 = 100 – 32 (68: rounding and adjusting)

Page 37: Subtracting to solve problems and puzzles (Calc 4·6 & 4·7)

Practice

1 Alice – 33 mm

2 43 mm – 32 mm = 11 mm

3 Fred – 65 – 32 = 33 mm

Alice – 65 – 43 = 22 mm

Musa – 65 – 28 = 37 mm

Going deeper

1 150 – 32 = 118

118 – 8 = 110

110 – 54 = 56

56 – 15 = 41

2 **a** 154 – 67 = 87

b 78 = 104 – 26

c 127 – 78 = 49

NPC Milestone 2

- To use compensating as a non-computational strategy for adding and subtracting.
- To know that it is important to look carefully at the numbers involved in a calculation before deciding which strategy to use.

Page 38: Exploring multiplying facts (Calc 5·1)

Practice

1 Children may give a range of answers that include:

5 + 5 + 5 + 5

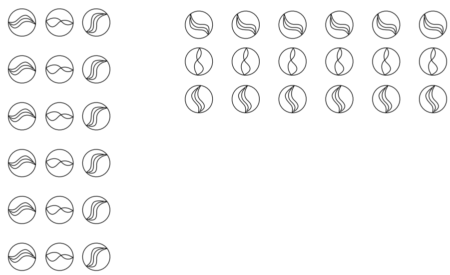
4 × 5

4 + 4 + 4 + 4 + 4

5 × 4

Children may even write 2 × 5 add 2 × 5.

2



3 **a** 12 cards **b** 24 cards **c** 0 cards

4 **a** 3 + 3 + 3 + 3, 4 × 3 – some children may also write 3 × 4.

b 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3, 8 × 3 – some children may also write 3 × 8.

c 3 × 0 or 0 × 3

Going deeper

1 May is correct as 12 shells can be arranged in several different arrays. Look for children who either draw or give examples such as a 1 × 12 array, 2 × 6 array, etc.

2 There could be 24, 12, 8, 6, 4, 3, 2 or 1 player/s.

3 An array is a collection of objects that are arranged in rows and columns. It is important that the rows and columns are organized into equal amounts.

Page 39: Writing multiplying sentences (Calc 5·2)

Practice

1 Look for children who have made the appropriate rod pictures. Encourage them to draw on cm-squared paper also. Ensure their pictures match their models.

2 They are all multiples of 12, and **b** and **d** are double **a** and **c** because 6 is double 3.

3 $3 \times 7 = 21$

4 **a** $4 \times 7 =$ **28**

b $8 \times 7 =$ **56**

c **7** $\times 8 = 56$

d Look for children who notice paterns such as half of 8×7 is 4×7 or that double 4×7 gives you 8×7. Look also for children who discuss the inverse operations.

Going deeper

1 Sofia's mystery number is 9; $9 \times 7 = 63$

2 Ensure children's own questions are accurate and include the answer.

3 Esme's two mystery numbers are:

1×32 or 32×1

2×16 or 16×2

4×8 or 8×4

Page 40: Arrays and the commutative property (Calc 5·4)

Practice

1 Neela and Tom grow the same amount of cabbages. This is because $3 \times 6 = 6 \times 3$.

2 **a** There will be 3 seeds in each of Neela's rows.

b $3 \times 12 = 36$

$12 \times 3 = 36$

Going deeper

1 Ben is correct, six 3-rods would fit on top of the three 6-rods.

2 $4 \times 6 = 6 \times 4$

$4 \times 6 = 24$

$6 \times 4 = 24$

3 The commutative law of multiplication means that you can multiply numbers in any order and the answer (product) remains the same.

It can help with multiplication tables as it can reduce the number of facts that you need to learn. For instance, when learning the 2×7 in the 2 times table, you are also learning part of the 7 times table.

Page 41: Improving fluency (Calc 5·5)

Practice

1 **a** 6 lots of 50p equal 300p

6 lots of 50p equal £3·00

6×50p = 300p

6×50p = £3·00

50p $\times 6$ = 300p

50p $\times 6$ = £3·00

6 lots of £5·00 equal £30·00

$6 \times$ £5·00 = £30·00

£5·00 $\times 6$ = £30·00

b 12 lots of 50p equal 600p

12 lots of 50p equal £6·00

12×50p = 600p

12×50p = £6·00

50p $\times 12$ = 600p

50p $\times 12$ = £6·00

12 lots of £5·00 equal £60·00

$12 \times$ £5·00 = £60·00

£5·00 $\times 12$ = £60·00

Going deeper

1 **a** $4 \times 3 =$ **12**

b $8 \times 3 =$ **24**

c $16 \times 3 =$ **48**

d $3 \times 32 =$ **96**

The facts are related; as the expression doubles, so does the product. For instance, double 4×3 is 8×3. And double 12 is 24. Similarly, 16×3 when doubled is 3×32, as this is the same as 32×3.

2 Look for children who choose either Molly's, Tia's or Ben's method to solve 6×8 and give their explanation as to why.

NPC Milestone $\boxed{2}$

- To recall multiplying and dividing facts for multiplication tables up to 12×12.
- To generalize and explain the effects of multiplying by 0 and by 1.

Page 42: Exploring dividing facts (Calc 6·1)

Practice

1 **a** 3 players **b** 7 players

2 Use the array to check that 21 divides by 3 to make 7 and by 7 to make 3.

3 **a** 16 players

b 8 players

c 4 players

4 As you double the amount of dominoes each player needs you halve the number of players that can play.

Going deeper

1 **a** and **b** Answers may vary – but ensure children's examples do represent real life.

2 48 ÷ 1 = 48

48 ÷ 2 = 24

48 ÷ 3 = 16

48 ÷ 4 = 12

48 ÷ 6 = 8

48 ÷ 8 = 6

48 ÷ 12 = 4

48 ÷ 24 = 2

48 ÷ 48 = 1

3 It is possible to share 13 counters between 13 children as each child would receive 1 counter. Some children might also suggest sharing the counters and having remainders.

Page 43: Writing dividing sentences (Calc 6·2)

Practice

1 **a** 32 pieces of wood

b 16 pieces of wood

c 8 pieces of wood

d 4 pieces of wood

Going deeper

1 **a** 18 fence panels

b 12 fence panels

c Fifteen 4 m fence panels and two 6 m fence panels total 72 m. Ten 6 m fence panels and three 4 m fence panels. Some children may be encouraged to be systematic and be guided to lay this out as a table.

d Rajesh is correct. 5 m panels would not fit exactly into 72 m as there would be a remainder of 2 metres.

Page 44: Finding dividing facts from an array (Calc 6·3)

Practice

1 **a** 4 groups of 6 apples

b 6 groups of 4 apples

c 24 ÷ 4 = 6   24 ÷ 6 = 4

2 Various answers. Check for children who use the context correctly when writing their own question.

3 **a** Look for children who find all of the possibilities and are systematic.

The orange tree arrays can be made as follows:

1 × 36

2 × 18

3 × 12

4 × 9

6 × 6

b 36 ÷ 1 = 36

36 ÷ 2 = 18

36 ÷ 3 = 12

36 ÷ 4 = 9

36 ÷ 6 = 6

36 ÷ 9 = 4

36 ÷ 12 = 3

36 ÷ 18 = 2

36 ÷ 36 = 1

The above answers realize that an array of 1 × 36 can have two associated dividing facts: e.g. 36 ÷ 1 and 36 ÷ 36.

Going deeper

1 **a** and **b** Look for a 3 × 7 and a 7 × 3 array.

c and **d** Look for 7 × 6 and a 6 × 7 array.

2 If you double the amount that you start with (the dividend) but still divide it by the same amount then the answer will also be doubled.

Page 45: Using dividing facts (Calc 6·4)

Practice

1 **a** Check children's drawings are accurate and extend up to 9 × 12 = 108 (9, 18, 27, 36, 45, 54, 63, 72, 81, 90, 99, 108).

2 Look for children who notice that the answers double each time. The 4th multiple of 9 is 36 and 8th multiple of 9 is double.

3 **a** 3 **b** 6 **c** 12

4 Tia is correct that the 7th multiple of 9 is 63. However, she is incorrect that 9 ÷ 63 = 7 as she has written the numbers in the wrong order.

Going deeper

1 **a** and **b** Use children's responses as assessment for learning. Look for children who use related patterns as tips for learning dividing facts in the games they make.

2 Dividing by 5 is the same as diving by 10 and then doubling (or times by 2), e.g. 40 ÷ 10 = 4 × 2 = 8 and 40 ÷ 5 = 8.

NPC Milestone 2

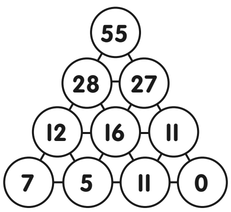
- To use the commutative property of multiplying and the inverse relationship between dividing and multiplying to speed up fluent recall of multiplying and dividing facts.

Page 46: Exploring inverse relationships (P&A 2·1 & 2·2)

For Practice question 1 and Going deeper question 1 you could give children a copy of number trios cut out from the photocopy master 31 from the *Number, Pattern and Calculating 4 Teaching Resource Handbook*.

Practice

1



The missing numbers are 55 at the top and 27 in the row below this. The are several possibilities for the bottom row including 7, 5, 11, 0; 6, 6, 10, 1; 5, 7, 9, 2; 4, 8, 8, 3; 3, 9, 7, 4; 2, 10, 6, 5; 1, 11, 5, 6; 0, 12, 4, 7

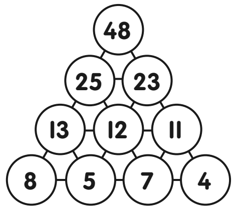
2 Answers will vary. Some may explain that they can use the inverse to find some of the missing numbers, e.g. 55 – 28 = 27.

3 and **4** The missing numbers across the top could be 1, 3, 0 and 16, 12, 23 down the side· Other possibilities are:

2, 4, 1	and 15, 11, 22
3, 5, 2	and 14, 10, 21
4, 6, 3	and 13, 9, 20
5, 7, 4	and 12, 8, 19
6, 8, 5	and 11, 7, 18
7, 9, 6	and 10, 6, 17
8, 10, 7	and 9, 5, 16
9, 11, 8	and 8, 4, 15
10, 12, 9	and 7, 3, 14
11, 13, 10	and 6, 2, 13
12, 14, 11	and 5, 1, 12
13, 15, 12	and 4, 0, 11

Going deeper

1



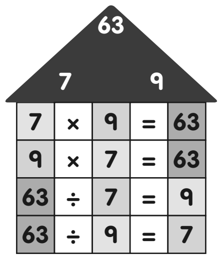
2 Using the inverse operation, there are three other facts. These are 8 + 3 = 11, 11 – 3 = 8, 11 – 8 = 3.

Page 47: Multiplying and dividing (P&A 2·2 & 2·4)

For Practice question 2 and Going deeper question 2 you could give children a copy of number trios cut out from the photocopy master 30 from the *Number, Pattern and Calculating 4 Teaching Resource Handbook*.

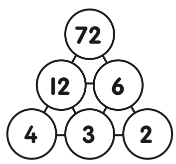
Practice

1



7 × 9 = 63, 9 × 7 = 63, 63 ÷ 7 = 9, 63 ÷ 9 = 7

2



3 Answers will vary. Some may explain that they can use an inverse operation to check their answers with examples like 72 ÷ 12 = 6.

4

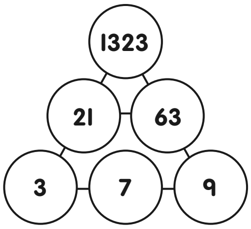
×	2	6
3	6	18
5	10	30

The missing numbers across the top could be 2 and 6 with 3 and 5 down the side, or 1 and 3 across the top with 6 and 10 down the side.

Going deeper

1 Answers will vary. One explanation is that 2 and 1 are the only common factors of 6 and 10 so these are the only numbers that can go in the first box along the top.

2



The missing numbers on the bottom row are 3, 7, 9.

3 Using the inverse operation, there are three other facts. These are 6 × 4 = 24, 24 ÷ 4 = 6, 24 ÷ 6 = 4.

Page 48: Turn arounds (P&A 2·5)

Practice

1

Add 20	
159	179
123	143
84	104

2 To work out the missing numbers you subtract 20 from each number on the right-hand side of the diagram.

3 a

Multiply by 6	
8	48
5	30
9	54

b

Divide by 4	
28	7
36	9
16	4

Going deeper

1 The rule is to subtract 19.

2 **a** 62 – 28 = 34 **b** 9 × 8 = 72 **c** 121 ÷ 11 = 11

3 The number Jess started with is 9. It can be found by using inverse facts. Firstly subtract 7 from 61 (61 – 7 = 54) and then divide 54 by 6 (54 ÷ 6 = 9).

Page 49: Solving problems with inverses (P&A 2·6, 2·7 & 2·8)

Practice

1 £20

2 £12·01 + £7·99 = £20

3 43 this is (5 × 8) + 3

Going deeper

1 Explanations will vary. Some will work through an example, e.g. starting with 5, double this is 10, add 4 is 14, divide by 2 is 7, subtract 5 is 2. We are left with 2 which is half of the 4 added in step 2. Others will explain the relationships in general, e.g. halving and doubling and adding and subtracting are inverse operations, meaning one undoes the other. Since we start with a number and then subtract it, we double and then halve. We are left with 2 because this is half of the extra 4 as we added to the original number.

2

	3	×	4	=	12
+	11			−	5
	14	÷	2	=	7

NPC Milestone 3

- To use inverse relationships between multiplying and dividing to record number trios and find solutions to different problems including missing number problems.
- To be able to explain how to use inverse operations to check answers to a calculation.

Page 50: Multiplying by 10 and scaling problems (Calc 7·1 & 7·2)

Practice

1 5 lorries

5 × 10 = 50

10 × 5 = 50

2 Various answers: e.g. **7** × 10 = 10 × **7**

12 × 10 = 10 × **12**

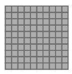
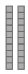
Going deeper

Time a normal battery lasts	Time a new battery lasts (10 times longer)
8 hours	**a** 80 hours
b 24 hours	240 hours
c 12 hours	5 days (5 days = 5 × 24 = 120 hours)
d 16·8 hours	1 week (7 days = 7 × 24 = 168 hours)

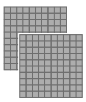
Page 51: Multiplying by 10 and place value (Calc 7·4)

Practice

1 a

Hundreds	Tens	Ones
 1	 2	0

b

Hundreds	Tens	Ones
 2	1	0

2 Fran saved £2·50 each week for 10 weeks.

3 Damien saved £20·50 each week for 10 weeks.

Going deeper

1 The amounts are the same as 10 × 8 × 10 = £800 and 80 × 10 = £800.

2 Look for children who explain the relationship between cm and mm, e.g. 1 cm = 10 mm. To convert cm to mm you multiply by 10 and to convert mm to cm you divide by 10.

3 **a** 20 cm is longer because 130 mm is 13 cm

b 42 cm is longer because 402 mm is 40·2 cm

Page 52: Dividing by 10 and place value (Calc 7·5)

Practice

1 **a** 4 m **b** 7 m **c** 19 m

2 Rajel will have the most amount of money. £15·50 ÷ 10 = £1·55, whereas 1100p ÷ 10 = 110p = £1·10.

3 Its body is 9 cm long. (900 mm ÷ 10 = 90 mm = 9 cm)

Going deeper

1 Connie should be told that to divide by 10 the digits move one place to the right. Removing a zero does not work with decimal numbers.

2 Various possibilities.

Look for children who use combinations of the same cabinet and then move on to a mixture of different sized cabinets, especially if they show some elements of being systematic.

Look also for evidence of calculating ÷ 10 and then fluency using known facts, e.g. that two 200 mm cabinets can be replaced with one 400 mm cabinet.

200 mm + 200 mm + 200 mm + 200 mm + 200 mm + 200 mm = 1200 mm (= 120 cm)

300 mm + 300 mm + 300 mm + 300 mm

400 mm + 400 mm + 400 mm

600 mm + 600 mm

200 mm + 200 mm + 200 mm + 200 mm + 400 mm

200 mm + 200 mm + 400 mm + 400 mm

200 mm + 200 mm + 200 mm + 600 mm

200 mm + 200 mm + 200 mm + 300 mm + 300 mm

300 mm + 300 mm + 600 mm

300 mm + 300 mm + 400 mm + 200 mm and so on.

Page 53: Multiplying and dividing by 100 (Calc 7·7)

Practice

Look for children who, once they have found the cost of 100 stickers in pence, then also calculate the equivalent price in pounds.

1 Strawberry sticker 6p × 100 = 600p = £6·00

Octopus sticker 9p × 100 = 900p = £9·00

Smiley sticker 35p × 100 = 3500p = £35·00

Album £10·50 × 100 = £1050·00

2 Look for children who use the suggested vocabulary appropriately, e.g. 50 is 10 times bigger than 5; 500 is 100 times bigger than 5.

Going deeper

1 **a** Look for children who write a clear explanation along with the answer:

To convert metres to cm you multiply by 100 and to convert cm to metres you divide by 100. So 8 m would equal 800 cm.

b 200 cm = 2 metres

2 **a** There are 10 years in a decade. There are 10 decades in a century. There are 10 centuries in a millennium.

b Each unit of time is ten times greater than the previous one; it is made up of ten of the previous unit.

3 Pablo is correct because 10 × 10 is the same as 100.

The pattern that connects these is that you divide by 10 each time.

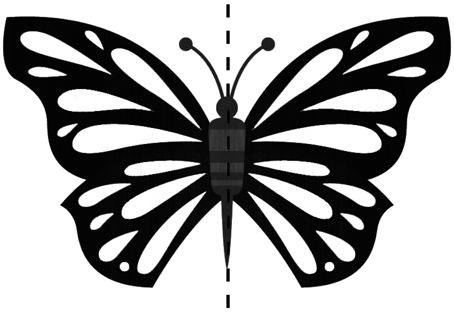
NPC Milestone 3

- To explain a general rule for multiplying and dividing by 10 and 100.

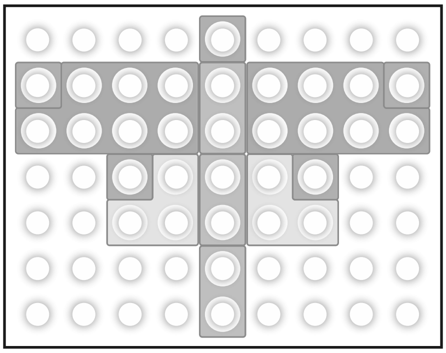
Page 54: Symmetrical objects and patterns (Geo 2·1 & 2·2)

Practice

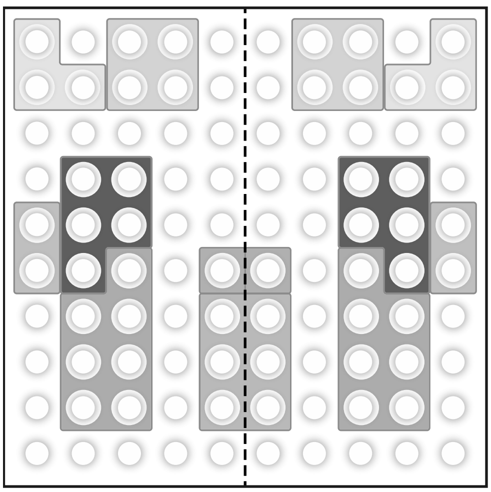
1 a



2 Designs will vary, e.g.

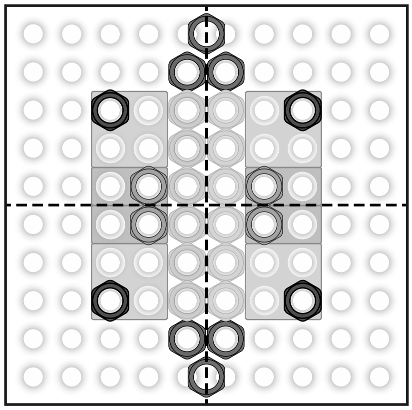


3



Going deeper

1 Responses will vary, e.g.

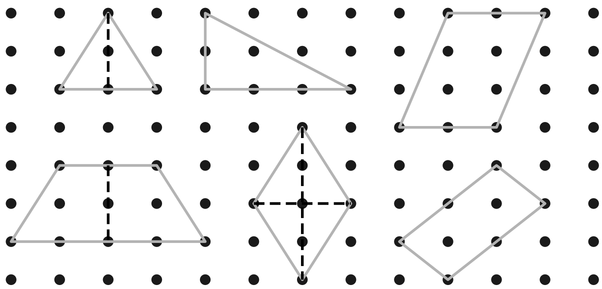


2 Designs will vary.

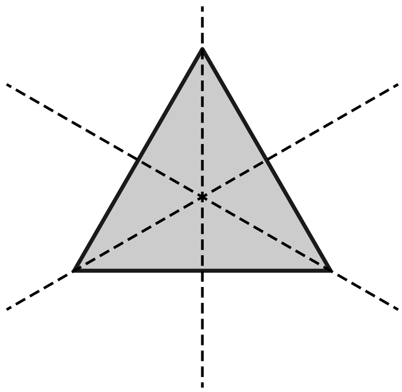
Page 55: Lines of symmetry in triangles and quadrilaterals (Geo 2·3 & 2·4)

Practice

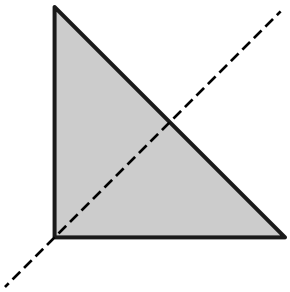
1



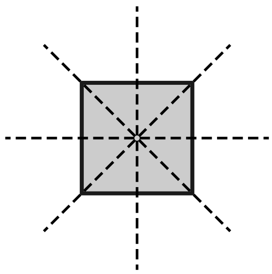
2 Children should draw an equilateral triangle.



3 Must be an isosceles right-angled triangle.



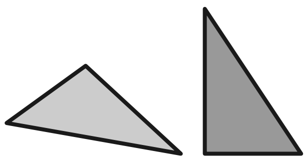
4



Going deeper

1 Dan is NOT correct as a square, rectangle and rhombus are types of parallelogram and they have lines of symmetry.

2 Responses will vary, e.g.



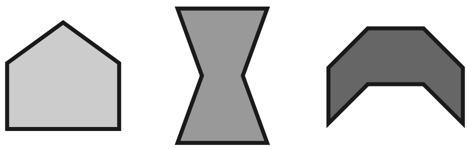
3 Scalene or right-angled triangles that are not isosceles will **not** have a line of symmetry. Equilateral and isosceles triangles do have symmetry.

Page 56: Symmetry in regular and irregular polygons (Geo 2·5)

Practice

1 A square is a regular shape and has 4 sides and 4 lines of symmetry. An equilateral triangle is also a regular shape and has 3 sides and 3 lines of symmetry.

2 **a**, **b** and **c** Drawings will vary but should show an irregular pentagon, hexagon and octagon, e.g.



3 When it is a 'regular' 2D shape.

Going deeper

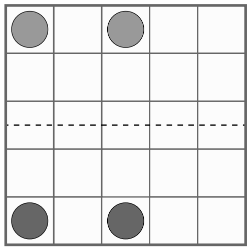
1 Drawings will vary.

2 Responses will vary.

Page 57: Completing symmetrical patterns and shapes (Geo 2·6)

Practice

1



Children may have moved the counters to make a square. This is ok too as long as they can explain why it is a rectangle.

2 Responses will vary.

3 Responses will vary.

Going deeper

1 Children's positioning of counters will vary. Ensure they are all symmetrical and all have 4 sides.

2 Responses will vary.

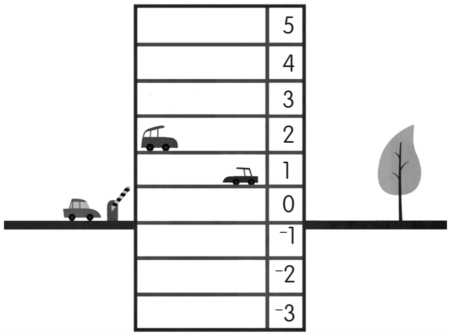
GMS Milestone 1

- Complete given symmetrical patterns, or create their own, with one vertical, horizontal or diagonal line of symmetry.
- Use a mirror, folded paper shape or drawing, to show the lines of symmetry in 2D-shapes when presented in different orientations.
- Explain why all regular polygons have the same number of lines of symmetry as the number of sides or vertices.

Page 58: Introducing negative numbers (NNS 4·1)

Practice

1



2 7, 6, 5, 4, 3, 2, 1, 0, $^{-}1$, $^{-}2$, $^{-}3$ … $^{-}20$

3 $^{-}15$, $^{-}14$, $^{-}13$, $^{-}12$ … … 0, 1, 2, 3, 4

Going deeper

1 $^{-}2$ is 4 floors away from 2

2 Starting with 3 then – = five times gives 2, 1, 0, $^{-}1$, $^{-}2$

3 Starting with $^{-}4$ then + = six times gives $^{-}3$, $^{-}2$, $^{-}1$, 0, 1, 2

Page 59: Temperature (NNS 4·2 & 4·4)

Practice

1 June, July and August

2 November, December and January

3 8 months (April, May, June, July, August, September, October and November)

4 It was 50 degrees warmer.

Going deeper

1 32 degrees

2 3 months (January, November and December)

3 8 months (March, April, May, June, July, August, September, October)

Page 60: Timelines (NNS 4·5)

Practice

1 1323 years

2 2340 years

3 572 BCE, 527 BCE, 321 BCE, 312 CE, 1260 CE, 1620 CE

4 790 BCE

Going deeper

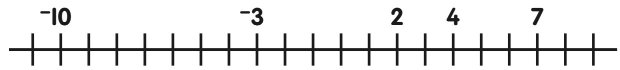
1 1323 BCE is after 2560 BCE so Tutankhamen could have been buried in a pyramid.

2 1313 BCE

Page 61: Number lines (NNS 4·3 & 4·6)

Practice

1

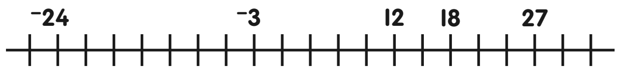


2 Answers will vary. Examples include: $^{-}8 < 13$, $^{-}5 < 9$, $^{-}12 < {}^{-}11$, $9 < 13$.

3 Tara will say '10'. She counts: $^{-}18$, $^{-}14$, $^{-}10$, $^{-}6$, $^{-}2$, 2, 6, 10.

Going deeper

1



2 Zane spins + 11, –10 and –9.

NPC Milestone 3

- To count backwards through zero to include negative numbers.
- To read, write and order positive and negative numbers within a range of $^{-}20$ to 20.

Page 62: Fractions and part–whole relationships (NNS 5·1 & 5·2)

Practice

1 $\frac{2}{8} = \frac{4}{16}$, $\frac{3}{4} = \frac{12}{16}$, $\frac{2}{4} = \frac{8}{16}$

2 Answers will vary. Examples might include 0·75, $\frac{6}{8}$, $\frac{9}{12}$, shaded shapes, drawing on grids, section of arrays, marks on number lines, drawings of real objects or Numicon Shapes/ number rods.

3 The missing numbers are $2\frac{1}{4}$, $4\frac{1}{2}$, $5\frac{1}{4}$.

Going deeper

1 $\frac{1}{4}$ and $\frac{2}{8}$ are equal if they are descriptions of an amount or whole that is the same. $\frac{1}{4}$ of a large bar of chocolate is larger than $\frac{2}{8}$ of a smaller bar.

2 Answers will vary. Examples include $\frac{1}{2} = \frac{2}{4}$, $\frac{3}{6} = \frac{2}{4}$, $\frac{6}{8} = \frac{3}{4}$, $\frac{2}{8} = \frac{1}{4}$ and so on.

Page 63: Comparing fractions (NNS 5·3 & 5·4)

Practice

1 The new row of $\frac{1}{3}$ fractions will go between the red $\frac{1}{2}$ row and the yellow $\frac{1}{4}$ row because each rod is smaller than a $\frac{1}{2}$ but bigger than a $\frac{1}{4}$.

2 **a** 4, 3, 2, 1 **b** 1, 2, 3, 4
c 1, 2, 3, 4, 5, 6, 7 **d** 1, 2, 3, 4

Going deeper

1 $\frac{1}{4} + \frac{1}{2}$
Answers will vary. Examples include $\frac{1}{12} + \frac{8}{12}$; $\frac{2}{12} + \frac{7}{12}$; $\frac{3}{12} + \frac{6}{12}$; $\frac{4}{12} + \frac{5}{12}$. The other two pieces must add to $\frac{9}{12}$, which is $\frac{3}{4}$ of the bar.

2 Answers will vary; some will explain that $\frac{1}{4}$ and $\frac{1}{3}$ only look the same in these diagrams because the rectangle that shows a $\frac{1}{4}$ is the same size as the rectangle showing $\frac{1}{3}$. Kieran could draw a double number line or two bar diagrams the same length to show quarters and thirds and then label $\frac{1}{4}$ and $\frac{1}{3}$ to show that $\frac{1}{4}$ is smaller than a $\frac{1}{3}$.

Page 64: Adding and subtracting halves and quarters (NNS 5·5)

Practice

1 **a** $\frac{1}{4}$ of an hour + $\frac{1}{2}$ of an hour = $\frac{3}{4}$ of an hour
$\frac{1}{4}$ of an hour + $\frac{3}{4}$ of an hour = 1 hour
$\frac{1}{2}$ of an hour + $\frac{3}{4}$ of an hour = $1\frac{1}{4}$ hours
b $\frac{1}{4}$ of an hour + $\frac{1}{2}$ of an hour + $\frac{3}{4}$ of an hour = $1\frac{1}{2}$ hours

2 **a** $\frac{1}{4} + \frac{1}{4} + \frac{1}{4} + \frac{1}{2} = 1\frac{1}{4}$
b $\frac{3}{4} - \frac{1}{4} = \frac{2}{4}$ or $\frac{1}{2}$
c $1 + \frac{1}{4} - \frac{1}{2} = \frac{3}{4}$
d $\frac{1}{2} + \frac{1}{4} - \frac{3}{4} = 0$

Going deeper

1 $\frac{1}{4}$ of an hour + $\frac{1}{2}$ of an hour = $\frac{3}{4}$ of an hour

2 Answers will vary. Examples include $\frac{1}{2} + \frac{3}{4} = \frac{3}{4} + \frac{1}{2}$, $\frac{1}{2} + 1 = \frac{3}{4} + \frac{3}{4}$, $\frac{1}{2} + \frac{1}{2} = \frac{3}{4} + \frac{1}{4}$

Page 65: Adding and subtracting fractions beyond 1 (NNS 5·6)

Practice

1 $\frac{2}{10} + \frac{3}{10} = \frac{5}{10}$

2 **a** $\frac{4}{7} + \frac{6}{7} = 1\frac{3}{7}$
b $\frac{2}{9} + \frac{4}{9} + \frac{5}{9} = 1\frac{2}{9}$
c $\frac{8}{11} - \frac{3}{11} = \frac{5}{11}$
d $\frac{8}{13} + \frac{7}{13} - \frac{6}{13} = \frac{9}{13}$

3 $1\frac{6}{7}$ ($\frac{13}{7}$), $2\frac{1}{7}$ ($\frac{15}{7}$), $2\frac{3}{7}$ ($\frac{17}{7}$), $2\frac{5}{7}$ ($\frac{19}{7}$), 3 ($\frac{21}{7}$)

Going deeper

1 $\frac{3}{5} + \frac{6}{5} = \frac{9}{5}$

2 Irena has added both numerators together and done the same with the denominators. Answers will vary. Some will show why the denominators are not added together by drawing pictures and comparing correct and incorrect answers, others will explain that the denominator describes the size of the fraction and that if you add the denominators when adding fractions, the new denominator doesn't describe its size. Irena wrote $\frac{1}{3} + \frac{2}{3} = \frac{3}{6}$ which means $\frac{1}{2}$ but $\frac{1}{3}$ and $\frac{2}{3} = \frac{3}{3}$ or a whole, not a half.

NPC Milestone 3

- To know that, when comparing fractions with a common denominator, the larger numerator represents the larger fraction.
- To make connections between fractions of a shape or fractions of one whole and fractions of a length or of a set of objects.

Page 66: Using the column method of adding (Calc 8·1)

Practice

1 **a** Number of visitors:

Number of visitors to each shop over the weekend

	Bakery	Supermarket	Book shop	Toyshop	Newsagents
Saturday	299	845	325	389	451
Sunday	299	967	150	376	35
Total	598	1812	475	765	486

b Answers may vary. Look for children who suggest/explain that the column method might be useful for calculating the supermarket and toy shop answers as these are 3-digit calculations that involve carrying, one of which has a 4-digit answer. Look also for children who state that the bakery question may be easier to do mentally or with jottings by calculating 300 + 300 – 2.

Going deeper

1 a

Money taken at the school fair

	Raffle	Cakes and drinks	Plants	Bouncy castle	Second-hand clothes
Last year	£128	£651	£89	£375	£109
This year	£1035	£649	£98	£450	£91
Total	£1163	£1300	£187	£825	£200

The cakes and drinks stall made the most money in total.

b Children's opinions on ordering these calculations may vary. They may state that the plants calculation of £89 + £98 is the easiest as it only involves two 2-digit numbers. Next, they may say that the bouncy castle was the second easiest as it involved carrying. The important thing is that children justify and explain each choice.

2 Answers may vary. Children may say that 1999 + 1999 is harder when using the column method as it involves carrying for the ones, tens and hundred columns. Also, that is a calculation that involves the addition of two 4-digit numbers. However, they may say that this is the easier calculation as the answer is simply 2000 + 2000 – 2.

Children may state that they found 867 + 479 harder as each column involved the addition of different digits and involved carrying in the ones, tens and hundred column.

Page 67: Grouping or regrouping in the column method (Calc 8·2)

Practice

1 Molly needs to score 403 points.

2 Ravi also needs 403 points.

3 They are the same. This is because their current scores were 50 points apart, as were their highest scores.

Going deeper

1 Total = 189. To gain this answer there are various possibilities that have combinations of the digits 2, 3 and 4 in the ones column and the 7, 6 and 5 in the in the tens column, e.g.

52 or 62

63 or 73

74 or 54

2 It is impossible for the hundreds answer to be a 2 or above as the three highest digits that can go in the tens column are 5, 6 and 7 and these have the value of 50 + 60 + 70 = 180 and, as such, is not greater than 200.

3 Similarly, other patterns that children might comment on may relate to the three digits that equal the 9 in the ones column. For instance, the 7 cannot go in the ones column as you would need to add two 1s for it to equal 9 and there is only one 1. Also, since to try to make it equal 19, the three highest digits available (5, 6 and 7) only total 18.

Page 68: Adding 3-digit numbers and measures (Calc 8·3, 8·5 & 8·6)

Practice

1 The total rainfall in England for spring, summer & autumn = 179 mm + 192 mm + 251 mm = 622 mm.

2 England, Wales and Northern Ireland: 179 mm + 284 mm + 231 mm = 694 mm

3 The place with the highest rainfall was Scotland with 1216 mm (England had 674 mm, Wales 1147 mm and Northern Ireland 881m).

Going deeper

1 and **2** Each column and row can total:

710 – when 235 is in the centre

711 – when 237 is in the centre

712 – when 239 is in the centre

	236		
237	235	238	= 710
	239		

	236		
239	237	235	= 711
	238		

	235		
236	239	237	= 712
	238		

	233		
235	231	237	= 703
	239		

3 Answers will vary. If they use consecutive odd numbers then yes, this is possible, e.g.

	233		
235	231	237	= 703
	239		

Page 69: Exploring the column method and money (Calc 8·7)

Practice

1 Two comics and a notepad would cost £3·23.

2 Notepad + pen + calculator = £3·50

3 An easier method might be to add 4 × £1·00 and take away 4 × 1p to equal £3·96.

4 Answers will vary, e.g. you can buy all six items to total £5·00: 99p + 125p + 150p + 45p + 6p + 75p = 500p = £5·00 or children may suggest an answer such as three calculators, a ruler and an eraser; four notepads; 100 erasers.

Going deeper

1 **a** The 7 hundredths and 3 hundredths make 10 hundredths, and the 1 should be carried across to the tenths as this represents one tenth. This one tenth should then be added to the existing 8 tenths to make 9 tenths.

b The hundredths are added correctly but the 1 tenth has not been carried over to the tenths column and so not been added on. The tenths column should total 10 tenths, carrying the 1 across from the ones column.

c The numbers are all correct in this calculation, but you don't need to show 'p' units, as the numbers are shown in pounds and you already have the '£' units.

2 The five combinations of numbers are:

£2·15 + £7·48 = £9·63 and £7·48 + £2·15 = £9·63

£5·86 + £3·41 = £9·27 and £3·41 + £5·86 = £9·27

£1·42 + £6·95 = £8·37 and £6·95 + £1·42 = £8·37

£1·34 + £6·58 = £7·92 and £6·58 + £1·34 = £7·92

£2·71 + £5·93 = £8·64 and £5·93 + £2·71 = £8·64

NPC Milestone 3

- To know that columns are added from right to left.
- To complete column calculations, recording the carrying or redistributed digit in the correct column and referring to this as the given number of tens or hundreds to carry.

Page 70: Using the column method of subtracting (Calc 9·1 & 9·2)

Practice

1 Explanations will vary.

a 31 **b** 31 **c** 31 **d** 76 **e** 22 **f** 24

2 The answers to **a**, **b** and **c** all have the same difference because the starting numbers (minuends) increase by 10 each time, as do the amounts that are subtracted (the subtrahends).

Going deeper

1 Bus B, 135 – 97 = 38. By rounding up or down the answers to the nearest 10, you can estimate which bus has a difference of 38. Then do an exact calculation for that one bus to check your estimation is correct. This is quicker than doing a calculation for every bus.

2 Bus C has the greatest difference between the number of passengers during the morning and afternoon as 135 – 61 = 74.

3 Answers will vary.

Page 71: Subtracting and redistributing hundreds and tens (Calc 9·3)

Practice

1

	Anna	Milly	Amir	Chad	Chrissy
Number of pages in book	335	435	406	500	675
Pages read	143	243	189	199	199
Pages left to read	192	192	217	301	476

2 Milly has read 100 more pages than Anna, however, they both have the same number of pages left to read as Anna's book has 100 pages fewer.

3 Answers will vary. Some children will have found Chad's and Chrissy's calculations easier as they can just subtract 200 and then add 1 back on.

Going deeper

1 When Peter subtracted 245 from 623 he should have got the answer of 378. Peter spotted his mistake when the inverse operation gave a different answer and he re-checked both calculations.

2 The possible correct combinations of numbers are:

963 – 215 = 748 and 963 – 748 = 215

927 – 586 = 341 and 927 – 341 = 586

837 – 142 = 695 and 837 – 695 = 142

792 – 134 = 658 and 792 – 658 = 134

864 – 271 = 593 and 864 – 593 = 271

Page 72: Exploring the column method and money (Calc 9·5)

Practice

1 Zoe would have £3·81 left.

2 Shaun bought a notepad for £1·25 and had £5·09 left.

Going deeper

1 Zoe had £6·05 and spent £1·95 on a calculator and a ruler so had £4·10 left.

Shaun had £6·34 and spent £2·24 on a notepad and comic so also had £4·10 left.

2 Answers may vary, however, look for children who suggest mental calculations and jottings would be a good way to solve this, e.g. since Jaz had £10·00 and bought 10 comics at 99p each, he spent £9·90, which is only a difference of 10p.

Similarly, some children might suggest that for every £1·00 Jaz has he could buy one comic and have 1p change. Since he has £10·00 he could do this 10 times and have 10p left.

Page 73: Using subtracting methods to compare measures (Calc 9·6)

Practice

1 The peregrine falcon is 219 km an hour faster than the needle-tailed swift (388 kmph – 169 kmph).

2 The Eurasian hobby's wingspan is 85 cm (224 cm – 139 cm).

3 640 km further (320 – 160 = 160, 160 × 4 = 640)

4 The peregrine falcon and the needle-tailed swift.

Going deeper

1 Children's own questions and answers will vary.

2 Asian elephant 3950 kg

African elephant 5800 kg

Hippopotamus 1454 kg

Indian rhino 2213 kg

NPC Milestone 3

- To review numbers involved in an adding calculation to make reliable estimates and decide whether the written column method is the most efficient.

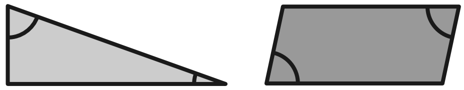
Page 74: Types of angles (Geo 3·1)

Practice

1 Acute

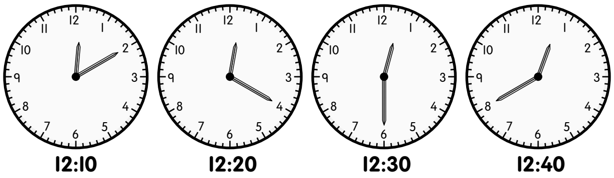
2 Responses will vary, e.g. 3:40 p.m., 12:25

3 Responses will vary, e.g.



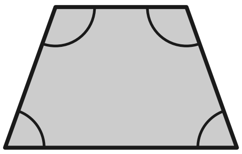
Going deeper

1 Responses will vary. Example response:



2 Children's shapes will vary,

e.g.



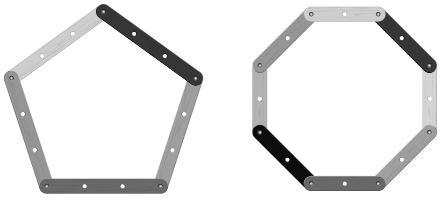
3 Children's shapes will vary. Encourage them to mark a right angle with a square and the obtuse and acute angles in different colours.

Page 75: Angles in polygons (Geo 3·2)

Practice

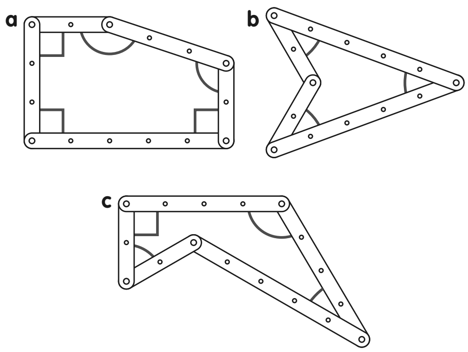
1 Square, equilateral triangle and regular hexagon.

2 All angles and all side lengths are the same, e.g.

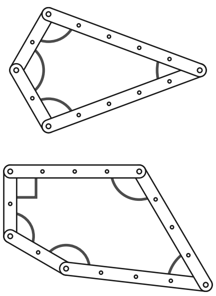


Going deeper

1 Children's shapes will vary.



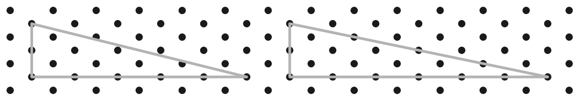
2 Children's explorations will vary.



Page 76: Angles in a triangle (Geo 3·3)

Practice

1

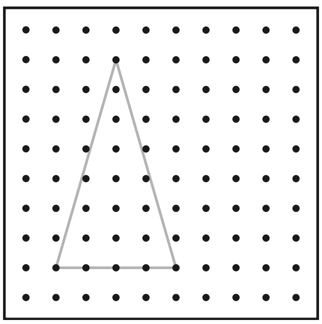


2 The right angle stays the same, but as the top angle gets bigger, the other angle gets smaller.

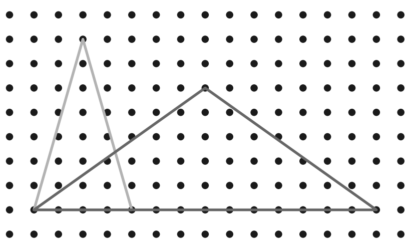
3 Children's triangles will vary but they should notice that, when one angle remains the same, one of the other angles increases while the other decreases.

Going deeper

1 a Children could use a geo board instead of isometric paper. Children's responses will vary, e.g.



b

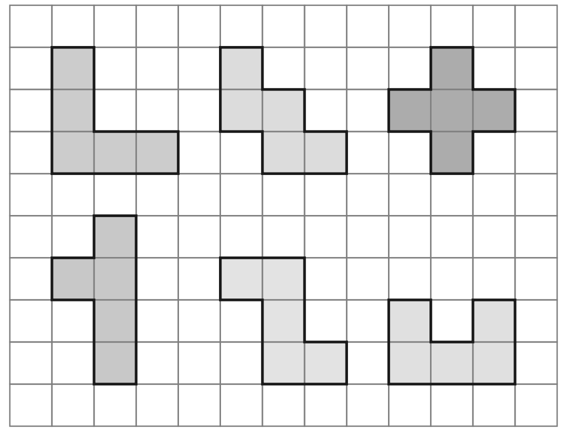


2 SOMETIMES TRUE: This example shows two angles decreasing and one increasing because it is an isosceles. For an equilateral triangle, the angles remain the same as the side lengths change.

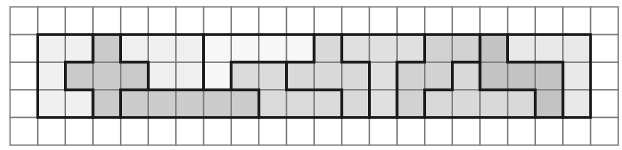
Page 77: Tessellating patterns (Geo 3·4)

Practice

1



2

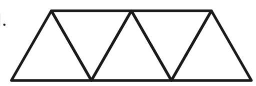


Going deeper

1 Each pentomino is 5 squares and there are 12 of them, so the total area of the rectangle needs to be 60 squares.

It is not possible for a 2 × 30 rectangle because many of the pentominoes are 3 units high.

2 Designs will vary, e.g.



3 After children's explorations, they should find that all types of triangle tessellate.

GMS Milestone 1

- Name polygons according to the number of sides or vertices.
- Test, or recognize, angles in polygons, saying if they are acute, right-angled or obtuse.

Page 78: Introducing decimal fractions (NNS 6·1, 6·2 & 6·3)

Practice

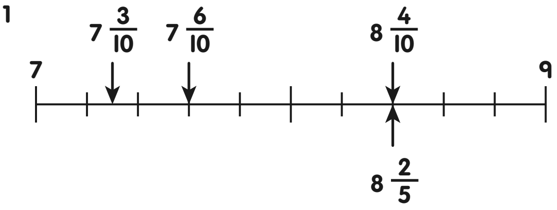
1 The arrow is pointing to $1\frac{5}{10}$ which can also be written as 1·5.

2 $2\frac{4}{10}$, $2\frac{5}{10}$, $2\frac{6}{10}$, $2\frac{7}{10}$, $2\frac{8}{10}$, $2\frac{9}{10}$, 3 … $4\frac{8}{10}$, $4\frac{9}{10}$, 5

3 4, $3\frac{9}{10}$, $3\frac{8}{10}$, $3\frac{7}{10}$, $3\frac{6}{10}$, $3\frac{5}{10}$ … $1\frac{2}{10}$, $1\frac{1}{10}$, 1

Going deeper

1



2 The end points are 5 and 15.

Page 79: Fractions and notation (NNS 6·4)

Practice

1 Answers may vary. 3·1 kg, 3100 g, 3 and $\frac{1}{10}$kg, $\frac{31}{10}$kg

2 Answers may vary. 3500 g, 3 and $\frac{5}{10}$kg, $3\frac{1}{2}$kg, $\frac{35}{10}$kg

3 Answers may vary. 2800 g, 2 and $\frac{8}{10}$kg, $\frac{28}{10}$kg

4 $\frac{2}{4} = 0{\cdot}5$

Going deeper

1 The red Shape is 0·5 or $\frac{5}{10}$, the other Shapes are orange = 0·1 or $\frac{1}{10}$, blue = 0·2 or $\frac{2}{10}$, yellow = 0·3 or $\frac{3}{10}$, green = 0·4 or $\frac{4}{10}$, turquoise = 0·6 or $\frac{6}{10}$, pink = 0·7 or $\frac{7}{10}$, green = 0·8 or $\frac{8}{10}$, purple = 0·9 or $\frac{9}{10}$.

2 **a** 3 **b** 0·4

Page 80: Representing decimals (NNS 6·5 & 6·6)

Practice

1 Answers will vary; some will show 0·6 using number rods, base-ten apparatus and Numicon Shapes. Other children might draw a number line or write fractions.

2 **a** The yellow rod would be 0·5, $\frac{5}{10}$ or $\frac{1}{2}$.

b 0·3 + 0·5 = 0·8 or $\frac{3}{10} + \frac{5}{10} = \frac{8}{10}$

Going deeper

1 **a** 0·1 would be a 5-shape

b 0·5 would be a 25-shape

c 0·7 would be a 35-shape.

2 **a** 0·1 would be a 2-shape

b 0·5 would be 10-shape

c 0·7 would be 14-shape.

Page 81: Comparing, ordering and rounding (NNS 6·7, 6·8 & 6·9)

Practice

1 3·1 (protein) > 2·1 (sugars)

2 0, 0·1, 2·2, 2·8, 3·5, 5·2, 11·5

3 protein 3 g, carbohydrate 7 g, sugars 2 g, fat 2 g, saturated fat 0 g, dietary fibre 1 g

Going deeper

1 0·159

2 951·0

3 **a** 15·90 **b** 95·10

NPC Milestone 4

- To know that the decimal point serves to separate the whole numbers and the fractional part of a mixed number.
- To express tenths as common fractions and decimal fractions.
- To use place value understanding to compare and order decimal fractions with one decimal place.

Page 82: Exploring equivalence (P&A 3·1, 3·2 & 3·5)

Practice

1 The sign should be '<' because RHS is 3 × 4, whereas LHS is only (2 × 4) + 3.

2 **a** < because LHS = 3 × 15, whereas RHS = 4 × 15

b > because RHS = 9 × 1

c < because 20 is 4 more than 16, but 11 is only 3 more than 8, so the difference on the RHS must be greater.

d = because the difference between 80 and 90 is 10, so (80 + 5) and (90 − 5) will 'meet' exactly halfway between 80 and 90.

Going deeper

1 Both 462 and 28 have been reduced by 10 to form the RHS, so the difference between LHS and RHS will remain the same.

2 > because the difference between the number pair on the LHS is 4 greater than the difference on the RHS. Visualized on a number line, the difference on the left is 'wider'.

3 260 is 4 smaller than 264, so by itself this alteration would make the difference 4 smaller. 140 is 2 more than 138, so this makes the difference another 2 smaller. Conclusion: The difference between (264 – 138) and (260 – 140) will be 6.

Page 83: Finding missing numbers (P&A 3·3 & 3·4)

Practice

1 The fourth box will weigh 28 kg. Because the third box (12 kg) is 3 kg less than the second box (15 kg), the fourth box will have to be 3 kg more than the first box (25 kg).

2 ○ = 3, △ = 6, and □ = 8

Going deeper

1 Try varying values for △. The bigger △ becomes, the smaller ○ can be, and the smaller △ becomes, the bigger ○ can be. So if △ were zero, ○ could be 10, so 10 is the maximum value for ○.

2 If we allow fractions or decimals, □ can be 5 (△ = $27\frac{1}{2}$ or 27·5). If we don't allow fractions or decimals, □ cannot be 5.

Page 84: Equivalence in number sentences (P&A 3·6)

Practice

1 Examples could be: 2 × 8 = 10 + 3 + 3, 4 + 5 + 7 = 16 × 1, (3 × 3) + 7 = 8 + 8, and 8 + (2 × 4) = 10 + (3 × 2).

2 Only expressions equivalent to 12 or 25 are repeated in the list, and there are four of each kind:

31 – 6, 12 + 13, 19 + 6 and 5 × 5 all = 25

48 ÷ 4, 3 + 9, 2 × 6 and 17 – 5 all = 12

There are six possible pairings in each set, so there are in all 12 balancing number sentences possible.

Going deeper

1 **a** 8. Since 13 is 2 less than 15, □ has to be 2 more than 6.

b 5. Since 30 is 30 less than 60, □ must be 30 less than 35.

c 35. 65 is 5 more than half of 120, so 120 – 65 is 5 less than half of 120, i.e. 55. So RHS must be 20 + 35.

Page 85: Brackets and the associative property (P&A 3·7 & 3·8)

Practice

1 **a** 3 + (2 × 10) = 3 + (4 × 5) **b** (3 × 10) + 5 = 5 × (3 + 4)

2 **a** 7 × (5 + 1) = 42 **b** 6 + (6 × 3) = 24

c 12 ÷ (3 × 2) = 2 **d** 3 + (8 × 2) = 19

3 Many answers are possible but correct use of brackets could follow this example: £2·50 + (2 × £5) = £12·50.

Going deeper

1 Three different cuboids can be made using either 12 pink rods, 8 dark green rods, or 24 red rods. These are described respectively below as the answers to 2.

2 (2 × 4) × 6, 2 × (4 × 6), and (6 × 2) × 4

3 Individual answers will vary, but the following are possible:

a 25 × 4 or 5 × 20 **b** 30 × 3

c 40 × 3 **d** 4 × 30

NPC Milestone 4

- To know that three numbers can be multiplied together in any order and the product will be the same.
- To find missing numbers in balancing number calculations involving adding, subtracting and multiplying.
- To know that brackets are used to show the order in which calculations are carried out.
- To develop strategies for comparing and adjusting calculations.
- To review numbers involved in a subtracting calculation to make a reliable estimate and decide whether a written column method is the most efficient.
- To know that using the inverse relationship between adding and subtracting is useful when checking calculations.

Page 86: A doubling strategy for multiplying (Calc 10·1 & 10·2)

Practice

1 **a** 2 × 7 = 14

b 4 × 7 = 28

c 8 × 7 = 56

The multiplicand doubles each time and so the answer also doubles.

2 **d** 16 × 7 = 112

3 **e** 2 × 14 = 28

f 4 × 14 = 56

g 8 × 14 = 112

Again, the answer doubles each time because the first number is doubled.

4 **h** 16 × 14 = 224

Going deeper

1 One row of stamps would cost 6 × 8p = 48p; two rows would be 96p.

2 16 rows of stamps

1 row = 48p, then keep doubling: (2 rows) 96p; (4) £1·92; (8) £3·84; (16) £7·68

Page 87: Multiplying in parts (Calc 10·3)

1 6 rows of 8 jam doughnuts add 1 row of 8 custard doughnuts equal 56 doughnuts.

5 rows of 8 jam doughnuts add 2 rows of 8 custard doughnuts equal 56 doughnuts.

4 rows of 8 jam doughnuts add 3 rows of 8 custard doughnuts equal 56 doughnuts.

3 rows of 8 jam doughnuts add 4 rows of 8 custard doughnuts equal 56 doughnuts.

2 rows of 8 jam doughnuts add 5 rows of 8 custard doughnuts equal 56 doughnuts.

1 row of 8 jam doughnuts add 6 rows of 8 custard doughnuts equal 56 doughnuts.

2 $(6 \times 8) + (1 \times 8) = 7 \times 8 = 56$

$(5 \times 8) + (2 \times 8) = 7 \times 8 = 56$

$(4 \times 8) + (3 \times 8) = 7 \times 8 = 56$

$(3 \times 8) + (4 \times 8) = 7 \times 8 = 56$

$(2 \times 8) + (5 \times 8) = 7 \times 8 = 56$

$(1 \times 8) + (6 \times 8) = 7 \times 8 = 56$

Going deeper

1 Yes, this is correct, because you are adding two extra rows (9 – 7), so if you take away these two extra rows, you will be left with the same number as before.

2 Answers will vary.

3 $(2 \times 4) \times 7 = 56$, $(4 \times 2) \times 7 = 56$, $7 \times 8 = 56$

Page 88: Working out multiplying facts (Calc 10·4)

1 **a** $3 \times 7 = (3 \times 4) + (3 \times 3)$

b $7 \times 3 = (4 \times 3) + (3 \times 3)$

c $5 \times 12 = (5 \times 8) + (2 \times 10)$

d $2 \times 5 = (2 \times 2) + (2 \times 3)$

e $4 \times 9 = (6 \times 4) + (3 \times 4)$

f $9 \times 4 = (4 \times 6) + (4 \times 3)$

2 If the numbers are swapped round, the total is still the same.

3 **a** $6 \times 8 = (2 \times 4) + (4 \times 10)$

b $6 \times 15 = (5 \times 6) + (6 \times 10)$

Going deeper

1 Answers will vary. Using the grid, children may suggest $(10 \times 6) + (2 \times 6)$ which is equivalent to 12×6, and then repeat this three times:

$12 \times 18 = (10 \times 6) + (2 \times 6) + (10 \times 6) + (2 \times 6) + (10 \times 6) + (2 \times 6)$.

Another possible answer is $(10 \times 3) + (2 \times 3)$ which is equivalent to 12×3, and then repeat this six times:

$12 \times 18 = (10 \times 3) + (2 \times 3) + (10 \times 3) + (2 \times 3) + (10 \times 3) + (2 \times 3) + (10 \times 3) + (2 \times 3) + (10 \times 3) + (2 \times 3) + (10 \times 3) + (2 \times 3)$.

2 **a** Leah has 9 £5·00 notes, 9 £2·00 coins and 9 £1·00 coins.

b $9 \times 8 = (9 \times 5) + (9 \times 2) + 9$

Page 89: Exploring the short written method of multiplying with teen numbers (Calc 10·5)

1 11 different products: 60 (12×5), 48 (12×4), 96 (12×8), 30 (15×2), 120 (15×8), 28 (14×2), 70 (14×5), 112 (14×8), 36 (18×2), 90 (18×5), 72 (18×4)

2 Yes, all the products are even because at least one of the numbers that was multiplying was an even number, and multiplying by an even number always gives an even product.

3 **a** 6×8 is 48 and not 42, so the ones should be 8 and not 2, making the answer 108.

b The 6 carried over has not been added: 3×8 is 24, plus the 6 is 30, making the answer 304.

c The 4 carried over from 6×7 (42) has been written above the line in the tens place, when it should be under the line. And the 4 carried over has not been added: 2×7 is 14, plus the 4 is 18, making the answer 182.

Going deeper

1 **a** The missing numbers are 98, 112 and 56.

b The missing numbers are 16, 96 and 24.

c The missing numbers are 17, 9 and 8.

NPC Milestone 4

- To use known multiplying facts and the distributive property to derive and record other multiplying facts.
- To use a doubling strategy and understanding of the distributive property to derive unfamiliar multiplying facts.

Page 90: A halving strategy for dividing (Calc 11·1 & 11·2)

Practice

1 $48 \div 2 = 24$

$48 \div 4 = 12$

$48 \div 8 = 6$

The divisor doubles each time and so the answer halves each time.

2 Might be 48 ÷ 16 = 3 as the amount being divided (dividend) remains the same, the number it is being divided by in each calculation (divisor) is doubling and as a result the answer (quotient) in each calculation is halving.

3 **e** 480 ÷ 2 = 240

f 480 ÷ 4 = 120

g 480 ÷ 8 = 60

As above, the divisor doubles each time and so the answer halves each time.

4 Might be 480 ÷ 16 = 30 as the amount being divided (dividend) remains the same, the number it is being divided by in each calculation (divisor) is doubling and as a result the answer (quotient) in each calculation is halving.

Also, the amount being divided (dividends) in **e**, **f** and **g** are 10 × greater than those in **a**, **b** and **c** as are the answers (quotients).

Going deeper

1 A strategy for dividing by 8 can be to halve, halve and halve again (÷2, ÷2 and ÷2)

2 Look for children who identify the patterns and do not just do both sides of the calculation.

a True. 36 ÷ 4 = 18 ÷ 2 as BOTH the dividend and the divisor in the second part of the equation calculation are half of that in the first part.

b True. 44 ÷ 2 = 88 ÷ 4 as BOTH the dividend and the divisor in the second part of the equation are double that of the first part of the equation. Similarly, BOTH the dividend and the divisor in the first part of the equation calculation are half that of the second part of the equation.

c False. 52 ÷ 2 = 26 ÷ 4. The dividend of 52 in the first part of the equation has been halved to get 26 in the second part of the equation, however, the divisor of 2 has been doubled to get a divisor of 4. For this to be correct, the divisor in the second part of the equation would have needed to follow the same 'change' and therefore also been halved.

Page 91: Using multiplying facts as a strategy for dividing (Calc 11·3)

Practice

1 **a** 39 ÷ 13 = 3. This can be found by combining 13 ÷ 13 = 1 and 26 ÷ 13 = 2.

b 65 ÷ 13 = 5. This can be found by combining 52 ÷ 13 = 4 and 13 ÷ 13 = 1.

c 156 ÷ 13 = 12. This can be found by combining 52 ÷ 13 = 4 and 104 ÷ 13 = 8.

2 Possible answers include:

91 ÷ 13 = 7. This can be made by using 13 ÷ 13 = 1 and 26 ÷ 13 = 2 and 52 ÷ 13 = 4.

182 ÷ 13 = 14. This can be made by using 26 ÷ 13 = 2 and 52 ÷ 13 = 4 and 104 ÷ 13 = 8.

3 Various possible answers. These could include:

195 ÷ 13 = 15. This can be made by using 13 ÷ 13 = 1, 26 ÷ 13 = 2, 52 ÷13 = 4 and 104 ÷ 13 = 8. Look for children who also continue to use this doubling strategy and come up with further facts.

Going deeper

1 By knowing 156 ÷ 13 = 12, Jez is able to work out:

a 312 ÷ 13 = 24 as he doubled his original known fact/equation.

b 624 ÷ 13 = 48 as he again used a doubling strategy.

c 1560 ÷ 13 = 120. Jez doubled 624 ÷ 13 = 48 to get 1248 ÷ 13 = 96· He then also used 312 ÷ 13 = 24.

2 Possible answers may be

52 ÷ 13 = 4 as the original known fact/equation has been halved.

208 ÷ 13 = 16 as the original fact/equation has been doubled.

260 ÷ 13 = 20 as the two new facts/equations have been combined.

416 ÷ 13 = 32 as the original fact/equation has been doubled and then doubled again.

Look also for children who incorporate their knowledge of place value. For instance, they may use their understanding of × 10. As such from 104 ÷ 13 = 8 they may realize that 1040 ÷ 13 = 80.

Page 92: Using the short written method of dividing (Calc 11·4)

Practice

1 **a** 15

b 14

c 15

2 **a** 126 **b** 150

Going deeper

Look for children who can give a written explanation as well as just writing out the correct calculation.

1 **a** The mistake is that the 2 tens were not carried across, so the calculation of how many 3s in 9 was made, whereas it should have been how many 3s are there in 29.

b The mistake is that when calculating how many 6s in 3 (hundreds) this has been assumed to be 0 and has then not been carried across to the tens column. The next part of the calculation should then have then been how many 6s in 36 (tens) to give an answer of 6, however, it has been calculated as how many 6s in 6 to give an answer of 1.

2 **a** Correct

b Correct

c Incorrect. This should be written as how many 4s in 88.

3 Other ways that 88 divided by 4 can be written include 88 shared between 4; how many groups of 4 in 88?

Page 93: Finding fractions of amounts using multiplying and dividing facts (Calc 11·5)

Practice

1 $12 \times 3 = 36$

$3 \times 12 = 36$

$36 \div 3 = 12$

$36 \div 12 = 3$

2 $\frac{9}{36}$ or $\frac{1}{4}$ of the cakes will have red icing on them. 9 out of 36 cakes.

Also look for children who make the links between fractions and dividing: $9 \div 36$

3 **a** Ravi would most likely draw an array 4×9 or 9×4.

b 15 cakes are not iced. Look for children who show their working:

$\frac{1}{4}$ of 36 = 9 cakes with blue icing

$\frac{3}{9}$ of 36 = 12 cakes with yellow icing

36 cakes take away the 21 iced cakes = 15 cakes not iced

Going deeper

1 $\frac{1}{2}$ of 8 = 4 or $\frac{1}{4}$ of 8 = 2

2 $\frac{3}{4} \times 20 = 15$

NPC Milestone 5

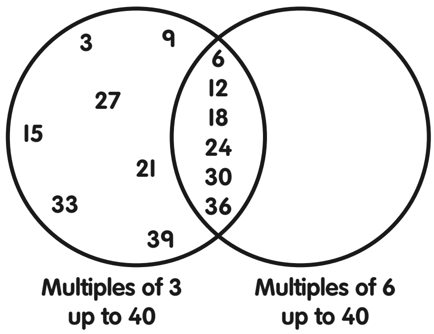
- To understand that known multiplying facts and the distributive property can be used to work out dividing facts.
- To use multiplying and dividing facts to find fractions of amounts.
- To understand that the way a remainder is expressed depends on the context of the problem.

Page 94: Exploring multiples (P&A 4·1 & 4·2)

Practice

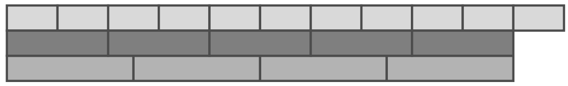
1 10, 20, 30 … These are multiples of 10.

2



All the multiples of 6 are also multiples of 3, so the multiples of 6 are all found within the intersection of the two sets.

3



The first three common multiples are 20, 40 and 60.

Going deeper

1 **a** Tia is thinking of 26.

b Ben is thinking of 91.

Page 95: Lowest common multiples (P&A 4·3)

Practice

1 They will both jog again on the same day after 15 days (the LCM of 3 and 5), so the day of the week will be two weeks and one day after the Sunday they started, i.e. on a Monday.

2

3 Answers will vary.

Going deeper

1 12 is a multiple of 1, 2, 3, 4, 6 and 12, so 12 can be the LCM of (1, 12), (3, 4) or (4, 6). If the numbers are both < 10, then they could be either 3 and 4 or 4 and 6.

2 18 is a multiple of 1, 2, 3, 6, 9 and 18, so 18 can be the LCM of (1, 18), (2, 9), (2, 18), (3, 18), (6, 9), (6, 18) or (9, 18). Children could use number rods to illustrate these possibilities, and/or test all possibilities systematically.

Page 96: Multiple problems (P&A 4·4)

Practice

1 The number of pegs is a multiple of 7, so could be: 7, 14, 21 or 28. Since it is also a multiple of 5, + 1, the number of pegs must be 21.

2 The numbers of pegs must all be multiples of 6, + 2. So they will be: 8, 14, 20, 26, 32, 38, 44, 50, 56, 62 and 68.

3 These are all multiples of 5, + 3.

Going deeper

1 These are multiples of 6, + 1. So the sequence is: 7, 13, 19, 25, 31 …

2 Molly and Ravi each have 28 pegs. Children can work this out by systematically trying possible group sizes.

Page 97: Multiples and factors (P&A 4·5 & 4·6)

Practice

1 2, 3, 4 and 6, 7, 8 are factors of the numbers within the body of the table, and numbers within the body of the table are multiples of 2, 3, 4 and 6, 7, 8.

2 If a number is a multiple of 6, then 1, 2, 3, and 6 will always divide into it exactly. (This is easily shown with number rods.)

3 Children are looking for another number with exactly six factors, so an example would be 32 (factors: 1, 2, 4, 8, 16, 32).

Going deeper

1 Factors: 50: 1, 2, 5, 10, 25, 50
51: 1, 3, 17, 51
52: 1, 2, 4, 13, 26, 52
53: 1, 53
54: 1, 2, 3, 6, 9, 18, 27, 54
55: 1, 5, 11, 55
56: 1, 2, 4, 7, 8, 14, 28, 56
57: 1, 3, 19, 57
58: 1, 2, 29, 58
59: 1, 59
60: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60

So, 60 has the most factors, and 53 and 59 (being prime numbers) have the fewest.

2 Jo is working on factors of 28: 1, 2, 4, 7, 14, 28.

NPC Milestone 5

- To understand that the factors of a number are those numbers that can be divided into it without leaving a remainder.
- To find pairs of factors.
- To find common multiples for two or more sequences.
- To make and use connections between multiplying number trios, multiples and factors.

Page 98: Multiplying in parts and the short written method (Calc 12·1 & 12·2)

Practice

1 Answers may vary. Encourage childern to include:
$18 \times 4 = (4 \times 4) + (5 \times 4) + (5 \times 4) + (4 \times 4)$

2
$$\begin{array}{r} 18 \\ \times \quad 4 \\ \hline 72 \\ \hline {\scriptstyle 3} \end{array}$$

3 Jen is correct. $20 \times 4 = 80$, $2 \times 4 = 8$, so $80 - 8 = 72$, which is equal to 18×4.

Going deeper

1 Ali is correct as they both equal 72. This is because the area stays the same when you double one part of a multiplication and half the other.

2 Various possible answers. Look for children who work systematically:

3 rows of 5 pears + 3 rows of 5 oranges + 3 rows of 1 apple $= (3 \times 5) + (3 \times 5) + (3 \times 1) = 3 \times 11$

3 rows of 4 pears + 3 rows of 5 oranges + 3 rows of 2 apples $= (3 \times 4) + (3 \times 5) + (3 \times 2) = 3 \times 11$

3 rows of 3 pears + 3 rows of 5 oranges + 3 rows of 3 apples $= (3 \times 3) + (3 \times 5) + (3 \times 3) = 3 \times 11$

3 rows of 2 pears + 3 rows of 5 oranges + 3 rows of 4 apples $= (3 \times 2) + (3 \times 5) + (3 \times 4) = 3 \times 11$

3 rows of 1 pear + 3 rows of 5 oranges + 3 rows of 5 apples $= (3 \times 1) + (3 \times 5) + (3 \times 5) = 3 \times 11$

3 rows of 5 oranges + 3 rows of 5 apples + 3 rows of 1 banana $= (3 \times 5) + (3 \times 5) + (3 \times 1) = 3 \times 11$

3 rows of 4 oranges + 3 rows of 5 apples + 3 rows of 2 banana $= (3 \times 4) + (3 \times 5) + (3 \times 2) = 3 \times 11$

3 rows of 3 oranges + 3 rows of 5 apples + 3 rows of 3 banana $= (3 \times 3) + (3 \times 5) + (3 \times 3) = 3 \times 11$

3 rows of 2 oranges + 3 rows of 5 apples + 3 rows of 4 banana $= (3 \times 3) + (3 \times 5) + (3 \times 4) = 3 \times 11$

3 rows of 1 oranges + 3 rows of 5 apples + 3 rows of 5 banana $= (3 \times 1) + (3 \times 5) + (3 \times 5) = 3 \times 11$

Page 99: Measurements and multiplying (Calc 12·4)

Practice

1 Car A (Ferrari 458): 1456 miles; Car B (BMW 3 series): 1085 miles; Car C (Lamborghini Spyder): 1407 miles; Car D (Rolls Royce Phantom): 1043 miles; Car E (Smart Car): 651 miles

2 575 miles

3 A possible question is: How many litres of petrol does Car D use in five full tanks?

Going deeper

1 Max buys 1485 ml orange juice (165 × 9), 2970 ml apple juice (330 x 9 or 1485 × 2), and 5940 ml water (660 × 9 or 2970 × 2). Look for children who notice the relationship between 165 ml, 330 ml and 660 ml. They may use this to calculate subsequent answers. For instance, you double the answer of the orange juice volume to calculate that of the apple juice volume. Similarly, you can then double the apple juice volume answer to get that of the water.

Look for children who also check their answers by both estimating the answer using their knowledge of multiplying by 10.

2 There are various possible combinations to get 2970 ml. Look for children who use the relationships between quantities. For instance, knowing that 9 × 660 ml apple juices total 2970 ml, then one of these 660 ml apple juices can be exchanged for 2 × 330 ml orange juices to get the same volume. Possible answers include:

2 × 165 ml orange juice = 330 ml

8 × 330 ml apple juice = 2640 ml

= 2970 ml

4 × 165 ml orange juice = 660 ml

7 × 330 ml apple juice = 2310 ml

= 2970 ml

2 × 165 ml orange juice = 330 ml

6 × 330 ml apple juice = 1980 ml

1 × 660 ml water = 660 ml

= 2970 ml

Page 100: Multiplying money (Calc 12·5)

Practice

1 **a** £11·25 **b** £23·75 **c** £37·45

2 The coach could total the cost for five players (£72·45) and then add on the cost of one more of each item (£72·45 + £2·25, £4·75 and £7·49 = £86·94), or he could divide the total by 5 to find the cost of all three items for one player and add that on (£72·45 ÷ 5 = £14·49. £72·45 + £14·49 = £86·94).

Going deeper

1 9 cartons of orange juice = £4·41 (49p × 9), 3 bottles of apple juice = £1·95 (65p × 3). The orange juice costs £2·46 more.

2 1320 ml of orange juice would cost £3·92; 1320 ml of apple juice would cost £2·60; 1320 ml of water would cost £2·38.

To work these costs out you should divide 1320 by the volume of each container and then multiply by the price, e.g. for orange juice: 1320 ÷ 165 = 8.
8 × 49p = £3·92

Page 101: Developing fluency and accuracy (Calc 12·6)

Practice

1 Two quick ways would be:

999 × 10 = 9990 subtract 1 × 999 (so subtract 1000 and add 1) = 8991

or 1000 × 9 = 9000 subtract 9 = 8991

A long way might be either the long written multiplication or grid method.

2 Molly's answer is incorrect as 75 × 6 does not equal 150 × 12 (75 × 6 = 450, whereas 150 × 12 = 1800). Look for children who can either estimate or explain that the quantities on either side of the equation being multiplied (for instance, both the numbers in 150 × 12) are greater quantities being multiplied together than 75 × 6.

3 Different methods that Molly could use to calculate 75 × 6 could be:

75 × 5 + 75 × 1. To calculate 75 × 5 you can do 75 × 10 = 750 and halve it to get 375. Then add 75 (or 25 and 50) to get 450.

75 × 2 × 3 (three lots of double 75)

Or Molly could use a short written multiplication or grid method.

Going deeper

1 There are various ways that 14 × 6 can be partitioned vertically other than just (10 × 6) + (4 × 6).

For instance:

14 × 6 = (7 × 6) + (7 × 6)

14 × 6 = (5 × 6) + (5 × 6) + (4 × 6)

Look for children who find different ways but choose and explain the one they prefer.

2 There are 125 × 9 = 1125 tiles.

Various ways to partition this patio include:

(100 × 9) + (20 × 9) + (5 × 9)

(60 × 9) + (60 × 9) + (5 × 9)

Some children may also see this as 125 × 9 = (125 × 10) – (125 × 1).

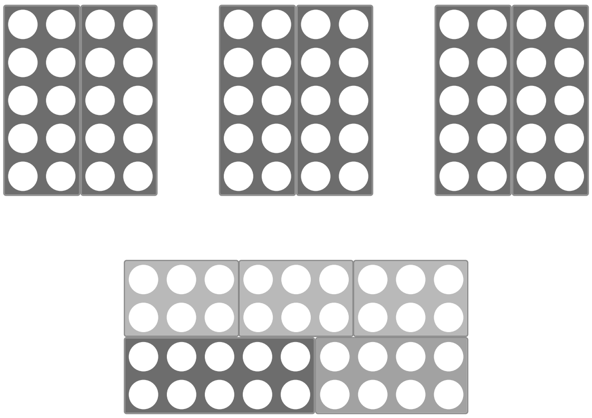
NPC Milestone 5

- To apply understanding of arrays to use the short written method for multiplying calculations.

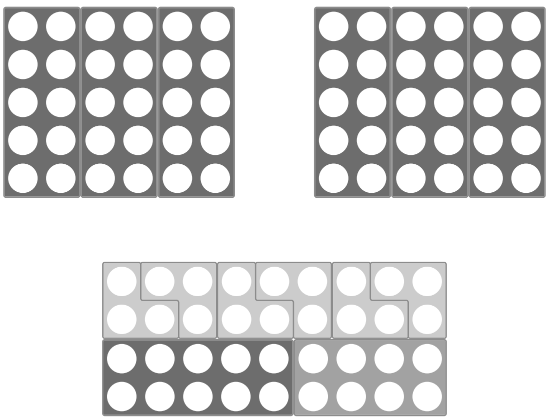
Page 102: Using the short dividing method (Calc 13·1 & 13·2)

Practice

1 Children may share into 3 equal groups giving 26 in each group:



Or use grouping. How many groups of 3 tens can be made? (2) How many groups of 3 ones can be made from the remaining 18? (6).



2 **a** 18 **b** 13 **c** 11 r4

Going deeper

1 **a** 65 **b** 6 **c** 42

Page 103: Solving measure problems involving dividing (Calc 13·3)

Practice

1 **a** 215 ml (645 ÷ 3) **b** 129 ml (645 ÷ 5)

2 **a** 150 g ÷ 3 = 50 g
150 g ÷ 4 = 37·5 g
150 g ÷ 5 = 30 g

b 285 g ÷ 3 = 95 g
285 g ÷ 4 = 71·25 g
285 ÷ 5 = 57 g

c 525 ml ÷ 3 = 175 ml
525 ml ÷ 4 = 131·25 ml
525 ml ÷ 5 = 105 ml

Going deeper

1 5 glasses because 895 ml ÷ 5 = 179 ml

2 Example response: 360 ml orange and 60 ml strawberry
Total: 420 ml

Page 104: Solving money problems involving dividing (Calc 13·4)

Practice

1 Yes, Molly is correct because
720p ÷ 12 = 60p per pencil
496 ÷ 8 = 62p per pencil

2 **a** 5-pack is better value **b** pack of 6 pens is better value

3 13 packs

Going deeper

1 A 12-pack costs £7·20 so each pencil costs 60p (£7·20 ÷ 12).
An 8-pack costs £4·96 so each pencil costs 62p (£4 ÷ 8 = 50p, 96p ÷ 8 = 12p: total of 62p).
So, the pencils in the 10-pack need to cost 61p each. 61p × 10 = £6·10

2 **b** gives more money to each person:
£7·50 ÷ 3 = £2·50
£9 ÷ 4 = £2·25

Page 105: Further practice with the short written method of dividing (Calc 13·5)

Practice

1 Children's choices of calculation will vary.

2 **a** 102 ÷ 12 **b** 216 ÷ 5

3 102 ÷ 12 = 8·5
216 ÷ 5 = 43·2

To make the largest quotient, the divisor needs to be small and the dividend needs to be large.

To make the smallest quotient, the divisor needs to be large and the dividend needs to be small.

Going deeper

1 Game, but examples below show how to get results in Table 3.

135 ÷ 9 = 15

198 ÷ 11 = 18

112 ÷ 7 = 16

216 ÷ 8 = 27

102 ÷6 = 17

190 ÷ 10 = 19

110 ÷ 5 = 22

168 ÷ 12 = 14

2 Multiply numbers from Tables 2 and 3 together to give numbers in Table 1.

15 × 9 = 135

18 × 11 = 198

16 × 7 = 112

27 × 8 = 216

17 × 6 = 102

19 × 10 = 190

22 × 5 = 110

14 × 12 = 168

NPC Milestone 5

- To use the short written method for dividing.
- To use multiplying facts to check short written dividing calculations.

Page 106: Solving problems involving more than one step (Calc 14·1)

Practice

1 £136 + £42 = £178

£124 + £55 = £179

£179 – £178 = £1

2 £92 + £55 = £147

£175 – £147 = £28

3 Themed: £136 + £42 =£178

Bouncy castle: £92 + £42 = £134

Cinema: £124 + £42 = £166

Swimming: £118 + £42 = 160

Themed: £136 + £55 = £191

Bouncy castle: £92 + £55 = £147

Cinema: £124 + £55 = £179

Swimming: £118 + £55 = £173

The difference between the most expensive and the least expensive is: £191 – £134 = £57

Going deeper

1 Themed party with sandwiches £136 + £42 = £178 – over budget by £3

Themed party with hot food £136 + £55 = £191 – over budget by £191 – £175 = £16

Cinema with hot food £124 + £55 = £179 – over budget by £4

2 Swimming and hot food £118 + £55 = £173 because £175 – £173 = £2

Page 107: Solving problems – adding and dividing (Calc 14·2)

Practice

1 **a** 140p ÷ 5 = 28p

b 100p ÷ 5 = 20p

2 Children may choose to use the strategy of working out the value of one item by dividing the cost of the pack by the number of items inside it.

80p ÷ 5 = 16p, 200p ÷ 5 = 40p

40p + 16p + 20p + 28p = £1·04

3 £2·50 – £1·04 = £1·46.

Going deeper

1 You would spend 26p more per child:

140p ÷ 4 = 35p (7p more)

80p ÷ 4 = 20p (4p more)

100p ÷ 4 = 25p (5p more)

200p ÷ 4 = 50p (10p more)

2 It would cost half the original amounts.

14p/notepad (14p less)

8p/balloon (8p less)

10p/lolly (10p less)

20p/pencil (20p less)

3 Responses will vary but children should recognize that pack prices need to be divisible by the number of items in the pack, e.g. 60p for 4 hats (making each hat 15p).

Page 108: Solving problems – multiplying and adding (Calc 14·3)

Practice

1 3 × £4·25 = £12·75

2 × £1·20 = £2·40

2 × £3 = £6

£12·75 + £2·40 + £6 = £21·15

2 Two strategies might be:
- multiplying each item by 3 and adding
- adding all together and multiplying by 3

e.g. £11·85 × 3 = £35·55

3 It can't be the cakes or grapes or strawberries as this would take it over £8·40 so it must be the biscuits and popcorn.

Going deeper

1 Children may find different ways to make £17, e.g.
- 4 punnets of strawberries and 2 punnets of grapes OR
- 4 packs of cakes OR
- 2 packs of cakes, 5 packs of biscuits and a punnet of grapes.

2 A range of possibilities, e.g.

1 pack of cakes and 5 packs of popcorn: £8·75

2 punnets of strawberries and 4 packs of popcorn: £9·60

1 punnet of strawberries and 5 packs of biscuits: £9·00

3 Responses will vary.

Page 109: Solving problems – subtracting and dividing (Calc 14·4)

Practice

1 45p because £2·30 – £1·40 leaves 90p for 2 bottles, so one bottle must be 45p.

2 £1·30

3 £1·60

Going deeper

1 60p juice and water 85p

70p juice and water 80p

80p juice and water 75p

90p juice and water 70p

2 **a** £1.25 **b** £6

NPC Milestone 5

- To select appropriate calculating operations, strategies and methods in a variety of situations involving more than one step.

Page 110: Calculating with analogue and digital times (Mea 1·1)

Practice

1 Molly 06:50 a.m.

Ravi 07:15 a.m.

2 **a** 6:25 a.m.

b 6:50 a.m.

c Explanations will vary but children may bridge through the $\frac{1}{2}$ hour, e.g. count back to 7:00 and then take off the extra.

Going deeper

MONDAY	Molly	Ravi	Anita	Donal
Gets up	6:50 a.m.	7:15 a.m.	7:05 a.m.	6:55 a.m.
Arrives at school	7:53 a.m.	7:58 a.m.	8:16 a.m.	8:38 a.m.
Leaves school	3:30 p.m.	4:05 p.m.	3:55 p.m.	3:25 p.m.
Arrives home	4:03 p.m.	4:33 p.m.	4:11 p.m.	4:07 p.m.

Page 111: Solving time problems (Mea 1·3, 1·4 & 1·5)

Practice

1 Rory's Quest – 8:15 p.m.

Tri-games – 9:20 p.m.

George the Dino – 9:00 p.m.

Tiger Tale – 8:25 p.m.

2 7:25 p.m.

Going deeper

1 Rory's Quest or Tiger Tale

2 6:35 p.m.

3 Responses will vary. Example: Space Race, Start time: 6:45 p.m., duration 1 hr 25 min

Page 112: The 24-hour clock (Mea 1·6)

Practice

1 Answers may vary. Accept all reasonable choices and explanations. Examples include:

a 06:40 **b** 12:47 **c** 16:03 **d** 19:38

2 00:14, 02:35, 06:40

3 Dark – 14 minutes past midnight

Going deeper

1 **a** 00:14, 02:35, 06:40· 12:47, 16:03, 19:38

b 12:14 a.m., 2:35 a.m., 6:40 a.m. 12:47 p.m., 4.03 p.m., 7:38 p.m.

2 Children's activity times will vary.

3 It depends whether her times are written in 24-hour notation or 12-hour notation. If 24-hour notation, then she is correct, as 12:47 is 47 minutes past midday whereas 01:30 is one thirty in the morning.

Page 113: Reading time graphs (Mea 1·8)

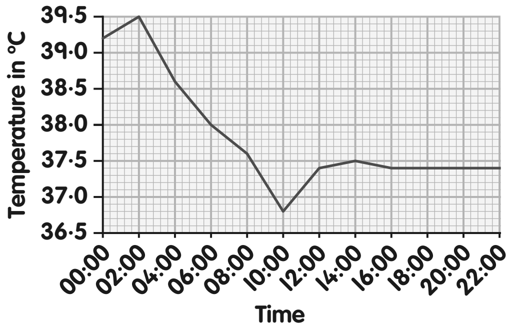
Practice

1 **a** 20:00 **b** 04:00

2 **a** 37·3˚C **b** 38·6˚C **c** 38·7˚C

Going deeper

1



Zoe's temperature continued to rise until 02:00, at which point it dropped quickly, reaching a low of 36·8˚C at 10:00. It then began to rise again but levelled off from 16:00 at a temperature of 37·4˚C.

GMS Milestone 2

- Convert 12-hour clock times from digital to analogue, and vice versa.
- Calculate times earlier or later than a given time, including when bridging an hour, e.g. 37 minutes later than twenty to ten.
- Use a digital stopwatch to measure the duration of an activity, reading the display as hours : minutes : seconds.
- Interpret information shown on a simple timetable and use this to work out time durations.
- Draw timelines to solve problems involving times and durations.
- Recall equivalences between units of time: seconds, minutes, hours, days, weeks, and choose appropriate conversions to solve problems.
- Read and say 24-hour clock times, e.g. 17:00 as "seventeen hundred hours".
- Write a given 12-hour clock time as a 24-hour clock time, and vice versa.

Page 114: Growing number patterns (P&A 5·1 & 5·2)

Practice

1 The sequence will be: 6, 8, 10, 12, 14, 16, 18, 20, 22, 24.

2 Multiply the number of tables by 2, and add 4. (Some children may say, "Add 2 to the last number" because each new table introduces 2 more chairs.)

3 The following answers all assume that tables are joined long side to long side each time, as in the Pupil Book illustration.

8-tables: 12, 16, 20, 24 … (Each new table introduces 4 more chairs.)

10-tables: 14, 18, 22, 26 … (Each new table introduces 4 more chairs.)

12-tables (6 × 2): 16, 20, 24, 28 … (Each new table introduces 4 more chairs.)

12-tables (3 × 4): 14, 20, 26, 32 … (Each new table introduces 6 more chairs.)

The rules for generating these sequences are:

8-tables: Multiply the number of tables by 4, and add 8.

10-tables: Multiply the number of tables by 4, and add 10.

12-tables (6 × 2): Multiply the number of tables by 4, and add 12.

12-tables (3 × 4): Multiply the number of tables by 6, and add 8.

Going deeper

1 3, 10, 17, 24, 31, 38 … Multiply the term number by 7, and subtract 4. (Children may notice that the 'constant difference' between terms is a key number; each new term increases by this number. We can then look at the first term and ask, "What has to be done to '1 × the constant difference' to make this first number?" – in the above example, subtract 4. So the first term can be described as, 'One times the constant difference, subtract 4'· The second term then becomes 'Two times the constant difference, subtract 4'. And so on.)

2 Look for five numbers with a common difference: 12, 21, 30, 39, 48. The tenth term will be 93.

3 Multiply the term number by 9, and add 3.

Page 115: Constant differences (P&A 5·3)

Practice

1 **a** 1, 2, 3, 4 … **b** 2, 4, 6, 8 …

2 9, 12, 15, 18, 21 …

3 Individual answers will vary, but children should be using the different colours to help them express a rule. Example: $6 + (1 \times 3)$, $6 + (2 \times 3)$, $6 + (3 \times 3)$ … They could say, "Multiply the term by 3, and add 6."

Going deeper

1 3×3, 4×3, 5×3, 6×3 …

2 10×2 counters, i.e. 20

3 Sequence is: $3 + (2 \times 5)$, $3 + (3 \times 5)$, $3 + (4 \times 5)$ … So the 20th term will be $3 + (21 \times 5) = 108$.

Page 116: Growing differences (P&A 5·4)

Practice

1 **a** 4, 8, 12, 16 … **b** 1, 4, 9, 16, 25 …

2 9, 16, 25, 36 …

3 The sequence rule could be described as: $(1 + 2)^2$, $(2 + 2)^2$, $(3 + 2)^2$ …, so the 8th term will be $(8 + 2)^2 = 100$.

Going deeper

1 The sequence rule could be described as: (1×3), (2×4), (3×5), (4×6) … so the 12th term will be $(12 \times 14) = 168$.

2 These numbers are known as the 'triangular numbers' and the difference between consecutive terms grows by 1 each time. So the next two terms will be: 15 and 21.

Page 117: Doubling patterns (P&A 5·5 & 5·6)

Practice

1 The number of branches doubles each year, so the sequence will be:

2, 4, 8, 16, 32, 64, 128, 256 … After 8 years the tree will have 256 branches (or 2^8).

2 This sequence will be: 3, 6, 12, 24, 48 … After 5 years the tree will have 48 branches.

Going deeper

1 The rule is: 'Add 5, and then double'.

2 The rule is: 'Double, and then add 5'.

NPC Milestone $\boxed{6}$

- To recognize and deduce rules for growing patterns including doubling sequences.

Page 118: Using coordinates (Geo 4·1)

Practice

1 A (0,10), B (1,2), C (3,4), D (5,8), E (7,3)

2 Cheese piece C

4 Cheese piece B

Going deeper

1 No, Tia is not correct. Coordinates are written with the coordinate on the x-axis first, followed by the coordinate on the y-axis, but Tia has listed her coordinates the wrong way round (8,5). The cheese is at coordinate (5,8).

2 Children's grids will vary.

3 (0,5) (1,5) (2,5) … $(x, 5)$

Page 119: Translating objects on a coordinate grid (Geo 4·2)

Practice

1 **a** Translated 4 units left. Before: (4,7), After: (0,7)

b Translated 4 units left and 2 down. Before: (7,3), After: (3,1)

2 Answers will vary.

Going deeper

1 **a** (7,6) **b** (6,8)

Page 120: Plotting shapes on a coordinate grid (Geo 4·3)

Practice

1 Right-angled triangle

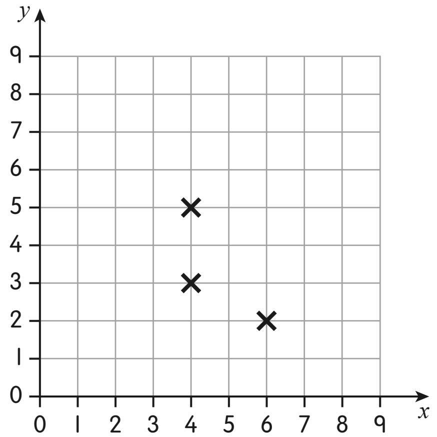
2 (6,5)

3 (7,6) (8,7) (9,8)

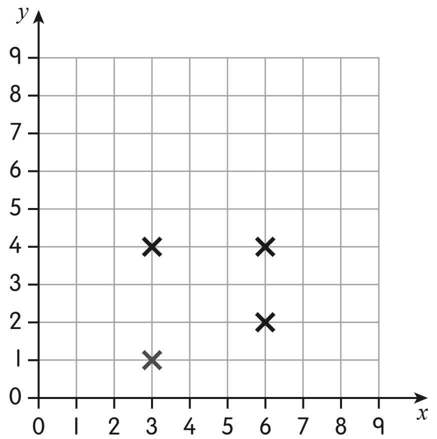
Going deeper

1 Children's responses will vary.

Example: new coordinate (6,2), making a scalene triangle.



2 Children's choice of vertices will vary, e.g.



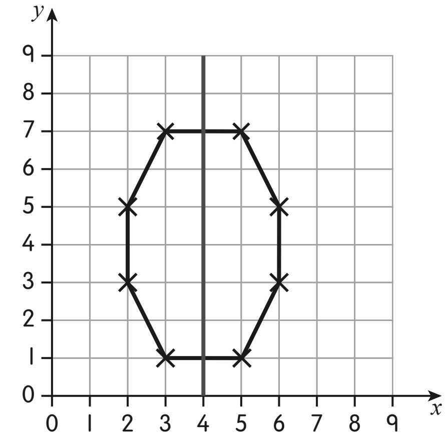
3 (6,7) and (3,4)

Page 121: Symmetry and coordinates (Geo 4·4)

You may want to provide children with coordinate grids to use with Going deeper question 3 or to support their work on other questions. They could be given the blank 10 by 10 grid on PCM 11 in the *Numicon Geometry, Measurement and Statistics 4 Teaching Resource Handbook* to label and adapt, or complete grid on PCM 16 in the *Numicon Geometry, Measurement and Statistics 5 Teaching Resource Handbook*.

Practice

1 (5,7) (6,5) (6,3) (5,1)

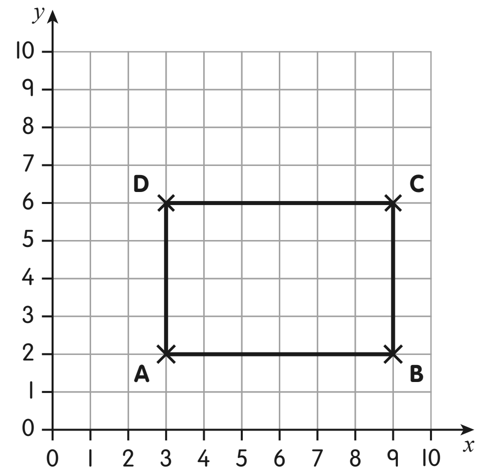


2 a Responses will vary. **b** Responses will vary.

Going deeper

1 Yes, Dave is correct. The other line of symmetry is $y = 4$. The coordinates are equidistant from each other.

2 a Responses will vary, e.g.



b The reflected coordinates share a common number, e.g. (**3**,2) (**3**,6).

GMS Milestone 3

- Label coordinate axes accurately and understand that coordinates show positions on the intersections of the gridlines.
- Locate and plot coordinates, given as (x, y), in the first quadrant, including coordinates that describe the vertices of a polygon.
- Translate a counter or object on a grid, describing the movements in units, e.g. down 4, right 3.

Page 122: Introducing proportion (NNS 7·1 & 7·2)

You may want to provide children with coordinate grids to use with the questions on this page. They could be given the blank 10 by 10 grid on PCM 11 in the *Numicon Geometry, Measurement and Statistics 4 Teaching Resource Handbook* to label and adapt, or the complete grid on PCM 16 in the *Numicon Geometry, Measurement and Statistics 5 Teaching Resource Handbook*.

Practice

1 **a** 4 **b** 10 **c** $\frac{11}{24}$

2 $\frac{1}{4}$ of the cars are blue, or, as a proportion, '1 in every 4 cars'

3 '5 in every 12' or '10 in every 24' cars are either red or blue. As a fraction, this proportion may be expressed as: $\frac{5}{12}$ or $\frac{10}{24}$, $\frac{15}{36}$, $\frac{20}{48}$, …

Going deeper

1 $\frac{21}{24}$ or $\frac{7}{8}$ are not black.

2 $\frac{1}{12}$ are diesel, so $\frac{6}{12}$ or $\frac{1}{2}$ are either diesel or electric. Therefore, $\frac{1}{2}$ or '1 in every 2' cars are neither diesel nor electric.

3 $\frac{1}{4}$ of the cars are blue, so $\frac{1}{4}$ of 36 = 9 blue cars are in the new car park.

Page 123: Fraction walls (NNS 7·3)

Practice

1 Factors of 18 are: 1, 2, 3, 6, 9, 18.

2 $\frac{1}{2}$ of 18 is 9, or, from the diagram: $\frac{9}{18}$, or $\frac{3}{6}$ of 18

3 $\frac{3}{4}$ of 20 = 15

4 **a** $\frac{4}{6} = \frac{2}{3}$ **b** $\frac{3}{8} = \frac{6}{16}$ **c** $\frac{2}{9} = \frac{4}{18}$ **d** $\frac{4}{5} = \frac{16}{20}$

Going deeper

1 The upper (left) box can only contain factors or certain multiples of 6; the lower (right) box can only contain factors or certain multiples of 3. So the possible answers are:

$\frac{1}{3} = \frac{6}{18}$ $\frac{2}{3} = \frac{6}{9}$ $\frac{3}{3} = \frac{6}{6}$ $\frac{6}{3} = \frac{6}{3}$ $\frac{18}{3} = \frac{6}{1}$

2 If $\frac{3}{5}$ of a number is 15, then $\frac{1}{5}$ is 5. So the number is 25.

Page 124: Simplifying fractions (NNS 7·4)

Practice

1 2 in every 6, or 1 in every 3 holes have yellow counters on them.

2 As above, then '3 in every 9', '4 in every 12' … or $\frac{1}{3}$, $\frac{2}{6}$, $\frac{3}{9}$, $\frac{4}{12}$ …

3 $\frac{16}{48}$ is the same proportion as it simplifies to $\frac{1}{3}$ (16 ÷ 16 = 1; 48 ÷ 16 = 3).

4 **a** $\frac{3}{4}$ **b** $\frac{3}{5}$ **c** $\frac{2}{3}$ **d** $\frac{5}{8}$

Going deeper

1 $\frac{1}{3} = \frac{2}{6} = \frac{4}{12}$

2 Because 19 is a prime number, it can have no common factors with 18 (other than 1). Therefore $\frac{18}{19}$ cannot be simplified.

Page 125: Tenths and hundredths (NNS 7·5)

Practice

1 **a** Each child will get $\frac{1}{5}$ of a cake.

b Answers will vary, but 6 ÷ 30 = $\frac{6}{30} = \frac{1}{5}$.

2 4 ÷ 100 = $\frac{4}{100} = \frac{1}{25}$ of a litre each. $\frac{1}{25}$ of a litre = 40 ml

Going deeper

1 **a** $\frac{1}{10} \div 10 = \frac{1}{100}$ **b** $\frac{3}{10} \div 10 = \frac{3}{100}$ **c** $\frac{7}{10} \div 10 = \frac{7}{100}$

2 Dividing tenths by 10 results in each tenth becoming ten times smaller, i.e. $\frac{1}{100}$: $\frac{1}{10} \div 10 = \frac{1}{10} \div \frac{10}{1} = \frac{1}{10} \times \frac{1}{10} = \frac{1}{100}$.

NPC Milestone 6

- To recognize and show, using diagrams, families of common equivalent fractions.
- To add and subtract fractions with the same denominator.

Page 126: Introducing hundredths (NNS 8·1 & 8·2)

Practice

1 $\frac{3}{10}$

2 Answers will vary, but examples could be: $\frac{71}{100}$, $\frac{72}{100}\left(\frac{18}{25}\right)$, $\frac{75}{100}\left(\frac{3}{4}\right)$ …

3 **a** $\frac{72}{100}$ m or $\frac{18}{25}$ m **b** $\frac{53}{100}$ m **c** $\frac{75}{100}$ m or $\frac{3}{4}$ m

4 $\frac{22}{100}$, $\frac{25}{100}$, $\frac{28}{100}$, $\frac{31}{100}$, $\frac{34}{100}$ …

Going deeper

1 $2\frac{35}{100}$ m, $2\frac{7}{20}$ m, 2·35 m, 235 cm, 2350 mm …

2 4 m 25 cm, 4·25 m, $4\frac{1}{4}$ m, 425 cm, 4250 mm …

3 $\frac{93}{100}$

Page 127: Decimals (NNS 8·3 & 8·6)

Practice

1 Some examples could be: $42\frac{53}{100}$, $3\frac{25}{100}$ (or $3\frac{1}{4}$), $6\frac{75}{100}$ (or $6\frac{3}{4}$)

2 Some examples could be: 0·61, 0·69, 0·65 …

3

4 3·55, 3·56, 3·57, 3·58, 3·59, 3·6, 3·61 …

Going deeper

1 **a** 2·39 **b** 5·83

2 The calculator ignores any zeros at the RH end of a decimal fraction. Users working with money need to interpret '5·7' as '£5·70'.

3 $\frac{1}{4} = 0{\cdot}25$

Page 128: Representing decimals (NNS 8·5 & 8·6)

Practice

1 1·26

2 $1\frac{26}{100}$ or $1\frac{13}{50}$

3 Reading from the top, each next number is 10 times larger than the previous one.

4 LHS 6·3, and RHS 6·4

Going deeper

1 Answers will vary, but children could use a baseboard (or laminate) to represent one whole (i.e. '1'). '0·3' can then be represented as three 10-shapes. $\frac{1}{10}$ of three 10-shapes is equivalent to one 3-shape or 0·03.

2 14·02 is closest. Then the next three closest numbers will be: 14·03, 14·05 and 14·23.

Page 129: Comparing and ordering decimals (NNS 8·7 & 8·8)

Practice

1 Answers will vary.

2 By systematically ordering possible numbers by their size, children can establish that the following are all the possible numbers: 2·37, 2·73, 3·27, 3·72, 7·23, 7·32.

3 Examples, from left to right, would be: 6·53, 6·35, 5·55.

Going deeper

1 Examples could be (from the top down): 3·54, 3·57, 3·63, 3·67, 3·79.

2 No, not a good idea. When ordering numbers in terms of their size, it is most efficient always to look at the most powerful digits first, i.e. always work along the digits from the left.

NPC Milestone 6

- To recognize and write decimal equivalents to $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$.
- To recognize and write decimal equivalents of any number of tenths or hundredths.
- To recognize that hundredths arise when dividing an object by a hundred and dividing tenths by ten.
- To use place value understanding to compare and order decimal fractions with two decimal places.

Page 130: Working with money (Mea 2·1 & 2·2)

Practice

1 **a** £0·06 **<** 60p **b** £1·30 **>** 103p **c** 70p **<** £0·75

2 Sharpener (60p), ruler (£1·10) and pencil (95p); sharpener (60p), pencil (95p), notebook (£1·30); notebook (£1·30), ruler (£1·10), sharpener (60p)

3 Sharpener and ruler = £1·70; 30p change
Sharpener and pencil = £1·55; 45p change
Sharpener and notebook = £1·90; 10p change

Going deeper

1 **a** £9·50 **b** £11·65

2 505p; five pounds and five pence.

3 Answers will vary. For example, 75p + £1·35 + 18p, rounded would be 80p + £1·40 + 20p = £2·40, compared to the actual total of £2·28, giving a difference of 12p. Can improve the estimate by rounding down two of the numbers, instead of rounding them up, so 70p + £1·30 + 20p = £2·20, giving a difference of 8p.

Page 131: Multiplying and adding money (Mea 2·3)

Practice

1 Approximately £18 (accept anything between £15 and £20).

2 £17·80

3 £13·30

Going deeper

1 10 cost £17·80, so 5 will cost £8·90, therefore 15 will cost £26·70.

2 £8·30 left to spend – 55p per bag. Any one item or combination of two stickers can be added to each bag.

Page 132: Using a table to organize information to solve money problems. (Mea 2·4)

Practice

1

Child	Amount per minute	Single amount	Total
Molly	35p	none	£6·30
Tia	none	£7	£7·00
Ravi	**40p**	**none**	£7·20
Ben	**none**	**£6**	£6·00

2 Ravi. See table above for totals.

3 16 minutes

Going deeper

1 **a** 20 minutes **b** 15 minutes

2 **a** £22 **b** £28 **c** £ 31·75

Page 133: Multiplying, adding and ordering money amounts (Mea 2·5 & 2·6)

Practice

1 **a** Lia (Nisha raises £14·85 and Lia raises £16·10)
b £30·95

2 **a** £ 8·75 **b** £ 8·10 **c** £8·55

ordered from smallest to largest: b, c, a

Going deeper

1 Lia had made £1·25 more than Nisha so, assuming Lia does not cycle any further, Nisha would only need to cycle another 1 km. This would make her total £16·20, which is 10p more than Lia's current total.

2 Both to cycle 14 km. £18·90 + £16·10 = £35 (but both cycling 13 km only raises £ 32·50)

GMS Milestone 3

- Convert money amounts between pounds and pence, recognizing that 1p is 1 hundredth of £1, e.g. 175p and £1·75.
- Use decimal notation to write, and say, the total value of a collection of notes and coins, e.g. write £2·46 and say, "Two pounds forty-six".
- Round money amounts to the nearest pound, and give real-life examples of when this skill could be useful.
- Present money data in a table and use this to solve problems, e.g. a sponsorship form showing how much more is needed to reach a target.

Page 134: Measuring distance in metres (Mea 3·1 & 3·2)

Practice

1 **a** School field **b** Library

2 Store room 2·09 m
Kitchen 3·6 m
School hall 3·83 m
Garden 4·75 m
Playground 5 m
Library 8·05 m
Head teacher's office 8·8 m
School field 15·25 m

Going deeper

1 Any distance between 2·09 m and 8·8 m

2 Responses will vary.

Page 135: Calculating with distances (Mea 3·3)

Practice

1 Roughly 1·5 km but estimates will vary. Children might round 325·8 m to 300 m; 314·6 m to 300 m; 286·5 m to 300 m; 218·25 to 200 m; and 430·75 m to 400 m, so 300 + 300 + 300 + 200 + 400 = 1500 m, or 1·5 km.

2 212·5 m

Going deeper

1 Jacob and Nadia – 640·4 m
Jacob and Omar – 612·3 m
Nadia and Omar – 601·1 m
Selina and Emma – 649 m

2 **a** 0·8 m by 5 cm **b** 120·5 m by 25 cm **c** 21 m by 50 cm

Page 136: Presenting distances in a bar chart (Mea 3·5)

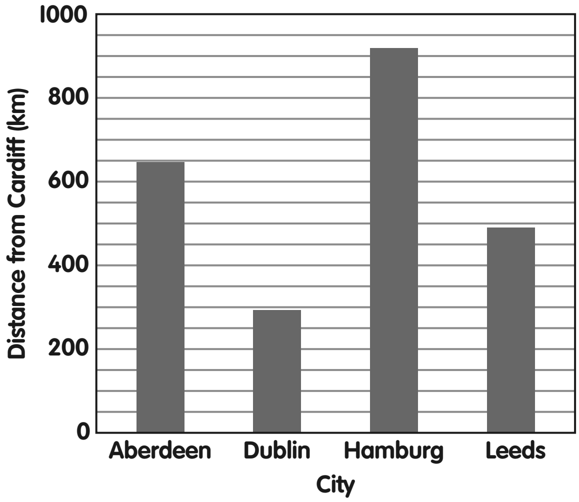
Practice

1 **a** 780 (or within range of 770–790)
b 350 (or within range of 340–360)

2 50 km (or within range of 30–60)

Going deeper

1 a



b Questions will vary.

Page 137: Metres and kilometres (Mea 3·6)

Practice

1 **a** 0·4 km **b** 0·8 km **c** 1·2 km

2 25

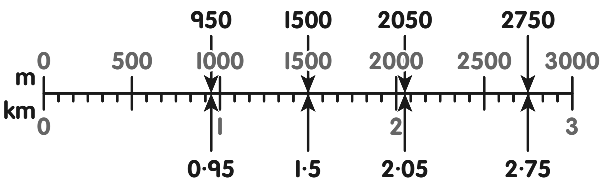
3 Greater, because 10 km is 10 000 m, which is greater than 1000 m.

4 30 500 m

Going deeper

1 7 km

2

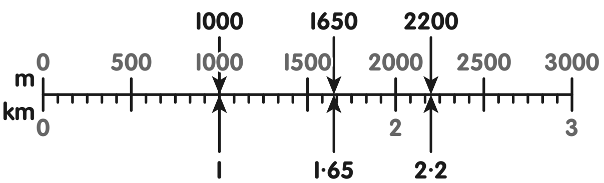


3 Answers will vary, e.g.

1 km

1·65 km

2·2 km



GMS Milestone 3

- Give reasonable estimates of length or distance, considering the unit and instrument most appropriate for the measurement task.
- Use decimal notation to write, and say, lengths in m, e.g. write 3 m 85 cm as 3·85 m and say "three point eight five metres".
- Convert lengths measurements between different metric units, knowing equivalences between mm and cm, cm and m, m and km.
- Record length data in a table, and construct a simple bar chart to find totals and differences.

Page 138: Calculating mass (Mea 4·1)

Practice

1 600 g

2 **a** Estimates will vary from 1200 g to 1300 g.

b Actual mass: 1 kg 250 g

3 Game, book and comic

Going deeper

1 **a** The game

b New total mass is 1210 g. The new item is 270 g, which is 40 g less than the item removed (310 g), so the new total will be 40 g less (1250 g – 40 g = 1210 g).

Page 139: Solving problems involving mass (Mea 4·2)

Practice

1 1 kg 700 g

2 850 g because half of 1700 g (the difference) is 850 g.

Going deeper

1 **a** Give 200 g from the heavier mass to the lighter mass making each 2 kg.

b Give 850 g from the heavier mass to the lighter mass making each 2 kg 150 g.

2 Any combination of three items can be taken EXCEPT: the sleeping bag, wash bag and any other item; the sleeping bag, saucepan and trousers; the sleeping bag, saucepan and torch.

Page 140: Measuring mass (Mea 4·3)

Practice

1 6·05 kg, 6·25 kg, 6·4 kg. When ordering numbers in terms of their size, it is most efficient always to look at the most powerful digits first, i.e. always work along the digits from the left.

2 6·4 kg – sack A

3 **a** 350 g or 0·35 kg

b Responses will vary. Example: 6·1 kg 6·3 kg

Going deeper

1 6·4 kg because this is equivalent to 6 kg 400 g, whereas 6·25 kg is 6 kg 250 g.

2 $\frac{3}{4}$ kg, $\frac{8}{10}$ kg, 850 g, 1050 g, 1·2 kg

3 Responses will vary. Example: 1·6 kg, 1 kg 750 g, 1·55 kg

Page 141: Problem solving (Mea 4·4)

Practice

1 814 g

2 272 g

3 414 g

Going deeper

1 542 g

2 Questions will vary.

GMS Milestone 4

- Weigh items using digital scales and present results in a conversion table, e.g. 3·45 kg, 3 kg 450 g, 3450 g.
- Round a list of masses and estimate the total, giving real-life examples of when this skill could be useful.
- Solve problems involving mass, including finding the mass of multiples of an item and the difference between the mass and a target total.

Page 142: Calculating with litres and millilitres (Mea 5·1)

Practice

1 Responses will vary, but can include:

1 × 600 ml, 1 × 900 ml

2 × 300 ml, 1 × 900 ml

2 × 600 ml, 1 × 300 ml

1 × 600 ml, 3 × 300 ml

5 × 300 ml

2 1 × 900 ml, 1 × 300 ml, 2 × 400 ml

2 × 600 ml and 2 × 400 ml

5 × 400 ml

4 × 300 ml and 2 × 400 ml

3 If children work systematically, starting with the largest container, they will find all the possible combinations. See answers to **2**.

Going deeper

1 Yes, it is possible. For example,

a 1 ℓ 600 ml: 900 ml, 400 ml, 300 ml

b 1 ℓ 700 ml: 900 ml, 2 × 400 ml

c 1 ℓ 800 ml: 900 ml, 600 ml, 300 ml

d 1 ℓ 900 ml: 900 ml, 600 ml, 400 ml

2 Yes, he could fill up the 400 ml container and pour it into the 300 ml container, leaving him with 100 ml in the 400 ml container.

Page 143: Calculating and converting between litres and millilitres (Mea 5·2)

Practice

1 380 ml

2 **a** Around 1500 ml, rounding each amount up or down to the nearest 100 ml.

b 1580 ml

3 Anna, Paul, Danek, Hazel

4 No, she drank 300 ml less than Danek and $\frac{1}{4}$ ℓ is 250 ml.

Going deeper

1 **a** 420 ml **b** 1 glass of water and 1 glass of milk

2 **a** $\frac{2}{5}$ ℓ **<** 0·5 ℓ

b 150 ml **<** 1·05 ℓ

c 0·03 ℓ = 30 ml

Page 144: Problems involving capacity (Mea 5·3)

Practice

1 **a** 240 litres **b** 8400 litres

2 21·6 litres

Going deeper

1 1800 seconds or 30 minutes

2 **a** 6 litres 700 ml

b The helicopter uses 40 litres of fuel in one hour, so in 10 minutes it will use one sixth of this amount. 40 ÷ 6 is 6r4 or $6\frac{2}{3}$. The $\frac{2}{3}$ is equal to approximately 666 ml, which rounds up to 700 ml.

Page 145: More problem solving (Mea 5·4)

Practice

1 1·125 litres

2 4 of each ingredient:
600 ml apple juice
1·2 litres orange juice
300 ml lime juice
2·4 litres of lemonade

3 550 ml

Going deeper

1 375 ml apple juice
750 ml orange juice
187·5 ml lime juice

2 30 cups at 40p/cup = £12

GMS Milestone 4

- Estimate the volume held within, or the capacity of, everyday containers, and describe the difference between these terms.
- Measure out a volume of liquid, when the capacity of the jug is smaller than the total volume required, e.g. 1.5 ℓ volume using a 300 ml jug.
- Convert between millilitres and litres, e.g. 1500 ml, 1 ℓ 500 ml, 1·5 ℓ, choosing the most appropriate units to use when solving problems.

Page 146: Solving problems systematically (P&A 6·1)

Practice

1 A 3 × 3 square will have to total 9, so the following combinations of odd Shapes are possible:

1s	3s	5s
9	-	-
6	1	-
4	-	1
3	2	-
1	1	1
-	3	-

2 & 3 A 4 × 4 square will have to total 16, so the following combinations of even Shapes are possible:

2s	4s	6s	8s
8	-	-	-
6	1	-	-
5	-	1	-
4	2	-	-
4	-	-	1
3	1	1	-
2	-	2	-
2	3	-	-
2	1	-	1
1	-	1	1
-	4	-	-
-	-	-	2
-	2	-	1

Going deeper

1 None. Since adding any two even numbers together produces another even number, no combination of even Shapes can produce an odd number of holes (or 1s).

2 1 × 1 – Yes; 2 × 2 – Yes (1 + 3); 3 × 3 – Yes (1 + 3 + 5); 4 × 4 – Yes (1 + 3 + 5 + 7); 5 × 5 – Yes (1 + 3 + 5 + 7 + 9)

3 Series of consecutive odd numbers always add together to form square numbers, i.e. 1 + 3 = 4, 1 + 3 + 5 = 9, 1 + 3 + 5 + 7 = 16. Children might like to investigate whether series of 'odd' Numicon Shapes will actually fit together physically to form squares for values beyond 9.

Page 147: Finding all possible scores (P&A 6·2)

Practice

1 a The different combinations of three counters chosen from a bag of four are as follows, with associated scores shown on the right:

Yellow	Green	Blue	Red	Score
X	X	X		111
X		X	X	1101
X	X		X	1011
	X	X	X	1110

b There are three different ways in which each colour may be paired with two other colours, chosen from four (see table above). These combinations give the four different corresponding scores shown alongside.

Going deeper

1 **a** and **b** The different combinations of three colours chosen from five possibilities are as follows, with corresponding scores shown on the right:

Red	Black	Yellow	Blue	Green	Score
X	X	X			6
X	X		X		7
X	X			X	8
X		X	X		8
X		X		X	9
X			X	X	10
	X	X	X		9
	X	X		X	10
	X		X	X	11
		X	X	X	12

2 Scores of 8, 9, and 10 are more likely since there are two ways in which each may be scored.

Page 148: Breaking a combination code (P&A 6·4)

Practice

1 **a** 20

b There are 5 possible keys for which key to press first (1, 2, 3, 4 or 5), then 4 remaining possibilities for each of the second pressings; 5 × 4 = 20.

2 36

This time keys may be repeated, so there are 6 possible keys for the first pressing, and 6 possibilities for each of the second pressings, giving 6 × 6 = 36 different combinations.

Going deeper

1 There are 5 possible keys for the first pressing (1, 2, 3, 4 or 5), 4 possibilities for each of the second pressings, and then 3 remaining possibilities after two keys have already been pressed: 5 × 4 × 3 = 60.

2 Children will explain the rule in individual ways, but assuming keys may be repeated, if there are 'k' keys and 'p' pressings required for a code, then the number of possible combinations will be $k \times k \times k \times k$ … 'p' times, or kp. So, for 10 keys and 3 pressings there will be 10^3 or (10 × 10 × 10) possible entry codes.

Where keys cannot be repeated, children will express this rule in their own ways, but with 'k' keys and 'p' pressings required for a code there will be $k \times (k - 1) \times (k - 2) \ldots \times (k - p + 1)$ different entry codes possible. So for 10 keys and 3 different pressings there will be 10 × 9 × 8 = 720 possible combinations. (See answer to GD1, above.)

Practice 149: Eliminating possibilities (P&A 6·5)

Practice

1 Many strategies are possible, but changing one of the numbers is a reasonable thing to try.

2 Using both the responses Tia now has, she knows that in her first guess either the 2 or the 3 was in the right position (because it can't have been the 1). She also knows that the 5 is in the wrong position in her second guess, because otherwise Ravi's response would have had to have shown two Shapes in the right position. By changing either the 2 or the 3 to 1 (a number that she knows to be completely wrong) she will discover whether the 2 or the 3 is in the right position in her first guess.

3 Since Tia now knows that 1 is a wrong number, and 5 is in the wrong position, it is 3 that must be in the right position. It now follows that in her first guess 2 was a correct number, but in the wrong position; so 2 should go in the first box. The solution now has to be 2, 5, 3.

Going deeper

1 **a** Responses will vary.

b Again, answers will vary but a key part of any strategy is to consciously make use of all the information given. Children will often move on from 'wrong' guesses without taking account of all the information available, and not connect what two or three guesses contribute together.

NPC Milestone 6

- To plan how to organize an investigation and keep systematic records of possibilities tried and tested.
- To begin to use their repertoire of number facts to predict the number of possibilities in a problem.

Page 150: Calculating perimeters of 2D shapes (Mea 6·1 & 6·3)

Practice

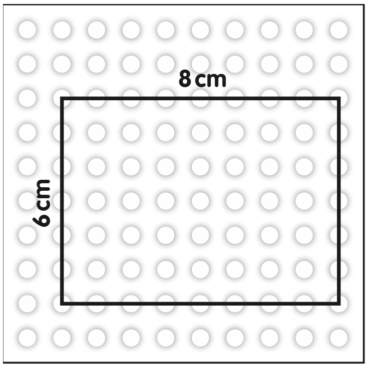
1 Oblong – 20 cm

Rhombus – 20 cm

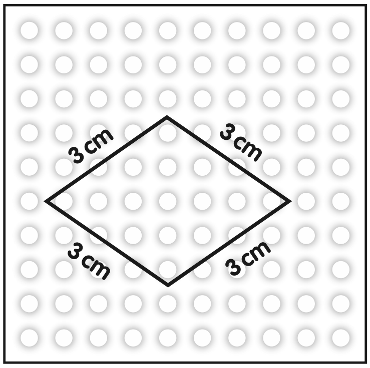
Trapezium – 18·5 cm

2 Responses will vary, e.g.

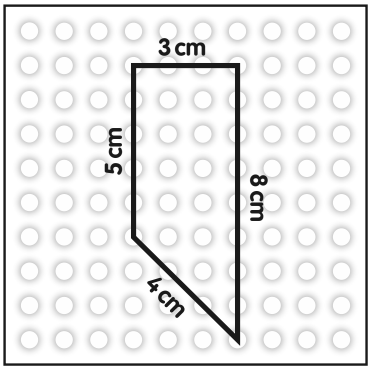
a



b



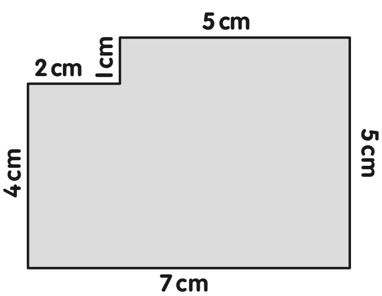
c



3 24 cm

Going deeper

1 Responses will vary, e.g.



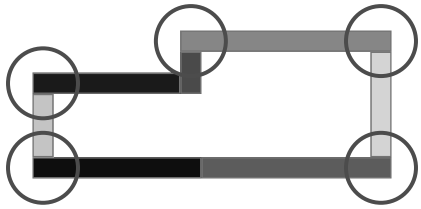
2 Responses will vary.

Page 151: Exploring area and perimeter (Mea 6·2 & 6·4)

Practice

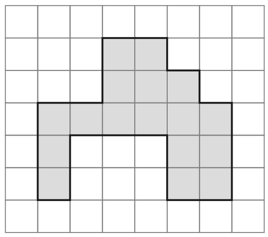
1 She has not. The correct perimeter of the white shape is 40 cm (7 + 3 + 7 + 2 + 8 + 5 + 8).

2 He would need to take away 4 cm/4 cubes as he has not allowed for the four corners of the shapes where the rod amount should not be included.



3 61 cm^2

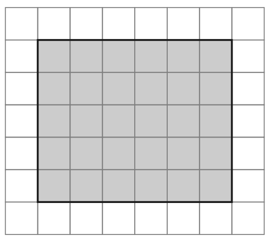
4 **a** Designs will vary, e.g.



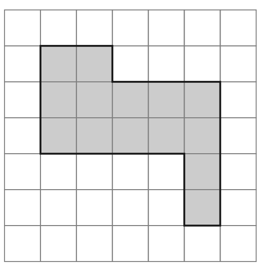
b Area for the example shape (areas will be different for different shapes): 17 m^2

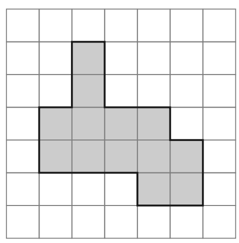
Going deeper

1 **a** and **b** Shapes will vary, e.g.



2 Shapes will vary, e.g.





Perimeter: 20 cm, Area: 13 cm^2

Perimeter: 20 cm, Area: 14 cm^2

Page 152: Finding the area of an oblong (Mea 6·5)

Practice

1 Their perimeters increase by 2 cm each time and their areas by 7 cm^2 each time.

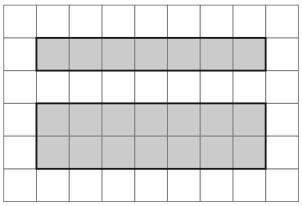
2 **a** Area: 42 cm^2, Perimeter: 26 cm

b The 10th oblong would have side lengths of 7 cm and 12 cm so its perimeter would be 38 cm and its area would be 84 cm^2.

3 Responses and sequences will vary.

Going deeper

1



2 350 cm^2

3 Children should make the link to multiplying and dividing facts.

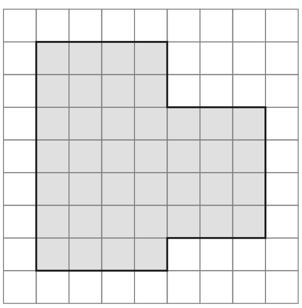
a 1 × 24
2 × 12
3 × 8
4 × 6

b 1 × 30
2 × 15
3 × 10
5 × 6

Page 153: Investigating shapes with the same area (Mea 6·6)

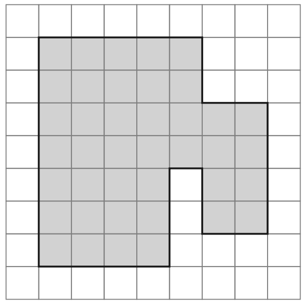
Practice

1 **a** Designs will vary but should all be 40 m^2, e.g.



b Answers will vary but, in this example, the perimeter is 28 m.

2 Designs should have an area of 40 m^2 and perimeter of 32 m, e.g.



Going deeper

1 Designs will vary.

2 Designs will vary.

GMS Milestone 4

- Devise methods for calculating the perimeter of regular polygons, e.g. multiplying the side length of an equilateral triangle by 3.
- Draw, or use equipment to make, different polygons that have the same perimeter.
- Use their own words to explain and show the difference between the terms perimeter and area.
- Find the area of rectilinear shapes and shapes with diagonal sides, by counting whole squares and/or adding fractions of squares.

Page 154: Exploring general rules (P&A 7·1)

Practice

1 Children can calculate that the answer will be (25 × 26) ÷ 2 = 325.

2 **a** The sequence can be described as: 1, (1 + 2), (1 + 2 + 3), (1 + 2 + 3 + 4) … and so on.

b The sequence in **2** is formed with the totals of series of consecutive whole numbers, and **1** asks for the total of a series of consecutive whole numbers.

Going deeper

1 Subtract the total of the first series from the total of the second series, i.e. 120 – 55 = 65.

2 Subtract the total for the series up to 6 from the total for the series to 11. So 66 – 21 = 45. The answers to **1** and **2** can be checked using another method, e.g. 11 + 12 + 13 + 14 + 15 = middle value × 5 = 13 × 5 = 65.

Page 155: Rod pattern sequences (P&A 7·2)

Practice

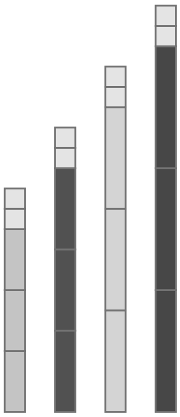
1 **a** (4 × 2) + 5 = 13 and (4 × 3) + 5 = 17

b (4 × 6) + 5 = 29

2 105. The total rod length of the first cross can be described as (4 × 2) + 2 or 5 × 2, that of the second cross as (4 × 3) + 3 or 5 × 3. So the total rod length of the 20th cross in the series will be (4 × 21) + 21 or 5 × 21 = 105.

Going deeper

1 Answers will vary. The rods could be side by side, or on top of each other, as shown.



2 The total rod lengths of the staircases shown are: 1, 3, 6 and 10. These are known as the 'triangular numbers'.

3 **a** Pairs of consecutive staircases can be put together to make squares.

b 4, 9, 16, 25 … These numbers are called the 'square numbers'.

Page 156: General statements (P&A 7·4)

Practice

1 Examples could be: 2 is the only number that is a factor of 14; 3 is the only odd number; 4 is the only square number; 10 is the only multiple of 5 (or the only 2-digit number).

2 **a** and **b** Examples could include:

Possible groups	Possible extras
Multiples of 3: 3, 27, 39	6, 12
Multiples of 2: 8, 22, 64	4, 10
Multiples of 8: 8, 64	16, 32
Multiples of 11: 11, 22	33, 44
Prime numbers: 11, 17	13, 19

3 Sometimes true. For example, choose pairs from: 6, 12, 16, 36, 41.

Going deeper

1 Examples could be as follows:

a Positive whole numbers are always larger than zero.

b Positive whole numbers are multiples of 6.

c Positive whole numbers are smaller than 1.

2 Not true. Compare 1·2 and 300·4.

Page 157: Being logical (P&A 7·5)

Practice

1 6 red, 8 blue, 4 yellow and 12 green

2 Answers will vary.

Going deeper

1 Possible answers are: 6529, 6925, 6727, 6628, 6826. The thousands and tens are always 6 and 2 but the hundreds and ones can change, as long as they total 14.

2 If B + C = 11 kg, and A + C = 8 kg, then parcel B is 3 kg heavier than parcel A. Since A + B = 9 kg, parcel A must weigh 3 kg. So parcel B weighs 6 kg, and parcel C weighs 5 kg.

NPC Milestone 6

- To notice patterns and predict from them to arrive at a general rule and explain their reasoning logically.

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