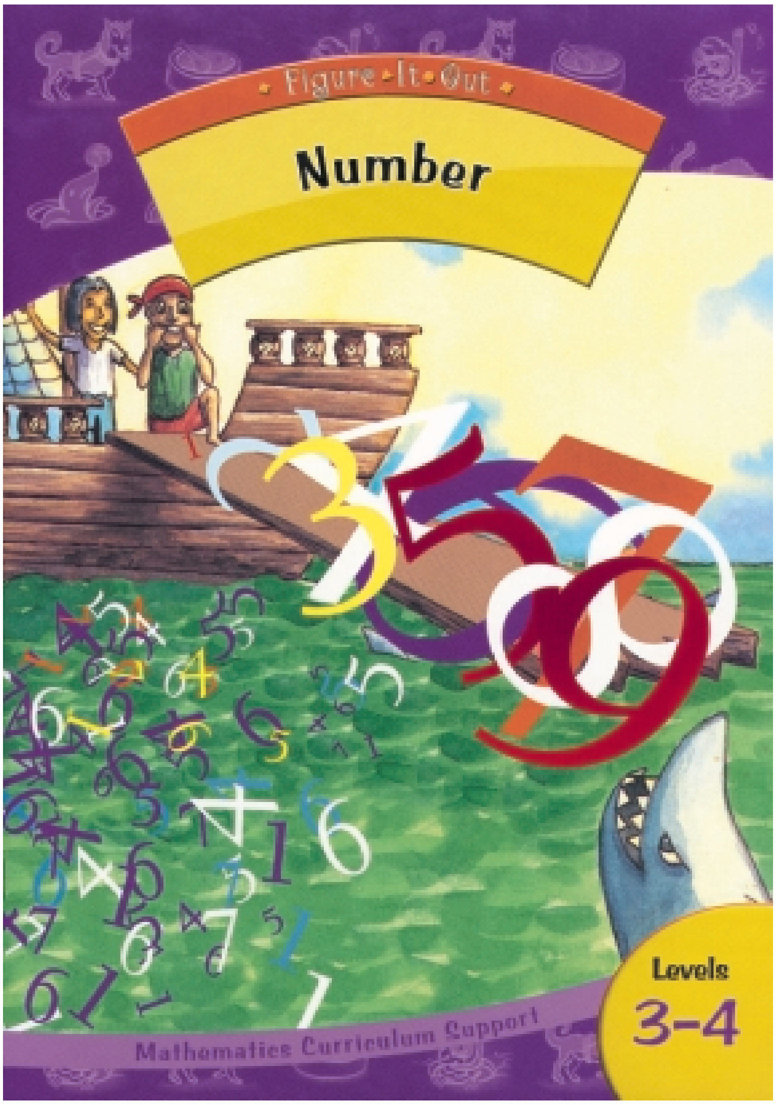
Answers and Teachers' Notes



MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Contents

Introduction

The Figure It Out series is designed to support *Mathematics in the New Zealand Curriculum.* The booklets have been developed and trialled by classroom teachers and mathematics educators. The series builds on the strengths of a previous series of mathematics booklets published by the Ministry of Education, the School Mathematics supplementary booklets.

Figure It Out is intended to supplement existing school mathematics programmes and can be used in various ways. It provides activities and investigations that students can work on independently or co-operatively in pairs or groups. Teachers can select particular activities that provide extension to work done in the regular classroom programme. Alternatively, teachers may wish to use all or most of the activities in combination with other activities to create a classroom programme. The booklets can be used for homework activities, and the relevant section in the teachers' notes could be copied for parents. These notes may also provide useful information that could be given as hints to students. The teachers' notes are also available on Te Kete Ipurangi (TKI) at www.tki.org.nz/community

There are eight booklets for levels 3–4: one booklet for each content strand, one on problem solving, one on basic facts, and a theme booklet. Each booklet has its own *Answers and Teachers' Notes*. The notes include relevant achievement objectives, suggested teaching approaches, and suggested ways to extend the activities. The booklets in this set (levels 3–4) are suitable for most students in year 6. However, teachers can decide whether to use the booklets with older or younger students who are also working at levels 3–4.

The booklets have been written in such a way that students should be able to work on the material independently, either alone or in groups. Where applicable, each page starts with a list of equipment that students will need to do the activities. Students should be encouraged to be responsible for collecting the equipment they need and returning it at the end of the session.

Many of the activities suggest different ways of recording the solution to a problem. Teachers could encourage students to write down as much as they can about how they did investigations or found solutions, including drawing diagrams. Where possible, suggestions have been made to encourage discussion and oral presentation of answers, and teachers may wish to ask their students to do this even where the suggested instruction is to write down the answer.

> The ability to communicate findings and explanations, and the ability to work satisfactorily in team projects, have also been highlighted as important outcomes for education. Mathematics education provides many opportunities for students to develop communication skills and to participate in collaborative problem-solving situations.
>
> *Mathematics in the New Zealand Curriculum,* page 7

Students will have various ways of solving problems or presenting the process they have used and the solution. Successful ways of solving problems should be acknowledged, and where more effective or efficient processes can be used, students can be encouraged to consider other ways of solving the problem.

Figure It Out

Number Answers

Page 1: Money Everywhere

Activity One

1.

	Amount withdrawn	Notes	Number of notes received
Monday	$7,560	$10	**756**
Tuesday	$89,000	$100	**890**
Wednesday	$940	**$10**	94
Thursday	**$130,000**	$100	1 300
Friday	$104,000	**$100**	1 040

2. Monday: 81 (75 $100 notes and six $10 notes)
   Wednesday: 13 (nine $100 notes and four $10 notes)

Activity Two

a. **i.** 49 **ii.** 206 **iii.** 380
   iv. 492 **v.** 2 070 **vi.** 41 040

b. Answers will vary. You could divide by 10 and then by 100, divide by 100 and then by 10, or divide by 1 000.

Activity Three

a. $4,743

b. $5,087

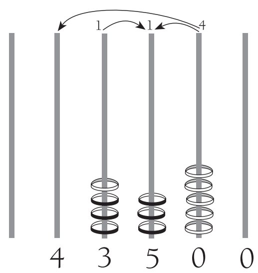
c. $6,484

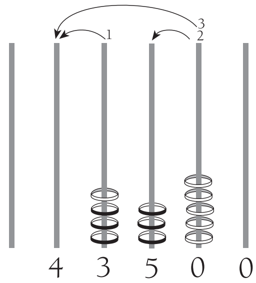
Page 2: Places to Go

Activity One

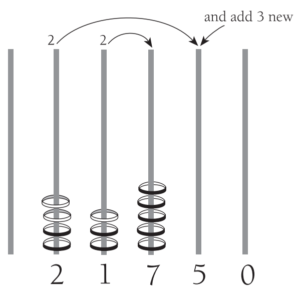
a. 4 350

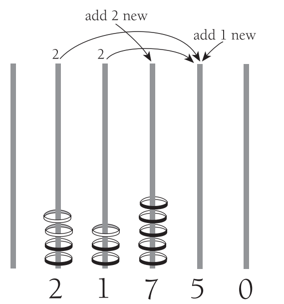
b. The new number is 43 500. Two ways of doing this are:





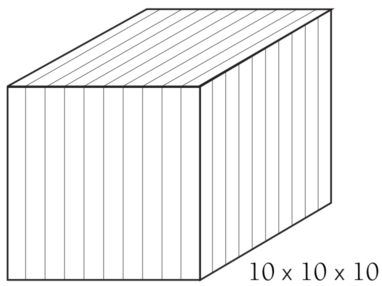
c. The number is now 21 750.
   Two ways of doing this are:





Activity Two

1. a. 10 x 10 x 10 or 100 x 10 x 1



b. 100 x 100 x 10 or 1 000 x 10 x 10 or 1 000 x 100 x 1

c. 100 x 100 x 100 or 1 000 x 100 x 10 or 1 000 x 1 000 x 1

2. Possible answers include: 1 000 x 1 000 x 1 000, 10 000 x 1 000 x 100, or 100 000 x 1 000 x 10. (In real terms, the possible measurements of a swimming pool would depend on whether the measurements were in cm or m.)

Page 3: A Watery Mission

Activity

a. Planet Pascal

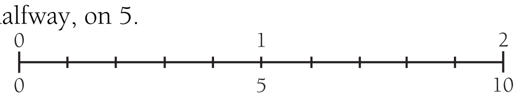
b. By working out how many of the 20 sections on each planet are land, you find out that approximately $^7/_{20}$ of Planet Pascal is land, leaving approximately $^{13}/_{20}$, or just under $^2/_3$, as water.

You could use a number line to decide which planet's water is closest to $^2/_3$.

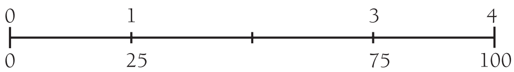
Pages 4–5: Stretch and Grow

Activity

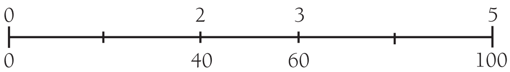
1. At the 5 marker. When Hercules is on 2, the ribbon is on 1, halfway between him and the start. So when he is on 10, the marker will be halfway, on 5.



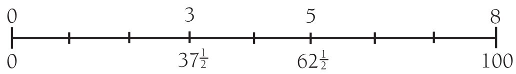
2. a. The yellow ribbon is at 25, and the blue is at 75. In the illustration, the yellow is at 1, and the dog is at 4, so the yellow is $^1/_4$ of the way along the cord. One-quarter of 100 is 25. The blue ribbon is at 3, and the dog is at 4. Three-quarters of 100 is 75.



b. The yellow is at 40 ($^2/_5$ of 100 = 40) and the blue at 60 ($^3/_5$ of 100 = 60).

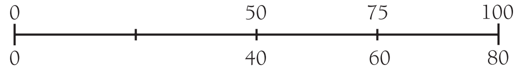


c. The yellow is at $37^1/_2$ ($^3/_8$ of 100 = $37^1/_2$) and the blue at $62^1/_2$ ($^5/_8$ of 100 = $62^1/_2$).

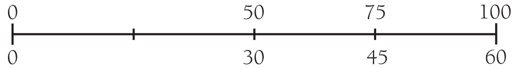


d. The yellow is at $33^1/_3$ ($^1/_3$ of 100 = $33^1/_3$) and the blue at $66^2/_3$ ($^2/_3$ of 100 = $66^2/_3$).

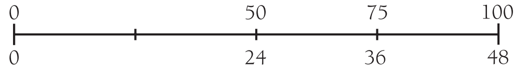
3. a. The yellow is at 40 and the blue at 60.



b. The yellow is at 30 and the blue at 45.



c. The yellow is at 24 and the blue at 36.



Pages 6–7: Changes, Highs, and Lows

Activity One

1. 2 033

2. a. Add 2 200.
   b. Add 2.
   c. Subtract 12 345.
   d. Subtract 5.
   e. Subtract 3.61.
   f. Add 0.05.
   g. Subtract 50.324.
   h. Subtract 2.997.

3. Problems will vary.

Activity Two

1. Mike will win (no matter what card he picks up) if Christine gets a card that is less than 5 to fill her tens □. Otherwise, Christine will win.

Remember that there are only three of each digit card, so there are no 5 or 9 cards left. If Mike picks up a 2, 3, 4, 6, or 7 in his turn (he started first, so he has first turn now), that would use up all three of those cards.

Mike	Christine
9 + 4☐ + 753 + 5 869	9 + ☐ 2 + 375 + 6 241
9 + 41 + 753 + 5 869 = **6 672**	9 + 12 + 375 + 6 241 = 6 637
9 + 42 + 753 + 5 869 = 6 673	9 + 22 + 375 + 6 241 = 6 647
9 + 43 + 753 + 5 869 = 6 674	9 + 32 + 375 + 6 241 = 6 657
9 + 44 + 753 + 5 869 = 6 675	9 + 42 + 375 + 6 241 = **6 667**
9 + 46 + 753 + 5 869 = 6 677	9 + 62 + 375 + 6 241 = 6 687
9 + 47 + 753 + 5 869 = 6 678	9 + 72 + 375 + 6 241 = 6 697
9 + 48 + 753 + 5 869 = 6 679	9 + 82 + 375 + 6 241 = 6 707

2. A game of High Wins and a game of Low Wins

Page 8: Waves Win

Activity

1. **a.** The 1.000 means that the concrete block is a whole unit, with no erosion. The 0.750 means that the erosion has been 0.250, or 25%, leaving 75% of the block still there.

   b. $^{750}/_{1000}$ (this means 750 ÷ 1 000, which in its simplest form is $^{3}/_{4}$)

2. **a.** 0.500

   b. 0.250

   c. 0.375

   d. 0.718

   e. 0.440

3. **a.** $^{1}/_{2}$

   b. $^{1}/_{4}$

   c. $^{3}/_{8}$

   d. $^{359}/_{500}$

   e. $^{11}/_{25}$

4. Teacher to check

Page 9: Bean Brains

Activity

1. 5
2. 75 red, 25 yellow
3. 40 blue, 60 green
4. 375 blue, 625 yellow
5. **a.** He is wrong because none of the jars' contents can be divided equally into groups of 3.

   b. Multiples of 3. The closest to the numbers already in the jar would be 9 beans, 99 beans, and 999 beans.

Page 10: Bottle Ups

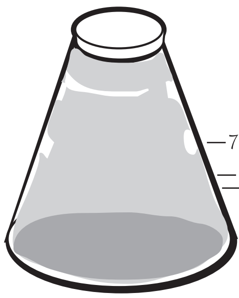
Activity One

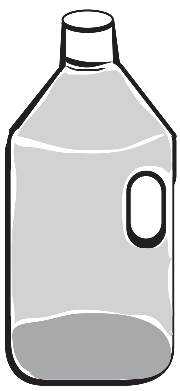
1. Practical activity
2. **a.** Answers will vary, but the students will probably discuss how they could convert the fractions of 1 L into mL, measure these mL amounts of water in the measuring jug, pour the water into the inverted bottle, and then mark the levels.

   b. Practical activity
3. Practical activity. You would mark your fuel tank by pouring in the contents of one of the bottles, marking the level as $^{1}/_{3}$, and then pouring in the contents of one of the other bottles to find the $^{2}/_{3}$ mark. (The third bottle is to help you separate the thirds.)
4. Predictions should be approximately 333 mL and 666 mL.

Activity Two

Practical activity. Answers may vary, but the levels should be similar to:





Page 11: A Long Look at Decimals

Activity

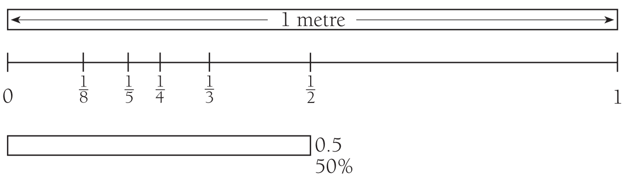
1. If Kylie measures the length to her fold mark, it will coincide with the 50 cm mark on the ruler. The full length of the ruler is 100 cm. So one part out of two is the same as 50 parts out of 100.

2. a. Practical activity. Teacher to check

   b.

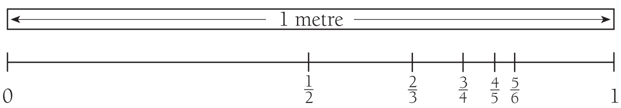
	Fraction	Decimal	Percentage
i.	$^1/_4$	0.25	25%
ii.	$^3/_4$	0.75	75%
iii.	$^1/_5$	0.2	20%
iv.	$^4/_5$	0.8	80%
v.	$^3/_8$	0.375	37.5%
vi.	$^7/_8$	0.875	87.5%
vii.	$^2/_{10}$	0.2	20%
viii.	$^5/_{10}$	0.5	50%

3.



4. $^5/_6$. Two ways of showing how you know this are:

   - using the number line you have made. (The one shown here only includes the fractions in the question.)



   - converting all the fractions into decimals or percentages. A table is a good way of showing this:

Fraction	Decimal	Percentage
$^1/_2$ (1 ÷ 2)	0.5	50%
$^2/_3$ (2 ÷ 3)	$0.6\dot{6}$	66.7%
$^3/_4$ (3 ÷ 4)	0.75	75%
$^4/_5$ (4 ÷ 5)	0.8	80%
$^5/_6$ (5 ÷ 6)	$0.8\dot{3}$	83.3%

Note: Percentages in this table are rounded to the nearest decimal.

Page 12: Hot Shots

Activity One

1. Splashin' Sachin (75%)
2. a. $^3/_4$
   b. $^2/_3$
   c. $^5/_8$
   d. $^1/_2$

Activity Two

Practical activity

Page 13: Head Cases

Activity

1. a. Scott:
   923 – 598 = □
   923 – 600 = 323
   323 + 2 = 325

   Stacey:
   923 – 598 = □
   598 + □ = 923
   + 2 + 300 + 23
   598 600 900 923
   2 + 300 + 23 = 325

   Kingi:
   923 – 598 = □
   923 – 500 = 423
   423 – 90 = 333
   333 – 8 = 325

   b. Discussion points will vary.

2. Methods will vary. Answers are:
   a. 551
   b. 273
   c. 216
   d. 459
   e. 436
   f. 619
   g. 251
   h. 778

Page 14: Kapa Haka

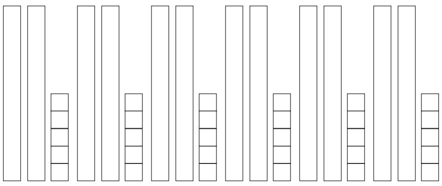
Activity

1. Yes. They will need to earn 100 points in each event. This would give them 567 points, one point more than Tairāwhiti, the leading group, who have 566 points.
2. Answers will vary, but they must earn a combined total of 298 for the last three events to get one point more than Ngāti Tainui, who have 564 points.

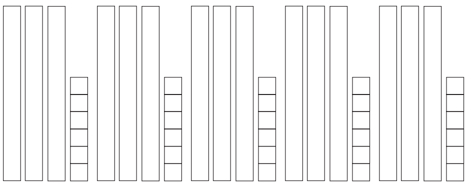
Page 15: Hard Times

Activity

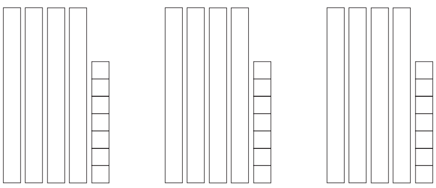
1. 4 x 30 = 120
   4 x 6 = 24
   so 4 x 36 = 144
2. **a.** 3 x 53
   b. 3 x 50 = 150
   3 x 3 = 9
   3 x 53 = 159
3. **a.** **i.** (6 x 25)



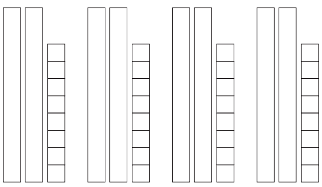
ii. (36 x 5)



iii. (47 x 3)



iv. 28 x 4



b. **i.** 150
ii. 180
iii. 141
iv. 112

4. **a.** $138
   b. $136
   c. $140

Page 16: Multiplication Roundabouts

Activity

a.	2 x 80 = 160	2 x 2 = 4	160 – 4 = 156
b.	5 x 30 = 150	5 x 2 = 10	150 + 10 = 160
c.	4 x 40 = 160	4 x 1 = 4	160 – 4 = 156
d.	9 x 40 = 360	9 x 1 = 9	360 + 9 = 369
e.	3 x 50 = 150	3 x 4 = 12	150 + 12 = 162
f.	8 x 60 = 480	8 x 1 = 8	480 – 8 = 472
g.	6 x 90 = 540	6 x 2 = 12	540 – 12 = 528
h.	7 x 30 = 210	7 x 1 = 7	210 – 7 = 203

Page 17: Lookalike

Activity

1. A 24 x 6 block is twice as long but half as wide as a 12 x 12 block. That is,
   24 x 6 = 12 x 2 x 6
   = 12 x 12.
2. **a.** **i.** 3 x 27 is three times as long as 9 x 9 but $^1/_3$ as wide.
   ii. 5 x 18 is half as long and twice as wide as 10 x 9.
   iii. 4 x 16 is half as long and twice as wide as 8 x 8.
   iv. 2 x 45 is $^1/_5$ as long and five times as wide as 10 x 9.
   b. The second statement in each pair is easier to solve because multiplying by 10 or a single digit is easier than multiplying by numbers greater than 10.

3. Possible equations include:

   a. 10 x 23 = 230

   b. 4 x 9 = 36

   c. 6 x 9 = 54

   d. 12 x 10 = 120

   e. 7 x 8 = 56

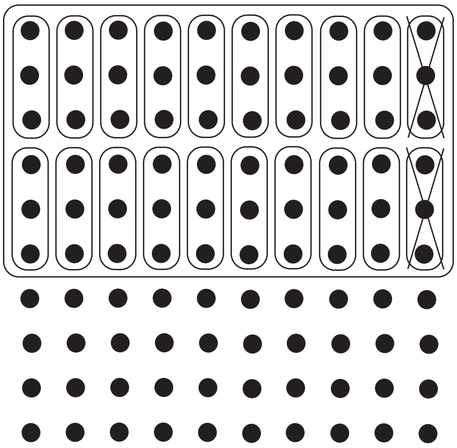
   f. 12 x 6 = 72

Page 18: Division Delights

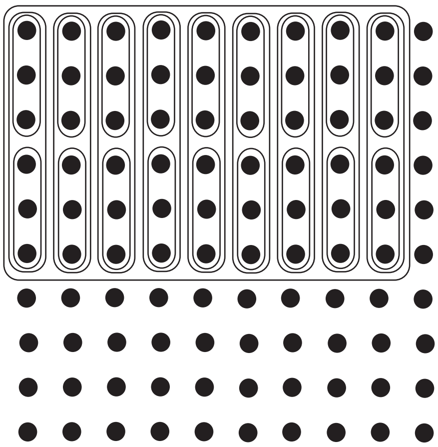
Activity

1. Answers will vary. One way of showing each method is:

   Sam



   Mae Ling



2. Methods and use of hundred fields will vary. Answers are:

   a. 16

   b. 13

   c. 18

   d. 13

   e. 29

   f. 19

Page 19: Digital Dilemmas

Activity

1. a.–b.
   The possible division expressions are:
   624 ÷ 8
   264 ÷ 8
   628 ÷ 4
   268 ÷ 4
   468 ÷ 2
   486 ÷ 2
   648 ÷ 2
   684 ÷ 2
   846 ÷ 2
   864 ÷ 2

2. a. 135 ÷ 9
   153 ÷ 9
   351 ÷ 9
   315 ÷ 9
   513 ÷ 9
   531 ÷ 9
   935 ÷ 1
   953 ÷ 1
   539 ÷ 1
   593 ÷ 1
   359 ÷ 1
   395 ÷ 1
   591 ÷ 3
   519 ÷ 3
   951 ÷ 3
   915 ÷ 3
   195 ÷ 3
   159 ÷ 3

   b. Yes. You have more answers because all combinations of the other three digits are divisible by 1, 3, and 9.

3. a. 652 x 83 = 54 116

   b. 368 x 25 = 9 200

   c. Answers will vary, but they should focus on organising the digits in either the largest or the smallest possible way and trialling them.

Page 20: Think Tank

Activity

1. Statement: 52 x 7 Answer: $364
2. Statement: 414 ÷ 46 Answer: 9 buses
3. Statement: 432 ÷ 12 Answer: 36 cans
4. Statement: 624 ÷ 8 Answer: $78
5. Statement: 18 x 7 Answer: 126 lollies

Page 21: More Thinking

Activity

1. 24 dresses (although the extra fabric may allow more if the dresses are laid out carefully to make full use of the material)
2. 60 days
3. Eight tubes of blue and 16 tubes of yellow
4. 210 km

Page 22: Using Exponents

Activity

1. $1,024 ($1 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 x 2 or $1 x 2^{10})
2. **a.** 8 (2 x 2 x 2 or 2^3)
   b. 27 (3 x 3 x 3 or 3^3)
   c. 64 (4 x 4 x 4 or 4^3)
3. 1 024 (4 x 4 x 4 x 4 x 4 or 4^5)
4. **a.** 222. No, it is less ($3^3 + 4^4 + 5^5 = 3\ 408$). The 4 and 5 in the second set have higher powers, which give bigger numbers.
   b. $10^3 = 1\ 000$
   $10^4 = 10\ 000$
   $10^5 = 100\ 000$
   $10^6 = 1\ 000\ 000$

Page 23: Walking the Plank

Game

A game using integers

The chances of winning or losing appear to be equal. The chances of facing the boat or the shark are equal, and the chances of a positive or negative number are also equal. Therefore the chances of moving in either direction are equal.

Page 24: Disappearing Dollars

Activity

1. $3
2. **a.** None
   b. He would have $20 left.
3. **a.** Yes. Frank has $18 worth of bills and $19 cash.
   b. Yes. Sally has $21 worth of bills and $25 cash.
   c. No. Georgia needs $5 more to pay her bill.
   d. No. Charlotte needs $9 more to pay her bills.

Figure It Out

Number

Teachers' Notes

Overview: Number

Title	Content	Page in students' book	Page in teachers' book
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About Number

Encourage the students not to use calculators in these number activities because the real value of each activity comes from increasing the students' sense of number. (However, in an activity such as that on page **6**, a calculator can be used as a means of checking the students' reasoning. The working out comes first.)

Instead of the students using calculators, encourage them to explore a variety of number strategies to help them solve number problems in their heads. This will ultimately lead to the students making more efficient and effective use of their calculators by using them only when they cannot quickly solve the problem in their heads. With increased number sense, they should also be able to quickly establish whether their solution is sensible through being able to effectively estimate their answers.

However, calculators are useful in other areas of teaching mathematics and as a tool in carrying out investigations.

Page One: Money Everywhere

Achievement Objective

- explain the meaning of the digits in any whole number (Number, level 3)

The activities on this page draw on the students' knowledge of place value and multiples of 10. It is important that they recognise and understand place value rather than just accepting a rule that involves crossing off one or two zeros. Nevertheless, the students should recognise that dividing by 10 results in crossing off a zero. The concept you need to reinforce is how many tens (or hundreds) can be formed from the number. The underlying concept is the understanding, not rote rules.

Activity One

Ensure that the students understand what they are being asked to do. You could ask them to explain the question, for example, "For Monday, I need to find out how many 10s there are in 7 560". From this, they may be able to rewrite the question as 7 560 ÷ 10 = and go on to solve the problem.

Again, the students need to look at the "total number of tens", not just the number in the tens column.

Students who are having difficulty could begin by working on simpler, similar problems, such as $30 in $10 notes, $600 in $100 notes, $750 in $10 notes, $3,000 in $100 notes, and $4,500 in $100 notes. The teachers' notes for page 8 of *Number*, Figure It Out, Level 3 discuss the concepts that students need to understand when dividing by 10 and 100. Some students may need to use money to help them solve the problem.

Activity Two

This activity is similar to **Activity One**, but here one more step is involved because the students have to find the number of bundles of notes, not just the number of notes. They may solve this by dividing the amount of money by 100 to find the number of $100 notes and then dividing the number of notes by 10 to get the number of bundles. Some students may notice that dividing by 10 and then by 100 produces the same result as dividing by 100 and then by 10. The students may also notice that a more efficient way of finding the number of bundles is to divide by 1 000. This is because dividing a number by 100 and then by 10 is the same as dividing by 1 000 (which is 10 x 100).

Activity Three

This place value activity asks students to count the number of notes and coins of each denomination and to work out the total value.

The students can use a variety of strategies to do this. One way is to calculate the total value for each denomination and add the amounts. For example:

4 x $1,000 = $4,000
7 x $100 = $700
4 x $10 = $40
3 x $1 = $3
$4,743

Other students may recognise that the 4 goes in the thousands place, the 7 in the hundreds place, and so on. This is a more efficient method, but the students need to remember to use a zero as a place holder if there are no notes of a certain denomination. For example, in question **b**, they may not recognise that there are no $100 notes and therefore may omit the zero in that place in their answer. This is a very common error with students who go directly to the answer instead of performing the step in the multiplication.

Question **c** requires the students to find the amount when there are five $1,000 notes and another fourteen $100 notes. Here, either the students will need to recognise that the fourteen $100 notes are equivalent to another $1,000 note and four $100 notes, or they will need to multiply each denomination and add the totals.

Encourage the students to explain and compare their strategies to see if any did go directly to the solution.

Page 2: Places to Go

Achievement Objective

- explain the meaning of the digits in any whole number (Number, level 3)

Activity One

The abacus is a physical model of place value and is a useful way to build on students' understanding of place value.

Each stem on an abacus is the same as a place value column. This is marked on the students' book: moving from the right to the left, there is the ones stem, the tens stem, the hundreds stem, and so on. When a number is multiplied by 10, all the rings on the abacus (or all the digits in the place value columns) have to move one place to the left. This means that there will be no rings left on the tens stem, so all these rings will need to be removed. That leaves one other ring for the students to move to change the number to 43 500. There are various ways of moving the rings to get the right answer. Two ways are shown in the Answers.

Question **c** can be solved by halving the number (43 500 ÷ 2 = 21 750) and then working out how to get this on the abacus. This question reinforces the students' understanding of place value.

Some students may prefer to have two sets of abacuses. They move the rings on one abacus but leave the other with the original set-up to check against.

As an extension, the students could try to find numbers on the abacus that can be halved and still use exactly the same number of rings. (The sums of the digits must be the same for the number and its half.)

For example, for the lowest four-digit number for which this is true (1 008):
1 + 0 + 0 + 8 = 9 rings. 1 008 ÷ 2 is 5 + 0 + 4 = 9 rings.

Activity Two

You may need to discuss with the students the fact that the "10" block is 10 *times* the size of the "one" – that is, multiplying by 10, not adding 9.

Discuss how you could make a block of 1 000. The most efficient way is to use 10 of the "100" block, either to make a long, thin block or, more conventionally, to make a cube (10 x 10 x 10).

If 1 centimetre cubes are used, the students can make the connection that 100 centimetres x 100 centimetres x 100 centimetres is the same as 1 cubic metre. The students may not have a concept of the size of a metre cube. You could ask them to make one up. One easy way of doing this is shown in *Measurement*, Figure It Out, Level 3, page 15.

Question **2** provides a good opportunity to discuss sensible answers and safety issues when investigating suggested measurements for a swimming pool.
"Would it be sensible to have a pool that is 10 centimetres deep or one that is 1 000 centimetres deep?"
"Would you have a pool that is 10 000 centimetres long and only 100 centimetres deep?"

Discuss whether the units of measurement are likely to be centimetres or metres.

Page 3: A Watery Mission

Achievement Objectives

- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)
- make sensible estimates and check the reasonableness of answers (Number, level 3 and 4)

Activity

This activity involves counting the sections to work out what fraction of each planet is water.
The students may count sections to find either the number of sections that are land or the number of sections that are water. Make sure that the students compare water with the total area and not water with land.

See *Answers and Teachers' Notes: Measurement*, Figure It Out, Level 3, pages 14–15 for ways to help the students count the irregular-shaped land masses.

Some students may question whether the sections are equal, as they are not squares. This could lead to an extension activity in which the students look at the different ways in which the 3-D world is shown on a 2-D map. The students could discuss which projections are more accurate and why.

Pages 4–5: Stretch and Grow

Achievement Objectives

- solve practical problems which require finding fractions of whole number and decimal amounts (Number, level 3)
- find fractions equivalent to one given (Number, level 4)

Activity

The students need to have the opportunity to explore the situations in this activity on their own and to discuss their answers. Then discuss with them the strategies that they could use to solve the problems in the activity.

Two strategies that could be used here are:

1. Expressing quantities as fractions and then finding that fraction of the whole amount or using equivalent fractions.

   In question **1**, the ribbon is initially at 1 and Hercules is at 2. If the ribbon starts halfway along the cord, it is still halfway along the cord when the cord is stretched. When the cord stretches out to 10, the ribbon will be at half of 10, which is 5.

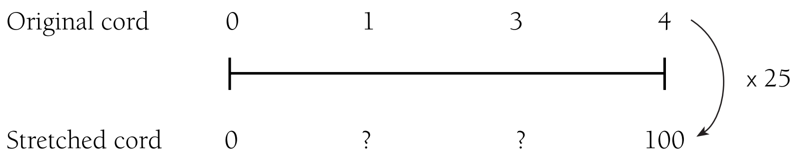
   Alternatively, we could say $^1/_2 = {}^?/_{10}$ and solve the problem using equivalent fractions.

   Each two-ribbon question has two parts to it. For example, for **2a**, the yellow ribbon is at 1 and Hercules is at 4. The yellow ribbon is $^1/_4$ of the way along the cord. One-quarter of 100 is 25, so the yellow ribbon ends up at 25. The blue ribbon is at 3, and Hercules is still at 4. The blue ribbon is $^3/_4$ of the way along the cord. Three-quarters of 100 is 75, so the blue ribbon ends up at 75.

   In the two-ribbon questions, make sure that the students are comparing the position of each ribbon to the position of Hercules and not to the position of the other ribbon.

2. Using a double number line or a table.

   A double number line can be used to represent these problems. (Double number lines have been shown in the Answers.) For example, for question **2a**:



   What do you multiply 4 by to get 100? (25) You then multiply the 1 by 25 to find the position of the yellow ribbon and the 3 by 25 to find the position of the blue ribbon.

   A table can also be constructed to represent the situations, for example, for question **2a**:

	Original	x 25 → Final
Cord length	4	100
Yellow ribbon at	1	25
	2	50
	3	75

   Working with double number lines and tables like these is a good basis for working with ratios in level 5 of the curriculum.

Questions **2c** and **d** are more difficult because they involve finding eighths and thirds of 100. One-eighth of 100 is $12^1/_2$, and $^1/_3$ of 100 is $33^1/_3$. Again, the students will find using double lines (as shown in the Answers) is a helpful strategy.

The students could also find these answers using the following method:

$\frac{3}{8}$ of 100

$= \frac{3}{8} \times 100$

$= \frac{3}{8} \times \frac{100}{1}$

$= \frac{300}{8}$

$= 300 \div 8$

$= 37\frac{1}{2}$

Question **3** involves the reverse process, where the rope is at its full extent and the students have to work out what the equivalent fractions are. For example, for **3a**, $^{50}/_{100} = {}^{1}/_{2}$. Half of 80 is 40, so the yellow ribbon will be at 40. Again, double number lines for question **3** are shown in the Answers.

Pages 6–7: Changes, Highs, and Lows

Achievement Objectives

- explain the meaning of the digits in any whole number (Number, level 3)
- explain the meaning of the digits in decimal numbers with up to 3 decimal places (Number, level 3)
- write and solve problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Number, level 3)

Activity One

The students could use calculators to check the results of what went on in their heads. If they are having difficulty, you could look at *Number*, Figure It Out, Level 3, pages 2–3, Activity Three. The students could do these easier exercises as a warm-up.

Activity Two

To determine the winner of the game in this activity, the students need to add up the numbers for each player to date and then consider the impact of drawing particular cards.

They need to realise that there are only three cards of each digit in the pack, and from this, they can work out the possibility of certain digits being drawn. For example, all the 5s and all the 9s have already been drawn, but only one 1 and one 8 have been drawn.

When the students play this game, encourage them to think of the strategies that will give them the best score. For example, to gain the highest score, they should try to put the largest digits in the positions that have the highest place value.

Page 8: Waves Win

Achievement Objectives

- express a fraction as a decimal, and vice versa (Number, level 4)
- find a given fraction or percentage of a quantity (Number, level 4)

Activity

Some students may need to use place value blocks or multilink cubes to help them with the visualising and counting in this activity. Those students with better visualisation skills will probably cope without using blocks or cubes, but these should be available to them, especially in questions **2c** and **d**.

Remember that the decimals come from comparing the number of blocks left in the given shape with those in the whole.

The students need to know the number of smaller blocks in the original. Get them to count the number remaining and write this as a decimal fraction of the whole. This may require converting fractions to decimals. Some students may be able to visualise the fraction for some of the blocks.

Page 9: Bean Brains

Achievement Objectives

- recall the basic multiplication facts (Number, level 3)
- find a given fraction or percentage of a quantity (Number, level 4)

Activity

Students can solve these problems by writing fractions. For example, in question **1**, half of the beans are red ($^1/_2$ of 10 = 5), and in question **2**, three-quarters of the beans are red ($^3/_4$ of 100 = 75).

In question **5**, the students need to recognise that 3 will not divide evenly into 10, 100, or 1 000, and so there cannot be exactly one blue bean and two orange beans out of every three beans. This concept is important when students come to write fractions as decimals because it helps to explain why $^1/_3$ is expressed as a recurring decimal ($^1/_3 = 0.\dot{3}$).

Setting the information out in tables can help solve these problems. For example, for question **3**:

	Blue	Green	Total
Beans in sample	2	3	5
Beans in jar			100

(x 20)

Find the number that 5 is multiplied by to get 100 (20).

Now complete the table by multiplying the other numbers in the table by the same number:

	Blue	Green	Total
Beans in sample	2	3	5
Beans in jar	40	60	100

(x 20)

An easy way to solve this problem is to use double number lines.

1.

0	1	2
0	5	10

Five beans are red.

2.

0	1	2	3	4
0	25	50	75	100

75 beans are red, and 25 are yellow.

3.

0	1	2	3	4	5
0	20	40	60	80	100

40 beans are blue, and 60 beans are green.

4.

0	1	2	3	4	5	6	7	8
0			375		625			1 000

375 beans are blue, and 625 beans are yellow.

Page 10: Bottle Ups

Achievement Objective

- find a given fraction or percentage of a quantity (Number, level 4)

Activity One

The students can use their measuring jug or cylinder to measure out the amounts for the marks on their bottle in question **2**. Dividing the height into eighths will not work because it does not allow for the varying diameter of the bottle.

The measuring jugs are more likely to be marked in millilitres than in eighths, so the students will need to calculate how many millilitres there are in $^1/_8$ of a litre, $^1/_4$ of a litre, and so on. Allow them to investigate various ways of marking their bottles. The easiest way is to fill the measuring jug to the required level (for example, $^1/_8$ of a litre or 125 millilitres), pour this into the bottle, and mark the level. (Note: The symbol for litre is L and that for millilitres is mL.)

In question **3**, the students divide 1 litre of water evenly between three 1 litre bottles to find the $^1/_3$ and $^2/_3$ marks. They need to measure out 1 litre because if they just fill the bottle up, it will be more than a litre. The three bottles need to be the same shape. Make sure they do not use the measuring jug for this part. Measuring between three bottles will help them realise that $^1/_3 + {}^1/_3 = {}^2/_3$.

When they predict what $^1/_3$ of a litre is in millilitres, they will probably realise that 1 litre, or 1 000 millilitres, doesn't divide evenly into three, so the answer will not be a whole number. (The difference is very small.)

Activity Two

In this activity, students need to take into account the way the shape of the bottle affects the water level. For example, 500 millilitres in the bottle on the left will be less than halfway up the bottle because the bottle is much wider at the bottom than the top. Those students who are having difficulty in visualising could experiment by putting the same amount of water into different-shaped bottles and comparing the water levels. Encourage the students to use logic and reasoning to answer the question before they model it in a practical exercise. (This activity links with investigations in Science.)

Page 11: A Long Look at Decimals

Achievement Objectives

- express quantities as fractions or percentages of a whole (Number, level 4)
- find fractions equivalent to one given (Number, level 4)
- express a fraction as a decimal, and vice versa (Number, level 4)
- express a decimal as a percentage, and vice versa (Number, level 4)

Activity

Although this practical activity is designed to help students to understand the relationship between equivalent fractions, decimals, and percentages, it also provides an opportunity to help them understand what a fraction actually is.

It is important for later work in mathematics that the students understand, for example, that $^1/_2$ is not a complete number in itself. It is, in fact, 1 (one whole) divided by 2. Similarly, $^1/_4$ is 1 divided by 4, $^7/_{15}$ is 7 divided by 15, and so on.

From this, you can encourage the students to see "$^1/_4$ = 0.25" as "1 ÷ 4 gives an answer of 0.25". Show them the working out of 1 ÷ 4 = 0.25:

```
  0.25
4)1.00
   8
  20
```

If they use a calculator to get an answer to 1 ÷ 4, they will then be less inclined to see the answer, 0.25, as a "magic" number. The students will have fewer problems in later years if they understand that the line between the numerator and the denominator in a fraction is the division operator (that is, it shows that the numerator is divided by the denominator) and not simply a line separating the top number of a fraction from the bottom.

In the practical activity on this page, the students use a metre (or 100 centimetre) ruler.
This reinforces their understanding that percentages are based on 100 or are the number of parts out of 100.

Recurring decimals in percentages (for example, $33.\dot{3}$ %) are generally rounded to the nearest decimal. However, you could discuss with the students fields of study such as science where extra precision may be necessary.

For this activity to work, the students need to fold their paper strips accurately.

The students could use a table to record their answers to **2b**. Reinforce their understanding of what a fraction is by getting them to include the division statement for each fraction:

Fraction	Decimal	Percentage
$^1/_4$ (1 ÷ 4)		
$^3/_4$ (3 ÷ 4)		
⋮		

In question **3**, the students need to include $^1/_3$. Some of them will know that this is $33.\dot{3}$ centimetres or $0.3\dot{3}$ metre or $33.\dot{3}$ %, but others will fold a strip of paper to find where the $^1/_3$ mark goes on the number line.

When they have done the above problems, there are several strategies that the students could use to answer question **4**. These include:

- plotting the fractions on the number line (the number furthest to the right on the number line is the largest)
- converting fractions to percentages to find the largest (conversion method: divide the numerator by the denominator and multiply by 100)
- converting fractions with different denominators to fractions with the same denominator (for example, $^1/_4 = {^2/_8}$ and $^3/_4 = {^6/_8}$).

Page 12: Hot Shots

Achievement Objective

- express quantities as fractions or percentages of a whole (Number, level 4)

Activity One

To convert the shooting statistics into percentages, most students will probably write the statistics as a fraction and convert that to a percentage, for example, $^{66}/_{88} \times 100 = 75\%$. They may also use other strategies. For example, they may recognise that Dunkin' Donna's 71 goals out of 142 shots is $^1/_2$ and know that this is 50%.

To simplify a fraction, the students need to find a number that can divide both the numerator and the denominator (with no remainder) and repeat this until there is no number that divides both these numbers. For example, with $^{66}/_{88}$, dividing the numerator and denominator by 2 gives $^{33}/_{44}$. Dividing this numerator and denominator by 11 gives $^3/_4$.

Activity Two

The students will calculate the percentages in a similar way to that in **Activity One.**

As an extension, the students could take turns shooting 12, 15, and 20 shots. Is there any relationship between the number of shots and the best shooter? The students could suggest reasons for this, for example:

- Players improve with practice.
- Players who have more shots get tired and so are less accurate.
- One player is more accurate than the others, no matter how many shots they have.

Page 13: Head Cases

Achievement Objective

- explain satisfactory algorithms for addition, subtraction, and multiplication (Number, level 4)

Activity

This activity encourages students to think through strategies that they could use to mentally solve subtraction problems.

All of the strategies shown require the students to think about the numbers involved in the calculation. This increases their number sense. With increased number sense and understanding, they can learn and even devise alternative strategies for solving number problems in other situations. Solving problems mentally improves number skills more than the vertical forms of working that have traditionally been taught.

The students' preferred methods will usually depend on their previous experience, so some may revert to the vertical form whenever possible. However, even when the students can competently perform the vertical form of working, there is considerable value in looking at, teaching, and encouraging them to devise alternative strategies.

Students might look at the problem in question **1a** this way:

$$923 - 598 = 900 - 600 + 23 + 2$$
$$= 325.$$

They might look at question **2c** in a similar way:

$$502 - 286 = 500 - 200 + 2 - 86$$
$$= 216.$$

These strategies do not necessarily make the task easier, but they are both valid and worth considering in terms of why they work.

Page 14: Kapa Haka

Achievement Objectives

- recall the basic addition and subtraction facts (Number, level 2)
- write and solve problems which involve whole numbers and decimals and which require a choice of one or more of the four arithmetic operations (Number, level 3)

Activity

To solve this problem, the students need to total the scores achieved by the four teams who have completed the activities and add up Ngāti Porou's score so far:

Ngāti Awa	552
Tainui	564
Tairāwhiti	566
Ngāti Kahungungu	513

So far, Ngāti Porou have 267 points. They can earn up to 300 more points if they get full points in the other three items. This would give them one point more than the current leader, Tairāwhiti.

To come second, they need to score 565, which means they need another 298. They can get this by scoring 100 in two categories and 98 in the third or 99 in two categories and 100 in the third.

Page 15: Hard Times

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

This activity uses a physical model to help students explore ways to multiply a two-digit number by a one-digit number. This activity will help them to develop and use mental strategies to solve multiplication problems.

Using the place value blocks, the students should see that an easy way to solve the problem is to collect all the tens blocks and then collect the ones blocks. They get the answer by adding the two totals together. For example, for question **1**,

4 x 30 = 120
4 x 6 = 24
Total = 144

You can write this as:

36 = 30 + 6

4 x 36 = 4(30 + 6).

The brackets show that both the 30 and the 6 are multiplied by 4:

= 4 x 30 + 4 x 6

= 120 + 24

= 144.

When the students have become familiar with this method using place value blocks, they may be able to solve the problems without using them, but let them use the blocks for as long as they need them. Students who are not using the blocks might approach question **4** like this:

Steven 3 x 40 = $120

3 x 6 = $18

Total = $138

or alternatively:

3 x 46 = 3(40 + 6)

= 3 x 40 + 3 x 6

= 120 + 18

= $138

Tama 4 x 30 = $120

4 x 4 = $16

Total = $136

Karla 5 x 20 = $100

5 x 8 = $40

Total = $140

Note that the setting out is different from the usual vertical form. This setting out shows the usual way that students think through the problem and leads to a better understanding of multiplication and finding estimates.

Page 16: Multiplication Roundabouts

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

This page shows another way to mentally multiply a two-digit number by a one-digit number. In this strategy, students round the two-digit number up or down to the nearest 10 to make the number easier to work with and multiply it by the one-digit number. Then they add or subtract the amount they rounded, multiplied by the one-digit number, to find the correct answer.

Encourage the students to solve the problems in their head and not write the working down. If they are finding this difficult, you could give them smaller numbers to multiply to begin with, or they could work in pairs. Ensure that they always round the two-digit number, not just the second number in the problem. For example, in questions **g** and **h**, the number to be rounded is the first number in the problem rather than the second, unlike the other problems.

Page 17: Lookalike

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

Here is another strategy that students can use to multiply a two-digit number by a one-digit number. As in the activities on pages **15** and **16** of the students' book, this strategy helps to develop students' number sense.

This strategy uses a physical model. When the students compare the representation of 24 x 6 and the representation of 12 x 12, they should see that the 24 x 6 model is half as wide but twice as long as the 12 x 12 model. The students could use a hundreds field to explore various ways of rearranging models of multiplication problems. Emphasise that they are trying to rearrange the model so that it represents a known multiplication fact. For example, they could rearrange the 24 x 6 model into an 18 x 8 model, but this is not a known multiplication fact.

When the students have become familiar with rearranging the models on a hundreds field, you could discuss ways of using this strategy without working on a hundreds field. In the above problem, for example, they may notice that they have halved the larger factor (24) and doubled the smaller factor (6). In question **2a i**, they divide the larger factor (27) by 3 and multiply the smaller factor (3) by 3. If they perform one operation on one of the factors, they must perform the opposite operation on the other factor, and the answer remains the same (because the opposite of division is multiplication).

Other students may approach the problem by renaming the large factor as two small factors and then combining the factors so that the problem becomes a known multiplication fact. For example, in question **1**, 24 x 6 can be renamed as 12 x 2 x 6, which can again be renamed as 12 x 12. This is possible because the order in which you multiply numbers does not matter.

Once again, encourage the students to solve these problems mentally rather than using a written form. In particular, they should not resort to using the vertical form. Students who are very competent at using the vertical form may prefer to use it, but as they solve more problems using this alternative method, they should begin to recognise that it is more efficient than writing out the problem in vertical form.

Page 18: Division Delights

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

This page builds on the use of mental strategies in the previous pages but this time applies them to division. Explanations of the mental strategies are given in the text on the page. A copymaster of the hundreds field is provided at the end of the notes.

For question **2**, you will need to check that the students' methods are valid. Look for strategies similar to those demonstrated in question **1**.

Page 19: Digital Dilemmas

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

The students will probably approach these problems by using trial and improvement, but there are several mathematical rules that can be used to solve the problems more efficiently. You could let the students begin working on the problems and, after a short time, discuss with the whole class how they are approaching the problems and whether anyone has found any quick ways to solve them. The more efficient methods are set out below.

Any arrangement of 4, 6, and 8 will be divisible by 2 because each arrangement will be an even number. None of the numbers will be divisible by 6 because to be divisible by 6, the number must be even and divisible by 3. To be divisible by 3, the sum of the digits must be divisible by 3.
For example, 2 x 4 + 8 = 16, which is not divisible by 3.

You still need to look at numbers divisible by 4 and 8.

For 4, these could be:
862
826
628
682
286
268

But to be divisible by 4, the number formed by the last two digits must be divisible by 4.
The number 28 is divisible by 4, and so is 68, therefore 268 and 628 are divisible by 4.
(Any number of hundreds is divisible by 4, for example, 600 ÷ 4 = 6 x 25.)

For 8, the numbers could be:
642
624
462
426
264
246

The rule here is: if the hundreds digit is even and the number formed by the last two digits is divisible by 8, then the number is divisible by 8. This means that only 624 and 264 are correct.
(Any even number of hundreds is divisible by 8, for example, 600 ÷ 8 = 3 x 25.)

For question **2a**, the rules that apply are:

- All numbers are divisible by 1.
- All numbers whose digits add to a number divisible by 3 are divisible by 3.
  1 + 5 + 9 = 15, which is divisible by 3, and therefore all numbers made using the digits 1, 5, and 9 will be divisible by 3.
- To check for divisibility by 9, the sum of the digits must be divisible by 9.
  1 + 3 + 5 = 9, which is divisible by 9, so all combinations of 1, 3, and 5 will be divisible by 9.
- To be divisible by 5, the number must end in 5 or 0, so there are no combinations of 1, 3, and 9 that are divisible by 5.

In question **3**, to obtain the largest possible product when two numbers are multiplied, you need to arrange the digits into the largest possible numbers. This means you need 800 x 60 or 600 x 80, with the other digits also arranged in the largest possible ways. The students should try several arrangements of digits to make sure they are getting the highest product.

To find the smallest possible product, you need to arrange the digits into the smallest possible number.

Encourage the students to think these issues through so that they can predict which numbers will give the largest products when multiplied together.

Page 20: Think Tank

Achievement Objective

- recall the basic multiplication facts (Number, level 3)

Activity

For each question, the students must first recognise which number operation is required. Then encourage them to use a strategy they have learnt in the previous pages to find the answer.

Encourage the students to use a variety of strategies or to find as many ways as they can to solve the problem. They might want to use place value blocks or a hundreds field. Examples of a strategy that could be used for each question are:

1. $7 x 52 → 7 x 50 + 7 x 2
→ 350 + 14
Total = $364

Ben's rounding strategy from page **16**

2. To find 414 ÷ 46:
Take 414 up to 460.
460 ÷ 46 = 10
Take off the difference between 414 and 460 (46) and divide it by 46:
46 ÷ 46 = 1
The answer is 10 – 1, which is 9.

Sam's rounding strategy from page **18**

3. To find 432 ÷ 12:
First, 360 ÷ 12 = 30
That leaves 72 ÷ 12 = 6.
The answer 30 + 6, which is 36.

Lena's rounding strategy from page **18**

4. To find $624 ÷ 8:
640 is close to 624.
640 ÷ 8 = 80
Take off the difference between 624 and 640 (16) and divide it by 8:
16 ÷ 8 = 2
The answer is 80 – 2, which is 78.

Sam's rounding strategy from page **18**

5. 7 x 18 = 7 x 3 x 6
= 21 x 6
= 126

The renaming strategy from page **17**

Allow the students to present their own strategies.

Page 21: More Thinking

Achievement Objective

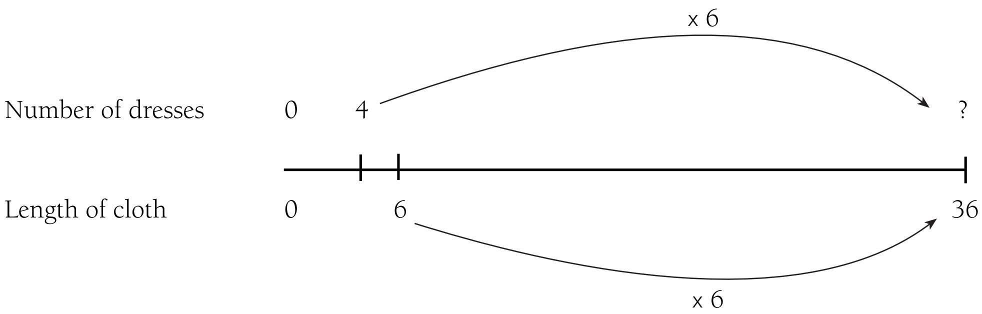
- recall the basic multiplication facts (Number, level 3)

Activity

These problems use similar skills to those used for pages **4–5** and **9** in the students' book.

Questions **1**, **2**, and **4** can be solved using either multiplication or a double number line.
For example, for question **1**:
4 dresses need 6 metres of cloth.
36 metres of cloth is 6 x 6 metres.
So the number of dresses made is 6 x 4 dresses = 24 dresses.

On a double number line, this would be:



A table is a useful strategy for question **3**:

	blue	yellow	white	
x 4	2	4	3	x 4
			12	

The three tubes of white paint are multiplied by 4 to give 12 tubes of white paint. The other two paint colours also have to be multiplied by 4 to give the number of tubes needed.

Page 22: Using Exponents

Achievement Objective

- explain the meaning and evaluate powers of whole numbers (Number, level 4)

Activity

These activities will familiarise the students with exponents (to the power of) and the way they are written. You could begin by discussing the concept of exponential growth and how rapid it is. If the students have some understanding of this, they will be better able to check the reasonableness of their answers. A good way to demonstrate this is to have the students line up on a rugby field sideline. The first student walks two paces, the next twice as far (2 x 2 = 4 paces), the next 2 x 2 x 2 = 8 paces, and so on. When the students stand in position, it gives a human graph.

In question **1**, Melissa doubles her money each year. (You may want to point out to the students that this is not a realistic scenario although it is a good way to understand the maths involved.) This can be shown on a table. Note the shorter way of writing the calculation, for example, 2^4. The exponent, 4, indicates how many times 2 is multiplied by itself.

	Calculation	Total money
End of first year	\$1 x 2	\$2
End of second year	\$1 x 2 x 2 = 2^2	\$4
End of third year	\$1 x 2 x 2 x 2 = 2^3	\$8
End of fourth year	\$1 x 2 x 2 x 2 x 2 = 2^4	\$16
…	…	…
End of tenth year	\$1 x 2^{10}	\$1,024

In question **2**, the students will be finding the volume, measured in unit cubes, of the larger cubes. The students will probably be used to finding the 2-D area of rectangles and the 3-D volume of rectangular prisms by multiplying the side lengths. They do the same type of calculation for this exercise. Encourage them to use exponent notation (for example, 3^3).

Question **3** involves powers of 4. The students could set the problem out in a table, as they did in question **1**, but by now they should be able to go directly to writing the problem as 4^5 or 4 x 4 x 4 x 4 x 4 = .

Question **4** tests the students' understanding of exponents. Having done the previous questions, they should recognise that $3^3 + 4^4 + 5^5$ must be bigger than $3^4 + 4^2 + 5^3$ because the exponents are bigger for the last two numbers.

As an extension activity, you could show the students how to calculate exponents on a calculator. This is a lot quicker than multiplying a number by itself several times. The exponent key is marked x^y. So to calculate 4^5, you press:

[4] [x^y] [5] [=]

Page 23: Walking the Plank

Achievement Objective

- explain the meaning of negative numbers (Number, level 4)

Game

This is a game to familiarise the students with integers. The negative sign is associated with moving backwards.

As an extension, encourage the students to record what they threw on their dice and then to try to work out their finishing position.
They could also swap their record of their dice throws with a classmate to see if they can work out each other's finishing position.
The students could also discuss whether varying the starting position would alter the outcome of the game.

Page 24: Disappearing Dollars

Achievement Objectives

- recall the basic addition and subtraction facts (Number, level 2)
- explain the meaning of negative numbers (Number, level 4)

Activity

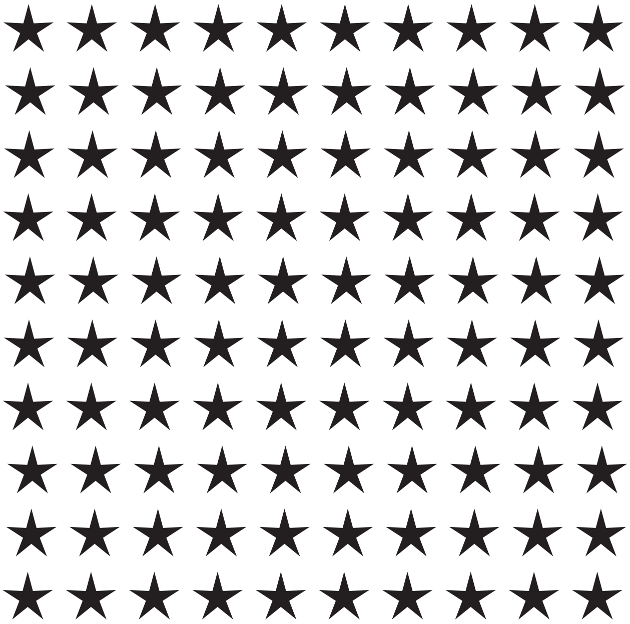
This activity uses addition, subtraction, and the concept of integers in a real-life context.

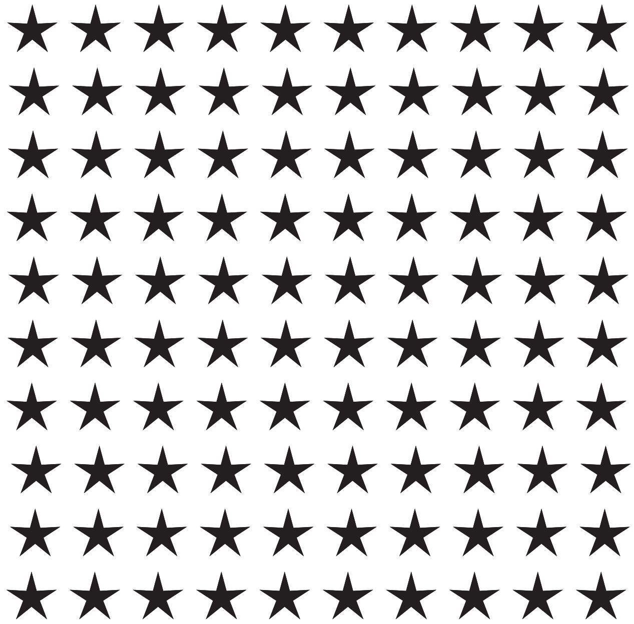
The students need to understand the concept of what happens when you subtract a bigger number from a smaller number: "What happens when you get less than zero?" "Can you get less than zero?" and so on.

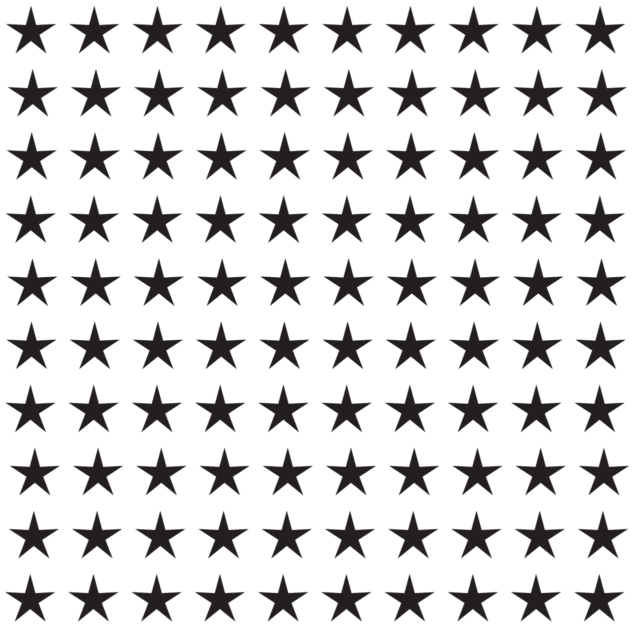
Money is a nice way to introduce the idea of negative numbers because most students have some concept of being in debt or owing someone money. You could combine this with a number line. For example: "You have $5. You owe your mother $10 and want to pay her back. You give her the $5. How much money do you have now? (You actually have $0, but you still owe your mother $5, so you are $5 in debt.) Show this on a number line."

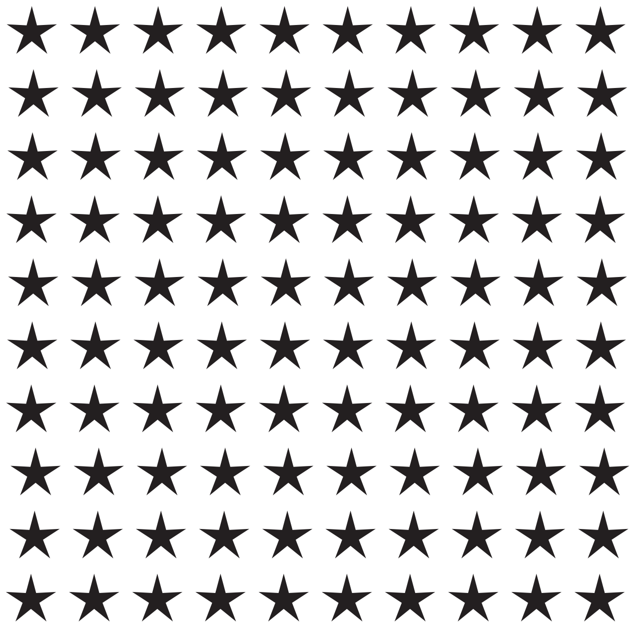
Questions **3c** and **d** introduce the idea of negatives in a nice gentle way. The answers say Georgia needs $5 more to pay her bills rather than saying Georgia has minus $5 or is $5 in debt. You could ask the students to demonstrate Georgia's situation on a number line, which would introduce the idea of negative numbers if you don't use the scenario above.

Copymaster: **Division Delights**









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