Qualifications and Curriculum Authority

Assessing pupils' progress in mathematics at Key Stage 3: Standards File

Pupil W

department for
children, schools and families

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Pupil W – Year 7 – Secure level 4

Assessing pupils' progress in mathematics at Key Stage 3

Assessment summary

Pupil W's attainment in mathematics overall is best described as secure 4. His performance is stronger in number and algebra and weaker in using and applying mathematics.

Using the Standards Files

- The current Standards Files are based on work planned and assessed in relation to the 1999 National Curriculum programme of study. A new set of Standards Files based on the 2008 National Curriculum are currently in production, but the current set will provide useful guidance on making APP assessments against national standards in the transition period as the new programmes of study are introduced.

- The commentaries in the Standards Files are provided for guidance and reference, and are much more extensive than any teacher would be expected to make when carrying out APP assessments. It is also important to remember that APP encourages and enables a broader overview of current learning, and that there is no need to collect special portfolios of pupils' work. Evidence from pupils' written and oral work, backed up by brief teacher's notes where necessary, is all that is required.

- The evidence base presented in each Standards File is necessarily partial, as it would of course be impractical to reproduce all of each pupil's work. Examples of each pupil's work have been selected to provide evidence to support judgements against APP criteria. This evidence should be considered in conjunction with the teacher's notes, which will provide a broader context and further justification for the assessments that are made.

Assessment focus

Using and applying mathematics; Algebra

Context

Classwork: In a unit of work on the properties of numbers and number sequences, pupils investigated handshakes. Their challenge was to find how many handshakes would take place if each of them shook hands once with everyone else in the class.

Teacher's notes

- begins methodically, working out the number of handshakes for 0, 1, 2, 3 people etc

- reasons about the numbers… 'the first person does three, the second person does another two, the third does one and the fourth person hasn't got to do any more, so that's six'

- organises a table of results for one to six people accurately, even though his diagrams are incomplete

- uses the pattern of differences to predict that 7 people will make 21 handshakes

Next steps

- compare results with others

- discuss how to create clear, complete diagrams

- use diagrams to check his and others' predictions

- use the number pattern to work out the number of handshakes for the whole class

- start to record predictions

Assessment focus

Calculating

Context

At the beginning of a unit on comparing and ordering decimals, pupils multiplied whole numbers and decimals by 10, 100 and 1000 using mental and informal written methods.

Teacher's notes

- multiplies whole numbers by 10, 100 and 1000

- is beginning to multiply decimals with one or two decimal places by 10, 100 and 1000

Next steps

- articulate what happens to each digit when multiplying by powers of 10

- estimate answers when multiplying decimals e.g. 0.53 × 1000 is roughly half of 1000 i.e. about 500

- discuss decimal notation and pupil's answers such as 00.3 and 516.0

- divide by 10, 100, 1000 and make links with multiplication

- understand the conventions associated with recording zero in numbers

Assessment focus

Calculating

Context

In a unit on using multiplication facts and division as the inverse operation, pupils divided by single digit numbers and then by two-digit numbers. The examples are drawn from work in two consecutive lessons.

Teacher's notes

- understands division as the inverse of multiplication

- uses short division to divide by a single digit number

- begins to use a chunking method to divide by a two-digit number

- lists multiples of the divisor to help

- use know facts, doubling, halving and place value to multiply by 40, 20, 10, 5 and 2 mentally

- uses a compact method to subtract three-digit numbers

Next steps

- develop and refine the chunking method, e.g. begin with a larger first chunk such as 30×26 rather than 20×26 followed by 10×26
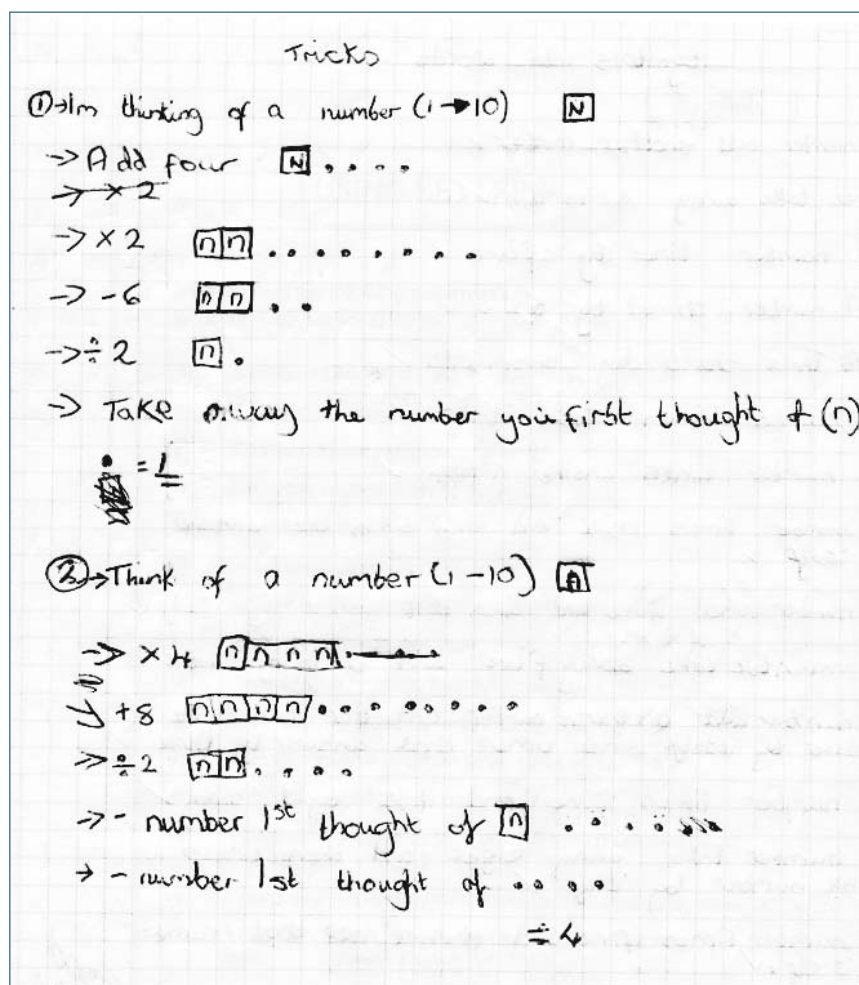
Assessment focus

Algebra, Calculating

Context

Classwork: At the beginning of a unit on algebraic expressions and equations, the teacher performed a series of "magic" mathematics tricks and then let the pupils in on the secret. The pupils created their own tricks, recording their methods, and performed the tricks at the end of the lesson.

Teacher's notes

- works with an unknown number that could have any value from 1 to 10

- records steps diagrammatically

- designs a trick as a series of operations, eventually eliminating the variable to leave a constant – the 'magic' answer

- understands that multiplication is distributive over addition, when he multiplies $n + 4$ by 2 and recognises that $(2n + 2) \div 2 = n + 1$, although he records the expressions as

$\boxed{n}\ \boxed{n}\ \bullet\ \bullet$ and $\boxed{n}\ \bullet$

Next Steps

- record steps using algebraic notation

Assessment focus

Algebra

Context

During a unit of work on algebraic expressions and equations, pupils constructed expressions to represent situations in arithmetic. In this lesson pupils were given statements and asked to write 'a number' as a letter or variable.

Teacher's notes

- uses letter symbols to represent unknown numbers
- uses index notation to represent squaring and cubing numbers
- understands the role of brackets and uses them to preserve the order of operations in particular examples
- begins to use conventional notation, e.g. $4x$ rather than $4 \times x$ but not yet consistently (e.g. $x^2 \times 3$)

Next steps

- express generalisations drawn from practical situations algebraically

What the teacher knows about Pupil W's attainment in number and algebra

Pupil W understands that addition and multiplication are commutative. He demonstrates an understanding that multiplication is distributive over addition even though he does not use these terms. He understands addition and subtraction and multiplication and division as inverse operations. He understands how brackets remove ambiguity in multi-step calculations and has begun to use indices to represent cubing and squaring. In his early work with algebra, Pupil W understands that algebraic operations follow the same conventions as number operations.

Pupil W uses letter symbols to represent unknown numbers and is beginning to manipulate algebraic expressions, recognising that $10(x + 7) = 10x + 70$ for example. He interprets the equals sign as 'has the same value as' and understands its role in an equation.

He is beginning to express the rule for a simple sequence in general terms. When building a pattern of tiles for a path for example, he described the general rule for the number of blue and white tiles in a path that is n tiles long as 'n lots of a blue and two whites'. With his group he decided how this could be recorded algebraically:
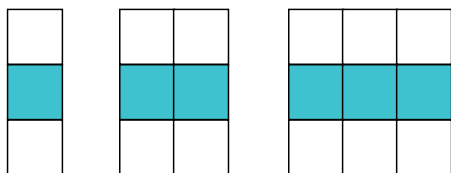
Total number of tiles $= n(B + 2W)$

Pupil W uses coordinates in the first quadrant.

He has a good understanding of place value. He orders decimals with up to three decimal places and rounds decimals to one or two decimal places. He uses place value to multiply whole numbers and, more recently, decimals by 10, 100, and 1000. Pupil W uses fractions to represent proportions of a whole and as positions on a number line between 0 and 1, when ordering probabilities for example. He recognises some fractions that are equivalent and uses this to convert a fraction such as $\frac{7}{20}$ into a decimal or percentage.

Pupil W continues sequences of numbers, including decimals and negative numbers, both forwards and backwards. He identifies properties such as multiple, factor and square. For example, he recognised all of the numbers in the sequence 6, 11, 16, 21, 26, 31… as one more than a multiple of 5 and predicted that 101 would be in the sequence.

Pupil W knows multiplication facts to 10×10 and uses them with doubling and halving to multiply two-digit numbers by a single digit number or multiple of 10 mentally. He uses multiplication facts when he divides, including dividing multiples of 10 by a single digit number mentally. He uses mental strategies to add and subtract two-digit and three-digit numbers. Pupil W has efficient written methods for adding several three-digit numbers and for subtraction and multiplication. He uses short division to divide larger numbers by a single digit number and is beginning to use a chunking method to divide by a two-digit number. When using a calculator to solve numerical problems he interprets the display in the context of the problem, for example interpreting 17.5 as £17.50.

Summarising Pupil W's attainment in number and algebra

Pupil W is beginning to demonstrate a few aspects of level 5, for example in his work with algebraic expressions and his efficient, compact non-calculator methods for adding, subtracting and multiplying two-digit and three-digit numbers. However, his performance in number and algebra still fits best with the level description for level 4, and his teacher describes it as high level 4. To consolidate level 4 and progress into level 5, he needs to develop his understanding of equivalent fractions to help him order a wider range of fractions for example. He needs to extend his written calculation methods to decimals and begin to solve problems involving simple ratio.

Assessment focus

Shape, space and measures

Context

Homework: At the beginning of a unit on shapes and their properties, pupils classified and measured angles.

Teacher's notes

- identifies acute and obtuse angles
- measures angles to within 2°

Next steps

- identify and measure reflex angles, using a 360° angle measurer

- measure and calculate angles at a point on a straight line and at a point

Assessment focus

Shape, space and measures

Context

Homework: At the beginning of a unit on transformations, pupils reflected shapes in horizontal and vertical lines.

Reflect each of these shapes in the mirror line
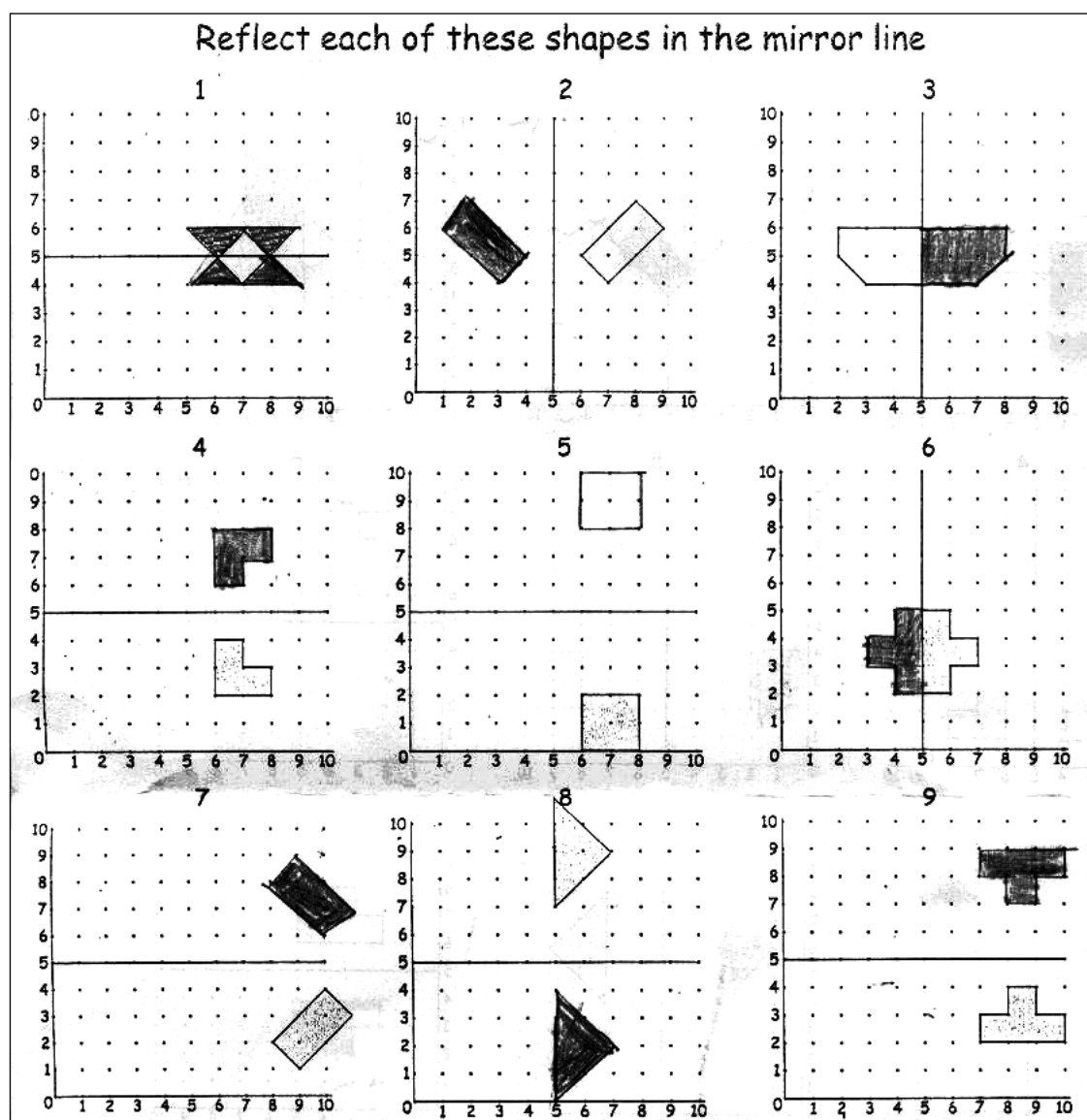
Teacher's notes

- reflects shapes about vertical and horizontal mirror lines
- begins to use the perpendicular distance of each vertex from the mirror line to reflect shapes that do not touch it or whose edges are not parallel or perpendicular to it

Next steps

- reflect shapes about a diagonal line e.g. about $y = x$

What the teacher knows about Pupil W's attainment in shape, space and measures

Pupil W uses a range of properties of shapes. For example, he recognises parallel sides and perpendicular sides in given quadrilaterals and triangles. He knows that a quadrilateral with just one pair of parallel sides is a trapezium and a quadrilateral with two pairs of parallel sides is a parallelogram. In a group challenge, given the clues, 'this shape is a quadrilateral, it has just one pair of parallel sides and it also has sides that are perpendicular to each other', Pupil W identified the correct shape from a set of mixed shapes. He reasons about position and movement, for example when deciding which pentominoes[1] could be folded to create an open box. He reflects shapes on a grid about a horizontal or vertical mirror line although he is less successful when the mirror line is presented diagonally. He translates shapes horizontally and vertically.

Pupil W identifies acute and obtuse angles and measures them to within 2°. He knows there are 360° in a whole turn. He measures and draws lines to within 2mm. He finds areas of shapes by counting squares and is beginning to use the formula for the area of a rectangle. He works out perimeters by measuring and adding lengths. He uses the terms area and perimeter consistently accurately. He interprets the scale on other measuring instruments, for example reading a value of 'about 275 grams' on a scale with increments of 25g and labelled every 100g.

Summarising Pupil V's attainment in handling data

Pupil W's attainment in shape, space and measures is best described as secure level 4. To make further progress within level 4 and into level 5 he needs to reflect shapes in mirror lines that are presented diagonally, perhaps in the context of reflecting in the line $y = x$ and looking at the relationship between the coordinates of the object and the image. He needs to begin to identify rotational symmetry including the order of rotation. In measures, he needs to interpret timetables and calculate time durations. He needs to develop his understanding of angles to include reflex angles and begin to reason about angles at a point and at a point on a straight line. He should continue to develop competence by using measuring instruments to draw with greater accuracy.

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1   arrangements of five congruent squares joined edge to edge

Assessment focus

Handling data

Context

Classwork: Pupils experimented with spinners. Each pair tested one spinner to investigate the likelihood of winning, keeping a tally of the results of 50 trials. Results for the class were collated and discussed. The teacher introduced the probability scale from 0 to 1. Pupils used a worksheet to express probability as a fraction for the first time.

Teacher's notes

- builds on class discussion to place descriptions of likelihood and numerical probabilities on a number line
- draws on practical experience and begins to engage with theoretical probabilities
- considers what fraction of each spinner the win sector represents
- begins to record probabilities as fractions

Next steps

- use dice, sets of dominoes and other structured sets to work out theoretical probabilities of particular events
- compare theoretical probabilities with experimental data from using the materials
- estimate probabilities from experimental data in less structured situations e.g. the probability of Y7 pupils having been born on any particular day of the week by collecting data about their birth dates
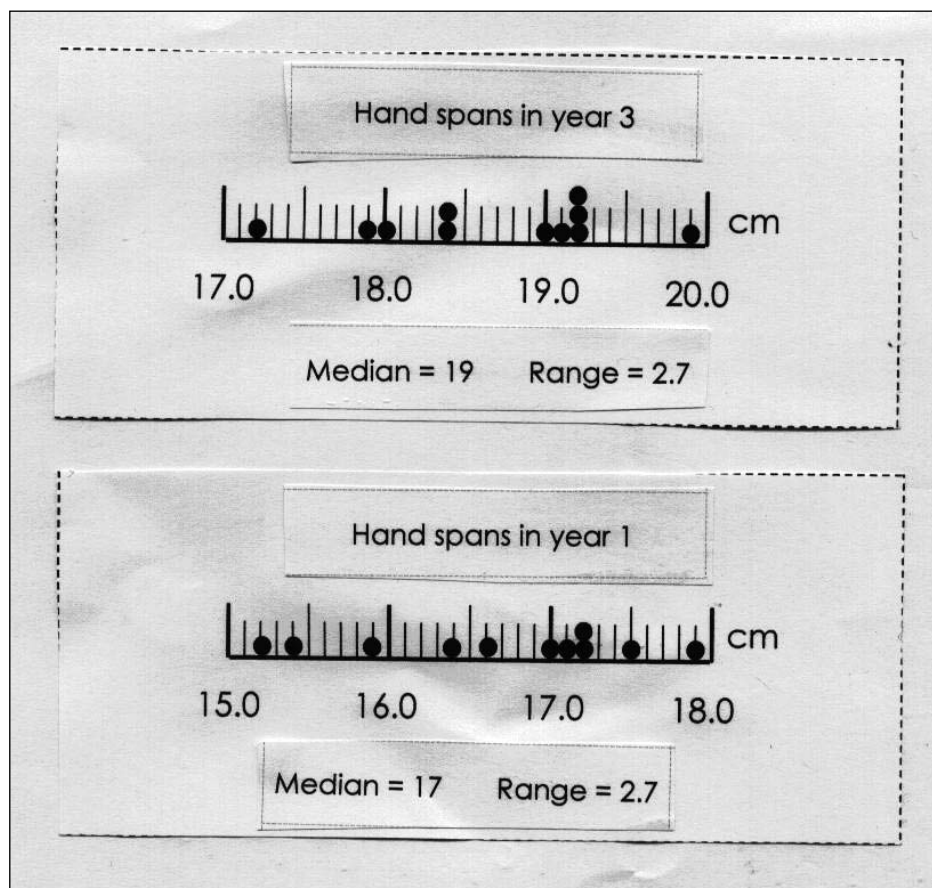
Assessment focus

Handling data

Context

Classwork: As part of a sequence of lessons on representing data and comparing sets of data using the median and range, pupils matched data to relevant statements and titles. Pupils worked in groups of three to consider six sets of data. As a record of the work each pupil retained two completed examples.

Teacher's notes

- understands median as the middle value in an ordered set of data
- counts the number of hand spans recorded and works out the position and value of the middle hand span in each display of data
- understands range as the difference between the minimum and maximum values
- compares sets and decides the year group that is represented
- explains that most of the hand spans for year 1 are less than those for year 3 and the median for year 1 is less
- notices that the range for each set is the same

Next steps

- compare the sets of data using the mode and talk about how the results differ
- talk about possible uses for the measures e.g. marketing gloves for children of a particular age

What the teacher knows about Pupil W's attainment in handling data

In class discussions about problems that might be addressed by statistical methods, Pupil W suggests questions and possible answers. He predicts results and collects and records discrete data to test his prediction. For example, when considering methods of transport to school he suggested a number of likely ways that pupils might travel. He suggested that walking would be the most common because there are lots of houses and flats near the school where pupils might live. He contributed to a class list of ways to travel and created his own table to record the results of a show of hands. In follow-up discussion, he suggested that results might be different in an older year group because more of the older pupils might cycle where pupils in year 7 might not be experienced enough to cycle in traffic.

With the support of probing questions Pupil W suggested, 'the difference between the smallest and the biggest hand in our class might be about the same as it was in year 1 and year 3, that's the same range, but our median will be bigger'. He interpreted an ordered list of hand span measurements for his class, from a spreadsheet, working out the median and range to test his prediction. He is beginning to recognise situations where the median or mode might be more suitable than the other. For instance, he recognised that the mode was not very helpful for the hand spans data from year 3. He explained, 'Just because three people got 19.2 cm that isn't really usual because 8 people didn't get that and most of the people were less than that.'

In the unit exploring handspan data he used the spreadsheet to group the data and plot bar charts for comparison. He constructs bar charts on paper, to represent how pupils travel to school for example. He also constructs simple line graphs such as a graph of the temperature in the classroom from a list of readings taken every 15 minutes over 3 hours. He chooses a suitable scale so that values can be read accurately enough and so that the graph will fit on the page.

Pupil W uses the language of probability appropriately. He places future occurrences of everyday events into order according to their likelihood. He understands the concept of a fairness in situations where each outcome is equally likely, for example when throwing a coin or using a spinner. He is beginning to express a theoretical probability as a fraction. He relates this to previous work on fractions and knows, for example, that $\frac{1}{3}$ is greater than $\frac{1}{4}$ so that an event with a probability of $\frac{1}{3}$ is more likely than an event with a probability of $\frac{1}{4}$.

Summarising Pupil W's attainment in handling data

Pupil W's attainment in handling data is judged to be secure level 4 even though he is beginning to demonstrate some aspects of level 5. To progress further within this level and into level 5 he needs more experience collecting and analysing grouped data using ICT where appropriate. He needs to extend the range of diagrams he uses for statistical representation to include simple pie charts and to develop his interpretation of graphs and diagrams. For example, he might use the temperature graph for a classroom to identify a period when the room was empty or use survey data about footwear in the class to predict the likelihood that the next pupil entering the room will be wearing shoes with laces.

What the teacher knows about Pupil W's attainment in using and applying mathematics

Pupil W uses group discussion to engage fully with problems and investigations. He draws on strategies that have been introduced in previous work. For example, in group discussion he suggested a way to find all possible pentominoes, recalling a strategy he had been shown for checking he had all possible arrangements of four squares in an earlier lesson. When engaging with the handshakes problem, Pupil W followed the teacher's example of using diagrams to model the handshakes. After completing the diagrams for 1, 2 and 3 people, he adapted the strategy and just worked out the extra handshakes needed when one more person joined the group. He used this to develop his table of results and predict how many would be needed for 7 people even though he did not persevere to find the number of handshakes needed for the whole class.

Pupil W is beginning to express the rule for a sequence of numbers in words; for example, he identified a pattern in the sequence 6, 11, 16, 21, 26, 31… He explained, 'The pattern goes up in fives, but they're not multiples of five. They are all one more than a multiple of 5.' He predicted that 101 would be in the sequence. When working on a problem of tiles for a path, he described the rule for a path that is n tiles long as 'n lots of a blue and two whites'. With the support of group discussion, he decided this could be recorded as $n(B + 2W)$.

He reasons about shapes, position and movement. For example, he used the clues, 'this shape is a quadrilateral, it has just one pair of parallel sides and it also has sides that are perpendicular to each other', to identify the correct shape from a set. He also worked out which pentominoes could be folded to create an open cube, before cutting out the shapes to check.

Summarising Pupil W's attainment in using and applying mathematics

Reviewing the way in which Pupil W uses the mathematics from across the other attainment targets and applies it to new situations, his teacher judges that his performance is best described as low in level 4. To make further progress within level 4, he needs to engage with a wider range of problems and investigations that involve using, more independently, appropriate mathematical procedures drawn from levels 3 and 4. He needs to develop ways to represent problems, for example using practical materials, diagrams or number sentences. He needs also to record steps in his solutions or investigations so that he can reflect on and check his approach as well as his accuracy. He needs to record his own conclusions to communicate to others or for himself at another time. He should try out his own ideas, perhaps by raising and following up his own questions or by suggesting an extension to a problem or investigation set for his group.

Pupil name.............W...........Class/group.........................Date.............

	Using and applying mathematics	Numbers and the number system	Calculating	Algebra	Shape, space and measure	Handling data
Level 5	• identify and obtain necessary information to carry through a task and solve mathematical problems • check results, considering whether these are reasonable • solve word problems and investigations from a range of contexts • show understanding of situations by describing them mathematically using symbols, words and diagrams • draw simple conclusions of their own and give an explanation of their reasoning ☐	• use understanding of place value to multiply and divide whole numbers and decimals by 10, 100 and 1000 and explain the effect • round decimals to the nearest decimal place and order negative numbers in context • recognise and use number patterns and relationships • use equivalence between fractions and order fractions and decimals • reduce a fraction to its simplest form by cancelling common factors • understand simple ratio ☐	• use known facts, place value, knowledge of operations and brackets to calculate including using all four operations with decimals to two places • use a calculator where appropriate to calculate fractions/percentages of quantities/measurements • understand and use an appropriate non-calculator method for solving problems that involve multiplying and dividing any three-digit number by any two-digit number • solve simple problems involving ordering, adding, subtracting negative numbers in context • solve simple problems involving ratio and direct proportion • apply inverse operations and approximate to check answers to problems are of the correct magnitude ☐	• **construct, express in symbolic form, and use simple formulae involving one or two operations** • use and interpret coordinates in all four quadrants ☐	• use a wider range of properties of 2-D and 3-D shapes and identify all the symmetries of 2-D shapes • use language associated with angle and know and use the angle sum of a triangle and that of angles at a point • reason about position and movement and transform shapes • measure and draw angles to the nearest degree, when constructing models and drawing or using shapes • read and interpret scales on a range of measuring instruments, explaining what each labelled division represents • solve problems involving the conversion of units and make sensible estimates of a range of measures in relation to everyday situations • understand and use the formula for the area of a rectangle and distinguish area from perimeter ☐	• ask questions, plan how to answer them and collect the data required • in probability, select methods based on equally likely outcomes and experimental evidence, as appropriate • understand and use the probability scale from 0 to 1 • understand and use the mean of discrete data and **compare two simple distributions, using the range and one of mode, median or mean** • understand that different outcomes may result from repeating an experiment • interpret graphs and diagrams, including pie charts, and draw conclusions • create and interpret line graphs where the intermediate values have meaning ☐
Level 4	• **develop own strategies for solving problems** • use their own strategies within mathematics and in applying mathematics to practical contexts • **present information and results in a clear and organised way** • search for a solution by trying out ideas of their own ☑	• **recognise and describe number patterns** • **recognise and describe number relationships including multiple, factor and square** • **use place value to multiply and divide whole numbers by 10 or 100** • **recognise approximate proportions of a whole and use simple fractions and percentages to describe these** • **order decimals to three decimal places** • begin to understand simple ratio ☑	• **use a range of mental methods of computation with all operations** • **recall multiplication facts up to 10 × 10 and quickly derive corresponding division facts** • **use efficient written methods of addition and subtraction and of short multiplication and division** • **multiply a simple decimal by a single digit** • solve problems with or without a calculator • check the reasonableness of results with reference to the context or size of numbers ☑	• **begin to use simple formulae expressed in words** • **use and interpret coordinates in the first quadrant** ☑	• use the properties of 2-D and 3-D shapes • **make 3-D models by linking given faces or edges and draw common 2-D shapes in different orientations on grids** • **reflect simple shapes in a mirror line, translate shapes horizontally or vertically and begin to rotate a simple shape or object about its centre or a vertex** • choose and use appropriate units and instruments • **interpret, with appropriate accuracy, numbers on a range of measuring instruments** • **find perimeters of simple shapes and find areas by counting squares** ☑	• **collect and record discrete data** • **group data, where appropriate, in equal class intervals** • continue to use Venn and Carroll diagrams to record their sorting and classifying of information • **construct and interpret frequency diagrams and simple line graphs** • **understand and use the mode and range to describe sets of data** ☑
BL	☐	☐	☐	☐	☐	☐
IE	☐	☐	☐	☐	☐	☐

Key: BL–Below Level   IE–Insufficient Evidence

Overall assessment (tick one box only)

Low 4 ☐	Secure 4 ☑	High 4 ☐	Low 5 ☐	Secure 5 ☐	High 5 ☐

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