



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

Pupil C



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Pupil C – Year 8 – Secure level 5

Assessing pupils' progress in mathematics at Key Stage 3

Assessment summary

Pupil C's attainment in each attainment target and in mathematics overall is best described as secure level 5.

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

Calculating

Context

Homework: At the beginning of a unit on calculating and solving numerical problems, pupils solved a series of problems involving the four operations. They interpreted their answers in the context of the question.

Home work

A teacher needs 220 book-lets. The book lets are sold in packets of 16. How many packets must the teacher order?

$220 \div 16 =$

$10 \times 16 = 160$
~~2x~~

$2 \times 16 = 32$

$1 \times 16 = 16$

10
2
1
1

14

$\begin{array}{r} 220 \\ 160 \\ \hline 60 \end{array}$

$\begin{array}{r} 560 \\ 32 \\ \hline 28 \end{array}$

$\begin{array}{r} 28 \\ 16 \\ \hline 12 \end{array}$

The teacher will need 14 packets because other-wise if she ordered 13 some children wouldn't have a leaflet.

Teacher's notes

- solves a word problem without a calculator
- identifies the appropriate operation to use
- uses a non-calculator method to divide a three-digit by a two-digit number
- rounds up after the division
- explains why rounding up is appropriate

Next steps

- solve more complex problems, for example, problems involving ratio and direct proportion
- refine the division method, for example, take fewer steps by using larger multiples of the divisor

Assessment focus

Numbers and the number system; Calculating

Context

Classwork: A mental mathematics lesson starter comparing fractions, decimals and percentages. Pupils had to fill in the gaps (the circled numbers were given by the teacher).

decimal	Percentage	fraction
<u>0.7</u>	70%	$\frac{35}{50}$
0.16	<u>16%</u>	$\frac{4}{25}$
<u>0.29</u>	29%	$\frac{29}{100}$
0.6	60%	<u>$\frac{3}{5}$</u>
0.65	<u>65%</u>	$\frac{13}{20}$
<u>1.24</u>	124%	$\frac{124}{100} = \frac{24}{100}$

Teacher's notes

- uses equivalence between fractions, decimals and percentages
- expresses an improper fraction as a mixed number
- reduces some of the fractions to their simplest form
- understands place value in decimals as well as whole numbers

Next steps

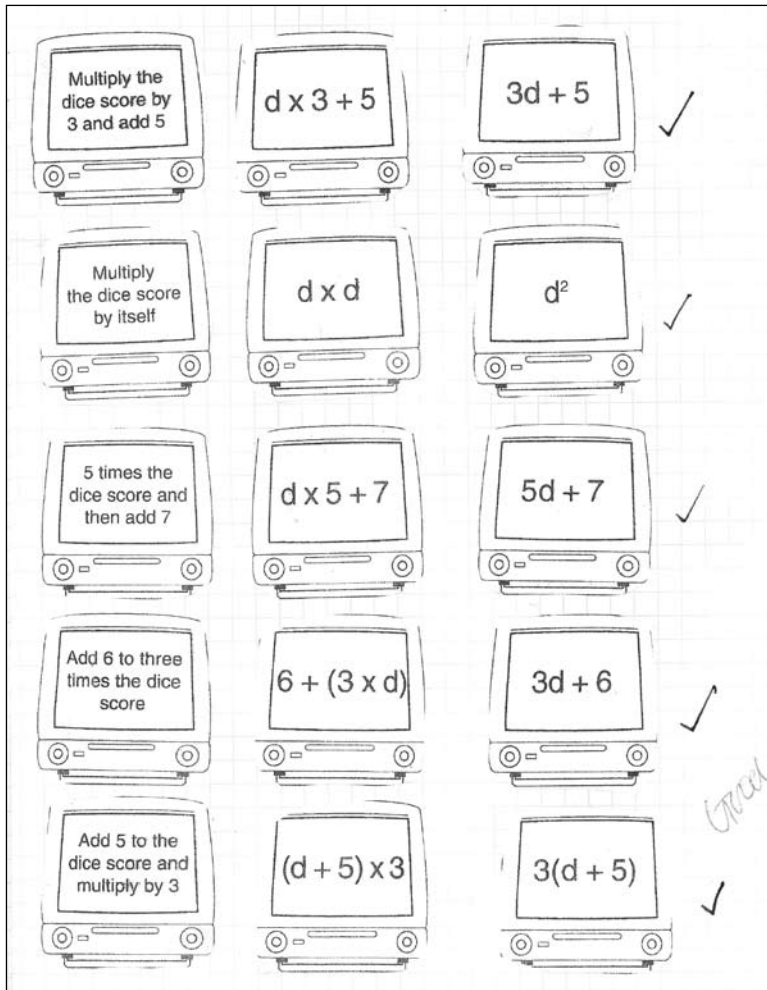
- extend understanding of place value to convert a wider range of values (e.g. 6%, 0.725)
- evaluate one number as a fraction or percentage of another simplifying fully where appropriate
- appreciate why it is important to record digits clearly, especially when using fraction notation

Assessment focus

Algebra

Context

Group work: During a unit on using algebra to express rules, groups of pupils sorted cards into sets of three. They substituted dice scores for d to check their results. They entered the calculations into a scientific calculator (algebraic logic) as a double check. Pupil C explained the results from her group to the rest of the class.



Teacher's notes

- understands the order of operations and use of brackets
- understands multiplication is commutative and explains why $(d + 5) \times 3$ is equal to $3(d + 5)$.
- understands algebra as generalised arithmetic
- justifies results to the class by demonstrating how she substituted values for d

Next steps

- match examples such as d^2 , without the assistance of examples such as $d \times d$
- link expressions to word sentences and explain the connection

Assessment focus

Algebra

Context

Classwork: Towards the end of a unit on using algebra to express rules, pupils manipulated algebraic expressions, including the use of a single pair of brackets.

1. $2(3f+5)$ $2 \begin{array}{cc} 2f & 5 \\ 4f & 10 \end{array} = 4f+10 \checkmark$

2. $3(2a+4)$ $3 \begin{array}{cc} 2a & 4 \\ 6a & 12 \end{array} = 6a+12 \checkmark$

3. $\frac{1}{2}(2e+5)$ $0.5 \begin{array}{cc} 2e & 5 \\ 1e & 2.5 \end{array} = 1e+2.5 \checkmark$

4. $6(4t+2)$ $6 \begin{array}{cc} 4t & 2 \\ 24t & 12 \end{array} = 24t+12 \checkmark$

5. $0.6(4y+7)$ $0.6 \begin{array}{cc} 4y & 7 \\ 2.4y & 4.2 \end{array} = 2.4y+4.2 \checkmark$

6. $5(2r-5)$ $5 \begin{array}{cc} 2r & 5 \\ 10r & 25 \end{array} = 10r-25 \checkmark$

7. $\frac{3}{4}(8a+b)$ $\frac{3}{4} \begin{array}{cc} 8a & 6 \\ 6a & 4.5 \end{array} = 6a+4.5 \checkmark$

8. $0.4(3j-5)$ $0.4 \begin{array}{cc} 3j & 5 \\ 1.2j & 2 \end{array} = 1.2j-2 \checkmark$

9. $6(3g-9)$ $6 \begin{array}{cc} 3g & 9 \\ 18g & 54 \end{array} = 18g-54 \checkmark$

10. $1.2(7y-8)$ $1.2 \begin{array}{cc} 7y & 8 \\ 8.4y & 9.6 \end{array} = 8.4y-9.6 \checkmark$

11. $-3(-2e+4)$ $-3 \begin{array}{cc} -2e & 4 \\ 6e & -12 \end{array} = 6e-12 \checkmark$

Teacher's notes

- understands multiplication is distributive over addition and subtraction
- multiplies by fractions and decimals such as $\frac{3}{4}$ and 0.6
- substitutes values to check her result has the same value as the original expression

Next steps

- extend to a wider range of expressions and values

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

Pupil C uses the order of operations in arithmetic. She has a good understanding of operations and relationships between them. She knows, for example, that addition and multiplication are commutative and that multiplication is distributive over addition and subtraction, and uses her own language to describe this. She has developed successful techniques for written calculations involving the four operations.

Pupil C understands that algebra is generalised arithmetic and that operations follow the same ordering conventions because symbols represent numbers. Pupil C manipulates algebraic expressions, multiplying an algebraic expression by a constant. She uses index notation and recognises for example that $3d \times d = 3d^2$. She checks results by substituting values into each expression to decide if they are equivalent or not.

Pupil C generates sequences, for example, when investigating border tiles for rectangles of different sizes. She predicts later terms in the sequence and expresses the general rule using function machines.

Pupil C understands place value in whole numbers and decimals, evaluating 1.24 as $\frac{124}{100}$. She multiplies and divides by 10, 100 and 1000 including in contexts such as converting millimetres to metres. She uses place value when she multiplies a decimal such as 0.4 by a single digit number mentally and to multiply larger numbers and decimals using written methods. She calculates equivalent decimals, fractions and percentages. She simplifies fractions using common factors. Pupil C orders fractions in contexts such as comparing probabilities. She calculates fractions and percentages of quantities. For example, she divides by 10 to find 10% and halves the result to find 5%. Working in this way and jotting interim results she calculates percentages such as 19% of a quantity by calculating 10%, then 20% and then calculating and subtracting 1%.

Pupil C interprets word problems set in real-life contexts. She identifies appropriate calculations to solve problems. She uses written methods to multiply and divide three-digit by two-digit numbers and extends the methods to include decimals in the context of money, mass and volume. She checks calculations using inverse operations. She estimates answers using approximations and uses her estimate to decide if her answer is of the correct magnitude. Pupil C solves problems involving ordering and calculating with negative numbers in contexts such as changes of temperature across 0 °C.

Summarising Pupil C's attainment in number and algebra

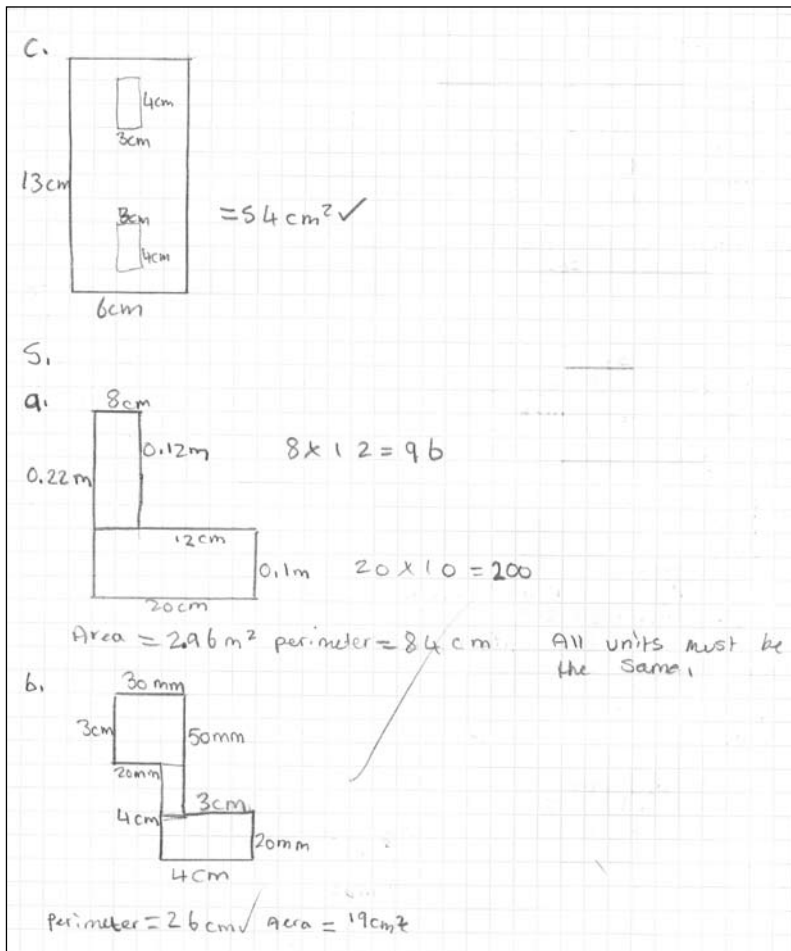
Pupil C's attainment in number and algebra is judged to be secure in level 5. To demonstrate evidence of working at high level 5 she needs to further develop methods for working with fractions and percentages. She needs to solve problems that involve ratio and direct proportion. Pupil C needs to develop her use of algebra so that she can express the rule for the n th term of a sequence.

Assessment focus

Shape, space and measures

Context

Classwork: During a unit on calculating the area and perimeter of shapes, pupils solved problems involving compound shapes and mixed units of length.



Teacher's notes

- divides compound shapes into rectangles
- interprets the diagrams and calculates edge lengths that are not given
- converts metres to centimetres and centimetres to millimetres, even though units are mixed in the labels for each diagram
- calculates mentally the areas of rectangles and adds or subtracts areas appropriately
- in self-evaluation, reminds herself that 'All units must be the same'

Next steps

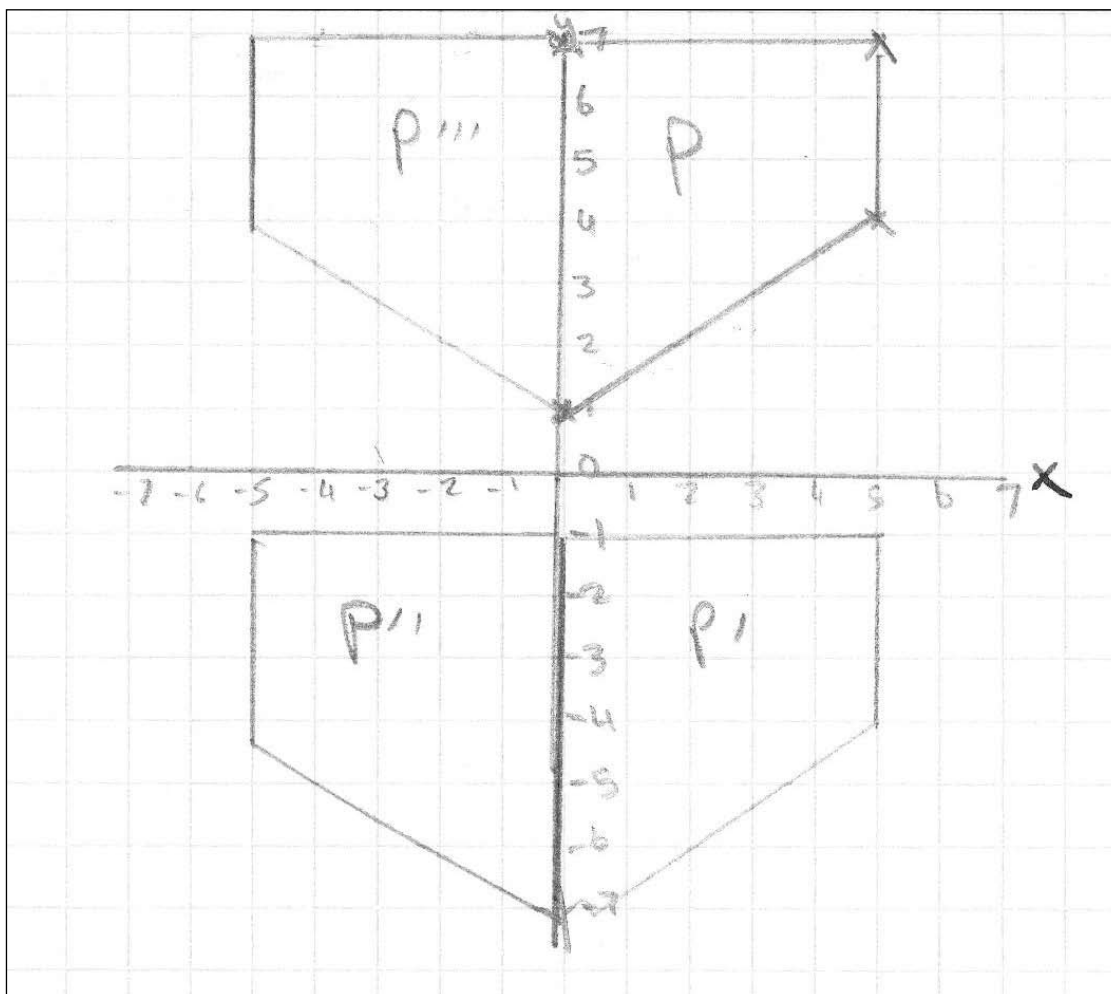
- consider the size of a square metre and the number of square centimetres it contains
- explore different ways of finding the areas of compound shapes which include triangles and rectangles

Assessment focus

Shape, space and measures

Context

Homework: In a unit of work on transformations, pupils reflected and translated shapes in all four quadrants.



Teacher's notes

- given the coordinates of vertices, draws a shape in the first quadrant (P)
- translates the shape to the fourth quadrant (P')
- reflects both shapes in the y-axis (P'') and (P''')
- comments on the relationships between coordinates in object and image

Next steps

- consider the effect of other transformations on the coordinates of corresponding vertices including reflection in other lines

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

Pupil C uses a range of properties of 2-D and 3-D shapes, recognising, for example, that the opposite faces of a cube are parallel and adjacent faces are perpendicular. Given a 2-D shape she finds all lines of reflective symmetry and identifies rotational symmetry. She reasons about shapes to solve a problem such as drawing a shape that has exactly two lines of symmetry. Pupil C solves problems involving angles at a point, at a point on a straight line and in a triangle. For example, she calculates the angle between intersecting diagonals of a regular octagon.

Pupil C translates shapes along an oblique line. She reflects shapes about the y and x axes of a grid and about $y = x$ and $y = -x$. She rotates shapes and predicts where a shape will be after a rotation of 90° or 180° , clockwise or anticlockwise, about one of its vertices or about the origin.

She interprets coordinates in all four quadrants. When reflecting shapes about the y-axis and x-axis, she compares the coordinates of corresponding vertices and explains, 'reflection is easy because when it's reflected in the y-axis, the x coordinates swap sign, and when it's reflected in the x-axis the y coordinates swap sign'.

When constructing shapes, Pupil C draws angles to the nearest degree and lines to the nearest millimetre. She uses the terms acute, obtuse and reflex to describe angles. She reads and interprets scales on measuring instruments such as rulers, weighing scales and measuring cylinders calibrated in different ways. Her experience of measuring supports her understanding of the relationship between units. She converts between metres, centimetres and millimetres, kilograms and grams and litres and millilitres.

Pupil C calculates areas and perimeters, distinguishing consistently between the two measures. She ensures units are consistent before calculating. She uses the formula for the area of a rectangle and finds areas of compound shapes that can be divided into rectangles.

Summarising Pupil C's attainment in shape, space and measures

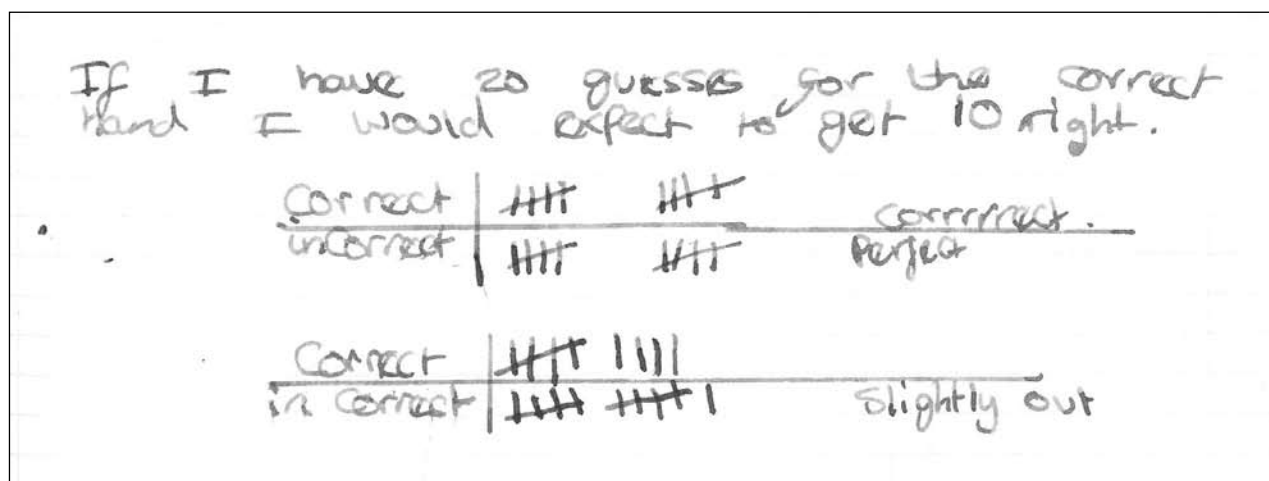
Pupil C's attainment in shape, space and measures is judged to be secure in level 5. To make further progress in this level she needs to develop her reasoning about shapes, positions and movements. She needs to construct a range of 3-D shapes to improve her reasoning about how a given net is related to the shape it will create. She needs to solve a range of problems such as drawing a quadrilateral that has exactly two lines of symmetry or two different isosceles triangles that both have a 30° angle.

Assessment focus

Handling data

Context

Classwork: In a unit on statistics and probability, pupils estimated probabilities and experimented to test their estimates. Working in pairs, one pupil hid a coin in one hand while the other guessed which hand held the coin. Pupils estimated the number of times they expected to guess correctly if the experiment was repeated 20 times. They then carried out the experiment.



Teacher's notes

- decides both outcomes, right hand and left hand, are equally likely and the probability of a correct guess is one half
- records the results of experiments clearly
- explains 'you can't expect to get exactly ten out of 20 each time' and 'if you did a 100 you should get about 50'

Next steps

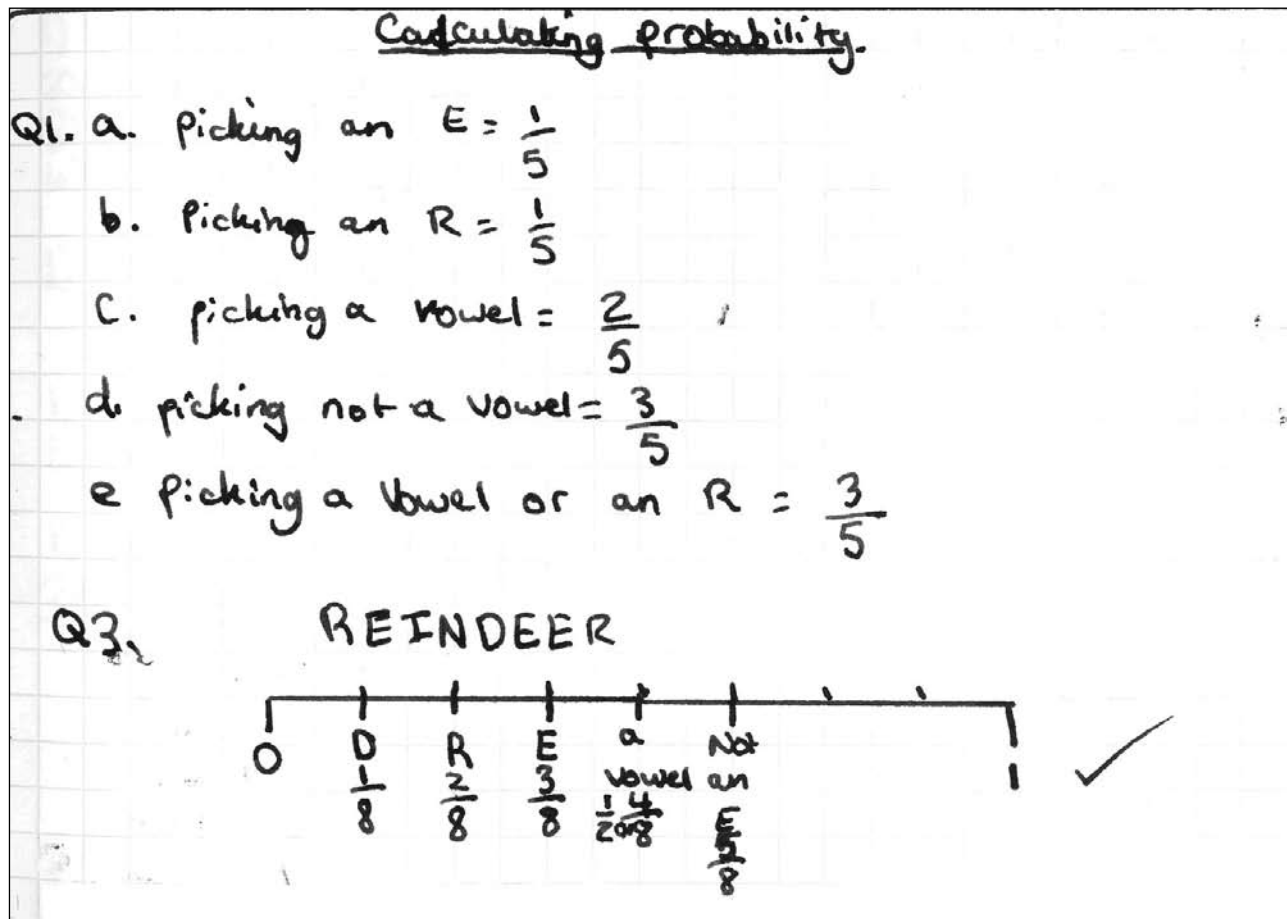
- compare results with other groups and the combined outcomes from all experiments in the class
- extend to other situations involving the outcomes of one or two events
- explore the nature of random events by investigating clustering of results

Assessment focus

Handling data

Context

Homework: In a unit on statistics and probability, pupils expressed probabilities as fractions and recorded them on a 0 to 1 scale. Amongst other examples, they considered cards with the letters for HORSE and REINDEER, and in each of these cases the probability of drawing particular cards at random.



Teacher's notes

- expresses theoretical probabilities as fractions
- orders fractions on a scale 0 to 1
- justifies probabilities, for example, why $p(\text{vowel}) = \frac{2}{5}$

Next steps

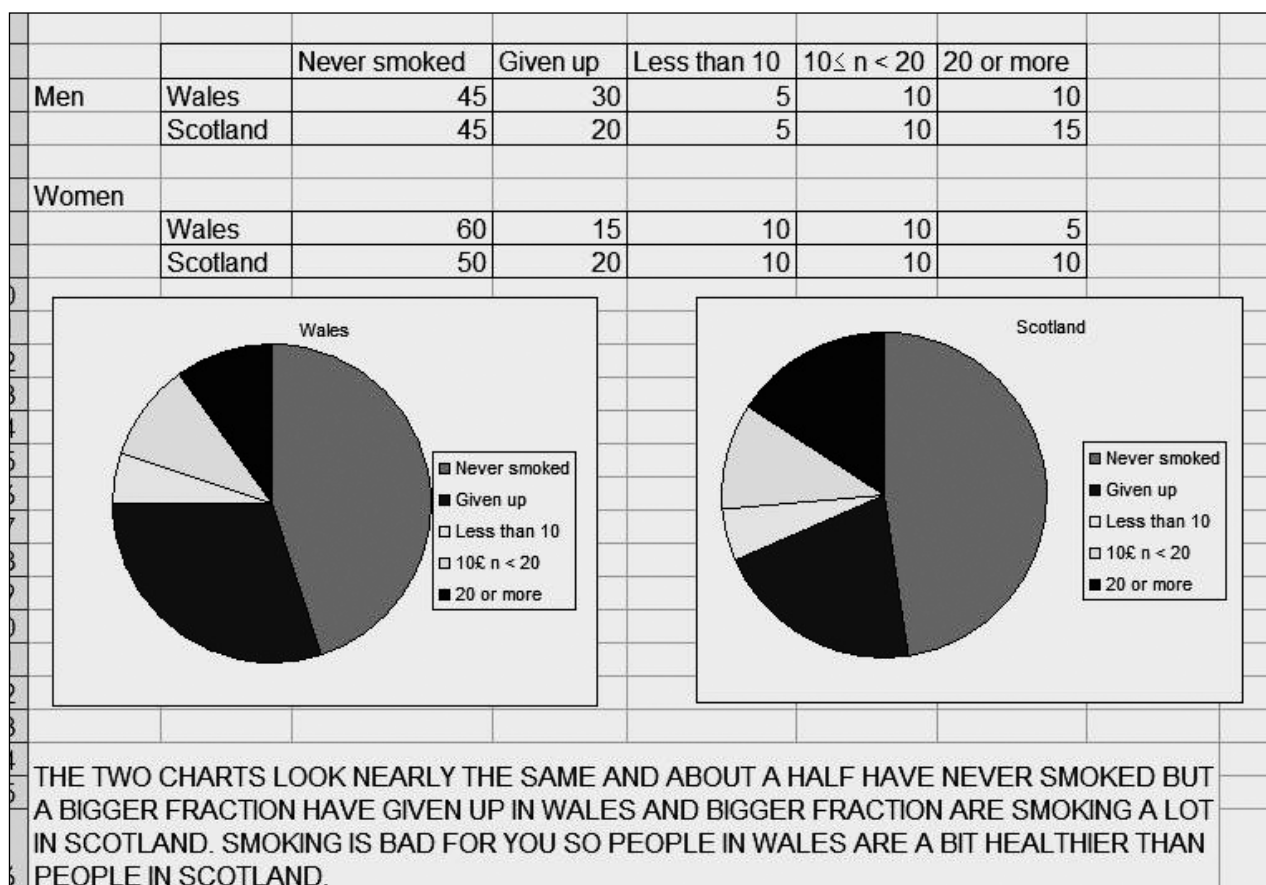
- compare the probabilities of 'E' and 'not E', 'R' and 'not R' from the REINDEER example
- discuss how to calculate the probability of 'not p' if given the probability of 'p'

Assessment focus

Handling data

Context

Classwork: In a unit on statistics, pupils used a spreadsheet that contained data on smoking habits in Wales and Scotland. They were shown how to construct pie charts. They then created their own pie charts, using the ICT, and compared data for the two countries.



Teacher's notes

- uses a spreadsheet of data to create pie charts
- interprets pie charts and compares sets of data
- understands that the charts show the proportion of the sample in each category and not the actual number

Next steps

- raise other questions about this data, for example, how do the results for women in the sample compare with the results for men?
- suggest further questions and the data that might help answer them

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

Given a set of data, such as information about smoking habits in Scotland and Wales, Pupil C processes and represents the data, interprets the graphs and charts that she creates and comments on what they show. She poses questions and represents the data in different ways to find answers. She groups discrete data and represents it using a bar graph. She understands that pie charts show the proportion of the sample in each category and that when comparing two pie charts, the sample size may be relevant. She is beginning to recognise when data is represented in a misleading way.

Pupil C uses the mode, median and range to compare data sets. For example, when pupils gave a score out of 5 to indicate the extent to which they agreed with a statement, she understood that a low range signified general consensus amongst the pupils, a high median signified that the class agreed with the statement and a low median showed that they disagreed.

In her work on probability, Pupil C understands that in situations where a number of events are equally likely, a probability can be calculated. She calculates probabilities related to a range of situations such as throwing a dice, flipping a coin or drawing a particular card from a set. She expresses probabilities as fractions and orders the fractions on a scale from 0 to 1. Pupil C understands that when flipping a coin, even though each outcome is equally likely, the number of heads and tails achieved may not be the same. She understands that if she repeats the experiment a large number of times, then the proportions of heads and tails are likely to be nearer to one half.

Pupil C can compare and order fractions within the context of probability. She has understood the probability number line and was able to link this theoretical exercise to the outcomes of an experiment.

Summarising Pupil C's attainment in handling data

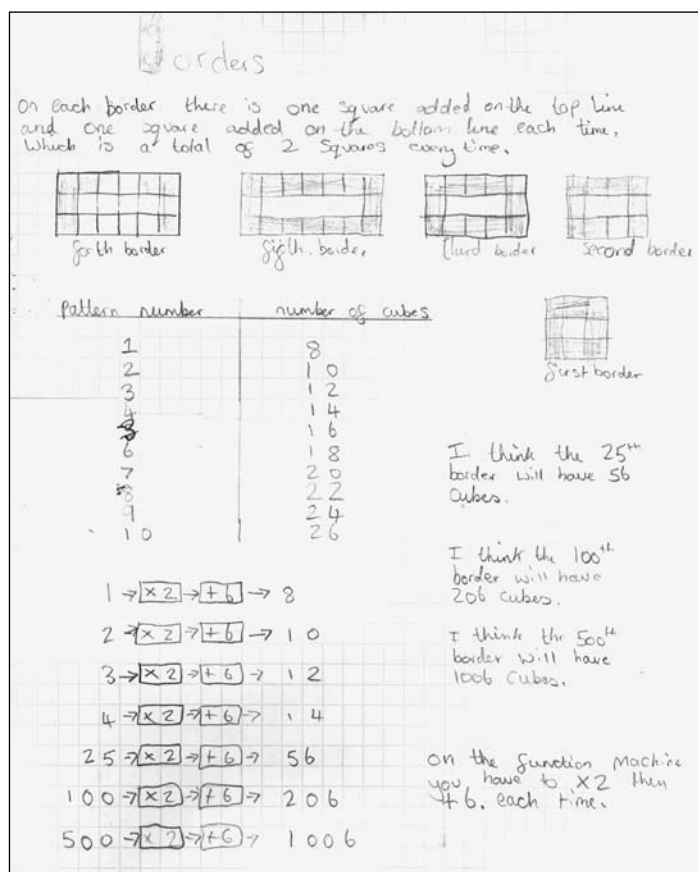
Pupil C's attainment in handling data is judged to be secure in level 5. To make further progress she needs to ask her own questions and plan how to collect the data needed to answer them. She needs to work with continuous data such as the heights of pupils in different year groups in the school.

Assessment focus

Using and applying mathematics

Context

Classwork: In a unit on number sequences and patterns, pupils investigated the number of 'tiles' needed to border a rectangle that is one unit wide. Linking cubes were available for pupils to create the sequence of rectangles practically.



Teacher's notes

- works methodically, drawing and labelling rectangles of increasing length
- presents her work in a clear and organised way
- identifies a pattern in results and expresses a generalisation using function machines
- predicts the number of border tiles needed for much longer rectangles
- poses her own questions to extend the work and investigates borders for rectangles that are 2 units wide, then 3 units wide

Next steps

- compare ways of describing the general rule with others in the class
- relate generalisations to the original context, justifying why they work

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

Given a starting point, such as finding the number of blue border tiles for a row of white tiles, Pupil C works methodically. In this example she increased the length of the row by one white tile at a time. When she investigated amounts that could be paid using no more than 10 coins, she worked from paying with one coin, two coins, etc. As she constructed a sequence of squares, using one diagonal of each square as an edge of the next, she was methodical in choosing which diagonal to use each time so that the design spiralled clockwise. By recording her work in a clear and organised way, she reveals patterns in results.

As she works on sequences generally, Pupil C continues sequences of positive and negative whole numbers and decimals. She reasons about further terms and continues sequences backwards to find earlier terms. She expresses the rule for a sequence using function machines.

Pupil C identifies other relationships. For example, reviewing the coordinates of the vertices of shapes and their reflections, she expressed the relationship in words, 'when it's reflected in the y-axis, the x coordinates swap sign, and when it's reflected in the x-axis the y coordinates swap sign'. As Pupil C noticed the relationship between the areas of successive squares, half of the first square forms a quarter of the next square so the area of the square doubles each time. She predicted that the area of the seventh square would be 64 times the area of the first.

Pupil C raises further questions to investigate. For example, in paying amounts with a limited number of coins she asked what denominations of coin occur in other currencies and if similar amounts could be paid with any given number of coins. After reviewing the coordinates of the vertices of shapes and their reflections, she went on to consider the effect of translations on the coordinates of vertices.

Summarising Pupil C's attainment in using and applying mathematics

In using and applying mathematics Pupil C's attainment is judged to be secure at level 5. Her reasoning is a strong aspect of her performance. To make further progress in level 5 she needs to use her reasoning and experience of a range of problems to develop strategies for engaging with more complex problems. She needs to have problems and investigations introduced in a way that provides scope for her to make decisions about the approach to take. She needs to explain and justify the decisions she makes and the conclusions she draws. She should begin to express generalisations algebraically.

Pupil name.....C.....Class/group.....Date.....

	Using and applying mathematics	Numbers and the number system	Calculating	Algebra	Shape, space and measure	Handling data
Level 5	<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/>	<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/>	<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/>	<ul style="list-style-type: none"> construct, express in symbolic form, and use simple formulae involving one or two operations use and interpret coordinates in all four quadrants <input checked="" type="checkbox"/>	<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/>	<ul style="list-style-type: none"> 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 <input checked="" type="checkbox"/>
Level 4	<ul style="list-style-type: none"> 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 <input type="checkbox"/>	<ul style="list-style-type: none"> 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 <input type="checkbox"/>	<ul style="list-style-type: none"> 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 <input type="checkbox"/>	<ul style="list-style-type: none"> begin to use simple formulae expressed in words use and interpret coordinates in the first quadrant <input type="checkbox"/>	<ul style="list-style-type: none"> use the properties of 2-D and 3-D shapes 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 points and find areas by counting squares <input type="checkbox"/>	<ul style="list-style-type: none"> 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 <input type="checkbox"/>
BL	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
IE	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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 ☐

Audience: Secondary mathematics subject leaders

Date of issue: 12-2008

Ref: **00717-2008BKT-EN**

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