CATCHING UP ON NUMERACY: USE OF CALCULATORS

DAVE KELSO
and
SHAUN McCARTHY

Illustrated by
CRAIG DIXON

THE Chalkface PROJECT

ISBN 1 86025 210 9

INTRODUCTION

The pack

Catching up on Numeracy: Use of Calculators is one of a series of packs which identify the concepts, skills and facts within the Numeracy strand Ma2. The pack provides a range of opportunities for students to further their knowledge and understanding of how the calculator can be used effectively in a variety of ways. It encourages and equips students to see the calculator as a tool to promote their understanding of mathematics. After investigating the principle functions and displays of the calculator, students are presented with a range of mathematical scenarios in which calculators are employed to make complex calculations easier and faster to manage.

Student suitability

The pack is written for use with mixed ability students in Years 7 to 9, and for lower ability groups in Year 10.

Using the pack

As with all Chalkface packs, each page provides a stand-alone lesson, with one or more core activities and a definite and identifiable conclusion for students to reach. It is desirable that (where possible) students use scientific calculators to undertake the work in the pack. (A full explanation of calculator types is given in the General Guidelines).

Added value

Full answers are given on every page of Teachers' Notes opposite each worksheet, which could offer the option of students marking their own work. The Teachers' Notes also give the page's aims, preparation needed, classroom management advice, differentiation possibilities, and extension activities. We presume that you have access to pen, paper and chalkboard, and that students are used to working both individually and in small and large discussion groups. If you have a query about how best to use the pack, we are happy to help; please write to us at the address below.

Other linked Chalkface packs

This pack is one of a series of three *Catching up on Numeracy* packs; the others being: *Mental Arithmetic* and *Pencil and Paper*.

The people involved

Dave Kelso, the consultant for this pack, is a teacher of Mathematics at Clyst Vale Community College. Shaun McCarthy is a freelance writer. The pack was illustrated by Craig Dixon and the cover and series design was by Michael Lopategui. Patricia Maxwell was the editorial co-ordinator, and Katherine Benzinski, the editor. Karen Reed was the layout artist. The Chalkface format was created by Susan Quilliam.

Photocopy laws

The text and pictures in this pack belong to The Chalkface Project Ltd. However, you may photocopy the sheets, provided you do so only for use within your own institution. If you wish to photocopy for any other use, you must write to us for permission, for which we may charge a fee.

How to contact us

The Chalkface Project, PO Box 1, Milton Keynes MK5 6JB
Tel: (01908) 340 340
Fax: (01908) 340 341
E-mail: sales@chalkface.com
Website: www.chalkface.com

Catching up on Numeracy: Use of Calculators © The Chalkface Project 2000
Last updated 12/12/00

ISBN 1 86025 210 9 Last updated 23/12/98

This pack was first published as *Adding Value in Numeracy: Use of Calculators*

CONTENTS

*	Scientific calculator desirable
**	Scientific calculator essential

Lesson-specific Teachers' Notes are to be found on the page facing each worksheet.

General Guidelines

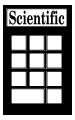
The Teachers' Notes opposite each page support the use of each specific page as required. These more general guidelines give advice on using the whole pack. They offer suggestions on preparation, running the lesson and follow-up work, and could form the basis of in-service training prior to using the pack.

Please remember to photocopy both the relevant Teachers' Notes and these General Guidelines if you are copying worksheets for a supply teacher to use.

Preparing for the lesson

- Specific preparation requirements are indicated in the *Preparation* section of the Teachers' Notes. You should always have available copies of the worksheet, pens, pencils and a chalkboard or equivalent.
- If possible, students should be encouraged to use scientific calculators – as many basic calculators order the sequence of 'mixed' calculations differently. This may result in answers which do not agree with those given in the Teachers' Notes. As a test, students should try pressing the following six buttons:

  2 + 5 x 3 =

  If the calculator reads 21, it is not using Cash Register Logic (CRL), and the mathematical skill of 'ordering' operations (putting division and multiplication before addition and subtraction) will have to be introduced until the answer to the above sum (17) is understood.
- 

This icon in the top right-hand corner of a worksheet, indicates that a scientific calculator would be particularly desirable, or essential, for the activities on that page. Specific details are given in the Teachers' Notes.
- Allow approximately an hour's lesson for each page. If there may be too much or too little work for an hour, this is indicated in the *Timing* section of the Teachers' Notes.
- You can link pages to make a double lesson; linkable pages are indicated under the heading *Links*.
- Possible classroom management challenges which may be created by the page are flagged in the Teachers' Notes under the heading *Points To Be Aware Of*.

The lesson

Pages are worded so that you can choose how to manage each in the classroom. However, as a general guideline, we suggest that you move from 'introductory chat' to individual work, through to paired or small group discussion, then to pooling ideas as a class. Where a specific approach is required which differs from this, it is indicated in the Teachers' Notes under the heading *Classroom Management*.

Each sheet contains a number of activities. These fall into several basic formats:

- **Thought starters**
- **Oral work**
- **Research**
- **Written work**
- **Reading**
- **Brainstorming**
- **Working in role or 'imagine' exercises**

Where a different approach might be more appropriate for less able (or more able) students, this is highlighted under *Differentiation*.

Following up on the lesson

The Teachers' Notes may include, where relevant, suggestions for *Extension Activities*. These are usually designed to carry the topic into a double lesson, or to provide an opportunity for out-of-classroom work.

– THE NUMERACY FRAMEWORK –

TEACHING PROGRAMME: YEAR 7 (Key objectives are highlighted in bold type.)

NUMBERS AND THE NUMBER SYSTEM

2–7 Place value, ordering and rounding

2–3 • Understand and use decimal notation and place value.

3–4 • Compare and order decimals in different contexts.

4–5 • **Order, add and subtract positive and negative numbers in context.**

6 • Round numbers, including to one and two decimal places.

6–7 • Make and justify estimates and approximations (of numbers and calculations).

8–9 Properties of numbers

8 • Recognise square numbers to at least 12 • 12, the cubes of 1, 2, 3, 4, 5 and 10, and the corresponding roots.

9 • Recognise and use multiples, factors and primes (less than 100); use tests of divisibility.

9 • Write numbers as products of primes, using index notation.

10–17 Fractions, decimals, percentages, ratio and proportion

10–12 • **Use the equivalence of fractions, decimals and percentages in describing proportions** and convert between them (e.g. to order fractions).

13–15 • Find fractions and percentages of quantities.

16–17 • Understand the relationship between ratio and proportion, use ratio and proportion to solve simple problems.

CALCULATIONS

18–19 Number operations and the relationships between them

18–19 • Consolidate understanding of the operations of multiplication and division, their relationship to each other and to addition and subtraction, and of the principles (not the names) of the arithmetic laws.

19 • Know and use the order of operations.

20–25 Mental methods and rapid recall of number facts

20 • Consolidate the rapid recall of number facts, including multiplication facts to 10 • 10, and quickly derive associated division facts.

21–25 • Consolidate and **extend mental methods of calculation to include decimals, fractions and percentages** (accompanied where appropriate by suitable jottings).

26–27 Written methods

26 • Consolidate efficient written methods of addition andsubtraction of whole numbers, and extend to decimals.

26–27 • **Refine written methods of multiplication and division of whole numbers to ensure efficiency, and extend to decimals with two places.**

28 Calculator methods

28 • Plan and carry out calculations using the facilities on a calculator, including the square root and percentage keys, the memory and brackets.

28 • Interpret the display on a calculator in different contexts (fractions, decimals, money, metric measures, time).

29 Checking results

29 • Judge whether an answer is reasonable and check results, including using:
– knowledge of the number system;
– rounding to approximate;
– inverse operations.

SOLVING PROBLEMS

30–38 Solving problems

30–35 • Solve problems and puzzles in a variety of contexts (number, algebra, shape, space and measures).

36 • **Choose and justify the use of an appropriate and efficient method for solving a problem.**

37 • Explain methods and reasoning, orally and in writing.

38 • Predict, generalise and suggest extensions by asking 'What if …?'

ALGEBRA

39–43 Equations and formulae

39 • **Use letters or symbols to represent unknown numbers or variables.**

40 • **Know that algebraic operations follow the same conventions and order as arithmetic operations.**

40 • Simplify linear algebraic expressions by collecting like terms; begin to multiply a single term over a bracket.

41–42 • Use formulae from mathematics and other subjects, substitute numbers in simple formulae and, in simple cases, derive a formula

42–43 • Construct and solve simple linear equations, selecting an appropriate method.

44–49 Sequences and functions

44 • Generate and describe in words common integer sequences, and sequences from practical contexts.

45–46 • **Generate terms of a sequence, given a rule (e.g. finding one term from the previous term, finding a term given its position in the sequence).**

47 • Describe the general term of a simple sequence in words, then using symbols.

48–49 • Express simple functions in words, then using symbols.

50–52 Graphs

50 • **Find co-ordinate pairs that satisfy a rule and plot these on a co-ordinate grid.**

50–51 • Recognise that a function such as $y = 3x + 7$ corresponds to a straight-line graph.

51–52 • Begin to plot the graphs of linear functions arising from real-life problems; discuss and interpret a range of graphs arising from real situations.

SHAPE, SPACE AND MEASURES

53-55 Lines and angles

53 • Use accurately the vocabulary and notation associated with lines and angles.

53-55 • **Recognise and use parallel lines and the sum of angles at a point, on a straight line and in triangles.**

56-59 Properties of shapes

56 • Visualise, describe and sketch 2-D shapes in different orientations.

57-58 • Use the geometric properties of triangles and quadrilaterals.

58-59 • Visualise and describe 3-D shapes from 2-D representations.

60-64 Transformations

60 • Understand and use the language and notation associated with reflections, translations and rotations.

60-61 • Reflect 2-D shapes in given mirror lines, and recognise line symmetry.

62 • Translate 2-D shapes.

63-64 • Rotate 2-D shapes about a given point, and recognise rotational symmetry.

65 Co-ordinates

65 • Consolidate use of the conventions and notation for 2-D co-ordinates in all four quadrants.

65 • Find co-ordinates of points determined by geometric information.

66 Construction

66 • Consolidate measuring and drawing:
– lines to the nearest millimetre;
– angles to the nearest degree, and extend to reflex angles.

66 • Construct triangles and other 2-D shapes, using a ruler and protractor.

67-71 Measures

67 • Use names and abbreviations of metric and imperial units for estimation, measurement, calculation and problem solving in contexts involving length, area, mass, capacity and time.

68 • **Convert from one metric unit to another** (e.g. grams to kilograms).

68 • Know rough metric equivalents of imperial measures in common use (feet, miles, pounds, ounces, pints, gallons).

68 • **Read and interpret scales on a range of measuring instruments.**

69 • Calculate the perimeter and area of compound shapes made up of rectangles.

70-71 • Calculate the surface area of cuboids and compound shapes made from cuboids.

HANDLING DATA

72-73 Specifying a problem, planning and collecting data

72 • Respond to a given problem, and predict and hypothesise about possible answers.

72 • Identify which data need to be collected and how.

73 • Collect data from surveys, experiments and secondary sources, and record in a frequency table, grouped where appropriate in equal class intervals.

74-75 Processing data

74-75 • Calculate statistics from data, using ICT as appropriate:
– find the mode of a small data set;
– calculate the mean of a set of discrete data, using a calculator for a large number of items;
– find the median of a small number of items;
– find and use the range of a set of values.

76-79 Representing data, and interpreting and discussing results

76 • Construct graphs and diagrams to represent data (e.g. bar-line graph, frequency diagram for a discrete variable).

77 • Use ICT to produce graphs and charts, and identify which are most useful in the context of the problem.

78 • Interpret diagrams and graphs (including pie charts), and draw inferences based on the shape of graphs and simple statistics for a single distribution.

79 • **Compare two simple distributions using the range and one of the measures of average.**

80-84 Probability

80 • Use vocabulary and ideas of probability, drawing on experience

81 • Recognise that probability is a way of measuring chance or likelihood; **know that probabilities lie between 0 and 1, and calculate probabilities based on equally likely outcomes in simple contexts.**

82 • Identify all possible outcomes of an experiment.

83 • Collect experimental data and record in a frequency table, and estimate probabilities based on the data.

84 • Compare experimental and theoretical probabilities in simple contexts.

Teachers' Notes
THE BASIC FUNCTIONS

Aims This page explores the basic functions of the calculator and students use these to undertake a range of straightforward calculations.

Classroom Management A discussion on the plus, minus, multiply and divide functions/buttons can lead into further explanation of the decimal calculator display. Some discussion on order of operations is also desirable. You might put one of the possible calculations from the **Answers** (below) on the board, as an example of how to tackle the main activity.

Answers There are many possible solutions. Also, where several operations are used together, one sequence of 'button pressing' may yield different answers, and this should be used in a discussion about calculator types (see General Guidelines). For instance:

2) 4 x 5 or 8 ÷ 2 x 5 (= 20)

3) 5 x 4 ÷ 1 + 3 - 2 - 1 (= 20)

4) 9 x 5 + 5 or 4 x 9 + 7 x 2 (= 50)

5) 7 + 2 x 9 ÷ 3 x 4 - 8 (= 100)

6) 1 x 2 x 3 x 4 x 5 - 6 - 7 - 8 - 9 + 10 (= 100)

Extension Activities Students could repeat these tasks using a variety of constraints: for instance, numbers could be used in order only, or all numbers could be used at least once, or twice.

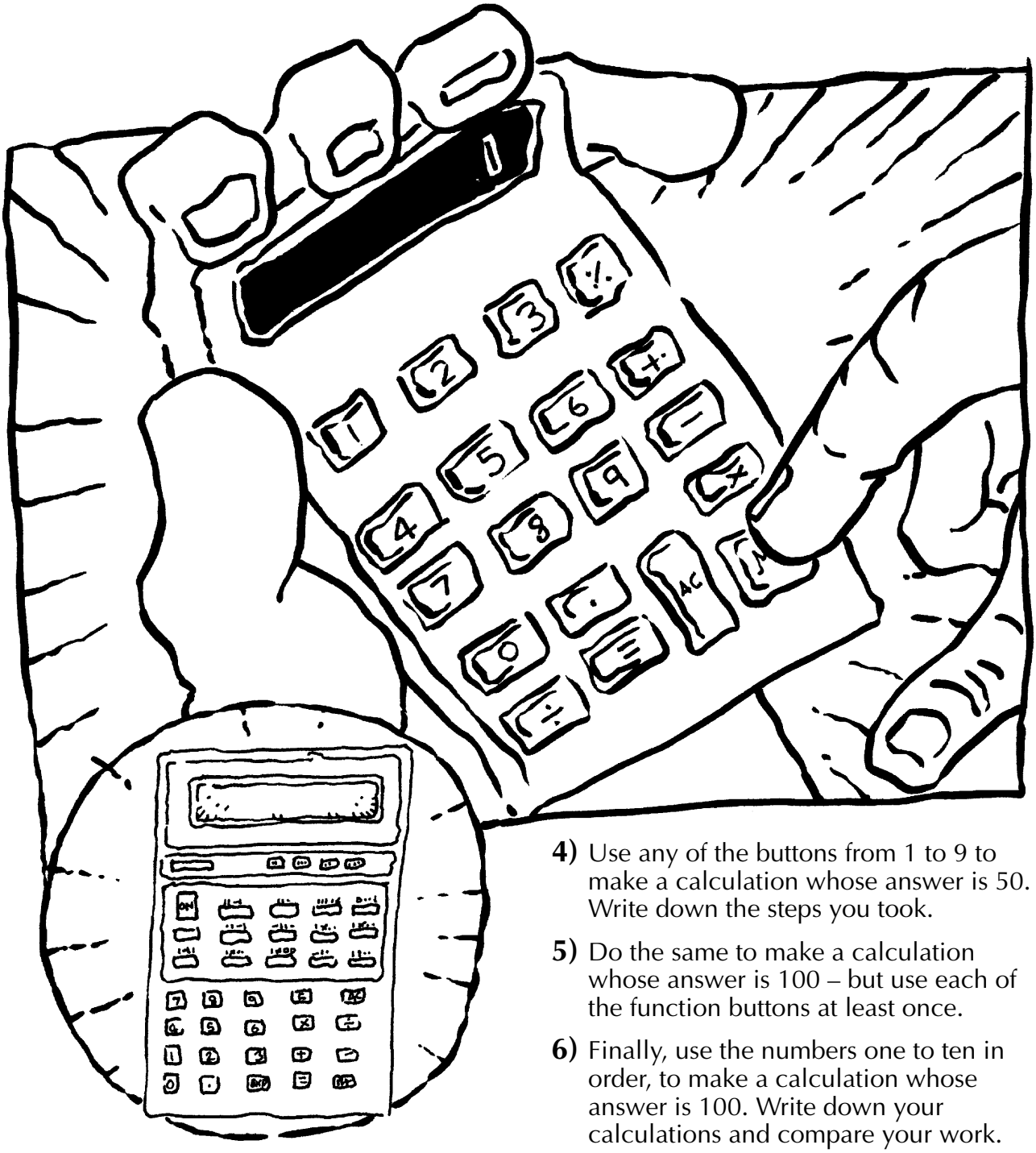
— THE BASIC FUNCTIONS —

1) Look at this drawing of a very simple calculator. Discuss exactly what each button is for. What happens when you press it?

These are the basic keys to be found on every calculator, including the more complex scientific calculator, also shown on the page.

2) Using only the buttons for 1 to 5 and the add, subtract, multiply and divide function buttons, use your calculator to make 20. Compare your methods.

3) Now, using the same buttons again, try to make a calculation whose answer is 20, which has at least eight steps in it. Write down each step.



4) Use any of the buttons from 1 to 9 to make a calculation whose answer is 50. Write down the steps you took.

5) Do the same to make a calculation whose answer is 100 – but use each of the function buttons at least once.

6) Finally, use the numbers one to ten in order, to make a calculation whose answer is 100. Write down your calculations and compare your work.

Teachers' Notes
MAXIMUMS

Aims This page focuses on the multiplication function of the calculator. Student use this to explore basic rules for the processing of large figure multiplications.

Classroom Management An introductory discussion focusing students on the strategy behind using a calculator to achieve complex multiplications, rather than its use to solve problems individually, is an important starting point for this page.

Answers

2) Using the biggest digit at the beginning of the multi-digit numbers always creates the biggest numbers to be multiplied and therefore the biggest answer. This rule can be extended to arrange the six digits in the two three-digit numbers always in descending order (964 and 875). The answer therefore is:
964 x 875 = 843 500.

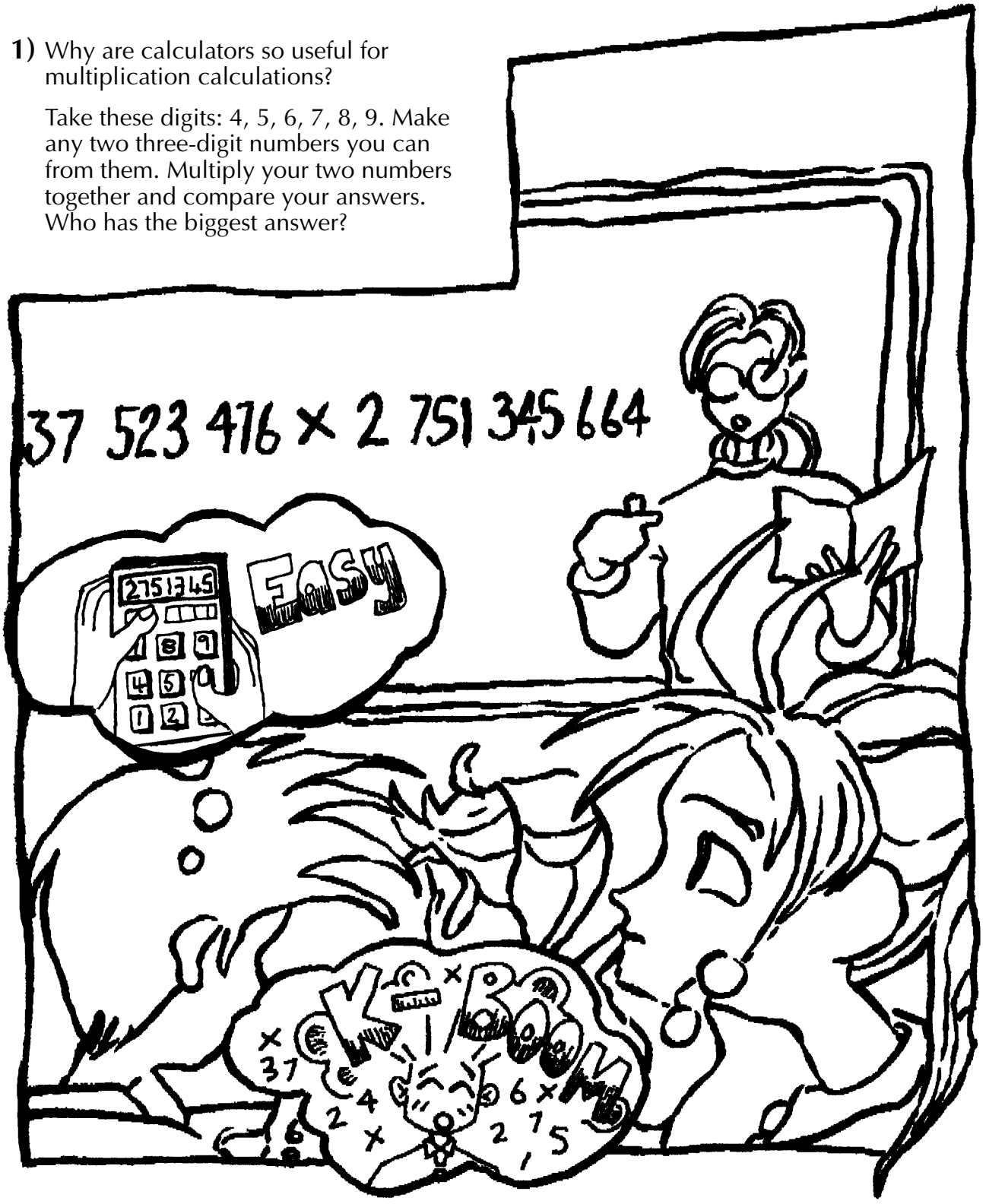
(Students should understand the theory behind these rules.)

Extension Activities Students could use the same numbers and process, but this time aiming to make a multiplication of two three-digit numbers with the smallest possible answer (468 x 579 = 270 972).

MAXIMUMS

1) Why are calculators so useful for multiplication calculations?

Take these digits: 4, 5, 6, 7, 8, 9. Make any two three-digit numbers you can from them. Multiply your two numbers together and compare your answers. Who has the biggest answer?



2) Which arrangement of the digits created the biggest answer when the two three-digit numbers were multiplied together? Work in pairs to see whether it is the biggest possible product.

3) Discuss how you need to arrange digits to find the biggest number in calculation like this.

What about finding the smallest answer?