Brombacher
& Associates

Developing Mathematics Assessment Tasks

A NumberSense workshop for Intermediate Phase teachers

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Annual assessment plan

Curriculum topic				Term 1	Term 2	Term 3	Term 4	Year
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		1.1b	Counting, ordering, comparing, representing & place value					
		1.1c	Calculations					
		1.1d	Calculation techniques					
		1.1e	Multiples & factors					
		1.1f	Properties of whole numbers					
		1.1g	Solving problems					
1.2	Common fractions	1.2a	Describing and ordering					
		1.2b	Calculations					
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1.3	Decimal fractions	1.3a	Recognising, ordering & place value [Grade 6 only]					
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		2.2b	Input & output values					
		2.2c	Equivalent forms					
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		3.2b	Characteristics of shapes					
		3.2c	Further activities					
3.3	Symmetry	3.3	Symmetry					
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		3.4b	Tesselations					
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		3.4d	Describe patterns					
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3.6	Position and direction	3.6	Location and directions					
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		4.3d	Calculations & Problem solving					
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		4.4d	History of time					
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		4.5b	Measuring instruments					
		4.5c	Units					
		4.5d	Calculations & Problem solving					
4.6	Perimeter, Surface Area and Volume	4.6a	Perimeter					
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5.1	Collecting and Organising	5.1	Collecting and organising data					
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5.3	Analysing, Interpreting and Reporting	5.3a	Interpreting data					
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		5.3d	Ungrouped data [Grade 5-6]					
5.4	Probability	5.4	Probability experiments					
			Total	[ ]	[ ]	[ ]	[ ]	[ ]

Notes:

Assessment task plan

Topic (from the curriculum)	Knowing	Applying	Reasoning	Total
	[ ]	[ ]	[ ]	[ ]
	[ ]	[ ]	[ ]	[ ]
	[ ]	[ ]	[ ]	[ ]
Total	[ ]	[ ]	[ ]	[ ]

Knowing

Facility in using mathematics, or reasoning about mathematical situations, depends on mathematical knowledge and familiarity with mathematical concepts. The more relevant knowledge a student is able to recall and the wider the range of concepts he or she has understood, the greater the potential for engaging in a wide range of problem-solving situations and for developing mathematical understanding.

Without access to a knowledge base that enables easy recall of the language and basic facts and conventions of number, symbolic representation, and spatial relations, students would find purposeful mathematical thinking impossible. Facts encompass the factual knowledge that provides the basic language of mathematics, and the essential mathematical facts and properties that form the foundation for mathematical thought.

Procedures form a bridge between more basic knowledge and the use of mathematics for solving routine problems, especially those encountered by many people in their daily lives. In essence a fluent use of procedures entails recall of sets of actions and how to carry them out. Students need to be efficient and accurate in using a variety of computational procedures and tools. They need to see that particular procedures can be used to solve entire classes of problems, not just individual problems.

Knowledge of concepts enables students to make connections between elements of knowledge that, at best, would otherwise be retained as isolated facts. It allows them to make extensions beyond their existing knowledge, judge the validity of mathematical statements and methods, and create mathematical representations.

1	**Recall**	Recall definitions; terminology; number properties; geometric properties; and notation (e.g., $a \times b = ab$, $a + a + a = 3a$).
2	**Recognize**	Recognize mathematical objects, e.g., shapes, numbers, expressions, and quantities. Recognize mathematical entities that are mathematically equivalent (e.g., equivalent familiar fractions, decimals and percents; different orientations of simple geometric figures).
3	**Compute**	Carry out algorithmic procedures for $+$, $-$, $\times$, $\div$, or a combination of these with whole numbers, fractions, decimals and integers. Approximate numbers to estimate computations. Carry out routine algebraic procedures.
4	**Retrieve**	Retrieve information from graphs, tables, or other sources; read simple scales.
5	**Measure**	Use measuring instruments; choose appropriate units of measurement.
6	**Classify/Order**	Classify/group objects, shapes, numbers, and expressions according to common properties; make correct decisions about class membership; and order numbers and objects by attributes.

Applying

The applying domain involves the application of mathematical tools in a range of contexts. The facts, concepts, and procedures will often be very familiar to the student, with the problems being routine ones. In some items aligned with this domain, students need to apply mathematical knowledge of facts, skills, and procedures or understanding of mathematical concepts to create representations. Representation of ideas forms the core of mathematical thinking and communication, and the ability to create equivalent representations is fundamental to success in the subject.

Problem solving is central to the applying domain, but the problem settings are more routine than those aligned with the reasoning domain, being rooted firmly in the implemented curriculum. The routine problems will typically have been standard in classroom exercises designed to provide practice in particular methods or techniques. Some of these problems will have been in words that set the problem situation in a quasi-real context. Though they range in difficulty, each of these types of "textbook" problems is expected to be sufficiently familiar to students that they will essentially involve selecting and applying learned facts, concepts, and procedures.

Problems may be set in real-life situations, or may be concerned with purely mathematical questions involving, for example, numeric or algebraic expressions, functions, equations, geometric figures, or statistical data sets. Therefore, problem solving is included not only in the applying domain, with emphasis on the more familiar and routine tasks, but also in the reasoning domain.

1	**Select**	Select an efficient/appropriate operation, method, or strategy for solving problems where there is a known procedure, algorithm, or method of solution.
2	**Represent**	Display mathematical information and data in diagrams, tables, charts, or graphs, and generate equivalent representations for a given mathematical entity or relationship.
3	**Model**	Generate an appropriate model, such as an equation, geometric figure, or diagram for solving a routine problem.
4	**Implement**	Implement a set of mathematical instructions (e.g., draw shapes and diagrams to given specifications).
5	**Solve Routine Problems**	Solve standard problems similar to those encountered in class. The problems can be in familiar contexts or purely mathematical.

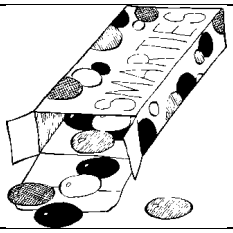
Reasoning

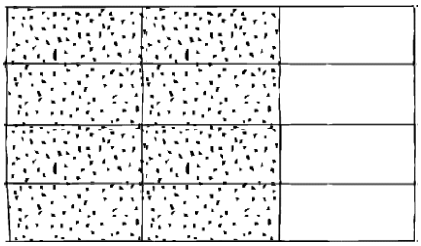
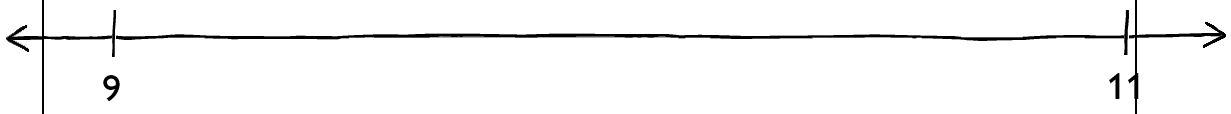
Reasoning mathematically involves the capacity for logical, systematic thinking. It includes intuitive and inductive reasoning based on patterns and regularities that can be used to arrive at solutions to non-routine problems. Non-routine problems are problems that are very likely to be unfamiliar to students. They make cognitive demands over and above those needed for solution of routine problems, even when the knowledge and skills required for their solution have been learned. Non-routine problems may be purely mathematical or may have real-life settings. Both types of items involve transfer of knowledge and skills to new situations, and interactions among reasoning skills are usually a feature. Problems requiring reasoning may do so in different ways, because of the novelty of the context or the complexity of the situation, or because any solution to the problem must involve several steps, perhaps drawing on knowledge and understanding from different areas of mathematics.

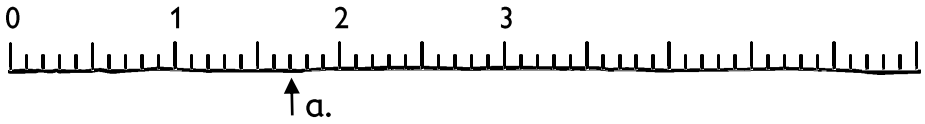
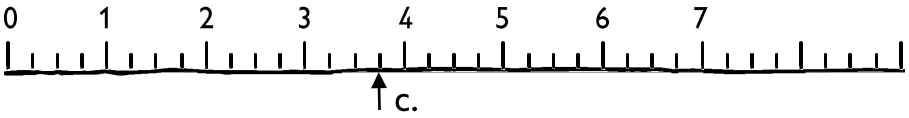
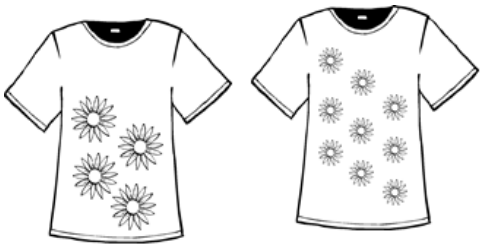
Even though of the many behaviors listed within the reasoning domain are those that may be drawn on in thinking about and solving novel or complex problems, each by itself represents a valuable outcome of mathematics education, with the potential to influence learners' thinking more generally. For example, reasoning involves the ability to observe and make conjectures. It also involves making logical deductions based on specific assumptions and rules, and justifying results.

1	**Analyze**	Determine, describe, or use relationships between variables or objects in mathematical situations, and make valid inferences from given information.
2	**Generalize/ Specialize**	Extend the domain to which the result of mathematical thinking and problem solving is applicable by restating results in more general and more widely applicable terms.
3	**Integrate/ Synthesize**	Make connections between different elements of knowledge and related representations, and make linkages between related mathematical ideas. Combine mathematical facts, concepts, and procedures to establish results, and combine results to produce a further result.
4	**Justify**	Provide a justification by reference to known mathematical results or properties.
5	**Solve Non-routine Problems**	Solve problems set in mathematical or real life contexts where students are unlikely to have encountered closely similar items, and apply mathematical facts, concepts, and procedures in unfamiliar or complex contexts.

Test items for analysis

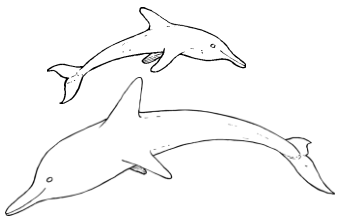
No.	Item	Content domain	Cognitive level
1.a)	Complete. 85 + 268 – 49 = _____		
1.b)	Complete. 214 × 24 = _____		
1.c)	Complete. 818 ÷ 18 = _____		
1.d)	Complete. 3 + 2 × 10 = _____		
1.e)	Complete. ____ × 4 – 8 = 40		
1.f)	Complete. 10 – (12 + 6) ÷ 3 = _____		
1.g)	Complete. 5 + 6 × 7 + (4 + 4) × 3 = ____		
1.h)	Complete. $1\frac{3}{5} + 2\frac{4}{5} =$ _____		
1.i)	Complete. $\frac{3}{4} + \frac{3}{16} =$ _____		
1.j)	Complete. 1,5 + 1,25 = _____		
1.k)	Complete. 30% of 100 = _____		
1.l)	Complete. 5% of 480 = _____		
2.a)	Jan calculates that there are 8 smarties in $\frac{1}{3}$ of a box of 24 smarties. Is Jan correct? Show your working. 		
2.b)	Susi calculates that there are 9 smarties in $\frac{1}{4}$ of a box of 36 smarties. Is Susi correct? Show your working.		

No.	Item	Content domain	Cognitive level
2.c)	Danie says:  *Something is wrong. I know that $\frac{1}{3}$ is larger than $\frac{1}{4}$ and that 9 is larger than 8. But according to Jan and Susi it seems like $\frac{1}{4}$ is larger than $\frac{1}{3}$.* Help Danie to understand that there is nothing wrong.		
3.	Describe the shaded part using two different fractions. 		
4.	Put these numbers on the number line as carefully as you can. $10\frac{1}{4}$ $10\frac{7}{8}$ $9\frac{5}{9}$  9 11		
5.	Mrs Viljoen uses $\frac{2}{3}$ of a litre of milk to make 1 pot of porridge.		
5.a)	How many litres of milk will she need to make 12 pots of porridge? Show your thinking.		
5.b)	How many pots of porridge can she make with $5\frac{1}{2}$ litres of milk? Show your thinking.		
6.a)	Circle the largest numbers in each row. 3,5 3,6 3,25		
6.b)	Circle the largest numbers in each row. 75% $\frac{7}{8}$ 0,6000		

No.	Item	Content domain	Cognitive level
6.c)	Circle the largest numbers in each row. 0,6 × 10 70 ÷ 10 0,2 × 4		
7.a)	Write the number represented by each arrow. 		
7.b)	Write the number represented by each arrow. 		
7.c)	Write the number represented by each arrow. 		
8.	A shop has blue and pink T-shirts. The blue T-shirts have 4 daisies and the pink T-shirts have 9 daisies. If there are 48 daisies altogether, how many blue T-shirts and how many pink T-shirts are there in the shop? 		
9.	Lisa cuts a ribbon 1,6m long into 4 equal pieces.		
9.a)	How many metres long is each piece?		
9.b)	How many centimetres long is each piece?		
10.	Mary won some money in a competition. • She spent $\frac{2}{3}$ of her winnings on an iPod. • She spent $\frac{2}{3}$ of what she had left over on clothes. • She spent $\frac{2}{3}$ of what she had left over on a present for her mother. • She spent the last R100 on a handbag. How much money did she win?		

<table>
<tr><th>No.</th><th>Item</th><th>Content domain</th><th>Cognitive level</th></tr>
<tr><td>11.</td><td>There are two dolphins: a small one and a large one.

When the small dolphin is given 1 fish to eat, the large dolphin is given 3 fish to eat. If the dolphins ate 24 fish altogether, how many fish did each dolphin eat? Show your thinking.

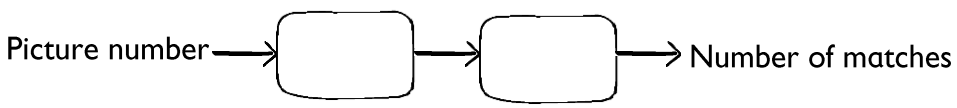
  </td><td></td><td></td></tr>
<tr><td>12.</td><td>Ayanda needs to pack 1 017 muffins into 36 boxes so that there are the same number of muffins in each box. Ayanda calculates 1 017 ÷ 36 to work out how many muffins she should pack in each box. Using her calculator she gets an answer of 28,25.

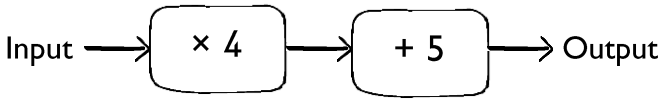
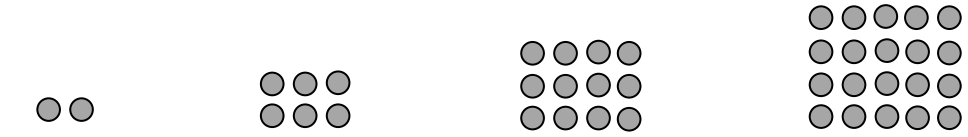
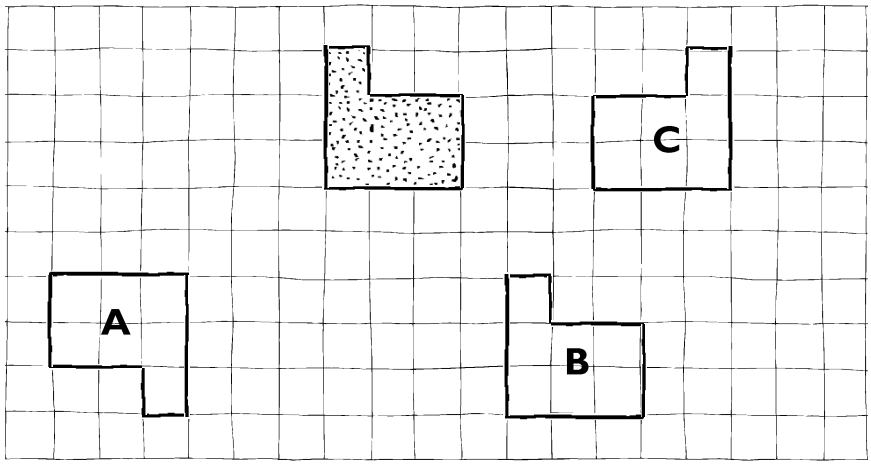
How many muffins will be left over?</td><td></td><td></td></tr>
<tr><td>13.</td><td>54 is multiplied by a three digit number to give an answer with four digits ending in 2.

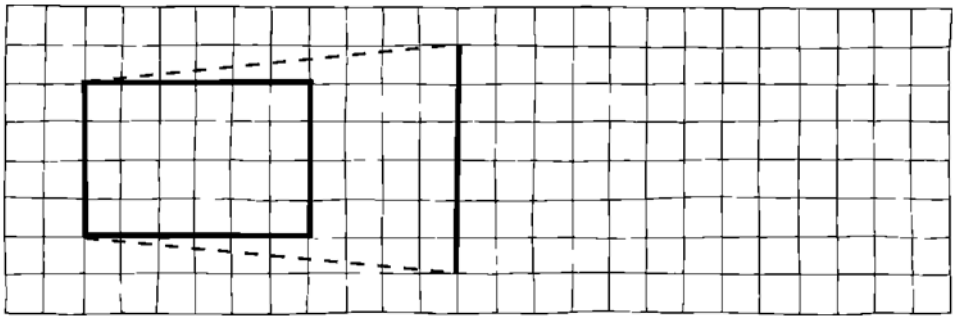
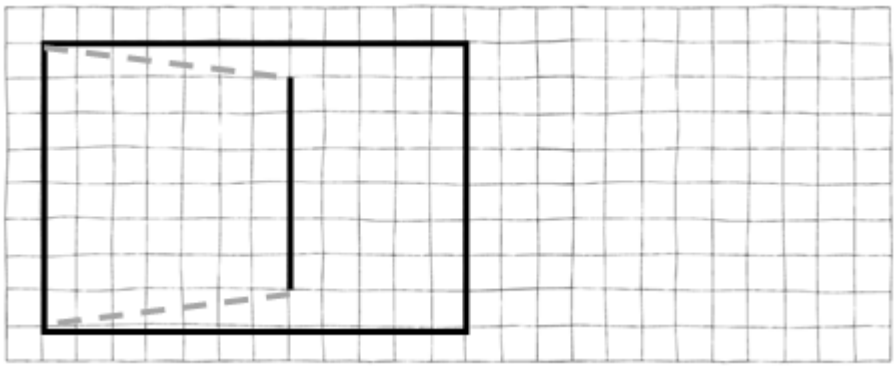
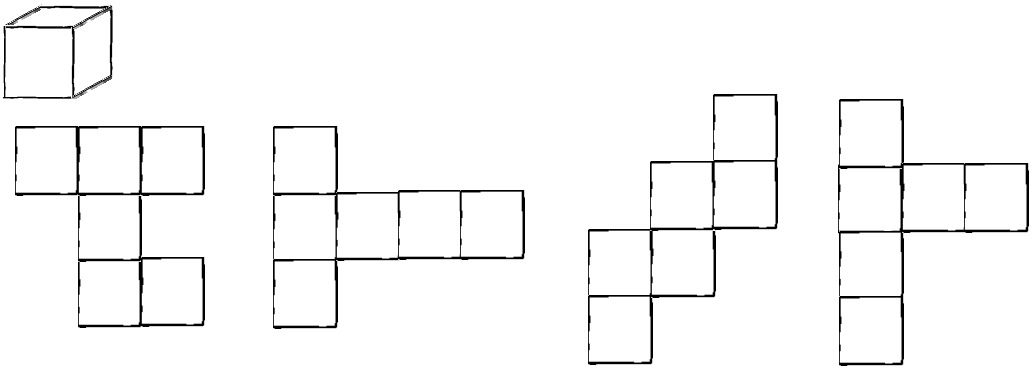
54 ×□□N = □ □□2

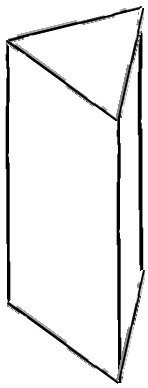
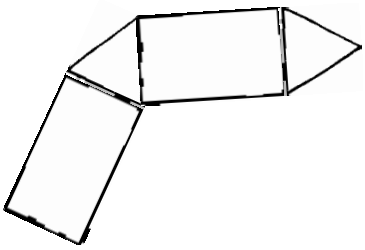
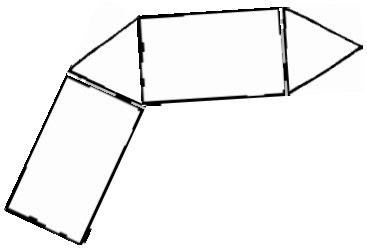
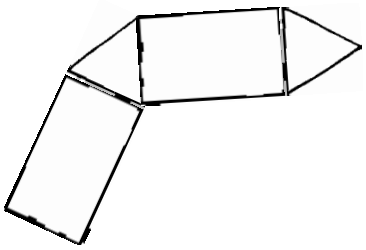
What are the possible values of N?</td><td></td><td></td></tr>
<tr><td>14.</td><td> 
Picture 1 Picture 2 Picture 3 Picture 4</td><td></td><td></td></tr>
<tr><td>14.a)</td><td>Draw the fourth picture.</td><td></td><td></td></tr>
<tr><td>14.b)</td><td>Complete the table.

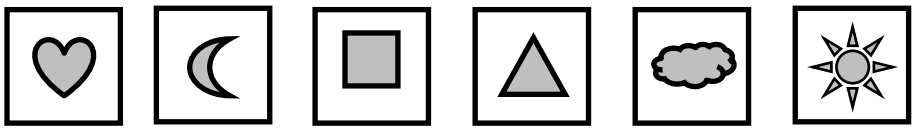
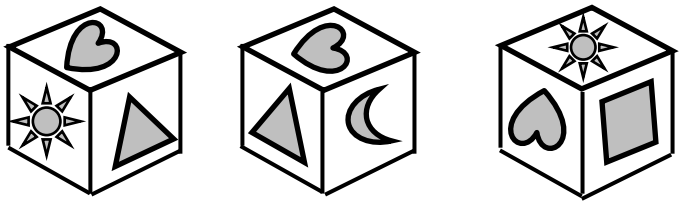
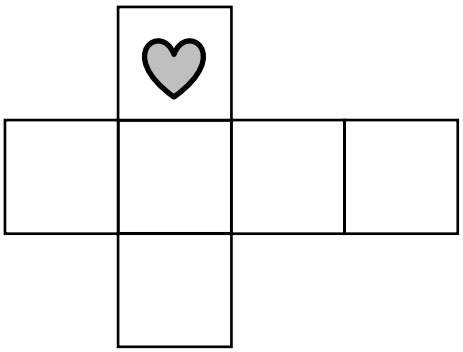
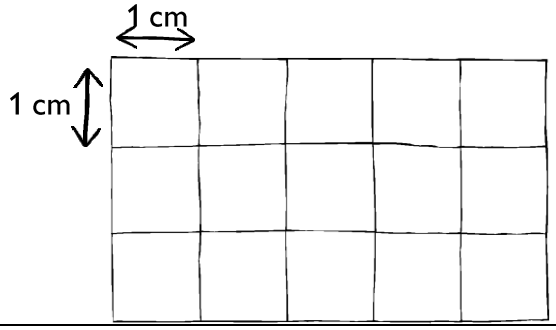
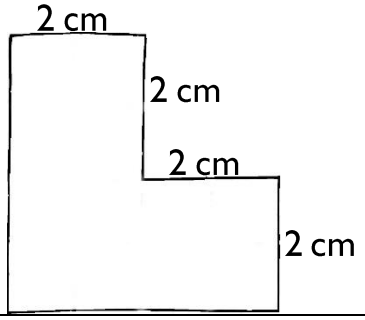
<table><tr><td>Picture number</td><td>1</td><td>2</td><td>3</td><td>4</td><td>10</td></tr><tr><td>Number of matches</td><td>7</td><td>10</td><td>13</td><td></td><td></td></tr></table></td><td></td><td></td></tr>
<tr><td>14.c)</td><td>Complete the flow diagrams.

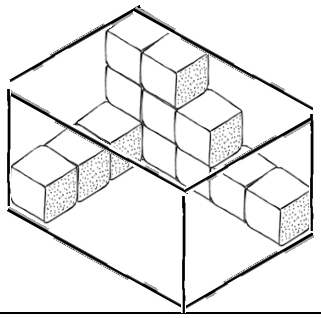
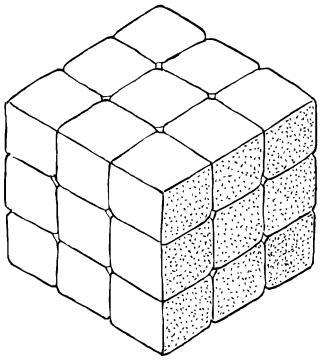
 
Picture number → → Number of matches</td><td></td><td></td></tr>
<tr><td>14.d)</td><td>Which picture number can be made with 67 matches?</td><td></td><td></td></tr>
</table>

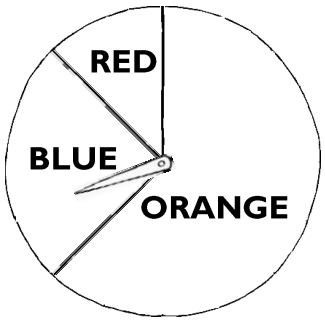
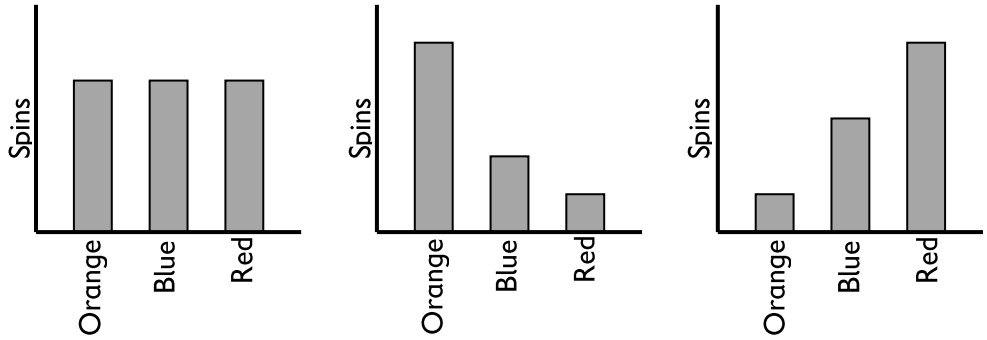
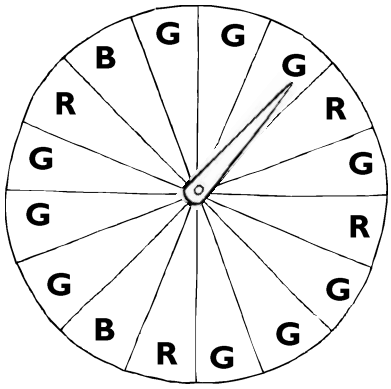
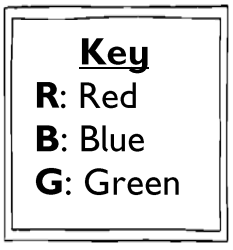
No.	Item	Content domain	Cognitive level
15.	Use the flow diagram to complete the table.  Input: 1, 2, 5 Output:		
16.	Tumi uses dots to build patterns as shown.  How many dots will she use for pattern 15? Show your thinking.		
17.	A, B and C are transformations of the shaded shape. Describe the transformations using one of the following: **Translation (slide)** **Reflection (Flip)** **Rotation (Turn)**  		

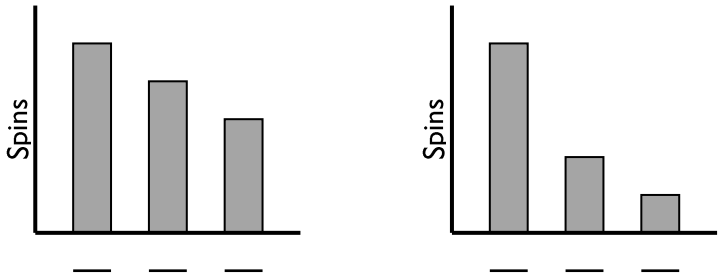
No.	Item	Content domain	Cognitive level
18.	Complete the enlargement. 		
19.	Complete the reduction. 		
20.	Steve has drawn some nets which he says will make a cube. Circle the nets that will work. 		

No.	Item	Content domain	Cognitive level
21.	Sally has drawn an incomplete net for the 3D object shown.  		
21.a)	What is the name of the 3D object?		
21.b)	Complete the net in two different ways.  		

No.	Item	Content domain	Cognitive level
22.	Here are the six faces of a cube in no particular order:  Here are three views of the cube:  Can you deduce where the faces are in relation to each other? Draw them on the net of this cube. 		
23.a)	Determine the perimeter. 		
23.b)	Determine the area.		
24.a)	Determine the perimeter. 		
24.b)	Determine the area.		

No.	Item	Content domain	Cognitive level
25.	How many cubes are needed to fill the box? 		
26.	Peter built a 3 × 3 × 3 stack of cubes. He says, "If I double the number of cubes in each row, double the number of rows in each layer and double the number of layers, I will need twice as many cubes to build a new cube." Is Peter correct? Explain 		
27.a)	Complete. 60 hours = _____ days and _____ hours		
27.b)	Complete. 23 days = _____ weeks and _____ days		
27.c)	Complete. 490 days = _____ years and _____ days		
28.	Abdul's cousin will arrive by train at 22:35. It takes Abdul half an hour to drive to the station and he wants to get there a quarter of an hour before the train is due. At what time must Abdul leave home to meet his cousin at the station?		
29.	The lengths (in minutes and seconds) of the first three songs on a CD are given: 2:15 2:50 2:45 How long is that in total?		
30.	There are seven trees in Steve's garden. Their ages are 11; 15; 18; 20; 24; 25 and 27 years.		
30.a)	What is the median age of the trees?		

No.	Item	Content domain	Cognitive level
28.b)	One tree is chopped down. Which of the trees could it be if the new median is 19 years? Justify your answer.		
31.	A spinner with red, orange and blue sectors is drawn below.  Circle the graph that best represents the results of 100 spins.  		
32.	A spinner with red, blue and green sectors is drawn below.   		

No.	Item	Content domain	Cognitive level
32.a)	Circle the graph that best represents the results of 100 spins. 		
32.b)	Label the bars on the <u>correct</u> graph. Use the labels ‘R’, ‘B’ and ‘G’.		
33.	The pie chart shows how much pocket money three children get. Ferial and Selwyn get the same amount and Thandi gets R12. How much pocket money does Selwyn get? Show your thinking. 		

Notes:

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