



Independent Schools  
Examinations Board

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# COMMON ENTRANCE AT 11+ & 13+ COMMON ACADEMIC SCHOLARSHIP AT 13+

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## MATHEMATICS

### Draft Specification

For teaching from September 2021 onwards

For examinations from November 2022 onwards



## ISEB CORE AIMS

Pupils who have pursued a course of study based on CE specifications and assessments will:

- Be equipped not only for the next stage of their education, but for life-long learning based on a secure foundation of subject knowledge, concepts and skills and be able to apply what they know to new situations.
- Be enthusiastic learners who are open to new ideas and experiences, curious, questioning and keen to experiment.

They will:

- Enjoy reading and be able to articulate clearly orally and in writing.
- Have the confidence to think, weigh up evidence and make up their own minds, and the resilience to learn from their mistakes.
- Have the skills to work independently and collaboratively.
- Understand how subjects connect with each other.
- Demonstrate cultural and environmental awareness and empathy, developing an understanding of their place in the world.



## INTRODUCTION

**N.B. The content of this specification is a revision of the specification released in 2014 for 13+. The content of this specification for 11+ is unchanged.**

The CE Mathematics specification is designed to instil in pupils the importance of the subject and its associated skills. It should motivate, inspire, encourage and reward pupils for their progress and achievements in Mathematics. The specification should encourage a breadth of experience in the development of pupils' mathematical skills. It should encourage the development of investigative thinking, reasoning and the application of mathematical knowledge to unfamiliar situations. It should provide pupils with a solid foundation for their future learning and give them a degree of confidence in themselves and the subject.

## AIMS

**A course leading to ISEB assessment in Mathematics at 11+ and 13+ should:**

- enable pupils to become fluent with fundamental mathematical concepts;
- encourage the development of investigative thinking, problem solving and reasoning skills;
- develop pupils' analytical skills, enabling them to select appropriate methods;
- encourage pupils to work logically and express mathematical ideas clearly, correctly and succinctly;
- instil confidence and resilience through an appreciation of the value of learning from mistakes;
- promote the idea that everyone can be successful in mathematics;
- motivate and reward pupils by enabling them to recognise and take satisfaction from their progress;
- instil in pupils the importance of the subject and its associated skills, including the applications of mathematics in other disciplines;
- enable pupils to recognise the beauty of mathematics through an appreciation of the simplicity and elegance with which mathematics expresses profound and interconnected ideas;
- provide a solid foundation for future progress.

## ASSESSMENT OBJECTIVES

### 11+

Candidates should be familiar with the skills and knowledge of the National Curriculum key stage 2 programmes of study. The principal focus of mathematics teaching at 11+ is:

- to ensure that pupils extend their understanding of the number system and place value to include larger integers
- to develop the connections which pupils make between multiplication and division with fractions, decimals, percentages and ratio
- to develop pupils' ability to solve a wider range of problems, including increasingly complex properties of numbers and arithmetic, and problems demanding efficient written and mental methods of calculation
- to introduce pupils to the language of algebra as a means for solving a variety of problems
- to consolidate and extend knowledge developed in number in geometry and measure; to ensure that pupils classify shapes with increasingly complex geometric properties and that they learn the vocabulary they need to describe them
- to ensure that pupils are fluent in written methods for all four operations, including long multiplication and division, and in working with fractions, decimals and percentages
- to ensure that pupils read, spell and pronounce mathematical vocabulary correctly

### 13+

During key stage 3, candidates build on the skills which they developed in key stage 2 and increasingly make connections between different aspects of mathematics. Candidates should build on key stage 2 and connections across mathematical ideas to develop fluency, mathematical reasoning and competence in solving increasingly sophisticated problems. They should also be able to apply their mathematical knowledge in science, geography, computing and other subjects.

Candidates should be familiar with the skills and knowledge of the National Curriculum key stage 3 programmes of study *as specified in the summary* (page 32).

## ASSESSMENTS

### Common Entrance at 11+

### Marks

	Marks	
One paper	100	60 minutes

Topics are centred on the National Curriculum for key stage 2 with particular reference to the Year 5 and 6 programmes of study; because of the timing of the 11+ examinations in November and January, not all statements will be examined, but it is recommended that those topics not included in the examination specification should still be taught in Year 6.

Candidates will be required to work one paper of 60 minutes' duration. All candidates should answer as many questions as possible. Whilst candidates should be familiar with the use of calculators, calculating aids may not be used in the examination.

### Common Entrance at 13+ Core Papers (all candidates)

### Marks

		Marks	
Paper 1	Non-calculator	100	60 minutes
Paper 2	Calculator	100	60 minutes
Short Mental Arithmetic Test		40	10 minutes

All candidates will be required to take two papers, one non-calculator and one calculator, each of 60 minutes' duration, and a short mental arithmetic test (10 minutes).

Candidates who show capability will **also** have the option of taking the additional paper, of 60 minutes duration. Calculators may be used for this paper.

### Common Entrance at 13+ Additional Paper (optional)

### Marks

	Marks	
One paper	100	60 minutes

### Common Academic Scholarship

### Marks

	Marks	
One paper	100	90 minutes

The Common Academic Scholarship Examination (90 minutes) will be based on the 13+ Common Entrance specification *for the Additional Paper*.

## 11+ SUBJECT CONTENT

In the specification below:

- the complete key stage 2 programmes of study for Years 5 and 6 are shown in the left-hand column
- *elements of the programme shown in italics will not be examined* at Common Entrance, but it is recommended that they still be taught before the end of Year 6; including non-statutory work
- further guidance and clarification about what will be examined at 11+ is given in the right-hand column
- for more detailed information, preparatory schools are advised to look at the *National Curriculum in England: Mathematics Programmes of Study* document, <https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study> published in September 2013 and updated in July 2014, including non-statutory notes and guidance

## 11+ MATHS

### National Curriculum descriptors

### 11+ examination guidance

#### NUMBER

Pupils should be taught to:

##### number and place value - Year 5

read, write, order and compare numbers to at least 1 000 000 and determine the value of each digit

count forwards or backwards in steps of powers of 10 for any given number up to 1 000 000

interpret negative numbers in context, count forwards and backwards with positive and negative whole numbers, including through zero

round any number up to 1 000 000 to the nearest 10, 100, 1000, 10 000 and 100 000

solve number and practical problems which involve all of the above

read Roman numerals to 1000 (M) and recognise years written in Roman numerals

##### number and place value - Year 6

read, write, order and compare numbers to at least 10 000 000 and determine the value of each digit

round any whole number to a required degree of accuracy

use negative numbers in context, and calculate intervals across zero

## 11+ MATHS (continued)

### National Curriculum descriptors

### 11+ examination guidance

#### addition, subtraction, multiplication and division - Year 5

solve number and practical problems which involve all of the above

include multistep problems, using the four operations and any relevant skills from those listed

add and subtract whole numbers with more than 4 digits, including using formal written methods (columnar addition and subtraction)

add and subtract numbers mentally with increasingly large numbers

use rounding to check answers to calculations and determine, in the context of a problem, levels of accuracy

solve addition and subtraction multi-step problems in contexts, deciding which operations and methods to use and why

identify multiples and factors, including finding all factor pairs of a number, and common factors of two numbers

know and use the vocabulary of prime numbers, prime factors and composite (non-prime) numbers

establish whether a number up to 100 is prime and recall prime numbers up to 19

multiply numbers up to 4 digits by a one- or two-digit whole number using a formal written method, including long multiplication for two-digit numbers

multiply and divide numbers mentally drawing upon known facts

include mental recall of multiplication and division facts up to  $12 \times 12$

divide numbers up to 4 digits by a one-digit number using the formal written method of short division and interpret remainders appropriately for the context

multiply and divide whole numbers and those involving decimals by 10, 100 and 1000



## 11+ MATHS (*continued*)

### National Curriculum descriptors

### 11+ examination guidance

recognise and use square numbers and cube numbers, and the notation for squared (<sup>2</sup>) and cubed (<sup>3</sup>)

solve problems involving addition, subtraction, multiplication and division including using their knowledge of factors and multiples, squares and cubes

solve problems involving addition, subtraction, multiplication and division and a combination of these, including understanding the meaning of the equals sign

solve problems involving multiplication and division, including scaling by simple fractions and problems involving simple rates

#### **addition, subtraction, multiplication and division – Year 6**

multiply multidigit numbers up to 4 digits by a two-digit whole number using the formal written method of long multiplication

divide numbers up to 4 digits by a two-digit number using the formal written method of long division and interpret remainders as whole number remainders, fractions, or by rounding, as appropriate for the context

*only division by numbers up to 12 or multiples of 10 will be examined, but teaching of division by other two-digit numbers in Year 6 is advised*

divide numbers up to 4 digits by a two-digit number using the formal written method of short division where appropriate, interpreting remainders according to the context

*only division by numbers up to 12 or multiples of 10 will be examined, but teaching of division by other two-digit numbers in Year 6 is advised*

perform mental calculations, including with mixed operations and large numbers

identify common factors, common multiples and prime numbers

use their knowledge of the order of operations to carry out calculations involving the four operations

solve addition and subtraction multistep problems in contexts, deciding which operations and methods to use and why

solve problems involving addition, subtraction, multiplication and division

## 11+ MATHS (continued)

### National Curriculum descriptors

### 11+ examination guidance

use estimation to check answers to calculations and determine, in the context of a problem, an appropriate degree of accuracy

#### fractions (including decimals and percentages) - Year 5

compare and order fractions whose denominators are all multiples of the same number

identify, name and write equivalent fractions of a given fraction, represented visually, including tenths and hundredths

recognise mixed numbers and improper fractions and convert from one form to the other and write mathematical statements  $> 1$  as a mixed number [for example,  $\frac{2}{5} + \frac{4}{5} + \frac{6}{5} = 2\frac{2}{5}$ ]

add and subtract fractions with the same denominator and denominators which are multiples of the same number

multiply proper fractions and mixed numbers by whole numbers, supported by materials and diagrams

read and write decimal numbers as fractions [for example,  $0.71 = \frac{71}{100}$ ]

decimals up to three decimal places

recognise and use thousandths and relate them to tenths, hundredths and decimal equivalents

round decimals with two decimal places to the nearest whole number and to one decimal place

read, write, order and compare numbers with up to three decimal places

solve problems involving numbers up to three decimal places

recognise the per cent symbol (%) and understand that per cent relates to 'number of parts per hundred', and write percentages as a fraction with denominator 100, and as a decimal

solve problems which require knowing percentage and decimal equivalents of  $\frac{1}{2}$ ,  $\frac{1}{4}$ ,  $\frac{1}{5}$ ,  $\frac{2}{5}$ ,  $\frac{4}{5}$  and those fractions with a denominator of a multiple of 10 or 25

solve number, measure, money and practical problems involving listed fraction, decimal and percentage skills

## 11+ MATHS (continued)

### National Curriculum descriptors

### 11+ examination guidance

#### fractions (including decimals and percentages) - Year 6

use common factors to simplify fractions; use common multiples to express fractions in the same denomination

compare and order fractions, including fractions  $> 1$

examination limited to fractions whose denominations are multiples of the same number, e.g.  $\frac{5}{6}$  and  $\frac{11}{12}$

*add and subtract fractions with different denominators and mixed numbers, using the concept of equivalent fractions*

*only fractions whose denominators are multiples of the same number will be examined and not mixed numbers, but teaching in Year 6 is advised*

multiply simple pairs of proper fractions, writing the answer in its simplest form [for example,

$$\frac{1}{4} \times \frac{1}{2} = \frac{1}{8}]$$

divide proper fractions by whole numbers [for example,  $\frac{1}{3} \div 2 = \frac{1}{6}$ ]

*this will not be examined, but teaching in Year 6 is advised*

*associate a fraction with division and calculate decimal fraction equivalents [for example, 0.375] for a simple fraction [for example,  $\frac{3}{8}$ ]*

*this will not be examined, but teaching in Year 6 is advised*

*identify the value of each digit in numbers given to three decimal places and multiply and divide numbers by 10, 100 and 1000 giving answers up to three decimal places*

*this will not be examined, but teaching in Year 6 is advised*

multiply one-digit numbers with up to two decimal places by whole numbers

use written division methods in cases where the answer has up to two decimal places

*this will not be examined, but teaching in Year 6 is advised*

solve problems which require answers to be rounded to specified degrees of accuracy

*this will not be examined, but teaching in Year 6 is advised*

## 11+ MATHS *(continued)*

### National Curriculum descriptors

### 11+ examination guidance

#### fractions (including decimals and percentages) - Year 6 *(continued)*

recall and use equivalences between simple fractions, decimals and percentages, including in different contexts

limited to halves, quarters, fifths, tenths and hundredths

## RATIO and PROPORTION

Pupils should be taught to:

### Year 6 only

solve problems involving the relative sizes of two quantities where missing values can be found by using integer multiplication and division facts

solve problems involving the calculation of percentages [for example, of measures, and such as 15% of 360] and the use of percentages for comparison

examination of percentages limited to multiples of 10, or 25% or 75%; but teaching in Year 6 of other percentages is advised

*solve problems involving similar shapes where the scale factor is known or can be found*

solve problems involving unequal sharing and grouping using knowledge of fractions and multiples

11+ MATHS (continued)

National Curriculum descriptors

11+ examination guidance

**ALGEBRA**

Pupils should be taught to:

**Year 6 only**

use simple formulae

will involve simple words and letters

NB: the treatment of algebra will be largely informal with the emphasis upon understanding that letters can represent unknowns and variables

generate and describe linear number sequences

will include finding term-to-term rules

express missing number problems algebraically

find pairs of numbers that satisfy an equation with two unknowns

enumerate possibilities of combinations of two variables

National Curriculum descriptors

11+ examination guidance

**MEASUREMENT**

Pupils should be taught to:

**Year 5**

convert between different units of metric measure (for example, kilometre and metre; centimetre and metre; centimetre and millimetre; gram and kilogram; litre and millilitre)

understand and use approximate equivalences between metric units and common imperial units such as inches, pounds and pints

## 11+ MATHS *(continued)*

### National Curriculum descriptors

### 11+ examination guidance

#### Year 5 *(continued)*

measure and calculate the perimeter of composite rectilinear shapes in centimetres and metres

calculate and compare the area of rectangles (including squares), and including using standard units, square centimetres (cm<sup>2</sup>) and square metres (m<sup>2</sup>) and estimate the area of irregular shapes

estimate volume [for example, using 1-cm<sup>3</sup> blocks to build cuboids (including cubes)] and capacity [for example, using water]

solve problems involving converting between units of time

including solving problems involving time and timetables

use all four operations to solve problems involving measure [for example, length, mass, volume, money] using decimal notation, including scaling

#### Year 6

*solve problems involving the calculation and conversion of units of measure, using decimal notation up to three decimal places where appropriate*

*this will not be examined, but teaching in Year 6 is advised*

use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to three decimal places

*convert between miles and kilometres*

*this will not be examined, but teaching in Year 6 is advised*

recognise that shapes with the same areas can have different perimeters and vice versa

## 11+ MATHS (continued)

### National Curriculum descriptors

### 11+ examination guidance

#### Year 6 (continued)

*recognise when it is possible to use formulae for area and volume of shapes*

*candidates should recognise when it is possible to use formulae to calculate the areas of right-angled triangles, including standard units of  $\text{cm}^2$  and  $\text{m}^2$ , otherwise this will not be examined, but teaching in Year 6 is advised*

*calculate the area of parallelograms and (non right-angled) triangles*

*only area of right-angled triangles will be examined, but teaching of areas generally in Year 6 is advised*

*calculate, estimate and compare volume of cubes and cuboids using standard units, including cubic centimetres ( $\text{cm}^3$ ) and cubic metres ( $\text{m}^3$ ), and extending to other units [for example,  $\text{mm}^3$  and  $\text{km}^3$ ]*

*find the volume of shapes by counting cubes and know the unit  $\text{cm}^3$  will be examined*

### National Curriculum descriptors

### 11+ examination guidance

## GEOMETRY - properties of shape

Pupils should be taught to:

#### Year 5

identify 3-D shapes, including cubes and other cuboids, from 2-D representations

will involve simple words and letters  
NB: the treatment of algebra will be largely informal with the emphasis upon understanding that letters can represent unknowns and variables

## 11+ MATHS (continued)

### National Curriculum descriptors

### 11+ examination guidance

#### Year 5 (continued)

know angles are measured in degrees; estimate and compare acute, obtuse and reflex angles

will include finding term-to-term rules

draw given angles, and measure them in degrees ( $^{\circ}$ )

identify:

angles at a point and one whole turn (total  $360^{\circ}$ )

angles at a point on a straight line and a half turn (total  $180^{\circ}$ )

other multiples of  $90^{\circ}$

use the properties of rectangles to deduce related facts and find missing lengths and angles

distinguish between regular and irregular polygons based on reasoning about equal sides and angles

#### Year 6

draw 2-D shapes using given dimensions and angles

*recognise, describe and build simple 3-D shapes, including making nets*

*this will not be examined, but teaching in Year 6 is advised*

compare and classify geometric shapes based on their properties and sizes and *find unknown angles in any triangles, quadrilaterals, and regular polygons*

*only finding angles in triangles and rectangles will be examined, but teaching in Year 6 of finding other unknown angles is advised*

*illustrate and name parts of circles, including radius, diameter and circumference and know that the diameter is twice the radius*

*this will not be examined, but teaching in Year 6 is advised*

recognise angles where they meet at a point, are on a straight line, or are vertically opposite angles and angles in a triangle, and find missing angles



11+ MATHS (continued)

National Curriculum descriptors

11+ examination guidance

**GEOMETRY - position and direction**

Pupils should be taught to:

**Year 5**

identify, describe and represent the position of a shape following a reflection or translation, using the appropriate language, and know that the shape has not changed

recognise that shapes with the same areas can have different perimeters and vice versa  
draw 2D shapes using given dimensions and angles

**Year 6**

describe positions on the full coordinate grid (all four quadrants)

only describing and plotting positions on a 2D grid as coordinates in the first quadrant will be examined, but teaching in Year 6 is advised

draw and translate simple shapes on the coordinate plane, and reflect them in the axes

reflecting in coordinate axes will not be examined, but teaching in Year 6 is advised

11+ MATHS (*continued*)

National Curriculum descriptors

11+ examination guidance

**STATISTICS**

Pupils should be taught to:

**Year 5**

solve comparison, sum and difference problems using information presented in a line graph

complete, read and interpret information in tables, including timetables

to include information presented in bar charts, pictograms, tables, line graphs and time graphs  
the collection and recording of discrete data including in grouped frequency tables, to include tallying

**Year 6**

interpret (*and construct*) pie charts and line graphs and use these to solve problems

candidates will be expected to interpret pie charts, including connecting their work on angles, fractions, and percentages; *the construction of pie charts will not be examined but teaching in Year 6 is advised*

calculate and interpret the mean as an average

data limited to discrete values in lists as frequency tables (but not grouped frequency tables)

## 13+ SUBJECT CONTENT

In the specification below:

- a brief outline of topics for the 13+ core papers is provided in the first table
- an outline of further topics for the additional paper is provided in the second table
- further guidance and examples of what will be examined at 13+ is given in the centre and right-hand columns
- national curriculum topics are provided in the final table to indicate which elements are examined at core and/or additional level
- for more detailed information, prep schools are advised to look at the *National Curriculum in England: Mathematics Programmes of Study* document, <https://www.gov.uk/government/publications/national-curriculum-in-england-mathematics-programmes-of-study> published in September 2013 and updated in July 2014, including non-statutory notes and guidance

## CORE LEVEL

Pupils should have knowledge and understanding of:

Further guidance

Examples (*not an exhaustive list*)

	NC	Number				
<b>Place Value</b>	1	Whole number and decimal place value Value of digits Placing numbers on number lines $\times$ and $\div 10$ , etc.				
<b>Ordering <math>&lt;</math>, <math>&gt;</math>, <math>=</math></b>	2	Ordering integers, decimals, fractions and percentages, including negatives and comparing using $<$ , $>$ , $=$ signs	$5.7 > 5.14$	$\frac{3}{5} = \frac{6}{10}$		3.08, 3.16, 3.8, 3.9, 31.6
<b>Prime numbers</b>	3	Identify prime numbers	120			105
<b>Factors</b>		List all factors of a number	$= 12 \times 10$			$= 5 \times 21$
<b>Multiples</b>		List multiples	$= 3 \times 2 \times 2 \times 2 \times 5$			$= 5 \times 3 \times 7$
<b>Common factors</b>		HCF and LCM tested implicitly				
<b>Common multiples</b>		Indices may be required for product of prime factors	What is the largest number that divides exactly into 120 and 105?			
<b>Highest Common Factor</b>						
<b>Lowest Common Multiple</b>						
<b>Product of prime factors</b>						
<b>4 operations including written formal methods for integers, decimals and fractions</b>	4	Arithmetic with fractions will be restricted to vulgar fractions but may require answers as mixed numbers Related word problem questions Fluency in times tables up to $12 \times 12$ expected	$12.8 + 5.72$ $87 \div 0.3$ $\frac{8}{15} \times \frac{9}{20}$	$58 - 5.8$ $\frac{5}{8} + \frac{7}{12}$	$1.7 \times 0.6$ $\frac{5}{9} - \frac{2}{9}$	$218 \times 43$ $12 \div \frac{2}{3}$

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Number		
<b>Mixed operations</b>	5	Including squares, cubes, square roots and use of brackets	$15 - 3 \times 4 + 1$ $= 15 - 12 + 1$ $= 4$	$2 \times 3^2 - (3 + 1)$ $= 2 \times 9 - 4$ $= 14$
				$4 - 12 \div 2$ $= 4 - 6$ $= -2$
<b>Inverse operations</b>	6	Understand the relationships between operations and their inverses		
<b>Powers and Roots</b>	7	Including powers of negative numbers		$\sqrt{81} + (-2)^3 - \sqrt[3]{27}$
<b>Conversion between Fractions, decimals and percentages</b>	9	Answers may have recurring decimals	$0.4 = \frac{4}{10}$ $= \frac{2}{5}$	$0.35 = \frac{35}{100}$ $= \frac{7}{20}$
				Convert to decimals: $\frac{7}{20}$ , $\frac{3}{8}$ , $\frac{5}{6}$
<b>Expressing one quantity as a fraction of another</b>	10			Tim has £7 and spends 42p. What fraction has he spent?
<b>Finding percentages of quantities</b>	10	Non-calculator methods for simple percentages, such as 5% or 30% Calculator methods for harder examples	10% : £3.20 20% : £6.40	increase = $0.23 \times £4500$ $= £1035$
<b>Expressing one quantity as a percentage of another</b>	10			Write 600g as a percentage of 2kg

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Number	
<b>Changing a quantity by a percentage</b>	10	Usually using a calculator Calculating profit and loss	A TV cost £250 but is increased in price by 17% Find the new price.
<b>Finding a percentage change</b>	10	Usually using a calculator	A shirt is bought for £56 and is sold for £44.80 Find the percentage loss.
<b>Rounding numbers</b>	13	Including to nearest 100, 10, whole number and decimal places Answers will be expected to be rounded sensibly where appropriate (Significant figures not required)	
<b>Estimation</b>	14	Rounding numbers sensibly to aid estimation Associated word problems	$\frac{348.2}{70.6} \approx \frac{350}{70}$ $= 5$ Estimate the cost of 41 books at £19.97 each.
<b>Ratio</b>	38 39 40 41	Expressing in simplest form Multiplying up to a given total or difference	8 : 12      3 : 5 2 : 3      21 : 35    35 cats
<b>Use of calculator</b>	15	Including use of ( ) $\sqrt{\quad}$ $x^2$ $x^y$ $\pi$	

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Algebra
<b>Simplification</b>	17 $x$ and $\div$ 20 Collecting like terms Multiplying out brackets Factorising by numerical factor	$3a^2 \times 2a$ $(3a)^2 + 2a^2$ $\frac{9a-a}{2}$ $\frac{15x}{3x}$ $5a - 2b - a + 4b$ $3a^2 + 2a^2$ $10 - 3(2a + 3)$ Factorise: $18a + 12$
<b>Substitution</b>	18 Substituting, including negatives and simple fractions, into expressions and given formulae	$a = 3, \quad b = -5, \quad c = \frac{1}{2}$ Find the value of $2a^2 - 3b$ , $\frac{\sqrt{10a+b}}{2}$ , $\frac{a}{c}$
<b>Forming expressions</b>	19	Jane has $x$ stars. Peter has 3 fewer than Jane. Sonia has twice as many as Peter. Peter: $x - 3$ Sonia: $2(x - 3)$
<b>Equations</b>	22 Solve linear equations and use to solve problems 23 These may have: a single denominator, fractional and negative solutions, brackets, variable on both sides	$3a + 2 = 14$ , $5a - 1 = 8$ $9a + 2 = 5a + 30$ , $\frac{a+3}{5} = 4$ $9(2a + 1) = 27$ , $\frac{2}{3}a - 1 = 9$
<b>Formulae</b>	22 Use of known and given formulae. 23 Drawing a line graph from a real-world formula	$s = u + at$ Find the value of $s$ when $u = -5, \quad a = 9.8$ and $t = 12$

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Algebra
<b>Straight line graphs</b>	26 In the form: 27 $y = \pm a$ , $x = \pm a$ , $y = \pm x$ 28 $y = mx + c$ 29 Gradient and $y$ intercept <b>not</b> required but own table of values or similar may be needed	Draw and label the lines $y = -5$ and $y = 3x - 2$
<b>Sequences</b>	31 Sequences may be arithmetic or geometric 32 $n^{\text{th}}$ term will not be tested explicitly, but may be useful 33 Consideration of square number, triangular numbers, Fibonacci, etc.	5, 8, 11, 14, ... Find next term. Find 20 <sup>th</sup> term. A sequence is made by $\times 3$ and $+1$ from previous term. Find 3 <sup>rd</sup> term. Find 1 <sup>st</sup> term.

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Measurement
<b>Metric units</b>	36 Knowledge, conversion and problems involving: mm, cm, m, km    g, kg    l, ml    s Knowledge and problems involving $^{\circ}\text{C}$ , square and cubic units	



**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Measurement
<b>Other units</b>	36 Knowledge, conversion and problems involving £, p, hours, minutes Some knowledge of °F, miles, feet, inches	
<b>Time</b>	Knowledge of 12-hour and 24-hour clock Calculating time and using timetables Relationship between times in hours expressed as mixed numbers or decimals and hours and minutes	Midnight 00 00 12:00a.m.  A train leaves at 11 38 and travels for $1\frac{3}{4}$ hours. When does it arrive?
<b>Money</b>	12 Knowledge of £ and p and common UK coins and notes 43 45 Problems involving calculations with and without a calculator	
<b>Speed, distance and time</b>	45 Understanding of units of speed: km/h, m/s, mph Use of formulae Answers may be expressed in hours and minutes Some simple mental methods for speed relating to 15, 20 or 30 minutes	$T = \frac{D}{S} = \frac{120\text{km}}{80\text{km/h}} = 1\frac{1}{2}\text{hours}$ = 1 hour, 30 mins 3 miles in 15 minutes. Speed = 4 x 3 =12 mph
<b>Area</b>	46 Area of rectangle, triangle, parallelogram, trapezium and composite shapes	$A = \frac{b \times h}{2}$
<b>Perimeter</b>	47 Perimeter of common shapes and composite shapes	

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

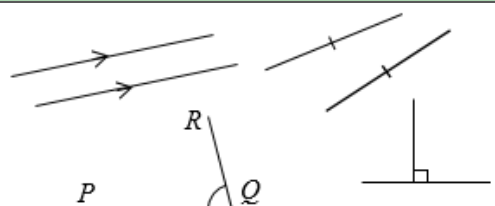
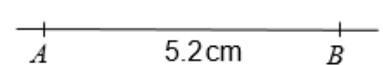
	NC	Measurement	
<b>Pi</b>	46	Area and circumference of circles	$A = \pi r^2$ $C = \pi D$
	47	Area and perimeter of sectors and composite shapes	
<b>Solids, nets, volume Isometric drawing</b>	60	Faces, edges, vertices Draw net of cuboid or prism on a grid Find surface area and/or volume of cuboid Draw cuboids on isometric grid	$V = l \times w \times h$
	68	Including conversion graphs, scatter graphs, travel graphs Draw, read off value and make predictions Reading from a curve may be required (but <b>not</b> drawing of curve)	

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Geometry
<b>Geometric terminology and symbols</b>	50 Parallel, perpendicular, right-angle, equal, regular, 51 irregular, equilateral, isosceles, similar, congruent  52 Point, line and angle notation: $PQ$ , $\angle PQR$	
<b>Measure and draw angles and lines</b>	52 Measure and draw line segments to nearest mm Measure and draw angles to the nearest degree	
<b>2D shapes</b>	50 Names and properties of polygons: triangle though to decagon Quadrilaterals: (isosceles) trapezium, parallelogram, kite, rhombus, rectangle, square Triangles: isosceles, equilateral, right-angled, scalene	
<b>Line symmetry</b> <b>Rotational symmetry</b>	50 Recognise and draw lines of symmetry Recognise order of rotational symmetry	
<b>Coordinates</b>	25 In all 4 quadrants, usually integer values	
<b>Transformations on coordinate grid</b>	53 Translation (in the form 3 units to the left, 1 unit down), reflection, rotation, enlargement (by positive integer) 55 Use of linear and area scale factor	

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Geometry
<b>Angle calculations</b>	55 Vertically opposite angles, angles on a straight line, 56 angles at a point, alternate and corresponding angles, and angles in triangles Multi-step angle chasing problems	
<b>Angles in polygons</b>	57 Finding exterior, interior and related angles 58 Finding the sum of the interior angles Knowledge of triangle: $180^\circ$ , quadrilateral: $360^\circ$ Finding the number of sides of a regular polygon	

**CORE LEVEL** *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Probability and Statistics		
<b>Probability</b>	62	Understanding probability ranges from 0 to 1		
	63	(impossible to certain)		
	64	Expressing probabilities as a fraction in lowest terms Listing all possible outcomes Finding likely number of events from a probability Some knowledge of dice and playing cards expected	$p(\text{red}) = \frac{8}{12}$  $= \frac{2}{3}$	H H H T H H H H T T H T H T H T T H H T T T T T
<b>Averages</b>	66	Finding mean, median, mode and range of a set of data	5 , 12 , 7 , 8 , 7 , 9	
		Understanding usefulness of types of average	$\text{mean} = \frac{48}{6}$ $= 8$	$\downarrow$ 5, 7, 7, 8, 9, 12
		Using mean to find total and next value	mode = 7	median = 7.5 range = 12 - 5 = 7
<b>Frequency tables, bar charts, pie charts</b>	67	Construct bar chart from a frequency table Interpret bar chart or pie chart		

## FURTHER TOPICS FOR ADDITIONAL LEVEL

Pupils should have knowledge and understanding of:

Further guidance

Examples (*not an exhaustive list*)

	NC		Number	
<b>Pythagoras' Theorem</b>	59 60			
<b>Further algebra</b>				
• Rearranging formulae	22			
• Simultaneous equations	25 30	2 equations and 2 variables, may be in context Solved algebraically or graphically		$5a + 2b = 39$ $3a - b = 19$
• Equations with more than one denominator	21			$\frac{2x}{3} + \frac{x-3}{4} = 5$
• Multiplying out brackets by a variable		May be required for further simplification or rearranging of formulae		
• Factorising by a variable				$5x(2x - 3) - x(x + 1)$ $5x^2 + x$
• Quadratic equations	35	Simple examples or solved graphically		$x^2 = 9$ $x(x + 2) = 2x + 16$
• Algebraic proof		May be asked to 'show that ...' Candidates should use $\square$ (a box) or Q.E.D. to conclude a proof		
<b>Plotting curves</b>				
	27	May be parabolic or reciprocal		$y = 10 - (x + 1)^2$
	31	May require own table of values or similar May be used for graphical solutions to equations		$y = \frac{5}{x}$
<b>Volume and surface area of prisms and cylinders</b>				
	46			

## FURTHER TOPICS FOR ADDITIONAL LEVEL *(continued)*

Pupils should have knowledge and understanding of:

Further guidance

Examples *(not an exhaustive list)*

	NC	Number
<b>Reverse percentages</b>	43	Finding the original value
<b><math>n^{\text{th}}</math> term of sequences</b>	32	May be tested explicitly
<b>Multi-part journeys</b>	45	Find average speed over multi-part journeys
<b>Enlargement by fractional scale factor</b>	54	
<b>HCF and LCM</b>	3	May be tested explicitly
<b>Significant figures</b>	13	
<b>Standard form</b>	8	With positive indices

## MENTAL ARITHMETIC: USEFUL STRATEGIES

### Addition and Subtraction

Commutative and not commutative

$$3 + 5 = 5 + 3 \quad (10 - 3 \neq 3 - 10)$$

Finding 10's complements, etc.

$$\begin{aligned} 8 + 5 + 2 + 5 \\ = 10 + 10 \end{aligned}$$

$$\begin{aligned} 23 + 94 - 3 + 106 \\ = 20 + 200 \end{aligned}$$

Using near multiples of 10, etc.

$$\begin{aligned} 19 + 32 \\ = 20 + 30 + 1 \end{aligned}$$

Relationship to multiplication

$$\begin{aligned} 7 + 7 + 7 + 7 + 7 \\ = 7 \times 5 \end{aligned}$$

$$\begin{aligned} 7 + 8 + 9 \\ = 8 \times 3 \end{aligned}$$

Subtraction by counting on

$$\begin{aligned} 57 - 48 \quad (\text{but understanding of the order must be maintained; not } 48 - 57) \\ = 7 + 2 \end{aligned}$$

Use of place value

$$360 - 123 \quad \text{subtract 100, subtract 20, subtract 3: } 360 \rightarrow 260 \rightarrow 240 \rightarrow 237$$

$$40 + 200 + 3$$



## MENTAL ARITHMETIC: USEFUL STRATEGIES *(continued)*

### Multiplication and Division

#### Extending from known times tables

$$7 \times 12 \rightarrow 7 \times 13$$

$$7 \times 12 \rightarrow 7 \times 24$$

$$4 \times 3 \rightarrow 40 \times 30$$

$$3 \times 9 \rightarrow 270 \div 90$$

$$6 \times 7 \rightarrow 4.2 \div 7$$

#### Finding multiples of 10, etc.

$$2 \times 17 \times 5$$

$$= 10 \times 17$$

#### Halving and doubling, etc.

$$5 \times 14$$

$$= 10 \times 7$$

$$15 \times 16$$

$$= 30 \times 8$$

$$28 \times 25$$

$$= 7 \times 100$$

## WHAT'S OUT AND WHAT'S IN?

a quick reference to some of the major changes

### What's OUT

#### From the Core Level

- |  |  |
|--|--|
| • Bearings                                   | Map scale drawings will <b>not</b> be examined, but candidates will still be expected to know compass directions                                       |
| • Constructions                              | Accurate drawing will <b>not</b> be examined, but candidates will still be expected to measure lengths and angles accurately                           |
| • Drawing of pie charts                      | Candidates will <b>not</b> be expected to draw pie charts but will still be expected to interpret them   |
| • Significant figures                        | Candidates will be specifically asked to round to nearest whole number, multiple of 10 or decimal place.<br>Estimation may involve 'sensible' rounding |
| • Determining averages from frequency tables | Frequency tables will be used, and mean, median and mode will be examined, but <b>not</b> from data extracted from a frequency table                   |

#### From the Additional Level

- All the above from the Core Level **except significant figures**
- Solving inequalities

## WHAT'S OUT AND WHAT'S IN? (*CONTINUED*)

### What's IN

#### From ALL levels

- |  |   |
|--|---|
| • Written mental arithmetic  | Tested in a new-style Mental Arithmetic paper with written questions rather than aural                                |
| • Increased testing of core skills (with fewer words)                                      |   |
| • Writing units in answers   |   |
| • Questions with less scaffolding  | Candidates will less often be led through problems step by step   |
| • An increased number of thought-provoking puzzles   | More unfamiliar problems may be presented towards the end of papers to encourage candidates to explore and experiment |
| • Expectation of greater quality of thought and working, rather than quantity of questions |   |

## NATIONAL CURRICULUM

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>NUMBER</b>			
1	understand and use place value for decimals, measures and integers of any size	✓	✓
2	order positive and negative integers, decimals and fractions; use the number line as a model for ordering of the real numbers; use the symbols =, ≠, <, >, ≤, ≥	=, <, > only	✓
3	use the concepts and vocabulary of prime numbers, factors (or divisors), multiples, common factors, common multiples, highest common factor, lowest common multiple, prime factorisation, including using product notation and the unique factorisation property	HCF and LCM terminology not expected	✓
4	use the 4 operations, including formal written methods, applied to integers, decimals, proper and improper fractions, and mixed numbers, all both positive and negative	mixed number arithmetic will not be examined, but answers may be required as mixed numbers	✓
5	use conventional notation for the priority of operations, including brackets, powers, roots and reciprocals	✓	✓
6	recognise and use relationships between operations including inverse operations	✓	✓
7	use integer powers and associated real roots (square, cube and higher), recognise powers of 2, 3, 4, 5 and distinguish between exact representations of roots and their decimal approximations	powers may go above 5 in puzzle questions	✓
8	interpret and compare numbers in standard form $A \times 10^n$ $1 \leq A < 10$ , where n is a positive or negative integer or 0	not examined	using positive indices only
9	work interchangeably with terminating decimals and their corresponding fractions (such as 3.5 and $\frac{7}{2}$ or 0.375 and $\frac{3}{8}$ )	✓	✓

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>NUMBER</b> ( <i>continued</i> )			
10	define percentage as 'number of parts per hundred', interpret percentages and percentage changes as a fraction or a decimal, interpret these multiplicatively, express 1 quantity as a percentage of another, compare 2 quantities using percentages, and work with percentages greater than 100%	percentages will be less than 100%	✓
11	interpret fractions and percentages as operators	✓	✓
12	use standard units of mass, length, time, money and other measures, including with decimal quantities	✓	✓
13	round numbers and measures to an appropriate degree of accuracy [for example, to a number of decimal places or significant figures]	significant figures will not be examined	✓
14	use approximation through rounding to estimate answers and calculate possible resulting errors expressed using inequality notation $a < x \leq b$	errors expressed using inequality notation $a < x \leq b$ will not be examined	
15	use a calculator and other technologies to calculate results accurately and then interpret them appropriately	✓	✓
16	appreciate the infinite nature of the sets of integers, real and rational numbers	not examined	✓

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>ALGEBRA</b>			
17	use and interpret algebraic notation, including: <ul style="list-style-type: none"> <li><math>ab</math> in place of <math>a \times b</math></li> <li><math>3y</math> in place of <math>y + y + y</math> and <math>3 \times y</math></li> <li><math>a^2</math> in place of <math>a \times a</math>, <math>a^3</math> in place of <math>a \times a \times a</math>; <math>a^2b</math> in place of <math>a \times a \times b</math></li> <li><math>\frac{a}{b}</math> in place of <math>a \div b</math></li> <li>coefficients written as fractions rather than as decimals</li> <li>brackets</li> </ul>		
		✓	✓
		✓	✓
		✓	✓
		✓	✓
		✓	✓
		✓	✓
18	substitute numerical values into formulae and expressions, including scientific formulae	knowledge and understanding of scientific formulae not expected	
19	understand and use the concepts and vocabulary of expressions, equations, inequalities, terms and factors	solving inequalities not examined	
20	simplify and manipulate algebraic expressions to maintain equivalence by: <ul style="list-style-type: none"> <li>collecting like terms</li> <li>multiplying a single term over a bracket</li> <li>taking out common factors</li> <li>dividing an expression by an integer or by another expression</li> <li>expanding products of 2 or more binomials</li> </ul>		
		✓	✓
		only number outside the bracket	may have variable outside bracket
		factor restricted to an integer	✓
		✓	✓
		not examined	

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>ALGEBRA (continued)</b>			
21	understand and use standard mathematical formulae; rearrange formulae to change the subject	rearranging formulae not expected but may be useful	✓
22	model situations or procedures by translating them into algebraic expressions or formulae and by using graphs	✓	may include simultaneous equations
23	use algebraic methods to solve linear equations in 1 variable (including all forms which require rearrangement)	✓	✓
24	use algebraic methods to solve linear equations in 2 variables (including all forms which require rearrangement)	not examined	✓
25	work with coordinates in all 4 quadrants	✓	✓
26	recognise, sketch and produce graphs of linear and quadratic functions of 1 variable with appropriate scaling, using equations in $x$ and $y$ and the Cartesian plane	functions will be linear in the form $y = \dots$	functions may require rearranging and may be quadratic
27	interpret mathematical relationships both algebraically and graphically	✓	✓
28	reduce a given linear equation in two variables to the standard form $y = mx + c$ ; calculate and interpret gradients and intercepts of graphs of such linear equations numerically, graphically and algebraically	$y$ intercept and gradient will not be examined	
29	use linear and quadratic graphs to estimate values of $y$ for given values of $x$ and vice versa and to find approximate solutions of simultaneous linear equations	graphical solutions to simultaneous equations will not be examined	graphical solutions to simultaneous equations may be examined
30	find approximate solutions to contextual problems from given graphs of a variety of functions, including piece-wise linear, exponential and reciprocal graphs	✓	✓
31	generate terms of a sequence either from a term-to-term or a position-to-term rule	✓	✓
32	recognise arithmetic sequences and find the $n$ th term	$n^{\text{th}}$ term will not be explicitly examined	$n^{\text{th}}$ term may be examined explicitly

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>ALGEBRA</b> <i>(continued)</i>			
33	recognise geometric sequences and appreciate other sequences which arise	✓	✓
34	solving simple linear inequalities	not examined	
35	solving simple quadratic equations	not examined	equations such as $x^2 = 9$ or $x(x + 2) = 2x + 16$



	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>RATIO, PROPORTION and RATES OF CHANGE</b>			
36	change freely between related standard units (for example time, length, area, volume/capacity, mass)	✓	✓
37	use scale factors, scale diagrams and maps	map scales and bearings will not be examined	
38	express one quantity as a fraction of another, where the fraction is less than 1 and greater than 1	✓	✓
39	use ratio notation, including reduction to simplest form	✓	✓
40	divide a given quantity into 2 parts in a given part:part or part:whole ratio; express the division of a quantity into 2 parts as a ratio	ratios may have up to 3 parts	
41	understand that a multiplicative relationship between 2 quantities can be expressed as a ratio or a fraction	✓	✓
42	relate the language of ratios and the associated calculations to the arithmetic of fractions and to linear functions	✓	✓
43	solve problems involving percentage change, including: percentage increase, decrease and original value problems and simple interest in financial mathematics	reverse percentages to find original value will not be examined	✓
44	solve problems involving direct and inverse proportion, including graphical representations	inverse proportion will not be examined	✓
45	use compound units such as speed, unit pricing and density to solve problems	knowledge of the term <i>density</i> will not be expected	average speed for multi-part journeys may be examined knowledge of the term <i>density</i> will not be expected

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>GEOMETRY and MEASURES</b>			
46	derive and apply formulae to calculate and solve problems involving: perimeter and area of triangles, parallelograms, trapezia, volume of cuboids (including cubes) and other prisms (including cylinders)	volume of prisms other than cuboids will not be examined candidates not expected to derive formulae	✓
47	calculate and solve problems involving: perimeters of 2-D shapes (including circles), areas of circles and composite shapes	radius or diameter will be given	candidates may be expected to find radius or diameter
48	draw and measure line segments and angles in geometric figures, including interpreting scale drawings	draw and measure line segments and angles only  in the examination, candidates will not be expected to draw accurately plane figures or scale drawings	
49	derive and use the standard ruler and compass constructions (perpendicular bisector of a line segment, constructing a perpendicular to a given line from/at a given point, bisecting a given angle); recognise and use the perpendicular distance from a point to a line as the shortest distance to the line	accurate drawing will not be examined  recognising the perpendicular distance from a point to a line as the shortest distance may be useful	
50	describe, sketch and draw, using conventional terms and notations: points, lines, parallel lines, perpendicular lines, right angles, regular polygons, and other polygons which are reflectively and rotationally symmetric	regular polygons will be limited to those whose exterior angle is an integral number of degrees names of polygons up to decagons will be expected	✓
51	use the standard conventions for labelling the sides and angles of triangle ABC, and know and use the criteria for congruence of triangles	✓	✓
52	derive and illustrate properties of triangles, quadrilaterals, circles, and other plane figures [for example, equal lengths and angles] using appropriate language and technologies	✓	✓
53	identify properties of, and describe the results of, translations, rotations and reflections applied to given figures	vector terminology will not be examined; translations will be described in terms of units moved left/right and up/down	

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>GEOMETRY and MEASURES</b> <i>(continued)</i>			
54	identify and construct congruent triangles, and construct similar shapes by enlargement, with and without coordinate grids	construction of triangles will not be examined enlargements will be by positive whole numbers linear and area scale factor may be examined	enlargements may be by a positive fractional scale factor  candidates may be required to deduce the scale factor and centre of enlargement
55	apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles	✓	✓
56	understand and use the relationship between parallel lines and alternate and corresponding angles	✓	✓
57	derive and use the sum of angles in a triangle and use it to deduce the angle sum in any polygon, and to derive properties of regular polygons	✓	✓
58	apply angle facts, triangle congruence, similarity and properties of quadrilaterals to derive results about angles and sides, including Pythagoras' Theorem, and use known results to obtain simple proofs	Pythagoras' Theorem will not be examined proofs will not be examined	Pythagoras' Theorem may be examined but not derived
59	use Pythagoras' Theorem and trigonometric ratios in similar triangles to solve problems involving right-angled triangles	Pythagoras' Theorem will not be examined trigonometry will not be examined	Pythagoras' Theorem may be examined but not derived trigonometry will not be examined
60	use the properties of faces, surfaces, edges and vertices of cubes, cuboids, prisms, cylinders, pyramids, cones and spheres to solve problems in 3-D	limited to cubes, cuboids, pyramids and prisms	limited to cubes, cuboids, pyramids, prisms and cylinders
61	interpret mathematical relationships both algebraically and geometrically	✓	✓

	National Curriculum Descriptors Pupils should be taught to:	Core Level	Additional Level
<b>PROBABILITY and STATISTICS</b>			
62	record, describe and analyse the frequency of outcomes of simple probability experiments involving randomness, fairness, equally and unequally likely outcomes, using appropriate language and the 0-1 probability scale	✓	✓
63	understand that the probabilities of all possible outcomes sum to 1	✓	✓
64	enumerate sets and unions/intersections of sets systematically, using tables, grids and Venn diagrams	Venn diagrams will not be examined explicitly	
65	generate theoretical sample spaces for single and combined events with equally likely, mutually exclusive outcomes and use these to calculate theoretical probabilities	combined events may be listed in a table	
66	describe, interpret and compare observed distributions of a single variable through: appropriate graphical representation involving discrete, continuous and grouped data; appropriate measures of central tendency (mean, mode, median) and spread (range, consideration of outliers)	✓	✓
67	construct and interpret appropriate tables, charts, and diagrams, including frequency tables, bar charts, pie charts, and pictograms for categorical data, and vertical line (or bar) charts for ungrouped and grouped numerical data	candidates may be asked to interpret pie charts but not to draw them	
68	describe simple mathematical relationships between 2 variables (bivariate data) in observational and experimental contexts and illustrate using scatter graphs	✓	✓