TEACHER'S GUIDE TO NUMERACY ASSESSMENT INSTRUMENTS

Contents

Introduction

The main aim of the project was to describe a series of important numerical concepts relevant to children's learning in the primary school. The progression thus suggested would be matched with assessment procedures and questions which could be used by class teachers to diagnose children's learning and their errors. The aim is to help teachers match their teaching to the child's knowledge. The intention is to discover performance in mathematics and some signs of understanding may be hidden by poor reading skills.

The four educators met and scrutinised the Number syllabus for each country, together with descriptions of expectations of learning in Primary Number by young children in five other countries. It was apparent that the curriculum for each of the project countries was very full of content matter and that in the first four grades the pupils were expected to learn the four operations and to apply them to larger and larger numbers. There was a tacit assumption that the fundamental concepts would be in place and the move from tens to hundreds and then thousands would be a smooth transition. Taking just statements which referred to whole numbers and which were common to all three curricula we have put together the table which occurs in the Appendix. The curriculum of each country was stated in terms of the grade for which it was intended. The table in the Appendix therefore keeps this format but the tests and the progression discussed here are not necessarily tied to grades. The table does not contain all the number work in the curriculum, but only the part dealing with whole numbers.

The duration of the project allowed less than a year for testing and collecting data so an attempt was made to split a grade's curriculum into three parts in the belief that the class being asked to do the questions would already have been taught the content matter they contained. In Malawi and Zambia two parts of the assessment were given six months into the school year and the last which assessed the Number work intended for the end of the school year was given to the grade above. It was therefore expected that the mathematics they contained would have been covered by the teacher. In Ghana the three tests were spread throughout the school year.

Mathematics

In most countries the primary school curriculum includes the study of mathematics. This study only investigated a small part of the mathematics considered suitable for pupils in grades 1 to 4. No attempt was made to assess Measurement or Geometry. Only 'Whole Numbers' were investigated and non-whole numbers such as Fractions and Decimals were omitted. This does not mean that the other aspects are unimportant, simply that this project investigated a limited section of mathematics. For the purpose of this study we deal with "familiarity with whole numbers and operations upon them'.

The government curriculum usually lists the content matter to be taught and does not emphasise the relative levels of difficulty. School mathematics involves facts, skills, strategies and problem solving. Facts do not need interpretation but do need memorising so that they can be produced when needed. The number bonds for addition of numbers less than ten are facts. Skills or procedural moves are taught and rehearsed and the teacher expects the child to produce the required routine when needed. For example children are taught a routine for doing addition questions when set out in a particular format. They are expected to remember the routine and not need further teaching. Strategies are not rehearsed and require the learner to make decisions on what facts and skills to use in a situation [which might be familiar]. In true problem solving the situation is likely to be unfamiliar and the learner must extract the mathematics before deciding on a strategy for solution. Real life problems do not come already labelled as requiring addition or multiplication. The project has done little work on problem solving as these appear seldom in the stated primary school work.

Primary school number work is important because most of subsequent mathematics relies upon a fluency and confidence in the use of number. It is therefore extremely important that time should be spent to consolidate each step and process in the learning of number.

Representation

Most children are unable to read when they start full-time schooling. Their Number work might start with the handling of objects, seeds, stones, bottle tops or manufactured apparatus. These tactile experiences can be recorded by words, symbols or pictures. Graphs and tables follow. Mathematical words have precise meanings and some, especially counting words are taught before they can be read by the student. It must be remembered that the child is a new learner and as such is reliant on being given accurate and understandable information by the teacher. The assessment procedures suggested here are often oral on the part of the teacher whilst the child might be expected to furnish the answer by displaying an array of objects or by pointing to a card. It is not expected that the child can read until at least grade four and even then the teacher may read out the questions if they think this desirable.

Assessment Procedures

A teacher needs to know how much mathematics the children understand if she/he is to plan the most effective way of proceeding. Therefore assessment is needed, not only of content to obtain the correct answer but also of increasingly sophisticated strategies. Children may be very restricted if their only Number strategies depend on the naive counting methods they used when very young. In order to diagnose misconceptions the teacher of the early grades needs to question the pupils orally using items that reveal inaccuracies. The child's reply must be recorded in some way. Interviews for assessment are opportunities for the child to talk rather than for the teacher to explain. The child needs time to set out his argument or to display his answer.

The testing instruments are:-

1. Interview questions with a record sheet for the teacher to write the child's answer. Both correct, incorrect answers and various methods the children use can be coded if the teacher wants a record of the whole class.
2. Test papers read out by the teacher and answers recorded on a printed sheet by the child.
3. Written test papers for those children who can read. Although the teacher should read out the questions if there is a problem in understanding.
4. Some children may be unfamiliar with a printed test paper. The teacher may need to discuss with the class how the paper is to be completed.
5. It is important that the pupils understand the task. It might need translation into another language or terms may need explanation. The translation / explanation must not provide prompts and should keep close to the original meaning

Progression

The progression of stages was agreed after the testing had taken place. It is included in the Appendix. Some topics which had appeared in tests for a certain grade had been far too difficult for the children in the three samples and so were moved to a later stage. The teacher should not expect Stage 2 to contain all the number concepts of the Grade 2 syllabus etc. The tests can be spaced throughout the school year to reflect what has been taught.

The assessment items for use in the first four grades are listed in four groups but they should not be regarded as only attached to each of the grades. No age level is given as in one grade there may be pupils of many ages. Grade 1 is regarded as the phase in which they start full time schooling.

Administration of the Tests

The children should be told that the tests/tasks are being given so that the teacher can obtain information to help them learn mathematics. The questions are not to catch them out and it should be clear what is being asked. The interviews particularly should be carried out in a relaxed, non-threatening environment. The pupils will need space in which they can write comfortably.

If the language used in the questions is unfamiliar to the pupils, the teacher may use expressions more frequently used in their class room BUT the meaning should not be changed. If the questions need to be translated into a local language, care must be taken that the task still tests the same thing, for example 'difference' should be translated into a similar expression and not into 'take away' which is another aspect of subtraction.

It is important to keep a record of the child's responses and where gaps in knowledge appear. Total marks for a paper are not as useful as the knowledge that 'place value' has not been understood. The class list will then show how many pupils seem to lack this understanding. There are questions which have two or three correct answers. The pupils might consider mathematics questions require just one response, so they should be encouraged to give as much information as they can. Diagrams may need to be explained as well as the layout of the questions.

Starting Number

In a first grade class there will be children who have been to a pre-school, some who have learned something about Number from siblings or parents and others who have had no mathematical experience. Counting is likely to be the first Number experience they have. The curriculum in each of the three project countries starts with counting, using English words for the numbers.

Counting

The crucial features of counting are:

a. The names [one, two, three...] belong in a particular order
b. To count a collection a number name is attached to each object. There is a name for each object and every name has an object.
c. The number of objects in a set is the last name in the counting sequence just used.

Initially the child may need to touch each object as the name is said, later counting might be done silently or by touching fingers.

How Many

a. The question 'How many?' can be answered by counting a set or if a small number is involved the total might be recognised immediately.
b. 'Are there as many as?' requires the comparison of two numbers or two sets of objects. It can be answered by matching the objects in the two sets one to one, by counting or by using number recognition. Equality occurs when the matching one to one leaves no object unmatched. The sameness is not influenced by the position of the objects.
c. 'How many more' seemed to be very difficult for the Zambian children. The question can be answered by matching two sets and by counting the difference or increasing the lesser until equality is achieved.

Recording

In grade 1 it is unlikely that the child can read, so the teaching of Number has to rely on objects, diagrams, said words and symbols. The symbols for numbers up to ten can be written to record how many. Each symbol represents a unique number.

Assessment Instruments

Stage One

Counting. The teacher interviews 1-1 and records as much information as she needs but at least according to the report sheet provided. The concepts being tested are: more than, less than, matching, number names, symbols, counting and order.

Initially there are objects the child can touch, he may say the number names out loud or to himself. He may keep a record on his fingers. In Stage1 part A the teacher can record what methods the child uses for a correct response as well as the ways in which error occurs. There are no numbers over ten. In Part B number names for collections of more than ten are used BUT they are not written in symbols as this would involve the concept of place value. Diagrams are provided for the sets, so there are no objects to be touched and moved

Besides making the numbers involved in the questions larger we are also looking for the child to be using increasingly sophisticated strategies. In Part B question 5, the sum of 5 and 3 is required and the question is posed with just the symbols. If the child cannot answer, the strips of stamps may be turned over to show the stamps and these can then be counted. The counting can also be more advanced .The child may start from 1 and count everything or he may assume the size of one set and count on, saying 6,7,8 to find the total. Even more advanced is the knowledge of the addition bonds when counting is not needed. Hence different codes are assigned for different methods of obtaining a correct answer. In teaching the intention is to lay a good foundation of knowledge and to encourage the child to move towards the most efficient way of working.

By the end of Part B we have expressions written entirely in symbols. It is important that the child can interpret these and say what they mean. The translation of number sentences into words and vice versa is important, if the child is not taught to do this he is left manipulating meaningless symbols.

The third part of Stage1 is a test paper composed of diagrams, the teacher describes orally what needs to be done. This can be carried out with the whole class as long as there are enough papers. Each question should be read and the child allowed enough time to complete what he can do before the next question is read out. To record the codes which are provided a class list is needed. The codes are assigned to correct answers and to certain incorrect ones. When addition is carried out by the child rather than the subtraction required and vice versa, a code is assigned. Children who always do addition no matter what the operation may not know of another operation. If the code is occurring often in the class there may be a case for re-teaching.

Addition Sums

Stage 1 ends with addition and subtraction to ten, with the questions written in a particular style. The teacher should note those children who are responding to the style but cannot translate the number sentence into words. They will be unable to use the rule if they do not know what it means.

Larger Numbers

The first experiences in school mathematics are usually concerned with finding the number of objects in a set. The numbers get larger as the child progresses through school and the child needs increasingly sophisticated methods of dealing with them. We have used words for numbers over ten but they have not been written. The next big step in Number is the writing of numbers using only ten digits but giving significance to how they are placed. This is a big step and is not easy. Children need experience in splitting collections into tens and then recording the total in terms of tens and ones [units]. The work might start with objects and then diagrams which show strips or bundles of ten. The aim is to deal with a bundle of ten in its own right so counting the number in a bundle every time is not sufficient. Earlier results showed children had great difficulty in interpreting diagrams. How to interpret diagrams needs teaching. Knowing addition bonds to make ten enables the child to move on from counting to quicker ways of working.

Stage Two

The assessment suggested for the first steps in Place Value is again done by 1-1 interviews, firstly with objects and then with diagrams, always moving towards the child being able to record an amount with two digits in the correct order. The teacher should be alert to reversals when the ten digit and the ones digit are put in the wrong order. e.g. 47 instead of 74. The second part of the assessment is a paper in which the questions are read out and the child responds by writing. Addition bonds to make ten are tested. The child is expected to search for more than one answer.

Stage 2 Part B tests the translation of diagrams showing bundles of ten into symbols put in a familiar format. This skill of translation needs teaching. Addition and subtraction are done where there is no need to regroup or decompose bundles of ten. The expression used to denote subtraction is 'take away' and the amount to be taken is in the form of an instruction and not shown in the diagram of bundles. The second part of the assessment is the completion of addition questions set out in a familiar format. None of the columns add up to ten or more.

Part C extends the theme of addition and subtraction but tests the 'difference' meaning of subtraction. The test is read out by the teacher but initially diagrams are provided so that the difference can be found from matching bundles and singles. The words 'take away' are not appropriate in the 'difference' situation as nothing is removed. The addition questions are in the usual format and include two from part B. Zero also appears. If the success rate drops when zero occurs then there are children who do not realise the particular properties of zero. When added to any number it does not increase that number. Any number subtracted from itself results in zero. Addition and subtraction are inverse operations and a number sentence involving one operation can be rewritten as one using the other.

Stage Three

The Number work contained in Stage 3 part A involves multiplication which although it appears in the syllabus may not have been taught by the end of grade 2. The test provided therefore should not be given to pupils until they have been introduced to the relevant aspects of this new operation. Two meanings of multiplication are used. Repeated addition is one of them but the other is a number of equal sized groups the total of which can be written as a multiplication. This latter meaning links more closely to division, which is usually introduced as a question of how many groups of a certain size can be obtained from a certain amount. The child is also asked to translate a situation into a number expression.

Stage 3 in Number assumes that the routines for addition and subtraction of two digit numbers where no decomposition or regrouping is required are used successfully by the pupil. The move in complexity is to the same routines but with a need to deal with the tens by breaking them down. There is also the introduction of hundreds. The assessment in Stage 3 Part B provides the means of checking that ideas met earlier are part of the child's repertoire of skills. The teacher is still asked to read out the questions although many are printed on the paper given to the pupil. Questions 1 to 5 deal with earlier work. If a child gets these incorrect then trying to introduce more complicated Number work is doomed to failure.

Some of the subtraction questions require decomposition i.e. the number on the top line is broken down (or decomposed) so that it has the same value but is in a more convenient form. Do not use the word 'borrow' since this is incorrect, the number on the top is made up of tens and ones which belong together. There is no borrowing and no paying back. The numbers are simply reformed in a more convenient form. The codes provided for the marking include one for the common error of always subtracting the smaller digit, no matter if it is in the number to be subtracted or not e.g those who write

$$\begin{array}{r} 32 \\ -\ \underline{17} \\ \underline{25} \end{array}$$

Children who do this do not understand that digits in the tens and one places and on the same line, belong together. Nor do they have the routine for subtraction at their fingertips except in the case of numbers less than ten. Question 7 tests two important number properties: a] A number subtracted from itself results in zero and b] Addition can be carried out in any order so the numbers given can be rearranged to make tens. Hundreds need to be introduced with as much care as tens. The relationship between adjacent columns in a written number is very important. The pictures show a square of 100 units. The child should be able to accept the hundred as an entity and not need to count them all each time the picture occurs. The teacher is asked to read out numbers which the child should record with the digits in the correct places not just tagged onto each other.

Part C in Stage 3 extends the range of numbers to thousands but you may find this is too early and that the pupil is not yet working efficiently with HTU. There are two questions on the test paper which need the child to know the meaning of thousands though not to use them. The teacher may read the questions one at a time although they are all printed. Children who need to write down question 1 in the familiar format need more work on tens and in reading number sentences [translating them into words]. Each of the parts only needs a change of digit in one column and an ability to count in tens. The three digit addition requires no rearrangement and simply employs single digit addition and subtraction. Two questions return to the meaning of multiplication met earlier. If they are badly done then the meaning of the symbol has not been retained. There is a question on ordering three digit numbers. Question 9 has two correct answers.

The Part D assessment is closely tied to the familiar routines and format. The questions involve larger numbers and it is important to put the digits in the correct columns, however the calculations require only one decomposition and mostly need only bonds up to ten applied a number of times. The errors of applying the wrong operation and of subtracting the smaller digit are coded. Two multiplication questions can be done by dealing with the tens and ones separately The last question sets a situation and the pupil is asked which operation would need to be carried out for the solution. The child needs to know the meaning of 'difference'. In the coding scheme the subtraction statement written correctly and, as if order did not matter, are both coded. Many children think subtraction can be done in any order. Of the four operations, addition and multiplication of two numbers can be done in either order but in division and subtraction the order matters.

Stage Four

By now the child has been introduced to numbers up to thousands, and the operations of addition and subtraction with numbers that large. In most schools the work will have been mainly computations when the question has been presented in a familiar format. The assessment up to now has avoided complexities requiring decomposition in more than one column. Also we have not tested the pupil's understanding of the relationship between columns. For example can the child write the number 25 hundred in the correct columns or will he put 25 in the H column? In Stage 4 Part A we assess the child's knowledge of the number system and place value. If the class finds these questions very difficult the teacher needs to check that these aspects have been taught and perhaps postpone testing until a later stage. Additions and subtractions are varied, some require exchanging. Check that the child is not simply able to deal with two digits in a question and note those who are still subtracting the smaller digit from the larger inappropriately. The only reference to multiplication and division is in the context of sharing a two digit number by a number less than ten.

In Part B we return to multiplication and division written in a familiar format, no remainders are involved. The whole number system used has been dependent on ten and in this test increasing by a factor of ten or by adding ten are tested. It is very easy for a teacher to describe multiplying by ten as 'adding zero'. This is incorrect. The child knows that adding zero to any number does not change it and here is a teacher saying that making it ten times larger does not change it. Multiplication and division are inverses and the child can use knowledge of one to solve questions using the other.

By the end of the tests used in Stage 4 the children in the three countries who tried the tests were finding the questions very difficult. They were in grades four and five. There were still many topics in the syllabus which did not appear in the assessments. The questions asked have been linked to the type of teaching the pupils are likely to receive and many of the questions will be familiar. What has been lacking is a feeling for number which allows a confidence in using numbers without being reliant on memory of routines which may not be understood. The following is a list of topics with some examples which appeared to fit naturally within Stage 4 and within the curriculum but which were too difficult for the trial samples.

Important Harder Topics

These topics were difficult for each sample of the 4th grade and even for those of Grade 5 who were tested.

1. Putting digits in the correct columns when there is a gap or other complexity e.g.
   Write 75 tens and 3

   Th   H   T   U

2. Multiplication and division by a 2 digit number e.g.

   $\begin{array}{r} 324 \\ \times 52 \end{array}$ $27\overline{)540}$

3. More than one operation e.g.

   $27 \div 3 = \square \times 3$

4. Flexibility with tens e.g.
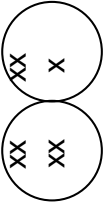
   10 sets of six is the same as six sets of 10 i.e. 60

5. Word problems.

The Use of a Diagnostic Test

A diagnostic test is used to diagnose children's understanding, errors they make and strategies they employ to find an answer. The only reason for doing this work is in order that the teacher then acts on this information. Errors children make reveal their level of understanding and give a clue for where the teacher should start working with that child. Leaving a hole in a pupil's knowledge and understanding just leads to further errors later. If most of the pupils in the class omit a question or get it wrong then the topic needs to be taught again but not necessarily in the same way. If the pupils did not understand the first time perhaps it was because the pre requisite earlier knowledge was not in place so he/she had no base on which to build. The teacher needs to check what the pupils do know and build on that.

Appendix 1 - Grade One

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Sorting collections according to criteria (teacher's and children's)	Placing and removing objects. Saying why/why not it belongs. Children placing themselves in groups by criterion.		Limit numbers (under 10)	Belongs, not	Oral and by watching child's actions
Order a collection (children, objects according to criteria)	Placing in order			Front, back, middle, larger, smaller.	Question with these words using objects.
Matching (leading to number) sets of different objects.	Dot diagrams	Matching 1-1		Same amount as. Is there a bead for every boy. More than/less than which has more?	Oral
Counting. Number names in sequence. One name per object. Last name is the number of objects.	Saying and pointing to object or touching. Show me as many fingers, as there are beads. How many is that?	Names in correct order.	Names said correctly, (GMZ Children count in English).	Names	Oral. How many do I have? Give me 'n'
Connecting name to symbol. Symbols 1-9	Numerals written 7 etc.		Shape, name, figure for each amount up to ten.		Show numeral give me this number of beads and vice versa.
				What is next what is missing what was the name before?	

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Count further As above with bigger numbers. Count forwards and backwards.	Cannot write over 9 as no place value notation yet.	Names in correct order (up to 30)	Number names to 30.	Names 10 – 30 (although not in tens and ones)	Counts collection how many more? Count all, count on, count on from larger
How many more in this collection than in that?	Pointing, matching	Matching and then counting.		Collect	
Towards addition of small numbers. Collecting two groups together. Order of collection.	Filling in counting sequence pointing and writing numerals under groups of objects eventually plus sign (small numbers sum to 9 or less)	Writing in figures what is said in words. Vice versa.	Number addition bonds to 10 verbally, to 9 written, including order reversal.	Add	Writing number sentence from a situation of putting two small gps together.
One more than, one less than is what number (up to 30)	Record addition, missing addends and equal sign			Same value as.	Reading number sentence from symbols and vice versa.
Subtraction (meanings: take away, difference, more than (count on) (only have add bonds to 10) Link between addn and subtraction.	Record -, =, ☐ 7 - ☐ = 5		Names – ordinal (oral)	Subtract, remove difference, take away	Oral instructions child symbolises and does operation with objects.
Ordinal numbers	Assigning (orally) ordinal names			Ordinal numbers up to tenth before, after.	

Appendix 1 - Grade Two

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Counting beyond 30 emphasis of pattern eg thirty one, thirty two.	No recording of numbers as no meaning of place value.	Counting – touching objects	Number names Twenty, Thirty etc up to hundred.		Oral – How many beans are there.
Counting in tens, grouping beads into tens.		Putting objects into tens.			Put down 5 groups of ten beads. Oral
Tens and ones and how to write. Importance of position and vv.	T U or T O to record bundles and singles	Showing bundles to match. Counting and recording	Number names already learned now linked to 2 digit writing.	One more, less than (no decomposition)	How do you write the number for this collection?
Importance of zero as place holder.	T U or T O to record with zero.				
Counting in tens.	Recording 10, 20 etc				
Addition 11 as 10 + 1 etc. Putting two collections together and recording, no changing.	Bundles/ones with others. Translating into symbols Write T U + T U	Putting tens with tens, units with units.	Addition bonds up to 10.	Zero, Tens, ones.	Translate array of objects into symbols. Moving away from counting in ones.
Addition with symbols (2 digits) no exchange	TU or T O 32 + 41	'Vertical form' addn collecting ones and tens.			Written 'vertical form'.
Bundles for add. But need for regrouping Record Counting for addition Adding in any order	Bundles to show 15, 17 TU 15 or T O 15 + 2	Put enough units together to get another ten.	Making tens, put appropriate numbers together 5+4+3+5+6+7	How many do I need to make 10? Order	Count on, count all, count from largest, know the number bonds.

Appendix 1 - Grade Two continued

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Bundles. Which pile has more? What is difference? Record on two lines with subtraction sign	Bundles (2 lines) T U 2 3 – Bundles 23 1 1 Bundles 11	See what does not match	Subtraction facts	Difference? Compare	How many more? Read this set of symbols to me ('vertical form').
Subtraction as take away (remove) bundles and verbal instruction. Recorded as subtraction	2 bundles and 3 singles remove a bundle and 2 singles T U 2 3 – 1 2	(tally on fingers) Units from units Tens from tens		Take away	Verbal instructions for subtraction to be done.
Addition and subtraction. Algorithms. No regrouping. Addition and subtraction inverses of each other	Rewrite addition and subtraction as each other.				Filling gaps in number sentence, addn rewritten as subtraction.
Zero added or subtracted. Addition, commutative, subtraction not				Zero	Number sentences from situations
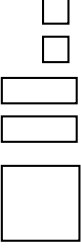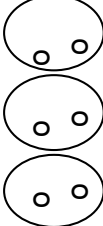
Appendix 1 - Grade Two continued

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Multiplication from arrays. Arrays of piles of beads. How many piles?	Record 5 piles of 4 5 x 4	Recording with x	Moving towards multiplication facts	Times, multiply, array.	Translate situation to multiplication sentence.
Rows and columns. Multiplication is commutative	Record either way 5 x 4 or 4 x 5 Single digits				
Multiplication as repeated addition . How many groups of 2?	2 + 2 + 2 + 2 + 2 is 5 x 2	Recording with x	Learning multiplication bonds small numbers. Product less than 25.		Translate repeated addition to multiplication sentence.
Division as sharing equally (initially pile of beads – 1 for you, 1 for me etc). 2 each. How many groups of 2.	Record answer as multiplication.			Share equally.	Practical sharing. Writing in symbols.
How many groups of 4 in to 20? Practical link to multiplication.	Record as 20 ÷ 4			Groups	Practical sharing. Writing in symbols.
Matching operation to word problem given.	Record in symbols.				Number sentences from problems.

Appendix 1 - Grade Three

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Subtraction single digit from 2 digit	(17 – 8 is 10 + 7 – 8)	Breaking 2 digit nos into T and U counting on.	Subtraction bonds to 10, linked to addition.	Matching symbols for 0-9 with words.	
Subtraction with decomposition (using bundles) Include zero in units, 2 digits	T U to record bundles and singles			Take away/ Difference	Pictures of bundles and singles. Oral instruction to remove.
Leading to symbolisation (in vertical form) (2 digits)	Record written sentences in symbols and vv (very simple) T U T U $-2\,\cancel{3}\,^{10}4$ $2+10+4$ $+8$ 2 8 2 $+8$	Question oneself what is being subtracted? Are there enough ones? Convert a ten. Now subtract from ones. How many left? Now subtract tens from tens.		Breakdown/ exchange NEVER BORROW AND PAYBACK	Algorithm
Addition and Subtraction as inverses.			A number subtracted from itself is 0. Link addn and subtrn facts	Zero More. Less.	
Adding 3 or 4 single digit numbers. Rearranging to give tens	Strings of numbers rearrange keeping + sign		Commutative law for addn but not subtrn.	'Order'	Strings of numerals to be rearranged.

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
Place value to produce hundreds, tens, units	☐☐☐☐ Record from picture		Importance of ten to place adjacent columns.	Hundreds, tens, ones (units)	Read out 3 digit numbers – record and vv. Put in correct columns.
Reading and writing numerals with HTU					
Ordering 3 digit numbers	Decision on hundreds first Then on tens.			One, ten, hundred less or more.	Put these in order.
Addition and subtraction of two 3 digit numbers and 2 digit numbers No decomposition	Setting out vertically H T U with figures in correct column.	What is being subtracted?	Correct columns	Difference. More than. Take away.	Algorithm from pictures and without.
Addn and subtrn 3 and 2 digit numbers with decomposition.	Setting out and breaking down.	What is being subtracted. Do I have enough ones, tens.	Bonds of ten.	'Breakdown' or similar. NEVER BORROW	Algorithm from pictures and without.
Sentences, symbols and algorithms for addn and subtrn	Reading and symbolising Choosing operation				Algorithm
Multiplication a) number of units taken 'n' times (n single digit)	How many twos? Record.			Times	Record situation in symbols with x
b) 2 digit by single digit. How many tens, units. No exchange	How many tens How many units Bundles Record	Multiply units and tens separately.	Times tables 2-5 counting in twos counting in fives.	Multiply, product.	Multiplication tens and ones separately.

Appendix 1 - Grade Three continued

Process/Content	Recording/Mathematizing	Routines	Facts (memory)	Vocab	Assessment
c) 2 digit by single digit with some units to tens exchange	Record as numerals 10 + 2 10 + 2 10 + 2	Writing carefully (Brackets?)			Examples of recording.
d) n (20+3) seen as 2n tens and 3n units					
Thousands, H,T,U Ordering 4 digit numbers.	Record from pictures		Relationship among adjacent columns.	Thousand	Read numbers, record, vv correct columns.
Number sense. Is it a reasonable answer? Estimating. Nearest ten, hundred, thousand Number patterns.			Times tables 6-9	Nearest closer to. Round up	Order, match to nearest.
Addition and subtraction of 4 digit numbers.					
Multiplication of 2 digit number by single digit number – regrouping in one and two columns.	Practical for collection and decomposition of extra column.	Algorithm – keeping place – addition and subtraction			Algorithms + translating word sentences to algorithms
Division of two digit number by single digit, no reminders. Link multn & division.	T U 3 5 x 6 Link to (6x30) + (6x5)	Algorithm for multiplication.		Remember 3 tens not just 3 etc.	Algorithm and link to expanded form.
Factors Which operation to use in this problem?	Share a) bundles b) symbolic c) with & without decomposition			Do I have enough to share?	
				Factor, multiple	Choose factors.

GRADE 4 CONTENTS OF SYLLABUS

The Grade 4 syllabus from Ghana, Malawi and Zambia tend to take the previously introduced topics and just introduce bigger numbers. A great many Number Concepts have been introduced in these four years of school.

(Remaining from GR.3 are Factors, Linking multiplication and division and more number sense. These have not been tested in GR.3)

Emphasis on same operations but bigger numbers (even 10 or 100 thousand). Numbers to be put in correct columns. Reading and writing large numbers. Value of the place in a written number.

Multiplication by 10

+, x, div., - with bigger numbers.

? Relationship among columns

Long division stated but we do not seem to have division by 10 (KH puts on restriction of x by no numbers beyond 2 digits, division by single digit with no remainder when in algorithm form).

Appendix 2 - Progression

Stage One Progression

Numbers less than 10

Objects. Matching two sets. As many as.

Counting objects. Using words (English) in correct order. Matching object to word (touching).

How many? Last name in count is answer to 'how many'. Position relative to other numbers.

Number symbols 1-9 matched with a set of objects.

Writing symbols.

Expression for addition, solved by counting.

Subtraction as removal, solved by counting.

———————————————————

Numbers more than 10 as well

Counting to 20 or 30 (not recording) orally. Matching names to objects.

How many more has one set than another (oral).

How many altogether from 2 sets (oral).

More than. Using numerals and also objects (not less than ten).

Symbolic. Expression for addition. Knowing number bonds.

Symbolic. Expression for subtraction. Knowing bonds.

Addition and subtraction in formal format nos < 10.

Ordinal numbers less than ten.

———————————————————

Appendix 2 - Progression

Stage Two Progression

Importance of Ten

Object in set. What is ten more than this number?

Addition Bonds of Ten

_____

Regarding ten objects as an entity (bundles etc) [Diagrams and materials]

Counting in tens – up to 90

_____

Writing numbers over 10 (Place Value)

Matching symbols (>10) to set of objects

Ten more than in symbols

_____

Addition of two digit numbers using diagrams, materials – move to symbols. (no regrouping in symbolic form)

Addition 2 digits algorithmic format (no regrouping)

_____

Subtraction as difference

Subtraction 2 digit nos., algorithmic format (no decomposition)

_____

Addition and subtraction are inverses of each other

_____

Subtraction as "how many more do I need?"

Appendix 2 - Progression

Stage Three Progression

How many groups in an array, using verb 'to share'.

Multiplication as an array.

Writing a multiplication expression from a picture (numbers less than ten).

Multiplication from repeated addition.

Importance of zero and its properties ($0 + n = n$, $n - n = 0$, $n - 0 = n$).

Addition of string of single digit nos. Order does not matter.

Addition / subtraction algorithm 2 digit nos. with re-grouping and decomposition.

Introduction of Hundred. Writing H T U numbers from words read out and from diagrams.

Ordering H T U numbers.

Algorithmic addition 3 digit nos. – no regrouping

Algorithmic subtraction 3 digit nos. – no regrouping.

Multiplication of 1 ten and n units by single digit no.

Writing expression from diagrams.

Writing thousand.

Putting Th H T U in correct columns.

Addition and subtraction Th H T U with no re-grouping.

Multiplication 2 digits by single digit (symbolic).

Division 2 digit by single digit (part of multiplication table).

Bold lines separating topics denote a large increase in difficulty.

Appendix 2 - Progression

Stage Four Progression

Relationship amongst columns in 3 digit nos.

Ordering numbers with 3 or 4 digits.

Addition and subtraction 3 digit numbers with regrouping (algorithmic format).

Addition and subtraction 4 digit numbers with regrouping (algorithmic format).

───────────────────────────────

Division of 3 digit nos. by single digit. No remainder.

───────────────────────────────

Multiply by 10. Two or 3 digit nos.

Division by 10. Two or 3 digit nos.

───────────────────────────────

Different sorts of numbers:- Even / odds, factors.

───────────────────────────────

Relationship between multiplication and division.

───────────────────────────────

There are more Number concepts (still within whole numbers) which occur in the Grade 4 syllabus and which were tested by the questions used in the research. BUT they were all too difficult for the children in our Zambian and Ghanaian samples (even at Grade 5).

Stage 1 Task - Part A

Equipment: 5 bottle tops, 7 seeds, 9 beads. Cards printed 3, 8.

---

1. Teacher sets out 5 bottle tops and seven seeds preferably of the same size.

○ ○ ○ ○ ○

o o o o o o o
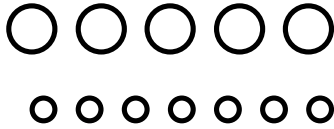
Teacher asks

a) Are there as many seeds as there are bottle tops?
b) Which set has most? Why?
c) Put more in the group that has less to make the two amounts the same.

[Note we have not used number, or how many].

2. Teacher shows a card with ┌ **3** ┐ written on it. Teacher asks

a) What number is this?
b) Show me that number of fingers

3. Shows ┌ **8** ┐

a) What number is this?
b) Give me that number of bottle tops

4. Teacher puts five beads on the table.

a) How many beads are there?
b) Can you write that number for me?
c) Teacher puts 9 beads down. How many beads are there?

5. Teacher puts 7 beads down.
a) How many beads are there?
b) (If correct) What number comes just before 7?
c) What comes just after 7?

Stage 1 Task - Part B

Equipment: Cards, stamps.

1. Teacher sets out 23 bottle tops in front of child and asks him to tell her how many there are.

2. Teacher shows two cards each of which has less than ten objects. She asks a. how many in this set? b. how many in this? c. how many more in this one than that one?
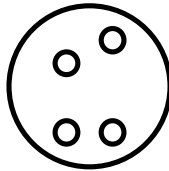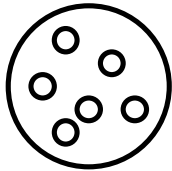
3. Teacher shows two cards, each shows a set of objects (over 10). "One set has more than the other. How many more has the larger set?"
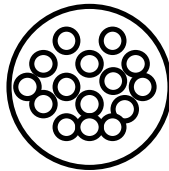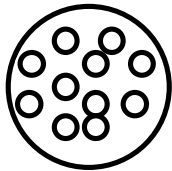
4.
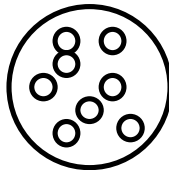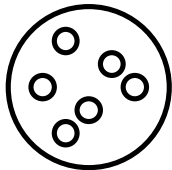
    How many are there altogether?

5. Teacher shows two strips of 'stamps',

    a)   places them end to end and quickly turns them over so that the child sees

3		5
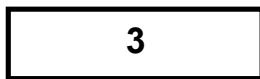
    How many stamps do I have?

    (If child unable to respond, Teacher says 'Shall I turn over the strips so that you can see the stamps?'. This enables the child to count squares).

    b)   Teacher says 'write a number sentence to show what you have done'. [The intention is to record in symbols, the teacher may use any expressions familiar to the child].

6. What is the answer to these additions? (Needs cards).

    a) 5 + 3,   c) 3 + 2
    b) 6 + 4,   d) 7 + 1

Stage 1 Task - Part C

Teacher reads out questions.

Children have test paper.
Familiar words may be used but not prompts.

1a.   Put a cross on the third person in the line (from the door).

1b.   Draw a ring round the sixth person from the door.

---

2.   John has 8 shells and Mary has 3 shells.

         How many more shells does John have?

---

3.   Roy has 7 cakes, a dog steals some, Roy has 2 cakes left.

         How many did the dog steal?

---

4 - 8.   Try these questions.

---

9.   The circle is in fifth place from the line.

         Draw in the circles that are in front of it.

Stage 1 Task - Part C

Name ....

Date ....

1.

2.

8   3

3.

4.   5 + 3 = ☐

5.   6 + 4 = ☐

6.   2 + 7 = ☐

7.   6 − 4 = ☐

8.   8 − ☐ = 4
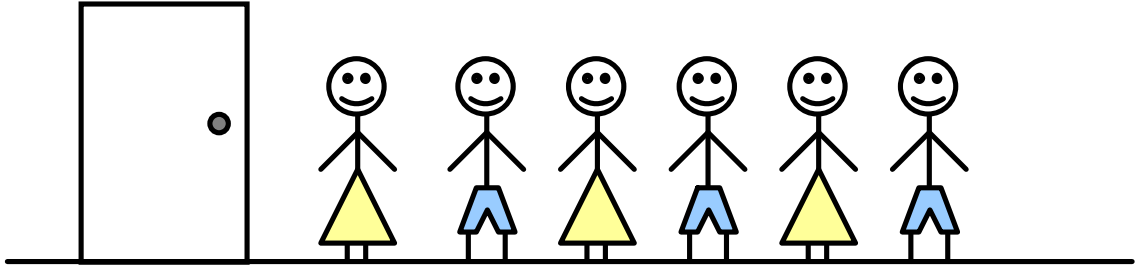
9.
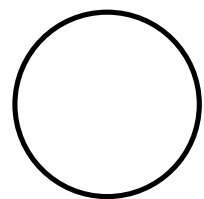
Child still cannot read. Some interview, some paper, mainly teacher reads, child records.

Equipment: Cards, buttons.

_____

1. Interview. Teacher puts a bowl of buttons (at least 35) and asks the child to.

   a) Count how many there are.
   b) Teacher asks 'What is the number ten more than that'.
   c) What is the number ten less than the number of buttons.

2. Interview. (Material cards with ten objects, others with less than 10). Teacher shows 5 cards, each has an array of ten objects. Teacher asks:

   a) How many altogether on these cards?
   b) Write down that number.
   c) Now here is another three on this card. How many altogether now?
   d) Write down that number.

3. Interview. Teacher uses same cards as in (2) and some more. Puts them on the table.

   a) Can you collect together cards to show 47?
   b) Write down that number.
   c) Show me the cards that match this number (written) 74.

TEST PAPER

Teacher reads out questions

4.   Write down the number shown in the picture.

5a.   What number is shown here?

5b.   How many more do you need to make 40?

          Write that number on the line underneath.

6.   Draw lines between pairs of cards which make ten

Stage 2 Task - Part A

Name ....

Date ....

4.

‖‖‖‖‖ ‖‖‖‖‖ ‖‖‖   ☐

5a.

‖‖‖‖‖ ‖‖‖‖‖ ‖‖‖‖‖ ‖‖‖‖   ☐

5b.   ....

6.

| 3 | 5 | 6 | 7 | 5 | 4 |
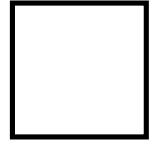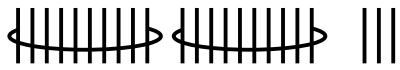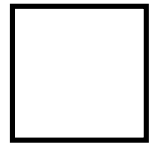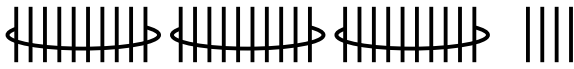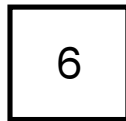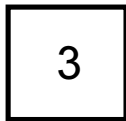
Stage 2 Task - Part B

Teacher reads out questions

Use words children will understand, without altering meaning, BUT no prompts.

---

1.   On your paper you can see pictures of two groups of sticks, some are in bundles of ten and there are some extra sticks. The top and bottom sets are put together.

        Draw a ring around the loose sticks which make ten. Show the sum under the TU heading and then add.

---

2.   Repeat above.

---

3.   From the bundles of ten and extra sticks take away a bundle of ten and two sticks (repeat).

        Show what you have done using the TU heading.

---

4.   Repeat above.

---

5 - 9.   Do the four questions shown.

Stage 2 Task - Part B

Name ....

Date ....
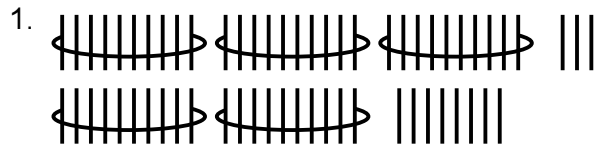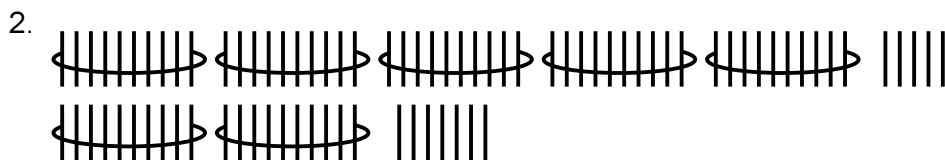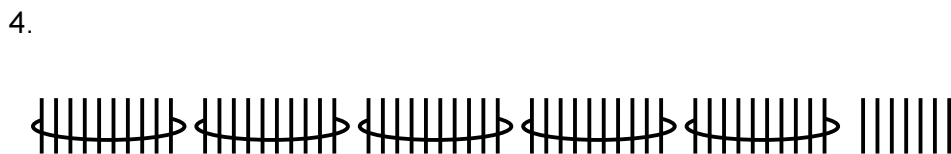
1.

	T	U
+		

2.

	T	U
+		

3.

	T	U
−		

4.

	T	U
−		

5.

```
 T U
 3 2
+1 5
-----

-----
```

6.

```
 T U
 5 4
+ 3 2
------

------
```

7.

```
 T U
 3 4
+ 6 5
------

------
```

8.

```
 T U
 4 0
+ 3 7
------

------
```

Stage 2 Task - Part C

Teacher reads out questions:

Use words children will understand without altering meaning. BUT no prompts.

---

1.   There are two numbers.
   Each number is shown in bundles of ten and singles. Write the numbers under the headings. Find the difference.

---

2.   Fred has 8 chickens, Jo has 3. What is the difference in the number of chickens?

---

3. - 7.   Do these.

8, 9.   You can see an addition question and next to it the start of a subtraction.

             Write the subtraction so that it tells you the same as the addition.

10, 11.   These have subtractions. We want the additions which tell you the same.
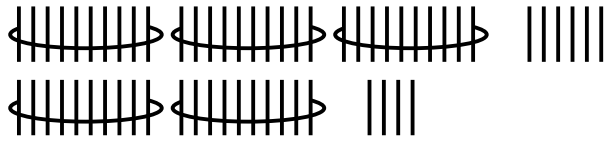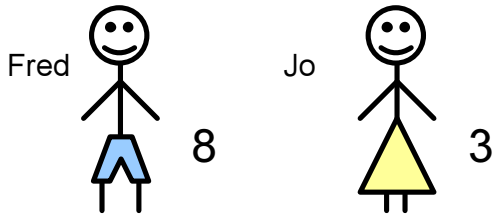
Name ....

Date ....

1.

        T   **U**

2.

Fred   8   Jo   3

Do these

3.
```
 T U
 3 4
+6 5
─────
```

4.
```
 T U
 4 0
+3 7
─────
```

5.
```
 T U
 5 6
+2 1
─────
```

6.
```
 T U
 3 4
−2 1
─────
```

7.
```
 T U
 2 4
−1 4
─────
```

8. $5 + 4 = 9$ $9 - .... = ...$

9. $6 + 2 = 8$ $8 - .... = ...$

10. $10 - 4 = 6$ $6 + ... = ...$

11. $9 - 3 = 6$ $......... + ... = ...$

Stage 3 Task - Part A

Teacher reads out questions

1a.   How many sets of beads are there? Put your answer in the box.

1b.   How many beads altogether. Put the answer in the other box.

2.   The picture shows rows of flowers.

        Write a multiplication about the flowers.

3a.   2 add 2 add 2 add 2 add 2 can be written as a multiplication. Write that multiplication.

3b.   5 times 3 can be written as an addition. We have started the adding for you.

4a.   May, Jim and Bob share these nuts equally between them. How many does each get. Put the answer in the box.

4b.   May, Jim and Bob each has 5 oranges. How many oranges do they have altogether? Put the answer in the box.

5.   How many groups of four are there in the 20 stones? Write your answer in the box.

6a.   John got 2 cakes on Monday, and on Tuesday, Wednesday, Thursday, Friday and Saturday (show fingers for these days). How many cakes did he get altogether? Write the answer in the box.

6b.   Write this as a multiplication underneath.

Stage 3 Task - Part A

Name ....

Date ....

1.　◯◯　◯◯　◯◯　◯◯
　　　◯　　◯　　◯　　◯

a) ☐

b) ☐

2.

.... **X** ....

3.　(a)　2 + 2 + 2 + 2 + 2 = ... **X** ....

　　(b)　5 x 3 = 3 + ...

4.　(a)

☐

　　(b)　☐
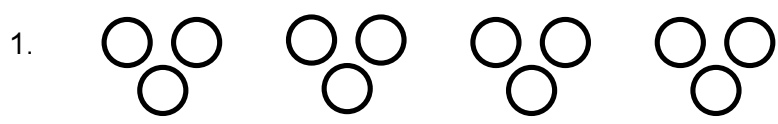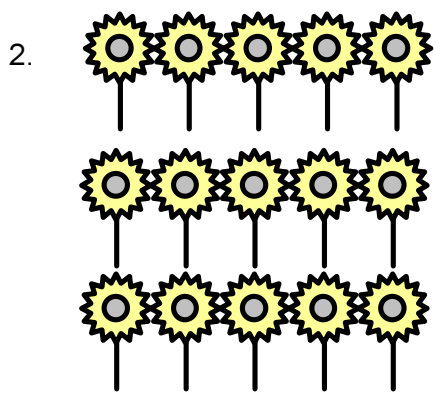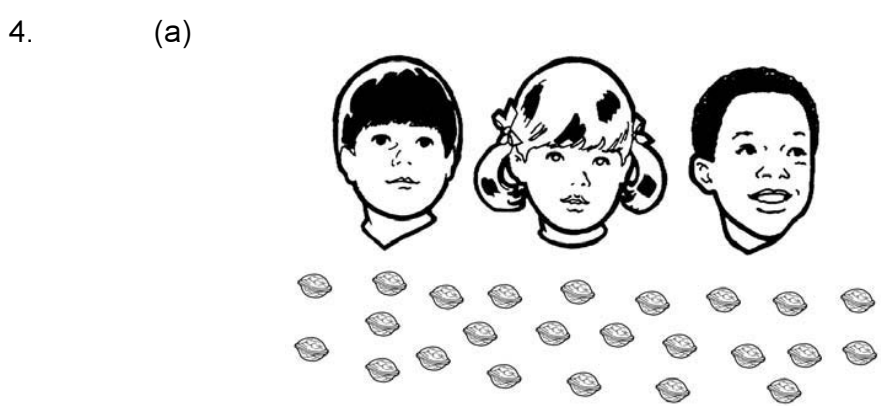
5.
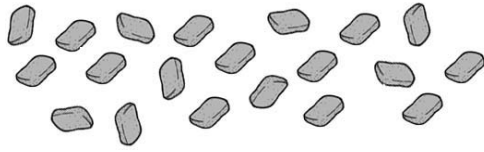
6.

.... X ....

Stage 3 Task - Part B

Teacher reads out questions

---

1.   Holding up card | three |

   Write down the number (figure) I am showing.

   Draw that number of circles.

2a.   Write the figures for these and do the addition.

2b.   Repeat.

---

3.   Draw in the box what you have if six sticks are removed.

---

4.   Repeat.

---

5.   I need 15 mangoes and I have 6 now. How many more do I need?

---

6.   Do these subtraction questions.

---

7.   Do the questions in number 7.

---

8.   Draw a line between the pair which add up to ten. We have done one for you. Do all the other pairs.

---

9.   Write down the number shown by the picture in a). Then do the same for b).

---

10.   Write down the numbers I will read out:

10a.   Four hundred and twenty five (repeat).

10b.   Five hundred and ten (repeat).

10c.   Two hundred and six (repeat).

Stage 3 Task - Part B

Name ....

Date ....

1.
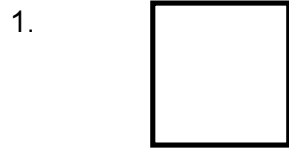
2a. five and three   ....

2b. six and four   ....

3.

4.

---
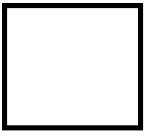
5. I need 15 mangoes and I have 6 now.
    How many more do I need?   ....

6.

a)   T U   b)   T U   c)   T U
     3 4   2 7   4 0
    – 2 8   – 1 4   – 1 7
    _____   _____   _____

---

7. Do these and get a result for each.

7a. 25 – 25 + 12 =

7b. 5 + 7 + 8 + 5 + 2 + 3 =

8. Draw a line between the pairs which add up to ten.
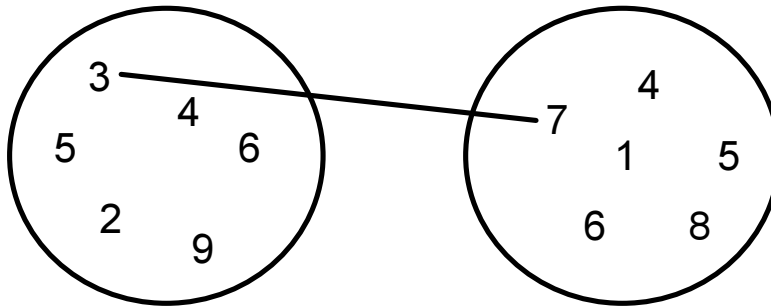
9. Write down the number shown by these pictures

9a
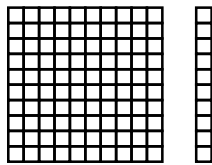
9b
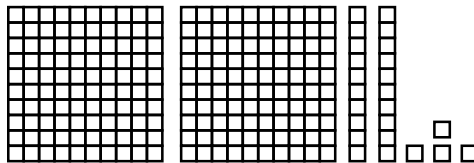
10a. four hundred and twenty five

10b. 5 hundred and ten

10c. 2 hundred and 6

Name ....

Date ....

1.   Write the answers.

1a. $18 - 10 = $ ⬜

1b. $39 - 29 = $ ⬜

1c. $54 + 10 = $ ⬜

2.   Put a ring round the bigger number in each pair.

2a.   568,   654

2b.   507,   705

3.   Do these:

3a.
```
H T U
  4 3 1
+ 3 2 5
───────
```

3b.
```
H T U
  2 0 6
+ 1 5 3
───────
```

3c.
```
H T U
  2 3 6
− 1 2 1
───────
```

3d.
```
H T U
  9 5 6
− 2 3 4
───────
```

4.   Write a multiplication question for this picture and find the total.

⬜ X ⬜ = ⬜
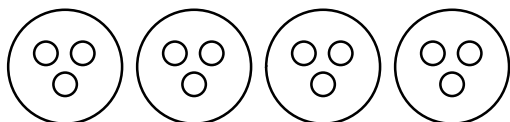
5. Write a multiplication and answer for this picture of bundles and ones.

    ⬜ **X** ⬜ **=** ⬜
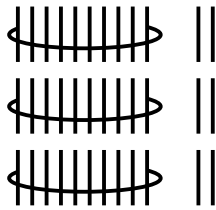
6. This amount is taken five times altogether.
    Write a multiplication question and find the answer.

    .... **X** .... **=** ....
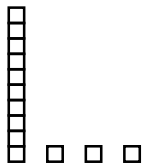
7. Put these numbers in order, the smallest first.

7a. 375, 361, 254, 481

7b. 680, 608, 860, 806

8. Tick which of these is eight thousand and twenty eight:

    800028   ....

    828   ....

    8028   ....

9. Tick the correct statements:

    One thousand is ....

    10 times bigger than 100   ....

    100 tens   ....

    ten tens   ....

Stage 3 Task - Part D

Name ....

Date ....

---

1.   Draw a line to connect a picture of sticks with the number of sticks.
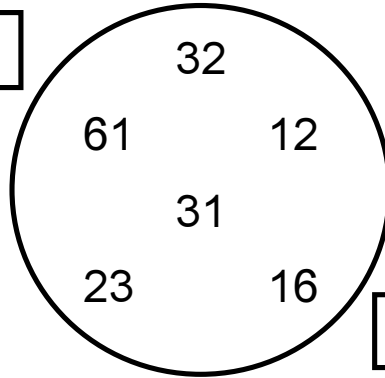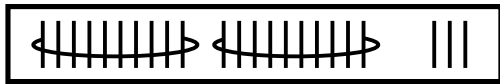
| | | |

32

61   12

31

23   16

---

2.   Draw a line between a picture of sticks and the number nearest to how many there are. There are two to do.

28
43
2a.   35
30
40
2b.
54
20

---
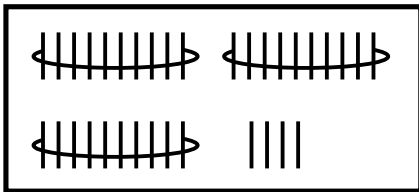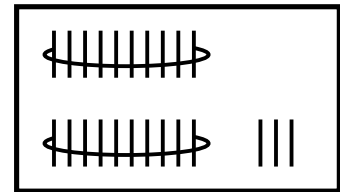
3.   Put these numbers in the right columns and add.

3a.   5212 + 1234 + 1431   Th H T U

3b.   3042 + 213 + 5633   Th H T U

Stage 3 Task - Part D continued

4.   Do this subtraction.

```
  Th H T U
     5 4 6 5
   − 4 4 4 4
   _____
```

_____

5.   Do these additions.

5a.
```
    H T U
    3 1 2
  + 2 2 2
  _____
```

5b.
```
    T U
    7 4
  + 4 7
  _____
```

5c.
```
    T U
    3 6
  + 5 2
  _____
```

6.   Do these subtractions.

6a.
```
    H T U
    3 5 6
  − 2 1 4
  _____
```

6b.
```
    T U
    7 4
  − 4 7
  _____
```

6c.
```
    T U
    3 6
  − 2 5
  _____
```

Stage 3 Task - Part D continued

7. Do these multiplications:

7a. 21 x 5 ☐

7b. 30 x 4 ☐

8. How many boxes of ten balls can I get from a sack of 85 balls? ☐

9. Do these divisions.

9a. $55 \div 5$ ☐

9b. $60 \div 6$ ☐

9c. $36 \div 4$ ☐

10. Peter has 35 oranges and Yusif has 21 oranges.

Which of these number sentences says what the difference is between the number of Peter's oranges and the number of Yusif's oranges.

Circle the expression.

35 + 21   21 x 35   35 – 21

21 + 35 $35 \div 21$ 21 – 35

Stage 3 Task - Part D continued

The teacher reads out the questions

1.   Draw a line to connect a picture of sticks with the number of sticks.

2.   Draw a line between a picture of sticks and the number nearest to how many there are. There are two to do.

3.   There are three parts to this question. Put the numbers so that the figures come under the right headings and add.

4.   Question four has a subtraction. Do it.

5.   Question five has three additions. Do them.

6.   Do these three subtractions.

7.   Do these multiplications.

8.   How many boxes of ten balls can I get from a sack of 85 balls? Write the answer in the box.

9.   Do these divisions.

10.   Peter has 35 oranges and Yusif has 21 oranges.

      Which of these number sentences says what is the difference between the number of Peter's oranges and the number of Yusif's oranges.

      Circle the expression.

Stage 4 Task - Part A

Name ....

Date ....

---

1.   Write these numbers:

     1a   One thousand, two hundred

<div></div>

     1b   Three hundred and forty one

<div></div>

     1c   Ten thousand, six hundred and forty

<div></div>

     1d   Fifty seven thousand, three hundred

<div></div>

     1e   Ninety seven

---

2.   In these numbers, what is the value of the figure underlined.

     2a   372$\underline{1}$

     2b   4$\underline{2}$731

---

3.   Put these in order of size. Largest to come first.

     731,   352,   7000,   3710

---

4.   12 olives are shared equally among 3 children. How many olives does each get?

---

5.   Ana puts six cakes in each box. She has 54 cakes. How many boxes does she use?

49

6. Do these questions. They are subtractions.

6a.
```
Th H T U
   3 2 4 1
 − 1 3 1 8
 _____
 _____
```

6b.
```
Th H T U
   5 4 6 5
 − 4 4 4 4
 _____
 _____
```

7. Do these additions.

7a.
```
Th H T U
   3 1 4 5
 + 1 6 1 2
 _____
 _____
```

7b.
```
Th H T U
   5 4 6 5
 +   6 2 5
 _____
 _____
```

8. Do these.

8a.
```
H T U
2 3 5
+ 1 1 7
_____
_____
```

8b.
```
H T U
5 7 3
+ 1 4 7
_____
_____
```

8c.
```
H T U
2 1 5
− 1 1 7
_____
_____
```

8d.
```
H T U
4 3 2
− 2 7 5
_____
_____
```

9. Do this addition.

2154 + 6261

Th   H   T   U

_____

_____

Stage 4 Task - Part B

Name ....

Date ....

1. Do these divisions.

   1a.   6) 360   1b.   8) 656

2. Which of the following is true when you multiply a number by ten. Tick your choice.

   2a.   You add ten to it ....

   2b.   You add a zero to it ....

   2c.   You move each figure to the column on the left ....

3. Do these

   3a. $150 \div 10$

   3b.   36 x 10

   3c.   Ten more than 27

   3d.   One hundred less than 153

4.

   41 x 5   How many tens in the answer?

5. The shop sells 350 loaves of bread each day. The baker has cooked 275 loaves. How many more does he need? Which of the following would you do to solve this problem?

   Underline it.

   350 + 275   275 − 350   350 − 275

   275 x 350 $350 \div 275$ 275 + 350

6.   Do these

6a.
$$\begin{array}{r} 24 \\ \times\ 5 \\ \hline \end{array}$$

6b.
$$\begin{array}{r} 74 \\ \times\ 8 \\ \hline \end{array}$$

7. $3 \times 2 \times \boxed{} = 24$

What number should go in the box to make this true?

8.   One more than 7299 is

9a.   73100 ....

9b.   72991 ....

9c.   7298 ....

9d.   7300 ....

Tick which you think is correct.

9.   Rewrite each multiplication as a division.

9a. $5 \times 4 = 20$ $20 \div \ldots\ldots\ldots = \ldots\ldots\ldots$

9b. $9 \times 8 = 72$ $\ldots\ldots\ldots \div \ldots\ldots\ldots = \ldots\ldots\ldots$

Stage 4 Task - Extra Numeracy

1.   1a.
$$
\begin{array}{r}
562 \\
\times\ 6 \\
\hline
\end{array}
$$

1b.
$$
\begin{array}{r}
324 \\
\times\ 52 \\
\hline
\end{array}
$$

2a.   Write 25 hundred and ten in the right columns

Th	H	T	U

2b.   Write 3 thousand and forty one

Th	H	T	U

2c.   Write 75 tens and three

Th	H	T	U

3.   Fred has 56 dollars. He needs ten times that to pay the bills.

    3a.   How much is the bill?

    ....

    3b.   How much more does he need?

    ....

4a.   63 | 126

4b.   63 | 1260

4c.   630 | 1260

5.   Dan has 264 mangoes to share equally among himself and his five friends. How many mangoes does each get?

6. A bus holds 52 passengers. The school is taking 230 children to the sea. How many buses do they need if all the children need to go at the same time?

7. Write the number that goes into the box to make the statement true.

7a. $25 \div 5 = 5 \times \boxed{}$

7b. $72 \div \boxed{} = 3 \times 4$

7c. $\boxed{} \times 2 = 12 \div 2$

8a. How many groups of 23 flowers can you get from a box of 237 flowers?

8b. How many bunches of 25 flowers can you get from a box of 500 flowers?

8c. How many groups of 17 can you get from 357

9. 41×5 has how many tens?

Stage 1 Coding Sheet - Part A

Question	Codes				
	1	**2**	**3**	**4**	**0**
1a	counts correct	matches correct	says 2 numbers correct	incorrect	omit
1b	counts correct	matches correct	2 numbers correct	incorrect	omit
1c	counts correct	matches correct	adds on correct	incorrect	omit
2a	correct (3)	answer 2	answer 4	other incorrect	omit
2b	correct	2	4	other incorrect	omit
3a	correct (8)	7	9	other incorrect	omit
3b	correct count	matching fingers		incorrect	omit
4a	correct count	correct without count		incorrect	omit
4b	correct (5)	reversal (ᒲ)		incorrect	omit
4c	correct count (9)	correct without counting		incorrect	omit
5a	counts correct (7)	correct without counting		incorrect	omit
5b	correct (6)	7		other incorrect	omit
5c	correct (8)	6		other incorrect	omit

55

Stage 1 Coding Sheet - Part B

Question	Codes						
	1	2	3	4	5	6	9
1	counts correctly	says correct number		counts incorrect			omit
2a	counts correctly	says correct number		counts incorrect			omit
2b	counts correctly	says correct number		counts incorrect			omit
2c	correctly matches	correctly counts on	knows number needed	incorrect match	incorrect count		omit
3	correct by match	correct by counting	knows numbers	incorrect match	incorrect count		omit
4	counts on	counts all	knows no addition	incorrect count on	incorrect counts all		omit
5a	no stamps correct, counts on	no stamps correct, counts 8 fingers	knows 3 + 5	uses stamps, correct count on	uses stamps, correct counts all	incorrect	omit
5b	3 + 5 = 8 5 + 3 = 8	3 + 5 or 5 + 3	3, 5 no signs	other incorrect			omit
6a	counts on correct	counts all correct	knows 5 + 3 = 8	incorrect			omit
6b	counts on correct	counts all correct	knows 6 + 4 = 10	incorrect			omit
6c	counts on correct	counts all correct	knows 3 + 2 = 5	incorrect			omit
6d	counts on correct	counts all correct	knows 7 + 1 = 8	incorrect			omit

Stage 1 Coding Sheet - Part C

Question	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	some mark on 3rd	mark 3rd from end				other incorrect	omit
1b	some mark on 6th	marked first				other incorrect	omit
2	5		11			other incorrect	omit
3	5		7	2	9	other incorrect	omit
4	8		2			other incorrect	omit
5	10		2			other incorrect	omit
6	9		5			other incorrect	omit
7	2		10			other incorrect	omit
8	4		12			other incorrect	omit
9	4 shapes	5 shapes				other incorrect	omit

Stage 2 Coding Sheet - Part A

Interview	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	counts correctly touching	counts correctly not touching	incorrect names	incorrect count	other correct	other wrong	omit
1b	ten more on fingers	adds 10	incorrect add	incorrect count			omit
1c	removes 10 correct	knows	subtracts	incorrect			omit
2a	correct knows 50	correct counts all dots	tens said as ones 5	incorrect other			omit
2b	correct 50	5					omit
2c	correct counts on	correct knows		incorrect			omit
2d	53	35	8			other wrong	omit
3a	correct 47		incorrect 74			other wrong	omit
3b	writes 47	74				other wrong	omit
3c	correct 74		incorrect reverse (47)			other wrong	omit
4	23	3				other wrong	omit
5a	35	30				other wrong	omit
5b	5	40				other wrong	omit
6a	5, 5	line them all				other wrong	omit
6b	7, 3					other wrong	omit
6c	6, 4					other wrong	omit

Stage 2 Coding Sheet - Part B

Interview	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	correct	other bundle				other wrong	omit
1b	33 28	33 82	6 3			other wrong	omit
1c	61	511	5	13		other wrong	omit
2a	correct	other bundle				other wrong	omit
2b	55 27	55 72	10 9			other wrong	omit
2c	82	712	28	32		other wrong	omit
3a	34 -12		12 -34			other wrong	omit
3b	correct answer		46			other wrong	omit
4a	57 -12		12 -57			other wrong	omit
4b	correct answer		69			other wrong	omit
5	47		23			other wrong	omit
6	86		22			other wrong	omit
7	99		31			other wrong	omit
8	77	70	17			other wrong	omit

Stage 2 Coding Sheet - Part C

Interview	Codes				
	1	**2**	**3**	**9**	**0**
1a	36 24	24 36		other wrong	omit
1b	12		60	other wrong	omit
2	3		11	other wrong	omit
3	99		31	other wrong	omit
4	77		17	other wrong	omit
5	77		35	other wrong	omit
6	13		55	other wrong	omit
7	10		38	other wrong	omit
8	9 - 4 = 5 OR 9 - 5 = 4	one part correct		other wrong	omit
9	8 - 2 = 6 OR 8 - 6 = 2	one part correct		other wrong	omit
10	6 + 4 = 10	one part correct		other wrong	omit
11	3 + 6 = 9 OR 6 + 3 = 9	9 + 3 = 6		other wrong	omit

Stage 3 Coding Sheet - Part A

	Codes				
	1	**2**	**3**	**9**	**0**
1a	4		3	other wrong	omit
1b	12		4	other wrong	omit
2	3 x 5 OR 5 x 3	15	3 + 5	other wrong	omit
3a	5 x 2 OR 2 x 5	10		other wrong	omit
3b	3 + 3 + 3 + 3 + 3	15	3 + 5	other wrong	omit
4a	8	24	3	other wrong	omit
4b	15	5 x 3	8	other wrong	omit
5	5	20	4	other wrong	omit
6a	12			other wrong	omit
6b	2 x 6 OR 6 x 2		2 + 2 + 2 + 2 + 2 + 2	other wrong	omit

Stage 3 Coding Sheet - Part B

	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	3		2	5		other wrong	omit
1b	000		correct for 2	correct for 5		other wrong	omit
2ai	5, 3	one correct				other wrong	omit
2aii	8		53			other wrong	omit
2bi	6, 4	one correct	64			other wrong	omit
2bii	10					other wrong	omit
3	llllllll	7	6			other wrong	omit
4	⬯⬯|	21	6			other wrong	omit
5	9		11			other wrong	omit
6a	6		14	62		other wrong	omit
6b	13			41		other wrong	omit
6c	23		37	57	30	other wrong	omit
7a	12			62		other wrong	omit
7b	30		signs of making 10s			other wrong	omit
8	all pairs		one set no reversal	only one pair		other wrong	omit
9a	110		11	2		other wrong	omit
9b	224		200204	8		other wrong	omit
10a	425		40025			other wrong	omit
10b	510		50010			other wrong	omit
10c	206		2006			other wrong	omit

Stage 3 Coding Sheet - Part C

	Codes					
	1	**2**	**3**	**4**	**9**	**0**
1a	8		28		other wrong	omit
1b	10		68		other wrong	omit
1c	64		44		other wrong	omit
2a	654		568		other wrong	omit
2b	705		507		other wrong	omit
3a	756		106	114	other wrong	omit
3b	359		53	153	other wrong	omit
3c	115		357		other wrong	omit
3d	722		1190		other wrong	omit
4	4 x 3 = 12 OR 3 x 4 = 12	12	4 x 3 OR 3 x 4		other wrong	omit
5	12 x 3 = 36 OR 3 x 12 = 36	36	12 x 3 OR 3 x 12		other wrong	omit
6	13 x 5 = 65 OR 5 x 13 = 65	65	13 x 5 OR 5 x 13		other wrong	omit
7a	correct order		reverse to correct		other wrong	omit
7b	correct order		reverse to correct		other wrong	omit
8	8028		828	800028	other wrong	omit
9	both top two	one correct	ticks all		other wrong	omit

Stage 3 Coding Sheet - Part D

Interview	Codes					
	1	**2**	**3**	**4**	**9**	**0**
1	all 3	2 correct	1 correct	32 not 23	other wrong	omit
2a	35		30		other wrong	omit
2b	20		30	28	other wrong	omit
3a	correct 7877	correct cols but no adding	correct cols addition wrong		other wrong	omit
3b	correct 8888	correct cols but no adding	correct cols addition wrong	213 in wrong cols	other wrong	omit
4	1021		9909	121	other wrong	omit
5a	534		90	110	other wrong	omit
5b	121		27	33	other wrong	omit
5c	88			24	other wrong	omit
6a	142		570		other wrong	omit
6b	27		121	33	other wrong	omit
6c	11		61		other wrong	omit
7a	105		15		other wrong	omit
7b	120		12		other wrong	omit
8	8	8 rem 5		does division	other wrong	omit
9a	11			does division	other wrong	omit
9b	10			does division	other wrong	omit
9c	9			does division	other wrong	omit
10	35 - 21	35 - 21, 21 - 35	21 - 35		other wrong	omit

Stage 4 Coding Sheet - Part A

	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	1200		1000200		1000, 200	other wrong	omit
1b	341		30041	3041	300, 41	other wrong	omit
1c	10640		1000060040	1640	10000, 600, 40	other wrong	omit
1d	57300		57000300	570300	57000, 300	other wrong	omit
1e	97		907			other wrong	omit
2a	2 ten	twenty 20	2			other wrong	omit
2b	2 thous.	2000	2			other wrong	omit
3	correct		correct reversed			other wrong	omit
4	4		3			other wrong	omit
5	9		6	54		other wrong	omit
6a	1923		4559	2137		other wrong	omit
6b	1021		9909			other wrong	omit
7a	4757		2533	1533		other wrong	omit
7b	6090		5240	4840		other wrong	omit
8a	352		122	118		other wrong	omit
8b	720		434	426		other wrong	omit
8c	98		102	332		other wrong	omit
8d	157		243	707		other wrong	omit
9	8415	Correct col no add		83115		other wrong	omit

Stage 4 Coding Sheet - Part B

	Codes						
	1	**2**	**3**	**4**	**5**	**9**	**0**
1a	60		10			other wrong	omit
1b	82		7			other wrong	omit
2	c		b	a	b & c	other wrong	omit
3a	15		5	25		other wrong	omit
3b	360		37	370		other wrong	omit
3c	37		1027	27	270	other wrong	omit
3d	53		143			other wrong	omit
4	20		205	4		other wrong	omit
5	350 - 275	350 - 275, 275 - 350	275 - 350	75		other wrong	omit
6a	120		2 lines correct	1 line correct		other wrong	omit
6b	592		2 lines correct	1 line correct		other wrong	omit
7	4		6	12		other wrong	omit
8	d		b	a	c	other wrong	omit
9a	correct		one piece correct			other wrong	omit
9b	correct		one piece correct			other wrong	omit

Stage 4 Coding Sheet - Extra Numeracy

Question	Codes							
	1	2	3	4	5		9	0
1a	3372							omit
1b	16848		2 lines correct	1 line correct				
2a	2510		25 in H					
2b	3041		341					
2c	753		75 in T					
3a	560		5610					
3b	504		56					
4a	2		20					
4b	20		2					
4c	2		20	200				
5	44		52 rem 4					
6	5		4 rem 22					
7a	1		5	25				
7b	6		12	72				
7c	3		12	24				
8a	10	10 rem 7						
8b	20		10					
8c	21		1					
9	20		4					

Stage 1 Interview Record - Part A

Name of pupil _____   Date _____

1.   a)   Correct. Child counts / Matches 1 - 1 / Says the two numbers without counting

         Child has incorrect answer. Why? _____

         _____

    b)   Correct. Reason by counting / matching / 2 numbers.

         Child has incorrect answer. Why? _____

         _____

    c)   Correct. Reason counting / matching / adding on

         Child has incorrect answer. Why? _____

         _____

2.   a)   Correct / Incorrect

    b)   Correct / Incorrect

3.   a)   Correct / Incorrect

    b)   Correct by counting / matching fingers

         Child has incorrect answer. Why? _____

         _____

4.   a)   Child counts correctly / correct without counting / incorrect

    b)   Correct / reversal / incorrect number

    c)   Child counts correctly / correct without counting / incorrect

5.   a)   Child counts correctly / correct without counting / incorrect

    b)   Correct / Incorrect

    c)   Correct / Incorrect

Stage 1 Interview Record - Part B

Name of pupil _____   Date _____

1.   Child counts correctly / incorrectly / says correct number

2.   a)   Child counts correctly / incorrectly **OR** knows correct number

        b)   Second set. Child counts correctly / incorrectly **OR** knows correct number

        c)   Child correctly matches / counts on / knows number needed
            OR
            Child incorrectly matches / counts on / knows number needed

3.   Finds correct number by counting / matching / knowing numbers

        Finds incorrect number by counting / matching / knowing numbers

4.   Correct counts on from either 6 or 8 / counts all / knows number addition correct

        Incorrect counts on from either 6 or 8 / counts all / knows number addition

5.   a)   Does not need to see stamps: Correct counts on from 3 or 5 / counts 8 on fingers /

            knows 3 + 5

            Needs to see stamps: Correct counts all / counts on from 3 or 5 / knows 3 + 5

    b)   Writes 3 + 5 = 8 (or 5 + 3 = 8) / 3 + 5 or 5 + 3 no equals sign / 3, 5 no operation sign

6a,b,c,d.

	5 + 3	6 + 4	3 + 2	7 + 1
Counts all				
Counts on from largest				
Counts on from smallest				
Knows number bond				

Stage 2 Interview Record - Part A

Name of pupil _____   Date _____

1.   a)   Child counts correctly touching / not touching / incorrect name order / incorrect count

        b)   Child counts 10 more on fingers / adds 10 to total / incorrect adding / incorrect finger count

        c)   Removes 10 buttons and counts correctly / knows number / subtracts correctly / incorrect

2.   a)   Child says _____

        b)   Child writes _____

        c)   Child says _____

        d)   Child writes _____

3.   a)   Child collects _____

        b)   Child writes _____

        c)   Child knows _____

4.-6.   on test paper.

Interview Sheet 1A

Paper 1a
Teacher Interviews child 1-1
Records as follows:

Name of child		School	
Age	Date	Boy/Girl	

1a   Does child count? Using fingers?

....

Does child match 1-1 using the objects?

....

Does child say the two numbers?

....

Does child use fingers to compare?

....

Difficulty child has .....

....

....

1b   Give reason child gives.

....

....

....

Difficulty child has.

....

....

1c   Method child uses to make sets same size.

....

....

2a

3	Child says .... Number of fingers shown..
8	Child says .... Number of bottle tops given ....

3a   Child says ….
5 beads, counts by touching each.

....

Counts silently.

....

Knows number.

....

3b   Copy what child writes.

....

Answer of child.

....

3c   9 beads, counts by touching each.

....

Counts silently.

....

3d   20 beads, names in correct order up to ....

Touches each bead as named

....

Does not touch or move bead but correct/incorrect.

....

4a   7 beads, child says

....

4b   Child says

....

4c   Child says

....

Interview Sheet 1B

Paper 1b
Teacher Interviews child 1-1
Records as follows:

Name of child		School	
Age	Date	Boy/Girl	

1.   Child counts touching/moving objects.

   ....

   Child counts silently.

   ....

   Correct/Incorrect (Number).

   ....

---

2.   a) Child says (for 6).

   ....

   b) Child says (for 4).

   ....

   Child counts touching/moving objects.

   ....

   Child counts silently.

   ....

   c) Child finds difference (describe method).

   ....

3.   Child counts each set by touching/moving/silently.

   ....

   Describe how child finds the greater e.g matches one to one, counts on.

   ....

   ....

Interview Sheet 1B continued

4.   Child counts each first.

....

Child counts on from smaller/larger.

....

Child uses number bonds.

....

5a   Child finds total from knowing number bonds.

....

Child counts 'stamps'.
(i) from 1   (ii) from 3   (iii) from 5

....

5b   Child writes.

....

....

6a   Child counts all (5+3) ....

Counts on from 5 ....

Knows 5 + 3 ....

Uses fingers ....

Answer...

6b,c,d

	6+4	3+2	7+1
Counts all			
Counts on from largest			
Counts on from smallest			
Knows number bond			
Uses figures			
Answer			

Interview Sheet 2A

Paper 2a
Teacher Interviews child 1-1
Records as follows:

Name of child		School	
Age	Date	Boy/Girl	

1a   Child counts touching/moving buttons? | Number of buttons |
|---|

....

Child counts silently.

....

Names in correct order.

....

Correct/incorrect number.

....

1b   Child says ....

Method used.

....

1c   Child says ....

Method used.

....

2a   (Showing cards) Child says.

....

2b   Child writes.

....

2c   Child says.

....

2d   Child writes.

....

3a   Child collects cards showing:

....

3b   Child writes.

....

3c   Child collects cards (list).

....

Correct/incorrect.

....

Counts in tens.

....

Counts how?

....

Resources
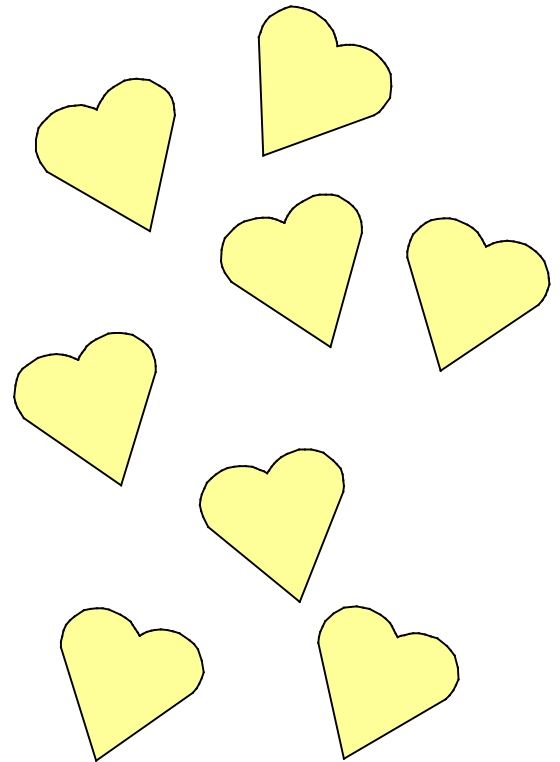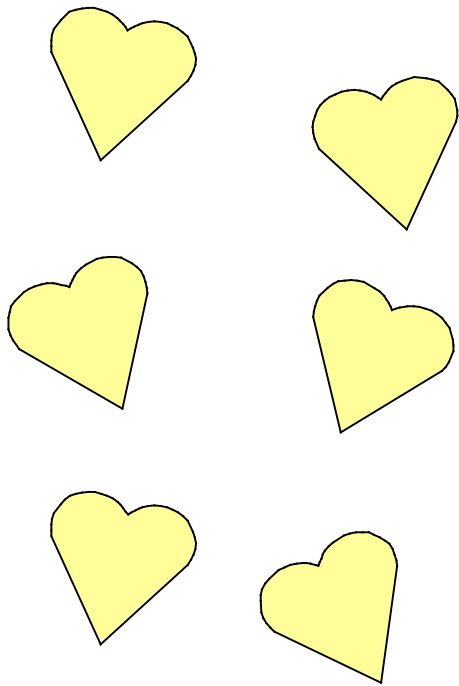
$$5 + 3$$

$$3 + 2$$

$$6 + 4$$

$$7 + 1$$

Resources

1b

Resources

2a

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