# MATHEMATICS in the National Curriculum



Department of Education and Science
and the Welsh Office

HER MAJESTY'S STATIONERY OFFICE


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LONDON: HER MAJESTY'S STATIONERY OFFICE

First published 1989
ISBN 0 11 270666 5

# Foreword

This Document contains provisions relating to attainment targets and programmes of study in mathematics, and is prepared by the Secretaries of State for Education and Science and for Wales in anticipation of an Order being made by them under Section 4 of the Education Reform Act 1988 referring to such a Document and directing that its provisions have effect in accordance with the Order.

The examples printed in italics serve to illustrate the attainment targets and programmes of study and are non-statutory.

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STATUTORY INSTRUMENTS

# 1989 No.

# EDUCATION, ENGLAND AND WALES

## The Education (National Curriculum) (Attainment Targets and Programmes of Study in Mathematics) Order 1989

*Made - - - -* *March 1989*

*Laid before Parliament* *March 1989*

*Coming into force in accordance with articles 2 to 5*

Whereas the National Curriculum Council, after due consultation, submitted to the Secretary of State and published its report on a proposal to make this Order which he had referred to it, in accordance with section 20(2) to (4) of the Education Reform Act 1988(**a**);

And whereas the Secretary of State had given notice of the said proposal to the Curriculum Council for Wales and to all other persons with whom consultation appeared to him desirable, in accordance with section 21(2) of the said Act;

And whereas the Secretary of State, in accordance with subsection (5) of the said section 20, and subsection (3) of the said section 21, duly published a draft of this Order and the other documents mentioned in those subsections and sent copies of them to the said Councils and to each of the persons consulted by them, and allowed a period of not less than one month for the submission of evidence and representations;

And whereas that period has now expired:

Now therefore the Secretary of State for Education and Science, as respects England, and the Secretary of State for Wales, as respects Wales, in exercise of the powers conferred on the Secretary of State by section 4(2)(a) and (b) and (4) of the Education Reform Act 1988 hereby make the following Order in the terms of the said draft with modifications(**b**):

### Citation, commencement and interpretation

**1.**—(1) This Order may be cited as the Education (National Curriculum) (Attainment Targets and Programmes of Study in Mathematics) Order 1989 and shall come into force in accordance with articles 2 to 5.

(**a**) 1988 c.40.
(**b**) The modifications are to the commencement provisions. The title of the associated Document has also been changed.

(2) In this Order –

"the Document" means the document published by Her Majesty's Stationery Office entitled "Mathematics in the National Curriculum"**(a)**;

references to the first, second, third and fourth key stages are references to the periods set out in paragraphs (a) to (d) respectively of section 3(3) of the Education Reform Act 1988;

references to levels of attainment are references to the levels set out in the Document in relation to each attainment target; and

references to ranges of levels of attainment are references to the range of levels of attainment specified for pupils of different abilities and maturities in respect of the key stage in question.

**2.** The provisions of this Order relating to the first key stage shall come into force –

(a) on 1st August 1989 in respect of pupils in the first year of that key stage who have attained the age of five years by that date and who do not have a statement of special educational needs; and

(b) on 1st August 1990 in respect of all other pupils.

**3.** The provisions of this Order relating to the second key stage shall come into force –

(a) on 1st August 1990 in respect of pupils in the first year of that key stage;

(b) on 1st August 1991 in respect of pupils in the second year of that key stage;

(c) on 1st August 1992 in respect of pupils in the third year of that key stage; and

(d) on 1st August 1993 in respect of all other pupils.

**4.** The provisions of this Order relating to the third key stage shall come into force –

(a) on 1st August 1989 in respect of pupils in the first year of that key stage who do not have a statement of special educational needs;

(b) on 1st August 1990 in respect of pupils in the first year of that key stage who have a statement of special educational needs and in respect of pupils in the second year of that key stage; and

(c) on 1st August 1991 in respect of all other pupils.

**5.** The provisions of this Order relating to the fourth key stage shall come into force –

(a) on 1st August 1992 in respect of pupils in the first year of that key stage; and

(b) on 1st August 1993 in respect of all other pupils.

**Specification of attainment targets and programmes of study**

**6.** It is hereby directed that the provisions relating to attainment targets and programmes of study set out in the Document shall have effect as provided in Articles 7 to 9 hereof for the purposes of specifying in relation to mathematics –

(a) attainment targets; and

(b) programmes of study.

**7.**—(1) Schedule 1 has effect in accordance with paragraph (2) for specifying the attainment targets (including the ranges of levels of attainment) for each key stage.

(2) The attainment targets described in the Document and set out in column 2 of Schedule 1 to this Order are specified in relation to the key stages set out beside them in column 1 of that Schedule, the levels applicable being those appropriate to the different abilities and maturities of the pupils being taught.

**8.**—(1) Schedule 2 has effect in accordance with paragraph (2) for specifying the programmes of study (including the range of levels of attainment) for each key stage.

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**(a)** ISBN 0 11 270666 5.

(2) The programmes of study described in the Document and set out in column 2 of Schedule 2 to this Order are specified in relation to the key stages set out beside them in column 1 of that Schedule, the levels applicable being those appropriate to the different abilities and maturities of the pupils being taught.

**9.** The examples printed in italics in the Document (which serve to illustrate the attainment targets and programmes of study therein described) do not form part of the provision made by this Order.

## SCHEDULE 1

Article 7

### SPECIFICATION OF ATTAINMENT TARGETS

| (1) *Key stages* | (2) *Attainment targets* |
|---|---|
| First key stage | Attainment targets 1–6 and 8–14; levels 1–3, where specified in the Document. |
| Second key stage | Attainment targets 1–14; levels 2–6, where specified in the Document. |
| Third key stage | Attainment targets 1–14; levels 3–8, where specified in the Document. |
| Fourth key stage | Attainment targets 1–14; levels 4–10, where specified in the Document. |

## SCHEDULE 2

Article 8

### SPECIFICATION OF PROGRAMMES OF STUDY

| (1) *Key stages* | (2) *Programmes of study (as described in the Document)* |
|---|---|
| First key stage | Levels 1 to 3. |
| Second key stage | Levels 2 to 6. |
| Third key stage | Levels 3 to 8. |
| Fourth key stage | Levels 4 to 10. |

Secretary of State for Education and Science

Secretary of State for Wales

## EXPLANATORY NOTE

*(This note is not part of the Order)*

Section 4(2) of the Education Reform Act 1988 places a duty on the Secretary of State to establish the National Curriculum by specifying appropriate attainment targets, programmes of study and assessment arrangements for each of the foundation subjects.

Section 4(4) allows for such an Order, instead of containing the provisions to be made, to refer to provisions in a Document published by Her Majesty's Stationery Office and to direct that those provisions shall have effect according to the Order.

This Order accordingly refers to "Mathematics in the National Curriculum" and provides for the attainment targets and programmes of study set out in it to have effect for the four key stages of a pupil's compulsory schooling. The Document sets out up to ten levels in respect of attainment targets to cover the full range of abilities and maturities of pupils of compulsory school age; the Order accordingly specifies as part of each attainment target the appropriate range of attainment levels.

The Order further provides that any examples printed in italics in the Document are for illustrative purposes only, and do not form part of the Order.

£XX.XX net

ISBN 0 11 000000 0

Printed in the United Kingdom for Her Majesty's Stationery Office

860 PO101 C 2/89 452 7102 O/N 46294

# Attainment targets and associated statements of attainment: key stages 1-4

Schedule 1 to the Education (National Curriculum) (Attainment Targets and Programmes of Study in Mathematics) Order 1989 specifies the levels applicable to pupils in each of key stages 1-4.

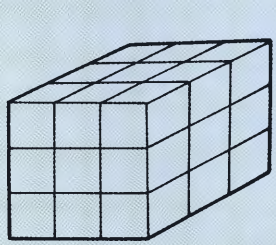
The attainment targets are set out in the groupings which will be used for reporting purposes.

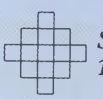
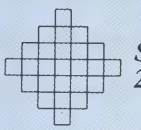
The examples printed in italics serve to illustrate the attainment targets and are non-statutory.

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 1: Using and applying mathematics

**Pupils should use number, algebra and measures in practical tasks, in real-life problems, and to investigate within mathematics itself.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • use materials provided for a task.<br>• talk about own work and ask questions.<br>• make predictions based on experience. | *Compare objects to find which is the longest, tallest, etc.*<br>*Talk about a set of objects being compared; ask questions such as: 'Which is the longest pencil?'*<br>*Use a balance to compare objects; predict which of two objects will be the heavier.* |
| 2 | • select the materials and the mathematics to use for a task.<br>• describe current work, record findings and check results.<br>• ask and respond to the question: 'What would happen if…?' | *Use handspans to measure the length of a table.*<br>*Devise stories for adding and subtracting numbers up to 10 and check with a calculator or apparatus.*<br>*Predict whether the contents of a cylinder will fill a cylinder of different dimensions.* |
| 3 | • select the materials and the mathematics to use for a task; check results and consider whether they are sensible.<br>• explain work being done and record findings systematically.<br>• make and test predictions. | *Estimate the distance around the school hall; select appropriate method for measuring and units to be used; measure and compare the results.*<br>*Sketch a plan of the school hall and enter measurements made.*<br>  <br>*Predict the number of cubes needed to construct this figure and test the prediction.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| **4** | • select the materials and the mathematics to use for a task; plan work methodically.<br>• record findings and present them in oral, written or visual form as appropriate.<br>• use examples to test statements or definitions. | *Devise a seating plan for a school concert using a system of coordinates for numbering tickets.*<br>*Explore the last digits of the multiples of various numbers: 8, 16, 24, 32, 40, 48,...; record and present the results.*<br>*Test the statement: 'If you add the house numbers of three houses next to one another you always get a multiple of 3', for various examples.*<br>$34 + 36 + 38 = 108 = 3 \times 36$<br>$81 + 83 + 85 = 249 = 3 \times 83$ |
| **5** | • select the materials and the mathematics to use for a task; check there is sufficient information; work methodically and review progress.<br>• interpret mathematical information presented in oral, written or visual form.<br>• make and test simple statements. | *Design a board game that makes use of coordinates in all four quadrants.*<br>*Use bus and train timetables to plan a journey.*<br>*Explore the results of multiplying together the house numbers of adjacent houses (eg. $6 \times 4 = 24$ $7 \times 9 = 63$ $8 \times 10 = 80$ $5 \times 7 = 35$); make a statement about the results and check using a calculator.* |
| **6** | • design a task and select appropriate mathematics and resources; check there is sufficient information and obtain any that is missing; use 'trial and improvement' methods.<br>• use oral, written or visual forms to record and present findings.<br>• make and test generalisations and simple hypotheses; define and reason in simple contexts with some precision. | *Design and make a device to measure accurately a given period of time, e.g. two minutes.*<br>*Plot Cartesian coordinates to represent simple function mappings:* $x \rightarrow 2x + 3$, *(or* $y = 2x + 3$*).*<br>*Explore the pattern:*<br>*Stage 1 1 square*  *Stage 2 5 squares*  <br>  *Stage 3 13 squares*  *Stage 4 25 squares*<br>*Use the difference method to extend the pattern; determine a rule for the sequence and test the rule.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 7 | • devise a mathematical task; work methodically within an agreed structure; use judgement in the use of given information; use 'trial and improvement' methods; review progress. | *Design a container from a rectangular sheet of card so as to maximise the capacity of the container.* |
| | • follow a chain of mathematical reasoning, spotting inconsistencies; follow new lines of investigation using alternative approaches. | *Explore the decimal representations of various fractions using a calculator or microcomputer; investigate various denominators and classify results in different ways; explore the validity of statements about decimal representations such as: '1/13 has a cycle of six repeating digits'.* |
| 8 | • devise a mathematical task and make a detailed plan of the work; work methodically, checking information for completeness; consider whether the results are of the right order.<br>• make statements of conjecture using 'if ... then ...'; define, reason, prove and disprove. | *Decide where to put a telephone box in the locality.*<br>*In exploring decimals and fractions with a calculator or microcomputer make statements of the type. 'If the denominator has prime factors other than 2 or 5, then the decimal will recur'; offer justifications, explanations and proofs of such statements.* |
| 9 | • design, plan and carry through a mathematical task to a successful conclusion.<br>• state whether a conjecture is true, false or not proven; define and reason; prove and disprove and use counter-examples; use symbolisation; recognise and use necessary and sufficient conditions. | *Design a wire frame lampshade with the design showing clearly the length of wire and area of material required.*<br>*Devise and test a statement about the minimum surface area for a cylinder of fixed volume.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| **10** | • design, plan and carry through a mathematical task to a successful conclusion; present alternative solutions and justify selected route.<br><br>• give definitions which are sufficient or minimal; use symbolisation with confidence; construct a proof including proof by contradiction. | *Investigate and design traffic light and 1-way systems for a city centre, given the street plan and traffic flows; present an analysis of the effects of the systems and suggest a best solution.*<br><br>*Rearrange the equation* $x^3-5x+3=0$ *to obtain the iterative formula* $x_{n+1}=\frac{(x_n^3+3)}{5}$ *and test whether it converges or diverges for different initial values of* $x$. |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 2: Number

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • count, read, write and order numbers to at least 10; know that the size of a set is given by the last number in the count.<br>• understand the conservation of number. | *Know that if a set of 8 pencils is counted, the answer is always the same however they are arranged.* |
| 2 | • read, write and order numbers to at least 100; use the knowledge that the tens-digit indicates the number of tens.<br>• understand the meaning of 'a half' and 'a quarter'. | *Know that 37 means 3 tens and 7 units; know that three 10p coins and four 1p coins give 34p.*<br>*Find a quarter of a piece of string; know that half of 8 is 4.* |
| 3 | • read, write and order numbers to at least 1000; use the knowledge that the position of a digit indicates its value.<br>• use decimal notation as the conventional way of recording in money.<br>• appreciate the meaning of negative whole numbers in familiar contexts. | *Know that 'four hundred and two' is written 402 and why neither 42 nor 4002 is correct.*<br>*Know that three £1 coins plus six 1p coins is written as £3·06, and that 3·6 on a calculator means £3·60 in the context of money.*<br>*Read a temperature scale; understand a negative output on a calculator.* |
| 4 | • read, write and order whole numbers.<br>• understand the effect of multiplying a whole number by 10 or 100.<br>• use, with understanding, decimal notation to two decimal places in the context of measurement.<br>• recognise and understand simple everyday fractions.<br>• recognise and understand simple percentages.<br>• understand and use the relationship between place values in whole numbers. | *Explain why the cost of 10 objects costing £23 each is £230.*<br>*Read scales marked in hundredths and numbered in tenths (1·89 m).*<br>*Estimate 1/3 of a pint of milk or 3/4 of the length of a piece of wood.*<br>*Know that 7 books out of a total of 100 books represents 7%.*<br>*Know that 5000 is 5 thousands or 50 hundreds or 500 tens or 5000 ones.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • use index notation to express powers of whole numbers.<br>• use unitary ratios. | *Know that $2^5 = 2 \times 2 \times 2 \times 2 \times 2$.*<br>*Use a ratio of 1:50 for drawing a plan of the classroom.* |
| 6 | • read, write and order decimals; appreciate the relationship between place values.<br>• understand and use equivalence of fractions and of ratios; relate these to decimals and percentages. | *Explain that 0·23 is 2 tenths and 3 hundredths or 23 hundredths.*<br>*Know that $\frac{2}{5} = \frac{4}{10} = 0{\cdot}4 = 40\%$.*<br>*State that lengths 8 cm and 12 cm in a drawing are in the ratio 2:3.* |
| 7 | • express a positive integer as a product of primes. | *Express 147 as $3 \times 7 \times 7$ or $3 \times 7^2$.*<br>*Find the HCF (Highest Common Factor) and LCM (Lowest Common Multiple) of two whole numbers.* |
| 8 | • express numbers in standard index form using positive and negative integer powers of 10.<br>• use index notation to represent powers and roots. | *Know that 1 million = $10^6$ and $22731 = 2{\cdot}2731 \times 10^4$.*<br>*Use the $x^y$ key on a calculator.* |
| 9 | • distinguish between rational and irrational numbers. | *Know that $\sqrt{2}$ and $\pi$ are irrational. Know the significance of recurring and non-recurring decimals in this context.* |
| 10 | • use the knowledge, skills and understanding attained at lower levels in a wider range of contexts. | |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 3: Number

**Pupils should understand number operations (addition, subtraction, multiplication and division) and make use of appropriate methods of calculation.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • add or subtract, using objects where the numbers involved are no greater than 10. | *Add to or remove from a set of everyday objects.* |
| 2 | • know and use addition and subtraction facts up to 10.<br>• compare two numbers to find the difference.<br>• solve whole number problems involving addition and subtraction, including money. | *Know that if 6 pencils are taken from a box of 10, there will be 4 left.*<br>*Find the difference between 7 and 3.*<br>*Work out the change from 20p when two biscuits costing 5p and 7p are purchased.* |
| 3 | • know and use addition and subtraction number facts to 20 (including zero).<br>• solve problems involving multiplication or division of whole numbers or money, using a calculator where necessary.<br>• know and use multiplication facts up to 5 x 5, and all those in 2, 5 and 10 multiplication tables. | *State that the date of the next Friday after Friday 8 May must be 15 May.*<br>*Find the cost of four calculators at £2·45 each.*<br>*Know that if tickets cost £4 each, only 4 can be bought with £18.* |
| 4 | • know multiplication facts up to 10 x 10 and use them in multiplication and division problems.<br>• (using whole numbers) add or subtract mentally two 2-digit numbers; add mentally several single-digit numbers; without a calculator add and subtract two 3-digit numbers, multiply a 2-digit number by a single-digit number and divide a 2-digit number by a single-digit number.<br>• solve addition or subtraction problems using numbers with no more than two decimal places; solve multiplication or division problems starting with whole numbers. | *Calculate mentally that there are 63 days in 9 full weeks.*<br>*Work out without a calculator how much longer 834 mm is than 688 mm. Work out mentally how much heavier an object weighing 75 kg is than one weighing 48 kg.*<br>*Work out how many chocolate bars can be bought for £5 if each costs 19p, and how much change there will be.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • (using whole numbers) understand and use non-calculator methods by which a 3-digit number is multiplied by a 2-digit number and a 3-digit number is divided by a 2-digit number.<br>• calculate fractions and percentages of quantities using a calculator where necessary.<br>• multiply and divide mentally single-digit multiples of powers of 10 with whole number answers.<br>• use negative numbers in context. | *Calculate 15% of £320; $\frac{3}{5}$ of 170 m; 37% of £234; $\frac{1}{10}$ of 2m.*<br>*Calculate*<br>*$70 \times 100$ leading to $70 \times 500 = 35000$;*<br>*$800 \div 10$ leading to $800 \div 20 = 40$.*<br>*Calculate the increase in temperature from –4°C (4 degrees of frost) to +10°C.* |
| 6 | • work out fractional and percentage changes and related calculations.<br>• calculate using ratios in a variety of situations.<br>• convert fractions to decimals and percentages and find one number as a percentage of another. | *Work out the cost of a computer which is offered at 15% discount in a sale.*<br>*Adapt a recipe for 6 people to one for 8 people; enlarge a design in a given ratio.*<br>*Express a profit of £12 as a percentage return on an investment of £180.* |
| 7 | • multiply and divide mentally single digit multiples of any power of 10, and realise that, with a number less than 1, multiplication has a decreasing effect and division has an increasing effect.<br>• solve multiplication and division problems involving numbers of any size.<br>• use the memory and bracket facility of a calculator to plan a calculation and evaluate expressions. | *Work out mentally*<br>*$80 \times 0{\cdot}2$ and*<br>*$600 \div 0{\cdot}2$.*<br>*Use a calculator to convert inches to centimetres given that there are 0·394 inches to the centimetre.*<br>*Distinguish correctly between* $\frac{7{\cdot}2}{9{\cdot}8 + 12{\cdot}7}$ *and* $\frac{7{\cdot}2}{9{\cdot}8} + 12{\cdot}7$. |
| 8 | • calculate with numbers in standard form (with positive and negative powers of 10).<br>• substitute negative numbers into formulae involving addition, subtraction, multiplication and division.<br>• calculate with fractions. | *Calculate* $\frac{3{\cdot}2 \times 10^4}{1{\cdot}6 \times 10^{-3}}$.<br>*Work out $s = ut + \frac{1}{2}at^2$ where $u$, $t$ or $a$ may have negative values.*<br>*Divide a 3 m strip of wood into two parts in a given ratio.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
| --- | --- | --- |
| 9 | • use the knowledge, skills and understanding attained at lower levels in a wider range of contexts. | |
| 10 | • use the knowledge, skills and understanding attained at lower levels in a wider range of contexts. | |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 4: Number

**Pupils should estimate and approximate in number.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • give a sensible estimate of a small number of objects (up to 10). | *Estimate the number of apples in a bag.* |
| 2 | • make a sensible estimate of a number of objects up to 20. | *Estimate the number of coats on the coat pegs.* |
| 3 | • recognise that the first digit is the most important in indicating the size of a number, and approximate to the nearest 10 or 100.<br>• understand 'remainders' given the context of calculation, and know whether to round up or down. | *Know that 37 is roughly 40.*<br>*Know that if egg boxes each hold 6 eggs, 4 boxes will be needed for 20 eggs, and if 3 boxes are filled the fourth box will have 2 eggs.* |
| 4 | • make use of estimation and approximation to check the validity of addition and subtraction calculations.<br>• read a calculator display to the nearest whole number.<br>• know how to interpret results on a calculator which have rounding errors. | *Estimate that 1472 – 383 is about 1100.*<br>*Interpret $7 \div 3 \times 3 = 6{\cdot}9999999$ if it occurs on a calculator.* |
| 5 | • use and refine 'trial and improvement' methods.<br>• approximate using a specified number of significant figures or decimal places. | *Find the edge of a cube whose volume is 100 $cm^3$ in the following way:*<br>*$4^3 = 64$; $5^3 = 125$ so the side is more than 4 cm, but less than 5 cm. As $4{\cdot}5^3 = 91{\cdot}125$, the side is greater than 4·5 cm etc.*<br>*Read a calculator display, approximating to 3 significant figures.* |
| 6 | • make use of estimation and approximation to check that the results of multiplication and division problems involving whole numbers are of the right order. | *Estimate that $278 \div 39$ is about 7.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 7 | • use the knowledge, skills and understanding attained at lower levels in a wider range of contexts. | |
| 8 | • make use of estimation and approximation to check that the results of calculations are of the right order. | *Recognise that* $\frac{0{\cdot}25 \times 83{\cdot}4}{5{\cdot}7}$ *is about 3 or 4.* |
| 9 | • be aware of the upper and lower bounds of numbers expressed to a given degree of accuracy. | *Calculate that the difference between two populations of 56 million and 48 million (given to 2 significant figures) lies somewhere between 55·5 and 48·5 (ie. 7 million) and 56·5 and 47·5 (ie. 9 million).*<br>*Know the difference between 4·60 and 4·6 as measurements; realise that a number written as 9·7 correct to one decimal place, can actually lie anywhere between 9·65 and 9·75 and be 9·65 or 9·75 depending on conventions.* |
| 10 | • calculate the upper and lower bounds in the addition, subtraction, multiplication and division of numbers expressed to a given degree of accuracy. | *Realise that if 12·5 and 3·7 are expressed to one decimal place, then 12·5 + 3·7 lies between 12·45 + 3·65 and 12·55 + 3·75; also that* $\frac{12{\cdot}5}{3{\cdot}7}$ *lies between* $\frac{12{\cdot}45}{3{\cdot}75}$ *and* $\frac{12{\cdot}55}{3{\cdot}65}$<br>*Know that* $\frac{6{\cdot}3 \times 2{\cdot}8}{0{\cdot}7}$ *lies between* $\frac{6{\cdot}25 \times 2{\cdot}75}{0{\cdot}75}$ *and* $\frac{6{\cdot}35 \times 2{\cdot}85}{0{\cdot}65}$ |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 5: Number/Algebra

**Pupils should recognise and use patterns, relationships and sequences and make generalisations.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • copy, continue and devise repeating patterns represented by objects/apparatus or one-digit numbers. | *Continue a threading bead pattern: red, red, blue, red, red, blue, ...*<br>*Continue the pattern 2, 1, 2, 1, 2, 1, 2, 1, ...* |
| 2 | • explore and use the patterns in addition and subtraction facts to 10.<br>• distinguish between odd and even numbers. | *Use counters to make various combinations to given totals.*<br>$5+0=5$ $5=4+1$<br>$4+1=5$ $=3+2$<br>$3+2=5$ $=3+1+1$<br>$2+3=5$ $=2+2+1$ *etc.*<br>$1+4=5$<br>$0+5=5$ |
| 3 | • explain number patterns and predict subsequent numbers where appropriate.<br>• find number patterns and equivalent forms of 2-digit numbers and use these to perform mental calculations.<br>• recognise whole numbers which are exactly divisible by 2, 5 and 10. | *Continue:* 5, 10, 15, 20, ...<br>*Continue:* $4+10=14$,<br>$14+10=24$,<br>$24+10=34$, ...<br>$27+31 = 20+7+30+1$<br>$= 50+8$<br>$= 58.$<br>$35+29 = 35+30-1$<br>$= 65-1$<br>$= 64$ |
| 4 | • apply strategies, such as doubling and halving, to explore properties of numbers, including equivalence of fractions.<br>• generalise, mainly in words, patterns which arise in various situations. | *Recognise that*<br>$23\times8=46\times4=92\times2=184\times1$<br>*and* $2/3=4/6=6/9=8/12=\ldots$<br>*Understand the patterns in addition and multiplication tables, including symmetry of results and relationships between multiplication by 2, 4 and 8 etc.*<br>*Construct matchstick squares, using an appropriate number of matchsticks to make 1, 2, 3, 4, ... squares.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • understand and use terms such as prime, square, cube, square root, cube root, multiples and factors.<br>• recognise patterns in numbers through spatial arrangements.<br>• follow simple sets of instructions to generate sequences. | *Find all the primes between 0 and 100. Is there a pattern?*<br>*Recognise square and triangular numbers and the relationship between them.*<br>*Produce a sequence in which the third or any subsequent number is the sum of the previous two numbers.*<br>*Understand the program:*<br>*10 FOR NUMBER = 1 TO 10*<br>*20 PRINT NUMBER*NUMBER*<br>*30 NEXT NUMBER*<br>*40 END.* |
| 6 | • determine possible rules for generating a sequence.<br>• use spreadsheets or other computer facilities to explore number patterns. | *Understand that 1, 2, 4, ... may be part of the sequence 1, 2, 4, 8, 16, ... or 1, 2, 4, 7, 11, ...*<br>*Use the difference method to explore sequences such as:* 2 5 10 17 26 ...<br>3 5 7 9 ...<br>2 2 2 ... |
| 7 | • use symbolic notation to express the rules of sequences (mainly linear and quadratic).<br>• understand the meaning of reciprocals and explore relationships.<br>• explore more complex patterns of number generated by a computer. | *Express in symbols the rules for the following sequences:* 1,3,5,..., $[2n-1]$<br>1,4,9,..., $[n^2]$<br>$\frac{1}{2}, \frac{2}{3}, \frac{3}{4}\ldots$ $\left[\frac{n}{n+1}\right]$<br>*Use the facts that $\frac{1}{2}$ is the reciprocal of 2; $\frac{a}{b}$ is the reciprocal of $\frac{b}{a}$.*<br>*Continue 1,3,2,2·5, ... (the next number is the mean of the two preceding numbers.)* |
| 8 | • understand the relationships between powers and roots.<br>• understand the role of a counter-example in the context of rules for sequences and in disproving hypotheses. | *Know that 3 is a fourth root of 81.*<br>*Find the number of regions created by joining points on the circumference of a circle; check whether the pattern 2,4,8, ... continues by doubling and accept eventually that it does not.* |
| 9 | • calculate growth and decay rates and display graphically. | *Know about rates of economic growth and decline and the half-life of radioactive elements.* |
| 10 | • use a calculator or computer to investigate whether a sequence given iteratively converges or diverges. | $x_{n+1} = \frac{\left(\frac{a}{x_n}\right) + x_n}{2}$, *for some value of a.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 6: Algebra

**Pupils should recognise and use functions, formulae, equations and inequalities.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 2 | • understand the use of a symbol to stand for an unknown number. | *Find the number to be inserted in the box to make the statement* $3 + \square = 10$ *true.* |
| 3 | • deal with inputs to and outputs from simple function machines. | *INPUT (machine) OUTPUT*<br>$3 \rightarrow 5$<br>$7 \rightarrow 9$<br>$4 \rightarrow 6$<br>*Describe what is happening to the left-hand numbers to get the numbers on the right-hand side. (What is the function?)*<br>*Use doubling and halving, adding and subtracting, FORWARD and BACKWARD (in LOGO) etc, as inverse operations.* |
| 4 | • understand and use simple formulae or equations expressed in words.<br>• recognise that multiplication and division are inverse operations and use this to check calculations. | *Recognise the relationship (function) between the corresponding members in the sets:* $\{2,3,10\} \rightarrow \{21,31,101\}$ *(i.e. multiply a number by 10 and add 1).*<br>*Solve a problem such as: 'If I double a number, then add 1 and the result is 49, what is the number?'*<br>*Know that if* $43 \times 8 = 344$ *then* $344 \div 8 = 43$. |
| 5 | • understand and use simple formulae or equations expressed in symbolic form.<br>• express a simple function symbolically. | *Use the fact that the perimeter* $p$ *of a rectangle is given by* $p = 2(a + b)$ *where* $a$ *and* $b$ *are the dimensions.*<br>*Know that* $a \times b$ *is written as* $ab$.<br>*If cakes cost 15p each then write* $c = 15 \times n$ *(or* $15n$*) where* $c$ *pence is the total cost and* $n$ *is the number of cakes.* |
| 6 | • solve linear equations.<br>• solve simple polynomial equations by 'trial and improvement' methods. | *Solve equations such as* $x^2 = 5$ *and* $x^3 = 20$ *using a calculator.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| **7** | • use the rules of indices for positive integer values.<br>• solve simple inequalities on a number line.<br>• solve a range of polynomial equations by 'trial and improvement' methods.<br>• use algebraic methods to solve simultaneous linear equations in two variables. | *Simplify expressions such as:* $2x^2 + 3x^2$, $2x^2 \times 3x^3$ *and* $(3x^2)^3$.<br>*List the values of* $n$ *where* $n$ *is a whole number such that* $-10 < 2n \leqslant 20$.<br>*Solve:* $x^2 + x = 5$, $x^3 + x = 20$ *by such a method.*<br>*Solve:* $2x - y = 9$, $x + 3y = 8$. |
| **8** | • manipulate simple algebraic expressions.<br>• solve a variety of linear and other inequalities.<br>• understand and use a range of formulae and functions. | *Find common factors such as* $a^2x + ax^2 = ax(a + x)$.<br>*Transform formulae such as* $V = IR$, $v = u + at$.<br>*Multiply out two brackets* $(ax + b)(cx + d)$.<br>*Solve* $3n + 4 < 17$, $x^2 \leqslant 16$.<br>*Use the formula* $T = 2\pi\sqrt{l/g}$ *to calculate one variable given the other.* |
| **9** | • express general laws in symbolic form.<br>• use the rules of indices for negative and fractional values. | *Work with direct proportion, inverse proportion and inverse square law.*<br>*Use* $x^0 = 1$, $y^{-3} = \frac{1}{y^3}$, $\frac{x^2}{x^3} = \frac{1}{x} = x^{-1}$, *where neither* $x$ *nor* $y$ *is zero.* |
| **10** | • manipulate a range of algebraic expressions as needed in a variety of contexts. | *Factorise a variety of algebraic expressions.*<br>*Solve quadratic equations by using factors, the common formula and iteration.*<br>*Simplify* $\frac{1}{x+2} + \frac{1}{x-3}$.<br>*Show that* $x^2 - 6x + 10 = (x-3)^2 + 1 \geqslant 1$, *(whatever the value of* $x$*).* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 7: Algebra

**Pupils should use graphical representation of algebraic functions.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 4 | Pupils should:<br>• know the conventions of the coordinate representation of points; work with coordinates in the first quadrant. | *Plot points; draw diagrams.*<br>*Create shapes by using DRAW and MOVE commands in BASIC in the appropriate graphics mode, or by using LOGO commands.*<br>*Draw graphs as required by other attainment targets.* |
| 5 | • understand and use coordinates in all four quadrants. | *Plot points and draw lines and figures, using the four quadrants.* |
| 6 | • use and plot Cartesian coordinates to represent simple function mappings. | $x \rightarrow x + 1$ *(or* $y = x + 1$*),*<br>$x \rightarrow x^2$ *(or* $y = x^2$*).* |
| 7 | • draw and interpret the graphs of linear functions.<br>• use graphical methods to solve simultaneous linear equations in two variables.<br>• generate various types of graphs on a computer or calculator and interpret them. | *Use travel graphs to solve distance/time problems.* |
| 8 | • know the form of graphs of quadratic functions and simple reciprocal functions.<br>• use straight-line graphs to locate regions given by linear inequalities. | $y = x^2 - x - 2$<br>$y = {}^{a}/_{x}$.<br>$x < 10, y > 6, y < 2x + 3$. |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 9 | • interpret and use $m$ and $c$ in $y = mx + c$ in a variety of contexts.<br>• solve equations using graphical methods. | *Use the graph of $y = x^2 + 5x$ to solve $x^2 + 5x = 7$.*<br>*Use the graphs of $y = x^2 + 5x$ and $y = x^3$ to solve $x^3 = x^2 + 5x$.* |
| 10 | • construct tangents to graphs at different points to determine gradients.<br>• find the approximate area between a curve and the horizontal axis between two limits, and interpret the result.<br>• sketch the graph of functions $y = f(x - a)$, $y = f(kx)$, $y = f(x) + a$ from the graph of $y = f(x)$ for different values of $a$ and $k$. | *Find velocity in distance/time graphs and acceleration in velocity/time graphs.*<br>*Understand and use the fact that the area under a velocity/time graph represents the distance travelled.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 1-8).

# Attainment Target 8: Measures

**Pupils should estimate and measure quantities, and appreciate the approximate nature of measurement.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • compare and order objects without measuring, and use appropriate language. | *Use language such as: long, longer than, longest; tall, taller than, tallest; heavy, light; before, after; hot, cold.* |
| 2 | • use non-standard measures in length, area, volume, capacity, 'weight' and time to compare objects and recognise the need to use standard units. | *Use handspans, strips of paper, conkers, etc. as measures.* |
| | • know how to use coins in simple contexts. | *Handle money – shopping activities in the classroom.* |
| | • know the most commonly used units in length, capacity, 'weight' and time, and what they are used for. | *Suggest things which are commonly measured in metres, miles, litres, pints, pounds, seconds, minutes, hours etc.* |
| 3 | • use a wider range of metric units. | *Use centimetre, kilometre, gram.* |
| | • choose and use appropriate units and instruments in a variety of situations, interpreting numbers on a range of measuring instruments. | *Use an appropriate tape/ruler to compare lengths that cannot be put side by side.* |
| | | *Read digital clocks correctly and analogue clocks to the nearest labelled division.* |
| | | *Read a speedometer on a car or bicycle correctly.* |
| | • make estimates based on familiar units. | *Estimate the height of a door in metres, the capacity of a bottle in litres, or a period of time.* |
| 4 | • understand the relationship between units. | *Use two units such as millilitres and litres to measure the capacity of the same jug.* |
| | • find areas by counting squares, and volumes by counting cubes, using whole numbers. | *Find the approximate area of a leaf; work out the approximate volume of a small box.* |
| | • make sensible estimates of a range of measures in relation to everyday objects or events. | *Estimate the length of a car, the capacity of a teacup, the 'weight' of a school bag.* |
| | | *Use timetables to anticipate time of arrival.* |
| | | *Estimate the time taken to complete a task.* |

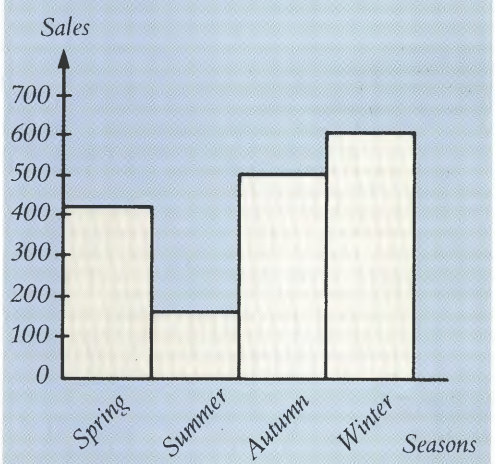
| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • understand the notion of scale in maps and drawings.<br>• use Imperial units still in daily use and know their rough metric equivalents.<br>• convert from one metric unit to another.<br>• measure and draw angles to the nearest degree. | *Draw a plan of a classroom on a scale of 1cm to 1m.*<br>*Recall that 1 kg is about 2 lb, 8 km is approximately 5 miles, 1 litre is about 1·75 pints.*<br>*Work out that 2·4kg is equivalent to 2400 g.* |
| 6 | • understand and use compound measures.<br>• recognise that measurement is approximate and choose the degree of accuracy appropriate for a particular purpose. | *Work out mean speed (distance/time), or density (mass/volume).* |
| 7 | • recognise that a measurement expressed to a given unit is in possible error of half a unit. | *Know that a distance of 10 kilometres lies between 9·5 and 10·5 kilometres, and a time of 9·57 seconds lies between 9·565 and 9·575 seconds.* |
| 8 | • carry out calculations using length, area and volume in plane and solid shapes.<br>• distinguish between the formulae for perimeter, area and volume by considering dimensions. | *Perform calculations using rectangles, triangles, parallelograms, trapezia, cubes, cuboids, cylinders, prisms and solids of constant cross-sectional area.*<br>*Recognise that $\pi d$ is a linear measurement and that $\pi r^2$ is an area measurement.*<br>*Identify from a range of formulae those which denote (say) volume*<br>$4\pi r^2$, $\frac{4\pi r^3}{3}$, $\frac{\pi r^2 h}{3}$ and $r(\pi + 2)$. |
| 9 | • calculate lengths of circular arcs and areas of shapes whose perimeters include circular arcs; calculate surface areas of cylinders and volumes of cones and spheres. | |
| 10 | • determine the possible effects of errors on calculations which involve measurements. | *Know that calculating the 'weight' of 100 identical objects, given the 'weight' of only one of them, magnifies the possible error.*<br>*Given the length and breadth of a rectangle calculate the range within which the area lies.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

# Attainment Target 9: Using and applying mathematics

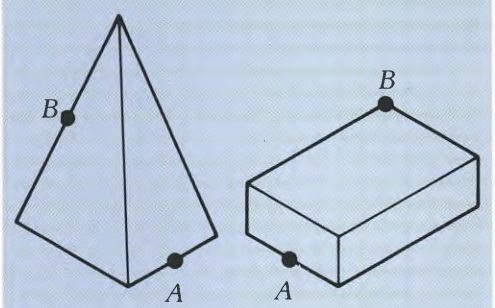
**Pupils should use shape and space and handle data in practical tasks, in real-life problems, and to investigate within mathematics itself.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 1 | Pupils should:<br>• use materials provided for a task.<br>• talk about own work and ask questions.<br>• make predictions based on experience. | *Make a collection of 3-D shapes from linking cubes.*<br>*Make up and tell stories about the 3-D shapes; ask questions such as: 'Which is the longest?'*<br>*Gain experience of the pattern of the school day; predict when the class will be in the hall for music and dance.* |
| 2 | • select the materials and the mathematics to use for a task.<br>• describe current work, record findings and check results.<br>• ask and respond to the question: 'What would happen if...?' | *Sort and classify a collection of coloured plane shapes using own criteria.*<br>*Describe how the classification of shapes was made and check the results.*<br>*Discuss a block graph showing the ways children in the class came to school that morning; respond to the question: 'How will the graph change if there are no buses running tomorrow?'* |
| 3 | • select the materials and the mathematics to use for a task; check results and consider whether they are sensible.<br>• explain work being done and record findings systematically.<br>• make and test predictions. | *Design and make a weather vane which involves reflective symmetry; test the weather vane and modify if necessary.*<br>*Keep a record of wind direction over a period of time; display the results in an appropriate chart and discuss the findings.*<br>*Experiment with a collection of dice with different numbers of coloured faces; predict the outcomes of rolling each die 50 times and test the predictions.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 4 | • select the materials and the mathematics to use for a task; plan work methodically.<br>• record findings and present them in oral, written or visual form as appropriate.<br>• use examples to test statements or definitions. | *Classify a set of plane shapes by considering line and rotational symmetry; present the results on a suitable display or chart.*<br>*Plan alternative layouts of furniture for the classroom, making use of squared paper; use coordinates to record the results.*<br>*Use linking cubes to explore the variety of 3-D shapes that can be made from a given number of cubes; test the validity of various statements such as: 'There are two different shapes that can be made from three cubes'.* |
| 5 | • select the materials and the mathematics to use for a task; check there is sufficient information; work methodically and review progress.<br>• interpret mathematical information presented in oral, written or visual form.<br>• make and test simple statements. | *Devise a survey to investigate the ages of cars passing the school by noting registration numbers; carry out the survey, discuss awkward cases (eg personalised number plates) and analyse results.*<br>*Collect and display a range of charts, diagrams and graphs gathered from newspapers; interpret the information contained in the display; discuss possible headlines to accompany different graphs.*<br>**Wellington boot sales**<br>  <br><br>*Make and test a statement such as: 'Most cars passing the school are over 3 years old'.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| **6** | • design a task and select appropriate mathematics and resources; check there is sufficient information and obtain any that is missing; use 'trial and improvement' methods.<br><br>• use oral, written or visual forms to record and present findings.<br><br>• make and test generalisations and simple hypotheses; define and reason in simple contexts with some precision. | *Investigate the maximum number of right angles in polygons with different numbers of sides.*<br><br>*Survey the class to find heights and weights and present the results in the form of a scatter graph.*<br><br>*Make a hypothesis about children's weight in relation to their height and test it by reference to a scatter graph.* |
| **7** | • devise a mathematical task; work methodically within an agreed structure; use judgement in the use of given information; use 'trial and improvement' methods; review progress.<br><br>• follow a chain of mathematical reasoning, spotting inconsistencies; follow new lines of investigation using alternative approaches. | *Conduct an experiment to find the probability of a drawing pin landing on its base when dropped from a certain height; consider the factors that might affect the result.*<br><br>*Make a collection of graphs or charts from daily newspapers; consider whether any of them are misleading or could be misinterpreted; discuss how the information could have been presented more clearly.* |

| No. of sides | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|
| No. of right angles | 1 | 4 | 3 | | |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 8 | • devise a mathematical task and make a detailed plan of the work; work methodically, checking information for completeness; consider whether the results are of the right order. | *Explore the distances between two points on the surface of a 3-D shape by taking different routes from one to the other; find the shortest routes along the edges and across the faces.*   |
| | • make statements of conjecture using 'if ... then ...'; define, reason, prove and disprove. | *Conduct a statistical investigation to test the conjecture: 'If the toss of a coin shows heads three times in succession it is more likely to show tails next time'.* |
| 9 | • design, plan and carry through a mathematical task to a successful conclusion.<br>• state whether a conjecture is true, false or not proven; define and reason; prove and disprove and use counter-examples; use symbolisation; recognise and use necessary and sufficient conditions. | *Investigate the A-series of paper sizes and design a comparable system for similar 3-D rectangular boxes.*<br>*Test the conjecture: 'A public car park will accommodate the same number of cars whatever their arrangement, where door-room and turning circles are standard'.* |
| 10 | • design, plan and carry through a mathematical task to a successful conclusion; present alternative solutions and justify selected route. | *Design and test a sideshow for the school fete which involves rolling 2p coins onto a flat surface on which is drawn a square grid pattern (a win being when a player's coin lands inside a square); explore different sizes of square and find the size which gives the stallholder an even chance of making a profit.* |
| | • give definitions which are sufficient or minimal; use symbolisation with confidence; construct a proof including proof by contradiction. | *Use critical path analysis to find the shortest time for building a house.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

# Attainment Target 10: Shape and space

**Pupils should recognise and use the properties of two-dimensional and three-dimensional shapes.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • sort 3-D and 2-D shapes.<br>• build with 3-D solid shapes and draw 2-D shapes and describe them. | *Sort a collection of objects of various shapes and sizes.*<br>*Make various constructions from a range of materials.* |
| 2 | • recognise squares, rectangles, circles, triangles, hexagons, pentagons, cubes, rectangular boxes (cuboids), cylinders, spheres, and describe them.<br>• recognise right-angled corners in 2-D and 3-D shapes. | *Create pictures and patterns using 2-D shapes or 3-D objects.*<br>*Select from a collection of 3-D objects those which have at least one flat surface.* |
| 3 | • sort 2-D and 3-D shapes in different ways and give reasons for each method of sorting. | *Sort shapes with a square corner, shapes with curved edges, shapes with equal sides or faces.* |
| 4 | • understand and use language associated with angle.<br>• construct simple 2-D and 3-D shapes from given information and know associated language. | *Know acute, obtuse and reflex angles, parallel, perpendicular, vertical and horizontal, etc.*<br>*Construct triangles, rectangles, circles, nets for cubes, pyramids and prisms.* |
| 5 | • understand congruence of simple shapes.<br>• explain and use angle properties associated with intersecting and parallel lines and triangles, and know associated language. | *Group together congruent shapes from a range of shapes.*<br>*Identify equal angles in a diagram.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 6 | • know and use angle properties and symmetry properties of quadrilaterals and other polygons.<br>• recognise and use common 2-D representation of 3-D objects.<br>• use computers to generate and transform 2-D shapes.<br>• classify and define types of quadrilaterals. | *Determine whether a tessellation of given shapes is possible.*<br>*Use isometric paper to represent 3-D.*<br>*Read simple plans and elevations.*<br>*Use LOGO to draw regular polygons and other shapes.* |
| 7 | • understand and apply Pythagoras' Theorem. | *Calculate a side of a right-angled triangle when the other two sides are known.* |
| 8 | • use sine, cosine and tangent in right-angled triangles in two dimensions. | |
| 9 | • calculate distances and angles in solids using plane sections and trigonometric ratios.<br>• understand the conditions for congruent triangles.<br>• find sine, cosine and tangent of angles of any size. | *Find the angle that the edge of a square-based pyramid makes with its base.* |
| 10 | • know and use angle and tangent properties of circles.<br>• sketch the graphs of sine, cosine and tangent functions for all angles.<br>• generate trigonometric functions using a calculator or computer and interpet them.<br>• use sine and cosine rules to solve problems, including simple cases in 3-D. | |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

# Attainment Target 11: Shape and space

**Pupils should recognise location and use transformations in the study of space.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • state a position using prepositions such as: on, inside, above, under, behind, next to, etc.<br>• give and understand instructions for moving along a line. | *Follow directions in a PE lesson.* |
| 2 | • understand the notion of angle.<br>• give and understand instructions for turning through right-angles.<br>• recognise different types of movement: straight movement (translation); turning movement (rotation); flip movement (reflection). | *Rotate body through 1, 2, 3, 4 right-angles.*<br>*Turn to left or right on instruction (PE games or LOGO).*<br>*Explore patterns in art and PE.* |
| 3 | • recognise the (reflective) symmetry in a variety of shapes in 2 and 3 dimensions.<br>• understand eight points of the compass; use clockwise and anti-clockwise appropriately. | *Study shapes and identify some lines and planes of symmetry.*<br>*Describe wind direction from a weather vane.* |
| 4 | • specify location by means of coordinates (in first quadrant) and by means of angle and distance.<br>• recognise rotational symmetry. | *Locate features on an ordnance survey map, given their grid references; use LOGO commands for distance and direction.*<br>*Turn shapes using tracing paper.* |
| 5 | • identify the symmetries of various shapes.<br>• use networks to solve problems.<br>• specify location by means of coordinates in the four quadrants. | *Find the centres, axes and planes of symmetry in a variety of plane and solid shapes.*<br>*Find the shortest route for a person delivering post.*<br>*Plot the vertices of a triangle (3,2), (−1,5), (−2,−6).* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 6 | • understand and use bearings to define direction.<br>• reflect simple shapes in a mirror line.<br>• enlarge a shape by a whole number scale factor.<br>• devise instructions for a computer to produce desired shapes and paths. | *Use bearings as a practical application: a ship's or aircraft's bearing or location of a buoy.* |
| 7 | • determine the locus of an object moving subject to a rule.<br>• enlarge a shape by a fractional scale factor.<br>• use coordinates (x,y,z) to locate position in 3-D. | *Find the locus of points equidistant from two fixed points.*<br>*Find the locus of points whose sum of distances from two fixed points is constant.*<br>*Predict relative movements of parts in a simple linked cog or pulley system.*<br>*Find some of the possible locations of the vertices of a cuboid of dimensions 4, 2, 1, if the position of one vertex is (3,2,0).* |
| 8 | • understand and use mathematical similarity; know that angles remain unchanged and corresponding sides are in the same ratio.<br>• understand and use vector notation. | *Calculate the effect of enlargement on linear dimensions.*<br>*Locate a point as a position vector; describe a translation in terms of a vector; interpret multiplication of a vector by a scalar.* |
| 9 | • understand and use the relationship between the surface areas of similar figures and between volumes of similar 3-D solids.<br>• understand and use the laws of addition and subtraction of vectors. | *Understand application to resultant forces and velocities.* |
| 10 | • understand how transformations are related by combinations and inverses.<br>• use matrices to define transformations in 2-D. | *Find inverses of transformations considered earlier.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

# Attainment Target 12: Handling data

**Pupils should collect, record and process data.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • select criteria for sorting a set of objects and apply consistently. | |
| 2 | • choose criteria to sort and classify objects; record results of observations or outcomes of events.<br>• help to design a data collection sheet and use it to record a set of data leading to a frequency table. | *Identify those children who walk to school and those who travel by bus or car.*<br>*Record the number and type of birds visiting the bird table:*<br>*Blackbird XX 2*<br>*Sparrow XXXXX 5*<br>*Robin X 1*<br>*Blue Tit XXX 3* |
| 3 | • extract specific pieces of information from tables and lists.<br>• enter and access information in a simple database. | *Read off a value from a table, the cost of an item in a catalogue, etc.*<br>*Handle weather statistics or personal data, such as height, date of birth, age, etc.* |
| 4 | • specify an issue for which data are needed; collect, group and order discrete data using tallying methods with suitable equal class intervals and create a frequency table for grouped data.<br>• understand, calculate and use the mean and range of a set of data.<br>• interrogate data in a computer database. | *Find and record the number of pupils born in each month of the year.*<br>*Calculate the means to compare the scoring records of two hockey teams which have played different numbers of games.* |

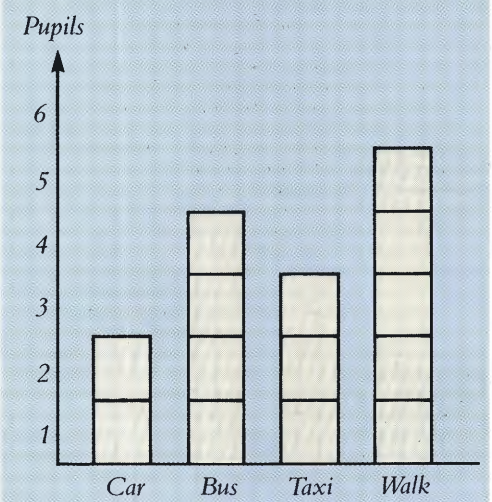
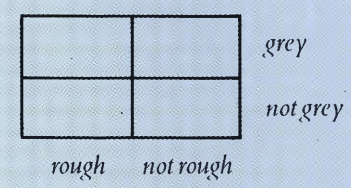
| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • design and use an observation sheet to collect data; collate and analyse results.<br>• collect, group and order continuous data using equal class intervals and create a frequency table for grouped data.<br>• insert and interrogate data in a computer database and draw conclusions. | *Devise a simple habitat recorder for an ecological survey.*<br>*Conduct a survey of cars passing with one, two, three, ... occupants.*<br>*Collect information about height of children in a year group.*<br>*Handle data arising through experiments or measurements in science, geography and CDT and from published sources in other areas of the curriculum.*<br>*Draw conclusions from census data about the effect of an epidemic.* |
| 6 | • specify an issue for which data are needed; design and use an appropriate observation sheet to collect data; collate and analyse results.<br>• design and use a questionnaire to survey opinion (taking account of bias); collate and analyse results. | *Determine the best location for a pedestrian crossing.*<br>*Conduct a survey of taste in poetry, music, literature, art, television programmes, etc.* |
| 7 | • specify a simple hypothesis; design and use an appropriate questionnaire to test it (only yes/no responses required); collect and analyse the results to see whether the hypothesis is valid.<br>• using relevant data, record and organise grouped data into class intervals suitably defined; produce a frequency table; calculate the mean (using a calculator).<br>• find the mean, median, mode and range of frequency distribution for a given set of data and interpret the results. | *Test the hypothesis that pupils/parents would prefer the school day to start at 0800 hours and finish at 1400 hours without a lunch break.*<br>*Prepare tables; calculate the mean:*<br>*(a) Measurement of heights:*<br>*Use 10cm intervals from 120–200cm:*<br>*class intervals defined as:*<br>*Interval* — *Mid Interval Point*<br>$120 \leqslant h < 130$cm — 125cm<br>$130 \leqslant h < 140$cm — 135cm<br>$140 \leqslant h < 150$cm — 145cm, etc.<br>*h = height (centimetres)*<br>*(b) Examination marks: Range 0–100, intervals of 10 marks:*<br>0- 9 mid point 4·5<br>10-19 mid point 14·5<br>20-29 mid point 24·5<br>30-39 mid point 34·5<br>*Compare the mean heights of sets of children of different ages and interpret.* |

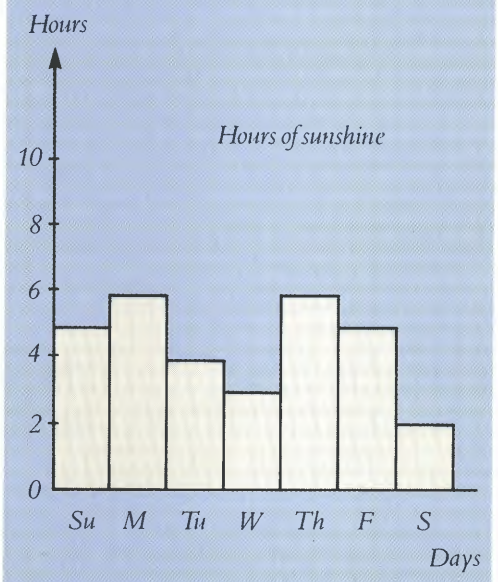
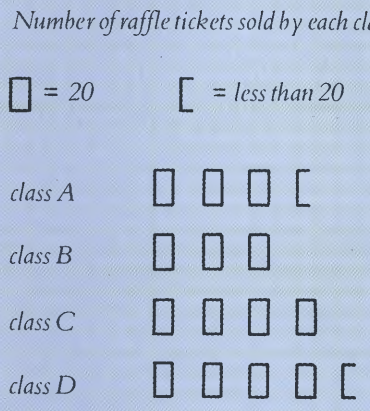
| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
| --- | --- | --- |
| 8 | • design and use an appropriate questionnaire with three or more possible responses to each question; collate and analyse the results to test an hypothesis.<br>• construct a cumulative frequency table. | *Analyse findings from a survey in which respondents have listed a set of products in order of preference.* |
| 9 | • use sampling to investigate a population and recognise the reliability of different sizes of samples. | |
| 10 | • describe the range of a variable using different measures of dispersion; calculate standard deviation of a set of data. | |

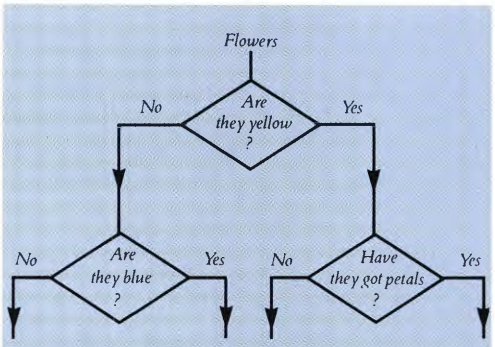
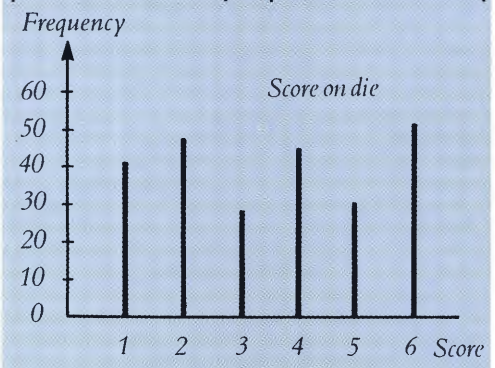
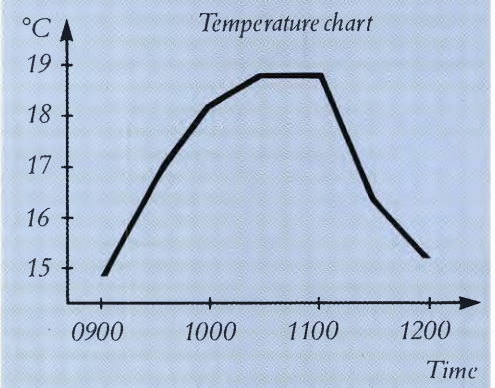
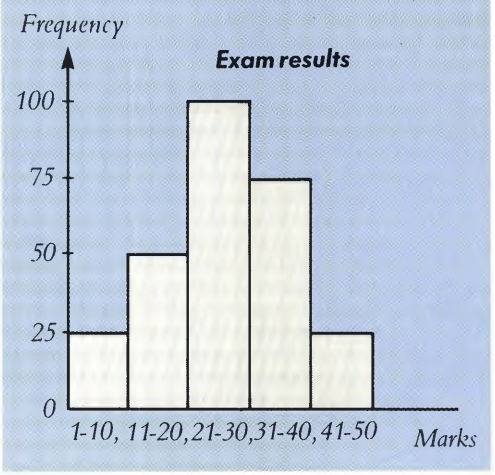
Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

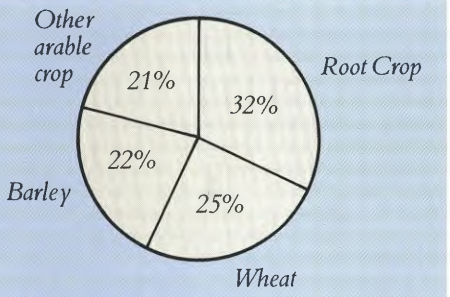
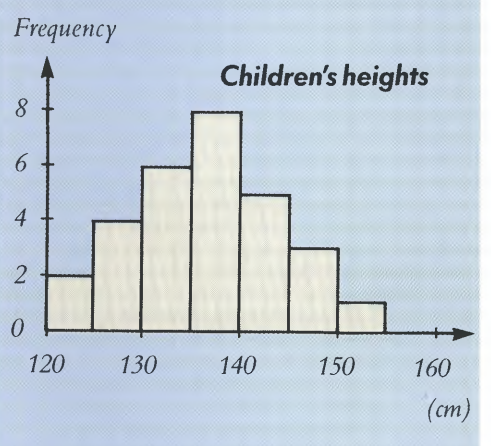
# Attainment Target 13: Handling data

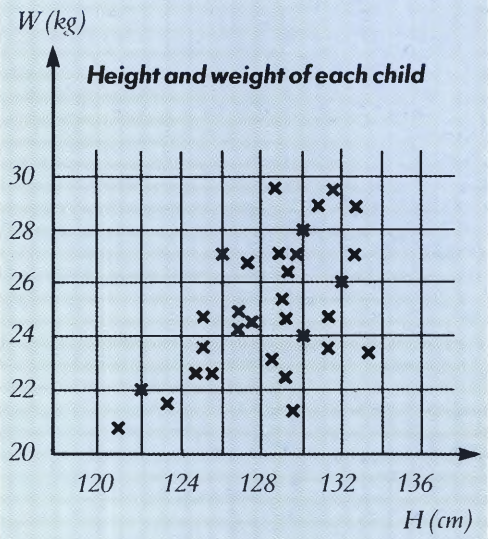
**Pupils should represent and interpret data.**

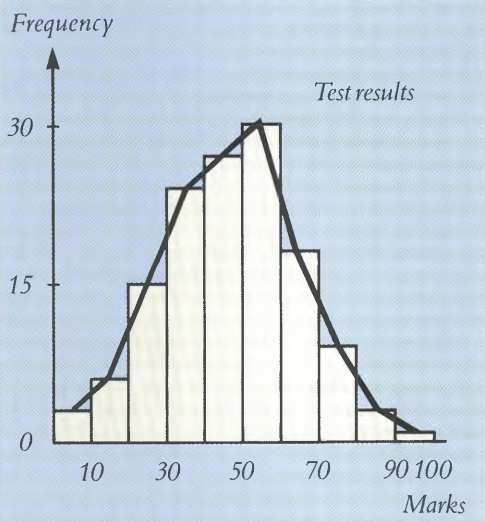
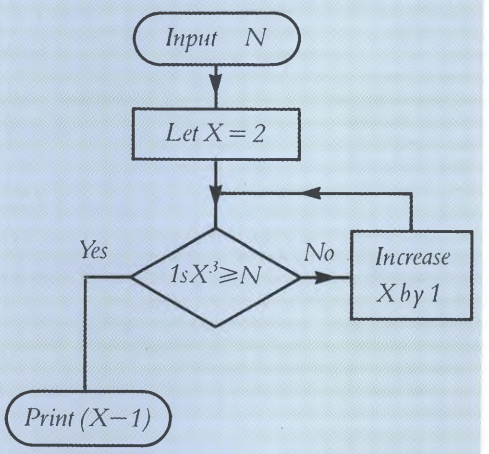
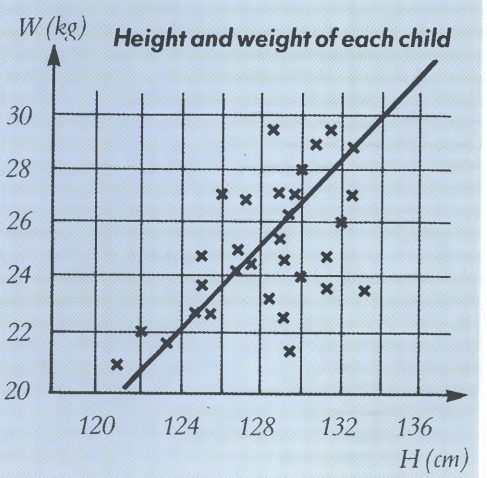
| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 1 | Pupils should:<br>• record with real objects or drawings and comment about the result.<br>• create simple mapping diagrams showing relationships; read and interpret them. | *Draw a simple picture to represent 'Children at our table'.*<br>*Link children's names to pets owned.* |
| 2 | • construct, read and interpret block graphs and frequency tables. | **Means of transport to school**<br>  |
| | • use diagrams to represent the result of classifying using two different criteria. |  <br>*(Carroll Diagram)* |

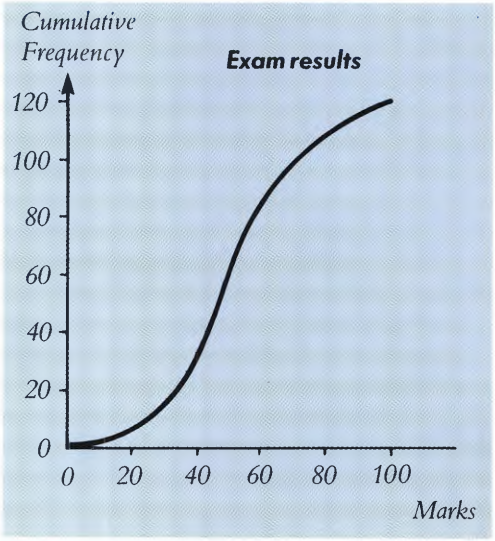
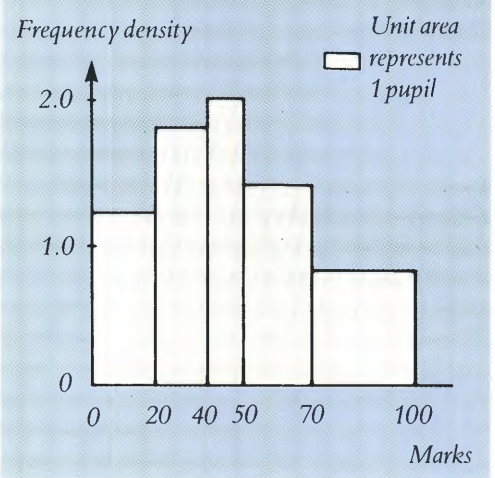
| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 3 | • construct and interpret bar charts. |  |
| | • create and interpret graphs (pictograms) where the symbol represents a group of units. |  |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 4 | • create a decision tree-diagram with questions to sort and identify a collection of objects. |   |
| | • construct, read and interpret a bar-line graph for a discrete variable (where the length of the bar-line represents the frequency). |   |
| | • construct and interpret a line graph and know that the intermediate values may or may not have a meaning. |   |
| | • construct and interpret a frequency diagram choosing suitable class intervals covering the range for a discrete variable. |   |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • construct and interpret a pie chart from a collection of data with a few variables; interpret pie charts already presented in journals or newspapers. |  <br>*Farming Statistics* |
| | • construct and interpret conversion graphs. | *Devise and use conversion graphs for different currencies, and for converting thermometer readings from Fahrenheit to Celsius.* |
| | • construct and interpret a frequency diagram choosing suitable class intervals covering the range for a continuous variable. | *Class intervals* — *Frequency*<br>$120 \leqslant h < 125$ — 2<br>$125 \leqslant h < 130$ — 4<br>$130 \leqslant h < 135$ — 7<br>$135 \leqslant h < 140$ — 8<br>$140 \leqslant h < 145$ — 5<br>$145 \leqslant h < 150$ — 3<br>$150 \leqslant h < 155$ — 1<br>*h = height (centimetres)*<br>  |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 6 | • create scatter graphs for discrete and continuous variables and have a basic understanding of correlation. |  |
| | • construct, describe and interpret information through two-way tables.<br>• construct and interpret network diagrams which represent relationships or connections. | *Record the orders from 10 people for various alternatives in a restaurant.*<br>*Use network diagrams to represent railway/ airline connections between a number of major cities.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 7 | • draw a frequency polygon as a line graph from a frequency distribution for grouped data; make comparisons between two frequency distributions. |   |
| | • construct and interpret flow diagrams with and without loops. |   *To find the largest whole number less than the cube root of a positive whole number N* |
| | • draw a line of 'best fit' by inspection on a scatter diagram. |   |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| **8** | • construct a cumulative frequency curve using the upper boundary of the class interval; find the median, the upper quartile, the lower quartile and the interquartile range; interpret the results. |   |
| **9** | • present a set of complex data in a simplified form, using a variety of diagrams and graphs and computer statistical packages.<br>• construct and interpret a histogram with understanding of the connection between area and frequency. | *Make a table from a government report or an opinion poll and prepare it for publication in the popular press.*<br>   |
| **10** | • interpret various types of diagrams such as those used in critical path analysis and linear programming.<br>• consider different shapes of histograms representing distributions with special reference to mean and dispersion, including the **normal** distribution. | *Use critical path diagrams in preparing for a social event or a business venture.* |

Knowledge, skills, understanding and use of number, algebra and measures (ATs 9-14).

# Attainment Target 14: Handling data

**Pupils should understand, estimate and calculate probabilities.**

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| | Pupils should: | |
| 1 | • recognise possible outcomes of simple random events. | *Realise that a new baby will be either a boy or a girl.* |
| 2 | • recognise that there is a degree of uncertainty about the outcome of some events and other events are certain or impossible. | *Recognise that it is:*<br>*certain* that 'it will get dark tonight';<br>*impossible* that 'I will be 20 tomorrow';<br>*uncertain* whether 'it will rain tomorrow'. |
| 3 | • place events in order of 'likelihood' and use appropriate words to identify the chance.<br>• understand and use the idea of 'evens' and say whether events are more or less likely than this.<br>• distinguish between 'fair' and 'unfair'. | *Decide for each of these statements if they are: 'very likely', 'likely', 'unlikely' or 'very unlikely':*<br>*'I shall arrive at school on time tomorrow';*<br>*'I shall be a millionaire someday';*<br>*'My favourite television star will visit my school';*<br>*'I shall support the school team tonight'.*<br>*Recognise that if a die is thrown there is an equal chance of an odd or even number but the chance of getting a particular number (say 5), is less than an even chance.*<br>*Recognise that if a 'fair' coin is tossed then there is an equal chance of a head or tail.* |
| 4 | • understand and use the probability scale from 0 to 1.<br>• give and justify subjective estimates of probabilities in a range of events.<br>• list all the possible outcomes of an event. | *0* — *1*<br>*No chance* — *Poor chance* — *Even chance* — *Good chance* — *Certain*<br>*Recognise that when a 'fair' coin is tossed the probability of heads is 1 out of 2 or ½.*<br>*What is the chance of it raining today?*<br>*List the different ways of scoring a total of 7 when throwing 2 dice.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 5 | • know that, when repeating the same experiment, different outcomes may result.<br>• distinguish between estimates of probabilities based on statistical evidence and those based on the assumptions of symmetry.<br>• know that if each of $n$ events is assumed to be equally likely the probability of one occurring is $1/n$. | *Know that you do not always get 5 heads in 10 tosses of a 'fair' coin and that very occasionally there will be none.*<br>*Know that a sound estimate of the probability that the next car passing the school would be a British car could be made by first doing a traffic survey.*<br>*Know that if the names of the 5 most common makes of car are put into a bag, the probability of picking a particular make of car is $1/5$.* |
| 6 | • identify all the outcomes when dealing with 2 combined events which are independent using diagrammatic, tabular or other forms.<br>• know that if there are several possible outcomes of an event (exhaustive and mutually exclusive), the total of these probabilities is 1 and that the probability of something happening is 1 minus the probability of it not happening. | *List all the outcomes when tossing 2 coins: HH, TT, TH, HT.*<br>*List all the outcomes when throwing 2 dice and show the total sums arising.*<br>*Recognise that if the probability of a machine failing is 0·05 then the probability of it not failing is 0·95.*<br>*Know what the probability is of drawing a green ball from a bag of 50 balls of 4 different colours (5 green, 15 blue, 20 yellow and 10 red), and know the probability of not drawing a green ball.* |
| 7 | • understand and use relative frequency as an estimate of probability.<br>• when assigning probabilities appreciate that relative frequency and equally likely considerations may not be appropriate and 'subjective' estimates of probability have to be made.<br>• understand and apply the addition of probabilities for mutually exclusive events. | *Know that when a 'fair' die is rolled many times each number will appear on approximately $1/6$ of the total number of throws and expect that the proportion will generally approximate to $1/6$ as the number of throws is increased.*<br>*Estimate by experimentation the probability of a drawing pin landing on its base.*<br>*Recognise that the statement: 'There is a 0·1 probability that a cure for cancer will be found in the next 2 years', cannot be based on evidence.* |

| LEVEL | STATEMENTS OF ATTAINMENT | EXAMPLE |
|---|---|---|
| 8 | • understand that when dealing with 2 independent events, the probability of them both happening is less than the probability of either of them happening (unless the probability is 0 or 1).<br>• calculate the probability of a combined event given the probability of 2 independent events and illustrate combined probabilities of several events using tabulation or tree-diagrams. | *Know that the probability of getting 2 consecutive sunny days over a weekend is less than the probability of getting a sunny Saturday or Sunday.*<br><br>*Given that there are 2 sets of traffic lights on the way to school and the probabilities of getting straight through the lights without having to stop are 0·6 and 0·4 respectively, find the probability of a cyclist having to stop at one set of lights, using a tree-diagram or otherwise.*<br>*Draw a tree-diagram, or use a tabulation to define all of the possible outcomes of 3 events, where each event has 2 outcomes, eg. tossing a coin 3 times.* |
| 9 | • produce a tree-diagram to illustrate the combined probability of several events which are not independent. | *An operation has a 60% success rate the first time it is attempted but if it is unsuccessful it can be repeated, but with a success rate of only 30%. The probability of success the third time is so low that surgeons are unwilling to operate. What is the probability that the operation will fail twice?* |
| 10 | • understand the probability of any two events happening. | |

# The programmes of study for key stages 1-4

**Schedule 2 to the Education (National Curriculum) (Attainment Targets and Programmes of Study in Mathematics) Order 1989 specifies the levels applicable to pupils in each of key stages 1-4.**

## LEVEL 1 PROGRAMME OF STUDY

To achieve level 1 within the attainment targets pupils should be:

### Using and applying mathematics

- using materials for a practical task.
- talking about own work and asking questions.
- making predictions based on experience.

### Number

- counting, reading, writing and ordering numbers to at least 10.
- understanding conservation of number.
- using addition and subtraction with numbers no greater than 10, in the context of real objects.
- making a sensible estimation of a number of objects up to 10.

### Algebra

- copying, continuing and devising repeating patterns.

### Measures

- comparing and ordering objects without measuring; using appropriate language.

### Shape and space

- sorting and classifying 2-D and 3-D shapes.
- building 3-D solid shapes and drawing 2-D shapes and describing them.
- using common words to describe a position.
- giving and understanding instructions for movement along a line.

### Handling data

- selecting criteria for sorting a set of objects, and applying them consistently.
- recording with objects or drawing.
- creating simple mapping diagrams showing relationships and interpreting them.
- recognising possible outcomes of random events.

## LEVEL 2

## PROGRAMME OF STUDY

To achieve level 2 within the attainment targets pupils should be:

### Using and applying mathematics

- selecting the materials and the mathematics to use for a practical task.
- describing work and checking results.
- asking and responding to the question: 'What would happen if ...?'

### Number

- reading, writing and ordering numbers to at least 100 and using the knowledge that the tens digit indicates the number of tens.
- understanding the meaning of 'half' and 'quarter'.
- knowing and using addition and subtraction facts up to 10.
- comparing two numbers to find the difference.
- solving whole number problems involving addition and subtraction, including money.
- making a sensible estimate of a number of objects up to 20.

### Algebra

- exploring and using patterns in addition and subtraction facts to 10.
- distinguishing odd and even numbers.
- understanding the use of a symbol to stand for an unknown number.

### Measures

- using non-standard measures in length, area, volume, capacity, 'weight' and time, comparing objects and recognising the need for standard units.
- using coins in simple contexts.
- knowing commonly used units in length, capacity, 'weight' and time.

### Shape and space

- recognising squares, rectangles, circles, triangles, hexagons, pentagons, cubes, rectangular boxes (cuboids), cylinders and spheres and describing them.
- understanding the notion of angle.
- understanding turning through right-angles and recognising right-angled corners.
- recognising types of movement: straight (translation), turning (rotation) and flip (reflection).

### Handling data

- choosing criteria to sort and classify objects; recording results or outcomes of events.
- designing a data collection sheet, recording data leading to a frequency table.
- constructing and interpreting frequency tables and block graphs.
- using diagrams to represent the result of classification using two different criteria.
- recognising a degree of uncertainty about the outcomes of some events and that other events are certain or impossible.

## LEVEL 3 PROGRAMME OF STUDY

To achieve level 3 within the attainment targets pupils should be:

### Using and applying mathematics

- selecting the materials and the mathematics to use for a task.
- checking results, considering whether they are sensible.
- explaining work and recording findings systematically.
- making and testing predictions.

### Number

- reading, writing and ordering numbers to at least 1000, and using the knowledge that the position of a digit indicates its value.
- using decimal notation in recording money.
- appreciating the meaning of negative whole numbers in familiar contexts, *e.g. a temperature scale.*
- knowing and using addition and subtraction facts to 20, (including zero).
- solving problems involving multiplication or division of whole numbers or money, using a calculator where necessary.
- knowing and using multiplication facts up to 5 x 5 and all those in 2, 5 and 10 multiplication tables.
- recognising the first digit is the most important in indicating the size of a number and approximating to the nearest 10 or 100.
- understanding remainders and knowing whether to round up or down.

### Algebra

- finding number patterns and equivalent forms of 2-digit numbers and using these to perform mental calculations.
- explaining number patterns and predicting subsequent numbers.
- recognising whole numbers divisible by 2, 5 and 10.
- dealing with inputs to and outputs from simple function machines.

### Measures

- using a wider range of metric units.
- choosing and using appropriate units and instruments; interpreting numbers on a range of measuring instruments.
- making estimates based on familiar units.

### Shape and space

- sorting 2-D and 3-D shapes and giving reasons.
- recognising (reflective) symmetry in a variety of shapes in 2 and 3 dimensions.
- using and understanding compass bearings and the terms 'clockwise' and 'anti-clockwise.'

### Handling data

- extracting information from tables and lists.
- entering and accessing information in a simple database.
- constructing and interpreting bar charts and graphs (pictograms) where the symbol represents a group of units.
- placing events in order of 'likelihood' and using appropriate words to identify the chance.
- understanding and using the idea of 'evens.'
- distinguishing 'fair' and 'unfair'.

## LEVEL 4

## PROGRAMME OF STUDY

To achieve level 4 within the attainment targets pupils should be:

### Using and applying mathematics

- selecting the materials and the mathematics to use for a task and planning work methodically.
- recording findings and presenting them in oral, written or visual form.
- using examples to test statements or definitions.

### Number

- reading, writing and ordering whole numbers.
- understanding and using the effect of multiplying whole numbers by 10 or 100.
- using, with understanding, decimal notation to two decimal places in the context of measurement.
- understanding and using relationship between place values in whole numbers.
- recognising and understanding simple fractions.
- recognising and understanding simple percentages.
- knowing multiplication facts up to 10 x 10 and using them in multiplication and division problems.
- adding and subtracting mentally two 2-digit numbers.
- adding mentally single-digit numbers.
- adding and subtracting two 3-digit numbers, without a calculator.
- multiplying and dividing 2-digit numbers by a single-digit number, without a calculator.
- estimating and approximating to check the validity of addition and subtraction calculations.
- reading calculator displays to the nearest whole number and knowing how to interpret results which have rounding errors.
- solving addition and subtraction problems using numbers with no more than two decimal places, and multiplication and division problems starting with whole numbers.

### Algebra

- exploring properties of numbers including equivalence of fractions.
- generalising patterns, *e.g. symmetry of results.*
- understanding and using simple formulae or equations expressed in words.
- recognising that multiplication and division are inverse operations and using this to check calculations.
- knowing the conventions of the coordinate representation of points; working with coordinates in the first quadrant.

### Measures

- understanding the relationship between units.
- finding areas by counting squares, and volumes by counting cubes.
- making sensible estimates of a range of measures in relation to everyday objects.

## LEVEL 4 PROGRAMME OF STUDY

### Shape and space

- understanding and using language associated with angle.
- constructing 2-D and 3-D shapes from given information.
- specifying location by means of coordinates in the first quadrant and by means of angle and distance.
- recognising rotational symmetry.

### Handling data

- specifying an issue for which data are needed.
- collecting and grouping discrete data, using frequency tables and block graphs with suitable equal class intervals.
- understanding, calculating and using the mean and range of a set of data.
- interrogating data in a computer database.
- constructing and interpreting bar-line and line graphs and frequency diagrams with suitable class intervals for discrete variables.
- creating a decision-tree diagram.
- understanding and using probability scale from 0 to 1.
- giving and justifying subjective estimates of probabilities.
- listing all the possible outcomes of an event.

## LEVEL 5

## PROGRAMME OF STUDY

To achieve level 5 within the attainment targets pupils should be:

### Using and applying mathematics

- selecting the materials and the mathematics to use for a task; checking there is sufficient information; working methodically and reviewing progress.
- interpreting mathematical information presented in oral, written or visual form.
- making and testing simple statements.

### Number

- using index notation to express powers of whole numbers.
- using unitary ratios.
- understanding and using non-calculator methods by which a 3-digit number is multiplied by a 2-digit number and a 3-digit number is divided by a 2-digit number.
- calculating fractions and percentages of quantities.
- multiplying and dividing mentally single-digit multiples of powers of 10.
- using negative numbers in context.
- using 'trial and improvement' methods and refining.
- approximating, using significant figures or decimal places.

### Algebra

- understanding and using terms such as 'prime', 'square', 'cube', 'square root', 'cube root', 'multiple' and 'factor'.
- generating sequences.
- recognising patterns in numbers through spatial arrangements.
- understanding and using simple formulae or equations expressed in symbolic form.
- expressing simple functions symbolically.
- understanding and using coordinates in all four quadrants.

### Measures

- understanding the notion of scale in maps and drawings.
- using Imperial units still in daily use and knowing their rough metric equivalents.
- converting one metric unit to another.
- measuring and drawing angles to the nearest degree.

### Shape and space

- understanding congruence of simple shapes.
- using properties associated with intersecting and parallel lines and triangles and knowing associated language.
- identifying the symmetries of various shapes.
- using networks to solve problems.
- specifying location by means of coordinates in four quadrants.

## LEVEL 5 PROGRAMME OF STUDY

### Handling data

- designing and using an observation sheet to collect data; collating and analysing results.
- collecting and grouping continuous data and creating frequency tables.
- inserting and interrogating data in a computer database and drawing conclusions.
- constructing and interpreting pie charts from a collection of data with a few variables.
- constructing and interpreting conversion graphs.
- constructing and interpreting frequency diagrams and choosing class intervals for a continuous variable.
- distinguishing between estimates of probabilities based on statistical evidence and those based on assumptions of symmetry.
- knowing that if each of $n$ events is assumed to be equally likely, the probability of one occurring is $1/n$.
- knowing that different outcomes may result from repeating an experiment.

## LEVEL 6

## PROGRAMME OF STUDY

To achieve level 6 within the attainment targets pupils should be:

### Using and applying mathematics

- designing a task and selecting the mathematics and resources; checking information and obtaining any that is missing; using 'trial and improvement' methods.
- presenting findings using oral, written or visual forms.
- making and testing generalisations and simple hypotheses; defining and reasoning with some precision.

### Number

- reading, writing and ordering decimals and appreciating place values.
- understanding and using equivalence of fractions and ratios.
- working out fractional and percentage changes.
- calculating using ratios in a variety of situations.
- converting fractions to decimals and percentages.
- using estimation and approximation to check that answers to multiplication and division problems involving whole numbers are of the right order.

### Algebra

- determining possible rules for generating sequences.
- using spreadsheets or other computer facilities to explore number patterns.
- solving linear equations; solving simple polynomial equations by 'trial and improvement' methods.
- using and plotting Cartesian coordinates to represent simple function mappings.

### Measures

- understanding and using compound measures, *e.g. speed, density.*
- recognising that measurement is approximate and choosing the degree of accuracy required for a particular purpose.

### Shape and space

- classifying and defining types of quadrilaterals.
- using angle and symmetry properties of quadrilaterals and polygons.
- using 2-D representation of 3-D objects.
- using computers to generate and transform 2-D shapes.
- understanding and using bearings to define direction.
- reflecting simple shapes in a mirror line.
- enlarging a shape by a whole number scale factor.
- devising instructions for a computer to produce desired shapes and paths.

### Handling data

- designing and using observation sheets; collating and analysing results.
- surveying opinions, using a questionnaire (taking account of bias).
- creating scatter graphs for discrete and continuous variables.
- constructing and interpreting information through two-way tables and network diagrams.
- identifying outcomes of two combined events which are independent.
- knowing that the total sum of the probabilities of mutually exclusive events is 1 and that the probability of something happening is 1 minus the probability of it not happening.

## LEVEL 7 PROGRAMME OF STUDY

To achieve level 7 within the attainment targets pupils should be:

### Using and applying mathematics

- devising a mathematical task; working methodically within an agreed structure; using judgement, 'trial and improvement' methods and reviewing progress.
- following a chain of mathematical reasoning; spotting inconsistencies; following new lines of investigation using alternative methods to overcome difficulties.

### Number

- expressing positive integers as a product of primes.
- multiplying and dividing mentally single-digit multiples of any power of 10.
- solving problems using multiplication and division with numbers of any size.
- using memory and bracket facility of a calculator to plan a calculation and evaluate expressions.

### Algebra

- using symbolic notation to express the rules of sequences.
- understanding the meaning of reciprocals and exploring relationships.
- exploring complex number patterns generated by a computer.
- using the rules of indices for positive integer values.
- solving simple inequalities on a number line.
- solving a range of polynomial equations by 'trial and improvement' methods.
- using algebraic methods to solve simultaneous linear equations in two variables.
- drawing and interpreting the graphs of linear functions and using graphical methods to solve simultaneous linear equations.
- generating various types of graphs on a computer or calculator and interpreting them.

### Measures

- recognising the possible error in a measurement.

### Shape and space

- understanding and applying Pythagoras' Theorem.
- determining locus of an object moving subject to a rule.
- enlarging a shape by a fractional scale factor.
- using coordinates to locate position in 3-D.

### Handling data

- specifying and testing a simple hypothesis.
- using and recording grouped data with class intervals suitably defined; producing a frequency table; calculating the mean using a calculator.
- finding the mean, median, mode and range of frequency distribution for given sets of data and interpreting results.
- drawing a frequency polygon as a line graph from a frequency distribution for grouped data.
- constructing and interpreting flow diagrams with and without loops.
- drawing a line of 'best fit' by inspection on a scatter diagram.
- understanding and using relative frequency as an estimate of probability.
- when assigning probabilities appreciating that relative frequency and equally likely considerations may not be appropriate and 'subjective' estimates of probability have to be made.
- understanding and applying the addition of probabilities for mutually exclusive events.

## LEVEL 8

## PROGRAMME OF STUDY

To achieve level 8 within the attainment targets pupils should be:

### Using and applying mathematics

- devising a mathematical task and making a detailed plan of the work; working methodically; checking information; considering whether results are of the right order.
- making statements of conjecture using 'if ... then ...'; defining, reasoning, proving and disproving.

### Number

- using index notations to represent powers and roots.
- expressing and using numbers in standard index form, with positive and negative integer powers of 10.
- substituting negative numbers into formulae.
- calculating with fractions.
- estimating and approximating to check that the results of calculations are of the right order.

### Algebra

- understanding the role of counter-example in the context of rules for sequences and in disproving hypotheses.
- understanding the relationships between powers and roots.
- solving a variety of linear and other inequalities.
- using a range of formulae and functions.
- manipulating simple algebraic expressions.
- knowing the form of graphs of quadratic functions and simple reciprocal functions.
- using straight line graphs to locate regions given by linear inequalities.

### Measures

- using knowledge and skills in length, area and volume to carry out calculations in plane and solid shapes.
- distinguishing between formulae for perimeter, area and volume by considering dimensions.

### Shape and space

- using sine, cosine and tangent in right-angled triangles, in two dimensions.
- understanding and using mathematical similarity.
- understanding and using vector notation.

## LEVEL 8 PROGRAMME OF STUDY

### Handling data

- designing and using a questionnaire with multiple responses, collating and analysing results to test an hypothesis.
- constructing a cumulative frequency table.
- constructing a cumulative frequency curve using the upper boundary of the class interval, finding the median, upper quartile, lower quartile and interquartile range, and interpreting the results.
- understanding that when dealing with two independent events, the probability of them both happening is less than the probability of either of them happening (unless the probability is 0 or 1); calculating the probability of a combined event given the probability of two independent events and illustrating combined probabilities of several events using tabulation or tree-diagrams.

## LEVEL 9

## PROGRAMME OF STUDY

To achieve level 9 within the attainment targets pupils should be:

### Using and applying mathematics

- designing, planning and carrying through a mathematical task to a successful conclusion.
- stating whether a conjecture is true, false or not proven; defining and reasoning; proving and disproving and using counter-examples; using symbolisation; recognising and using necessary and sufficient conditions.

### Number

- distinguishing between rational and irrational numbers.
- being aware of upper and lower bounds of numbers expressed to a given degree of accuracy.
- using the knowledge, skills and understanding attained at lower levels in a wider range of contexts.

### Algebra

- calculating growth and decay rates and displaying them graphically.
- expressing general laws in symbolic form.
- using rules of indices for negative and fractional values.
- interpreting and using $m$ and $c$ in $y = mx + c$.
- solving equations using graphical methods.

### Measures

- calculating lengths of circular arcs and areas of shapes including circular arcs; calculating surface area of cylinders and volumes of cones and spheres.

### Shape and space

- calculating distances and angles in solids using plane sections and trigonometric ratios.
- understanding the conditions for congruent triangles.
- finding sine, cosine and tangent of angles of any size.
- using the relationship between surface areas of similar figures and for volumes of similar 3-D solids.
- understanding and using the laws of addition and subtraction of vectors.

### Handling data

- using sampling to investigate a 'population' and recognising the reliability of different sizes of samples.
- constructing and interpreting a histogram with understanding of the connection between area and frequency.
- presenting a set of complex data in a simplified form using a variety of diagrams and graphs and computer statistical packages.
- producing a tree-diagram to illustrate the combined probability of several events which are not independent.

## LEVEL 10 PROGRAMME OF STUDY

To achieve level 10 within the attainment targets pupils should be:

### Using and applying mathematics

- designing, planning and carrying through a mathematical task to a successful conclusion; presenting alternative solutions and justifying selected route.
- giving definitions which are sufficient or minimal.
- using symbolisation with confidence; constructing a proof including proof by contradictions.

### Number

- calculate the upper and lower bounds in the addition, subtraction, multiplication and division of numbers expressed to a given degree of accuracy.
- using the knowledge, skills and understanding attained at lower levels in a wider range of contexts.

### Algebra

- using a calculator or computer to investigate whether a sequence given iteratively converges or diverges.
- manipulating a range of algebraic expressions in a variety of contexts.
- constructing tangents to graphs to determine the gradient.
- finding the approximate area between a curve and the horizontal axis between two limits, and interpreting the result.
- sketching the graph of functions derived from other functions.

### Measures

- determining the possible effects of error on calculations involving measurements.

### Shape and space

- knowing and using angle and tangent properties of circles.
- sketching the graphs of sine, cosine and tangent functions for all angles.
- generating trigonometric functions using a calculator or computer and interpreting them.
- using sine and cosine rules to solve problems including simple cases in 3-D.
- understanding how transformations are related by combinations and inverses.
- using matrices to define transformations in 2-D.

### Handling data

- describing the range of a variable using different measures of dispersion; calculating standard deviation of a set of data.
- interpreting various types of diagrams such as those used in analysis of critical path and linear programming.
- considering different shapes of histograms representing distributions with special reference to mean and dispersion, including the **normal** distribution.
- understanding the probability for any two events happening.

Department of Education and Science
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Circular No 6/89
7 March 1989

To: Local Education Authorities

Chief Education Officers of
Inner London Boroughs
and the City Remembrancer

Heads and Governing Bodies
of Maintained Schools

Teacher Training Institutions

Other bodies

# THE EDUCATION REFORM ACT 1988:

# NATIONAL CURRICULUM: MATHEMATICS AND SCIENCE ORDERS UNDER SECTION 4

CONTENTS

## I INTRODUCTION

1. This Circular provides guidance on the Orders for mathematics and science which the Secretary of State laid before Parliament in March 1989* under Section 4 of the Education Reform Act 1988.

2. The guidance contained in this Circular does not constitute an authoritative legal interpretation of the provisions of the Act: that is exclusively a matter for the courts.

3. All enquiries about this Circular should be addressed to


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## II BACKGROUND

4. Under Section 4 (2) of the Act the Secretary of State may by Order specify in relation to each National Curriculum foundation subject such attainment targets and programmes of study as he considers appropriate.

5. In July 1987 the Secretary of State appointed working groups to advise him on attainment targets and programmes of study for mathematics and science. In the light of the groups' recommendations, the Secretary of State published proposals which were the subject of statutory consultation. In England this consultation was carried out by the National Curriculum Council (NCC) whose advice was published on 5 December 1988. The Secretary of State accepted NCC's advice and, on 19 December 1988, published draft Orders and Documents containing details of the attainment targets and programmes of study for the two subjects. The Education (National Curriculum) (Attainment Targets and Programmes of Study in Mathematics) Order 1989 and the Education (National Curriculum) (Attainment Targets and Programmes of Study in Science) Order 1989, which reflect this second round of consultation, were laid before Parliament in March 1989. All previous versions of attainment targets and programmes of study for mathematics and science are now superseded.

6. As is provided for in the statutory requirements, details of the attainment targets and programmes of study are contained in Documents published by Her Majesty's Stationery Office (HMSO) entitled:

(i) "Mathematics in the National Curriculum"
(ISBN 0 11 270666 5);

(ii) "Science in the National Curriculum"
(ISBN 0 11 270667 3).

* Precise date not known at time of printing.

7. Copies of these documents, which include facsimiles of the Orders, are being sent to recipients of this Circular.

8. Both the Orders and the associated Documents have statutory force, with the exception of the italicised examples in the Documents which illustrate the meaning of certain statements of attainment and some aspects of the programmes of study.

9. The provisions in the Orders and the Documents will start to come into force for each of the four key stages on the commencement dates shown below:

| | |
|---|---|
| First key stage | 1 August 1989 |
| Second key stage | 1 August 1990 |
| Third key stage | 1 August 1989 |
| Fourth key stage | 1 August 1992 |

Precise information about commencement dates for particular cohorts of pupils, and about exceptions, is given in paragraphs 17 to 29 below and the Table on page 5.

## III KEY STAGES

10. For the purposes of the National Curriculum the Act divides the period of compulsory schooling into four key stages. The first key stage begins with a pupil becoming of compulsory school age and ends at the end of the school year in which the majority of pupils in his or her class attain the age of seven.

11. The second key stage for a pupil is the period beginning at the start of the school year in which the majority of pupils in his or her class attain the age of eight and ends at the end of the school year in which the majority of pupils in his or her class attain the age of eleven.

12. The third key stage is the period beginning at the start of the school year in which the majority of pupils in his or her class attain the age of twelve and ends at the end of the school year in which the majority of pupils in his or her class attain the age of fourteen.

13. The fourth key stage begins at the start of the school year in which the majority of pupils in his or her class attain the age of fifteen and ends when the majority of pupils in his or her class cease to be of compulsory school age.

14. Thus — except at the start of the first key stage which depends on a pupil reaching compulsory school age — key stages are defined by reference to the age of the majority of pupils in a class or teaching group. An individual pupil might, however, be younger or older. Section 3(6) of the Act makes clear that it is the teaching group which a pupil is in for each foundation subject, not the registration class, which determines the key stage which is applicable to the pupil for that subject. This enables a pupil to be taught with another age group for one or more subjects where appropriate, eg in order to pursue a subject at a higher or lower level, while being taught with his or her peer group for other subjects. There is nothing, however, in the Act to require pupils to repeat a year, or to move early to a higher year group.

15. In some cases, for example in small primary schools, pupils may be in classes or teaching groups spanning more than one age group. To deal with this, Section 3(5) of the Act gives head teachers the right to determine a pupil's key stage according to his or her chronological age, rather than according to the chronological age of the majority of pupils in the class or teaching group.

## IV COMMENCEMENT DATES

16. Details of the commencement dates are set out in the Table on page 5. The following paragraphs offer an explanatory commentary on the Table.

### First key stage

17. For the school year 1989-90 only, the attainment targets and programmes of study set out in the Orders for mathematics and science and the associated Documents will apply only to pupils who have reached the age of five by 1 August 1989, and not to those who become of compulsory school age subsequently during this school year. However, even though the attainment targets and programmes of study will not apply statutorily to pupils who become five during the year, it will frequently make sense for them to start work based on the requirements, for example, where others in the class are following the statutory programmes of study. Also for this year only, the attainment targets and programmes of study will not be a requirement for pupils with statements of special educational needs, in order to give time for their statements to be revised if necessary. However, the Secretary of State hopes that schools will start statemented pupils on work based on the requirements from the school year 1989-90, where it is sensible for them to do so.

18. In 1989-90, the requirements will apply only to pupils in the first year group of compulsory schooling — year 1[1] (other than those exempted as above). They will not apply to pupils in the second year of the first key stage — Year 2 — even if they are five year olds.

19. For the school year 1990-91 and beyond, the attainment targets and programmes of study will apply to all pupils in the first and second years of the first key stage. This includes pupils with statements unless their statements have disapplied or modified the requirements in accordance with Section 18 of the Act. It is expected that most statements will not have references to modification or disapplication. Further details about pupils with special educational needs and temporary disapplication under regulations to be made under Section 19 are contained in paragraphs 55 to 59 below, or can be obtained from Circular 5/89.

20. During the summer of 1991, pupils at the end of the first key stage, who will mostly have had nearly six terms of teaching covering the requirements, will be assessed against all the applicable attainment targets. But this assessment will be a trial run and the results will not be required to be reported formally to parents. The first formal assessment at the end of the first key stage for which results will be required to be reported to parents will be in the summer of 1992, ie for the second cohort of pupils who have been taught according to the requirements in the Orders and associated Documents.

### Third Key Stage

21. For the school year 1989-90, attainment targets and programmes of study for mathematics and science will apply to pupils entering the first year of the third key stage — Year 7 — ie pupils in a teaching group in which the majority of pupils will reach the age of 12 during the school

[1] Terminology recommended by the National Curriculum Council and described in Circular 5/89 "The Education Reform Act 1988: The School Curriculum and Assessment".

TABLE

## MATHEMATICS AND SCIENCE SECTION 4 ORDERS — (ATTAINMENT TARGETS AND PROGRAMMES OF STUDY) COMMENCEMENT DATES[1]

| [5] | Key stage 1 | Key stage 2 | Key stage 3 | Key stage 4 |
|---|---|---|---|---|
| 1989 | 1st cohort [3] [4] (year 1) [2] | — | 1st cohort [4] (year 7) | |
| 1990 | 1st & 2nd cohorts (years 1 & 2) | 1st cohort (year 3) | 1st & 2nd cohorts (years 7 & 8) | |
| 1991 | 1st unreported assessment [6] | 1st & 2nd cohorts (years 3 & 4) | 1st, 2nd & 3rd cohorts (years 7, 8 & 9) | |
| 1992 | 1st reported assessment | 1st, 2nd & 3rd cohorts (years 3, 4 & 5) | 1st unreported assessment [6] | 1st cohort (year 10) |
| 1993 | | 1st, 2nd, 3rd & 4th cohorts (years 3, 4, 5 & 6 | 1st reported assessment | 1st & 2nd cohorts (years 10 & 11) |
| 1994 | | 1st unreported assessment [6] | | 1st assessment (GCSE) |
| 1995 | | 1st reported assessment | | |

Notes

1. Paras 16-29 of Circular refer.
2. References in brackets to year numbers follow terminology recommended by NCC and approved by Secretary of State.
3. Only those aged 5 by 1 August 1989 and excluding 5 year olds in classes mainly of 6 and 7 year olds (see paras 17, 18 of Circular).
4. Excluding pupils with statements (1989-90 exception only).
5. Commencement dates for attainment targets and programmes of study are 1 August in each year. Assessment will take place in the summer of the calendar year.
6. The first assessments, the results of which will not be required to be formally reported to parents, will apply to the first cohort of pupils to whom the attainment targets and programmes of study apply — ie to pupils in years 1 and 7 in 1989-90 (key stages 1 and 3) and to pupils in year 3 in 1990-91 (key stage 2). The first reported assessments will be of the second cohort of pupils to whom the attainment targets and programmes of study apply — ie to pupils in years 1 and 7 in 1990-91 (key stages 1 and 3) and to pupils in year 3 in 1991-92 (key stage 2).

year 1989/90. Pupils entering the third key stage will not necessarily have completed all the work in mathematics and science which is covered by the attainment targets and programmes of study for the first two key stages. Through liaison with primary schools and appropriate internal assessment arrangements, teachers will need to make an early review of the levels of attainment which these pupils have reached across the attainment targets as a whole. Professional judgments can then be made about the choice of programme of study material within the range set for the third key stage appropriate to individual pupils' needs.

22. For the school year 1989-90 only, the attainment targets and programmes of study will not be requirements for pupils with statements of special educational needs entering the first year of the third key stage. This is to allow time for their statements to be revised if necessary. However, the Secretary of State hopes that schools will start statemented pupils on work based on the requirements from the school year 1989-90, where it is sensible for them to do so.

23. From Autumn 1990, all pupils (including statemented pupils) in the second year of the key stage — year 8 — will be required to work towards the attainment targets and undertake the programmes of study, as will pupils with statements of special educational needs in the first year of the key stage. From Autumn 1991, the requirements will apply to all pupils in the third year of the key stage.

24. During the summer of 1992 pupils at the end of the third key stage will be assessed against the applicable attainment targets, but the results of this assessment will not be required to be reported formally to parents. The first formal assessment at the end of the third key stage for which results will be required to be reported to parents will be in the summer of 1993.

Second Key stage

25. For the school year 1990-91, attainment targets and programmes of study for mathematics and science will apply to all pupils (including those statemented) entering the first year of the second key stage — year 3 — ie in a teaching group in which the majority of pupils will reach the age of eight during the school year 1990-91. Thereafter the requirements will extend to each successive year of the key stage (see Table).

26. During the summer of 1994 pupils at the end of the second key stage will be assessed, but the results of this assessment will not be required to be reported formally to parents. The first formal assessment at the end of the second key stage for which results will be required to be reported to parents will be in the summer of 1995.

Fourth Key Stage

27. For the school year 1992-93, attainment targets and programmes of study for mathematics and science will apply to all pupils (including those statemented) entering the first year of the fourth key stage — year 10 — ie pupils in a teaching group in which the majority of pupils will reach the age of fifteen during the school year 1992-93. The requirements will extend to pupils in the second year of the key stage — year 11 — from Autumn 1993.

28. For science, the requirements will be satisfied if pupils follow either the Model A or Model B course as contained in the Document published by Her Majesty's Stationery Office entitled 'Science in the National Curriculum'. (See also paragraphs 43-46 below). Syllabuses for courses leading to public qualifications will need to be revised as necessary by then.

29. During the summer of 1994 pupils at the end of the fourth key stage will be assessed, and the expectation is that, for the great majority, this assessment will be through GCSE. The School Examinations and Assessment Council (SEAC) is considering the relationship between GCSE and National Curriculum assessment arrangements at age 16, and the place of alternative qualifications.

## V ATTAINMENT TARGETS

30. The Act defines attainment targets as the knowledge, skills and understanding which pupils of different abilities and maturities are expected to have by the end of each key stage. They provide the objectives for what is to be learned in each subject during that key stage. The Task Group on Assessment and Testing (TGAT) recommended, and the Government has accepted, that attainment should be assessed on a ten level scale covering the whole period of compulsory schooling. Assessment at or near the end of each key stage will demonstrate which of these attainment levels, each of which is defined by a statement or a number of statements of attainment, an individual pupil has reached. The level reached by a pupil at any given age will reflect the number of years of schooling he or she has had, what they have been taught and how well, and individual ability and maturity.

## VI PROGRAMMES OF STUDY

31. These are defined in the Act as the matters, skills and processes which are required to be taught to pupils of different abilities and maturities during each key stage. They set out the essential ground to be covered to enable pupils to meet the attainment targets at the range of levels specified for each key stage. The programmes of study for mathematics are explicitly related to each of the ten levels of attainment. In science, programmes of study are set out by reference to key stages: each programme of study matches the range of attainment target levels specified for that key stage.

### Range of levels of attainment targets for each key stage

32. For mathematics and science the range of levels for each key stage has been established after considering the advice of TGAT, and in the light of the recommendations of the subject working groups and the advice of NCC.

33. Ranges of levels are specified for the key stages (KS) as follows:

| | Science | Mathematics |
|---|---|---|
| KS1 | 1 - 3 | 1 - 3 |
| KS2 | 2 - 5 | 2 - 6 |
| KS3 | 3 - 7 | 3 - 8 |
| KS4 | 4 - 10 | 4 - 10 |

34. It is expected that the attainments of the great majority of pupils at the end of key stages will fall within the specified ranges of levels. Of course, pupils' actual attainments, as measured by assessment, may fall outside the ranges specified in the Orders; but during the key stage teachers are required to teach with a view to pupils achieving levels of attainment within the ranges specified. Most pupils' attainment is likely to lie at the middle, or close to the middle, of the ranges. In formulating the statements of attainment which define the levels, the working assumption, which will need to be tested in practice, has been that pupils should typically be

capable of achieving around levels 2, 4, 5/6 or 6/7 respectively at or near the reporting ages of 7, 11, 14 and 16. The levels at the outer limits of the ranges will be achieved by a minority of pupils only. At the end of each key stage schools will be able to determine the appropriate levels at which pupils should be assessed.

35. In relation to programmes of study, the ranges specify what is to be taught to pupils in a particular key stage. Teachers will need to select material from the programmes of study for particular key stages, within the ranges of levels specified, appropriate to their pupils' individual needs. For the second, third and fourth key stages the programme of study material associated with the extremes of the ranges specified is unlikely to be appropriate for any but a minority of pupils. For most pupils in the second, third and fourth key stages, programme of study material associated with the levels of attainment around the middle of the range is likely to be more appropriate. Thus the ranges indicate the extent of differentiation which may be required: they do not indicate that all the programme of study material within the ranges should be taught to all or even most pupils within the key stage in question.

Flexibility for teaching outside the ranges of levels specified

36. The ranges specified for the key stages have been set so as to accommodate the great majority of pupils. In the light of pupils' actual attainments at each key stage, the ranges may need to be modified. However, there are a number of ways in which the current provisions allow for pupils to be taught programme of study material at a level above or below the ranges specified, where it is sensible to do so:

(i) provided the pupil is mainly taught programme of study material within the range of levels appropriate to his or her key stage, schools may teach the pupil for part of the time at a level falling outside the key stage. For example, an 8 year old not ready for work at level 2 (bottom of the range specified for the second key stage) might be given work at level 1 for part of the time; conversely, a pupil in the third key stage in science who had, in the teacher's view, already achieved a level 7 standard against some attainment targets (top of the range specified for the third key stage), might be given work on an individual basis at level 8, while remaining in his or her class of 13 year olds.

(ii) where it makes sense and is practicable, the pupil may be moved up or down a key stage for the subject in question by placing him or her in a teaching group in which the majority of pupils are older or younger — see pararaph 14 above. There is, however, no requirement or expectation that pupils should be held back or pushed forward a key stage, except where the school judges this to be in the best interests of the pupil;

(iii) a statement of special educational needs may specify some modification in the ranges of levels appropriate at different key stages for the individual child.

37. It is expected that the flexibility offered by (i) and (ii) above will deal with very nearly all cases where pupils need to be taught outside the ranges specified for key stages, and that there should be no need, on this account, for a significant increase in the extent to which statementing procedures are used. The Department will keep under review the effect of the new provisions on statementing practice.

Attainment targets applicable to each key stage

38. The Government has accepted the advice of NCC, which in turn reflected the advice of the Science Working Group, that Attainment Target 7 - Making New Materials -, Attainment Target 8 - Explaining How Materials Behave -, and Attainment Target 17 - The Nature of Science -, should not apply to pupils in the first and second key stages. Thus, although the range of levels for these attainment targets includes levels which are appropriate for some pupils in the second key stage, there is no requirement for pupils in this key stage to start working towards them.

39. Alongside and within the statements of attainment and programmes of study there are illustrative examples in italics. As indicated in paragraph 8 above, there is no statutory requirement for these examples to be taught.

## VII SCHEMES OF WORK

40. Under Section 10 (2) of the Act the head teacher has a duty to secure the implementation of the National Curriculum. The head will need to consider with his or her staff whether existing schemes of work adequately cover the attainment targets and programmes of study, or whether modifications are required.

41. In his comments on the science and mathematics working groups' reports, the Secretary of State queried the weightings proposed for the suggested 'profile components' — groupings of attainment targets for assessment and reporting purposes. In their advice published in December 1988, NCC noted that there was a distinction to be drawn between weighting as an indication of importance in planning a scheme of work and weighting for assessment and reporting. The assessment and reporting aspects of weightings are being considered further by SEAC. Although they are not part of the statutory requirements established by the present Orders, it is the Secretary of State's view that, in drawing up their schemes of work for mathematics and science, schools should be guided by the weightings recommended by NCC, in considering the relative importance in the curriculum of the aspects to which the weightings relate. These weightings are:

Science

| Key stage | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| | | | | % |
| 1) Exploration of Science | 50 | 45 | 35 | 30 |
| 2) Knowledge and Understanding of Science | 50 | 55 | 65 | 70 |

Mathematics

| Key stages | 1-4 |
|---|---|
| | % |
| Knowledge, skills, understanding and use of | |
| 1) Number, Algebra and Measures | 60 |
| 2) Shape and Space and Data Handling | 40 |

The HMSO Documents 'Science in the National Curriculum' and 'Mathematics in the National Curriculum' present the attainment targets in the groupings ('profile components') to which the above weightings attach.

42. There are no statutory requirements regarding either the amount of time to be spent on subjects, or the timetabling and organisation of subjects. Thus, for example, schools are free to determine how they organise their science teaching: separate subject science teaching, integrated, combined, modular, and all other possible models of organisation are allowed. It also means that, where it makes sense to do so, schools may arrange for appropriate elements of the science programmes of study to be taught by specialists in other subjects, for example, geography teachers may teach some of the aspects of science in which they have particular expertise.

## VIII ALTERNATIVE MODELS FOR SCIENCE IN THE FOURTH KEY STAGE

43. As indicated in paragraph 28 above, the Order for science and the associated Document provide for alternative courses for pupils in the fourth key stage. All schools with pupils in the fourth key stage are required to offer one of these courses for their pupils: they may offer both. The Secretary of State's firm view is that all schools should offer the full course of seventeen attainment targets ( Model A), leading to a double award GCSE, and should ensure that the majority of pupils take it. It will be particularly important to ensure that boys and girls have equal opportunity and equal encouragement to undertake the full Model A course.

44. Schools may also provide the alternative course of ten attainment targets (Model B). This is designed for a minority of pupils who may need, for whatever reason, to spend more time on other subjects, for example, to develop a special talent in music or foreign languages. Model B has been designed to be challenging at all levels, and will lead to a single award GCSE. If a pupil who has taken this course wishes to continue with the study of advanced level science post-16 he or she may need to take a bridging course.

45. There may also be some pupils who wish to undertake more extended or specialist study of science in the fourth key stage than is required by the attainment targets and programmes of study. Subject to the requirements of Section 1 of the Act, and provided they cover the attainment targets and programmes of study in either Model A or Model B, they are free to do so. It is for schools themselves to decide what are the most appropriate arrangements to meet the needs of their pupils, bearing in mind the Secretary of State's view that all schools should offer at least Model A. It will be for SEAC to consider any necessary changes in GCSE syllabuses to ensure that they are consistent with the attainment targets and programmes of study, and that there are appropriate arrangements for the assessment and certification of attainment in any extension studies.

46. Under Section 17 of the Education (No 2 ) Act 1986, LEAs must make a statement of current policy for the secular curriculum for county, voluntary and special schools which they maintain. This may state the LEA's policy on the provision of one or other, or both, of the Models for science in the fourth key stage. This may, however, be subject to modification by a school's governing body under Section 18 of the 1986 Act. The head teacher is required to secure the organisation and delivery of the secular curriculum in accordance with the governing body's current statement, including any modification of the local authority's policy: it will be for the head teacher to determine in individual cases which Model an individual pupil pursues where both are offered by the school.

## IX CROSS-CURRICULAR THEMES

47. Aspects of cross-curricular themes are covered in the mathematics and science attainment targets and programmes of study. For example, in science, aspects of health education are covered in Attainment Targets 3 and 4, and environmental education in Attainment Targets 8 and 9. The mathematics framework may make a useful contribution to consumer education and economic awareness.

48. Some schools may wish to bring together a number of cross-curricular aspects in the mathematics and science framework. They are free to do so. The NCC is considering a framework for the whole curriculum and this may, in due course, lead to recommendations and guidance on a coordinated approach to cross-curricular themes.

## X REVIEW AND UPDATING

49. NCC is responsible for keeping the National Curriculum under review and advising the Secretary of State on requirements for changes in the light of experience. Her Majesty's Inspectorate will also be monitoring schools' experience of the statutory requirements. In addition the Department will be making its own evaluation.

50. The provisions contained in the Orders and the associated Documents will be updated and revised as necessary in the light of experience.

## XI ASSESSMENT ARRANGEMENTS

51. The achievement of each individual pupil in each of the applicable mathematics and science attainment targets will have to be assessed at or near the end of each key stage by a combination of externally-determined standard assessment tasks (SATs) and teachers' own assessments. As a general basis for these arrangements, the Government has accepted the general model proposed by the Task Group on Assessment and Testing (see paragraphs 40-45 of Circular 5/89 for more details on assessment). SEAC has been invited to consider and advise on the detailed development and implementation of these arrangements. The precise arrangements will be determined by the Secretary of State in the light of advice from SEAC in good time before the first cohorts of pupils concerned, those aged 5 and 11 in 1989, reach the end of key stages 1 and 3 respectively in summer 1991 and summer 1992.

52. In the meantime, schools will wish to build on their existing assessment and recording procedures and apply them to pupils from around the start of each key stage:

i. to ensure that individual pupils are working at the appropriate level for any given attainment target and programme of study;

ii. to be able to inform those with an interest — and most notably parents, or other teachers with either current or imminent responsibility for the pupil — about any individual pupil's progress; and

iii. to build up a bank of relevant information about a pupil's progress, including possibly samples of work, on which to draw in the context of any discussions about the level that a pupil is judged to have reached at the end of the key stage.

53. It is intended to make Regulations shortly governing the relevant recording arrangements. These arrangements will come into force for all pupils attending maintained primary, secondary or

special schools, including grant-maintained schools, from 1 September 1989. Whilst they will apply to all pupils, they will have a particular relevance to those to whom the Orders, on which this Circular provides guidance, relate.

54. Regulations will be introduced later under Section 22 of the Act covering, inter alia, the manner and form in which the recorded assessments of individual pupils are to be made available to parents and other interested parties, and the manner and form in which the recorded aggregate results of schools are to be made available more generally. As indicated in paragraphs 20, 24 and 26 the results of the assessments of the first cohort of pupils to enter the first, second and third key stage in these subjects will not be required to be reported formally to parents. Assessments in both these subjects will however be required to be reported formally for the second and subsequent cohorts.

## XII PUPILS WITH SPECIAL EDUCATIONAL NEEDS

55. Paragraphs 32 to 35 above have explained that the range of levels specified in the Orders for the four key stages should be broad enough to cover the substantial majority of the ability spectrum at each reporting age. Paragraph 36 has explained the flexibility which the Orders allow for dealing with pupils: for example some pupils with special educational needs, who need to be taught at levels outside the ranges specified for key stages. The Government does not envisage that it will be necessary to prepare Regulations under Section 17 of the Act to modify or disapply the ranges specified in the Orders for pupils with special educational needs.

56. A statement of special educational needs under the 1981 Education Act may modify or disapply any or all of the requirements of the National Curriculum if they are inappropriate for an individual pupil. This ensures that any departure from the National Curriculum will be decided in the light of educational, medical, psychological and other evidence about the pupil, including the views of the pupil's parents. That procedure is subject to consultation with parents and to their right of appeal under the 1981 Act.

57. The provisions under Section 19 of the Education Reform Act 1988, which will be the subject of statutory consultations, will allow head teachers temporarily to disapply or modify the National Curriculum's requirements for individual pupils where they judge that a pupil falls within the cases and circumstances to be specified in the Regulations. These provisions may be applied to pupils with special educational needs as to all other pupils. They, like others, may be subject to medical problems, family crises, and other major difficulties which may make temporary withdrawal from the National Curriculum necessary. In addition these temporary withdrawal measures may also be used, not automatically, but in cases where it is considered essential, in respect of a pupil who is believed to have special educational needs, and is either being assessed or reassessed under the 1981 Act, or is having a statement of special educational needs prepared.

58. Schools should bear in mind that the objective of the National Curriculum is to ensure that each pupil should obtain maximum benefit, by stretching the pupil to reach his or her potential, but without making impossible demands. Provisions for modification or disapplication should be applied sensitively and positively.

59. It is the responsibility of the local educaton authority to ensure that pupils with statements of special educational needs have their statements amended, if this is necessary, to take account of the introduction of the National Curriculum, in time to meet the timetable set out in paragraphs 16 to 29 above.

## XIII PREPARING FOR IMPLEMENTATION

60. A comprehensive statement of statutory responsibilities in relation to the National Curriculum is set out in Circular 5/89. Those responsible for implementing the mathematics and science requirements may wish to be aware of further guidance in preparation, and may find it helpful to be reminded of the resources and opportunities which are available for carrying out their responsibilities.

61. Schools are being given two additional closure days in calendar year 1989 in order to make preparations for the introduction of the National Curriculum. Those schools with pupils to whom the mathematics and science attainment targets will apply from the beginning of the Autumn term 1989 may wish to use part of this additional time to prepare for the implementation of the mathematics and science requirements.

62. LEAs may also wish to make use of the existing Education Support Grant (ESG) funding for primary science and technology, for mathematics, and the new ESG provision for the core curriculum subjects; and of provision made under the Local Education Authority Training Grants Scheme (LEATGS).

63. The Department's Circulars on the 1989-90 ESG programme and the LEATGS invited schools to prepare National Curriculum Development Plans. Plans will need to reflect the timetable for the introduction of the mathematics and science requirements.

64. NCC, in association with SEAC, plan to issue non-statutory guidance to help teachers with implementation, giving priority to teachers involved in introducing the mathematics and science requirements from Autumn 1989. In addition NCC are working with the Open University to produce training materials.

65. For the purpose of enabling development work or experiments to be carried out, Section 16 of the Act provides that the Secretary of State may direct, as respects a particular maintained school, that the provisions of the National Curriculum shall not apply, or shall apply with modifications. This Section has now been brought into effect by means of The Education Reform Act 1988 (Commencement No. 5) Order 1989 made on 6 February. This enables proposals for development work and experiments which would require disapplication or modification of the statutory requirements for mathematics and science to be approved by the Secretary of State, if appropriate. The detailed arrangements for this are set out in paragraphs 49 to 54 of Circular 5/89. The Secretary of State has made clear that he is not disposed as a matter of policy to make exceptions for development projects in the first year of operation of the National Curriculum.

## XIV DISTRIBUTION ARRANGEMENTS

66. Three copies of this Circular are being sent directly to all primary, middle deemed primary schools and special schools. They are also being sent copies of the mathematics and science Documents in ring binders. Five sets of all the Documents for each subject, together with the ring binders, are being sent directly to all secondary and middle deemed secondary schools. The ring binders and Documents will be the property of the school. LEAs have been asked to indicate how many additional copies of the documents and ring binders they will require. These will be sent to LEAs for distribution. Further priced copies of the Documents will be available from HMSO.

67. As and when modifications are made (in accordance with Section 20 of the Act) to the mathematics and science attainment targets and programmes of study, amendment pages will be distributed.

68. The text of the Documents is also expected to be available on disc for those who might wish to use this for training purposes or for analysis in devising schemes of work. Further details will be available, in due course, from the contact points given in paragraph 3 above.

D J S HANCOCK

Prepared by the Department of Education and Science. Produced by the Central Office of Information 1989.
Printed in the UK for HMSO Dd8172070. C2750 3/89 EDUCJ0314NE.

The Education Reform Act 1988 provides for the establishment of a National Curriculum for all pupils of compulsory school age in maintained schools in England and Wales.

The National Curriculum comprises English, mathematics and science as core subjects and seven other foundation subjects: history, geography, technology, a modern foreign language, music, art and physical education. Additionally, in Wales, Welsh is a core subject in Welsh-speaking schools and an eighth foundation subject in the remainder.

The Act provides for the Secretary of State to specify in relation to each core and other foundation subject such attainment targets, programmes of study and assessment arrangements as he considers appropriate. This document contains details of the attainment targets, programmes of study and assessment arrangements for mathematics, as specified by Order.


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**Prepared by the Department of Education and Science. Produced by the Central Office of Information 1989.**
**Printed in the UK for HMSO. Dd 8172869. EDUC J8104NE.**