

Framework and Test Specifications for the

2009 National Assessment of Mathematics

Second and Sixth Classes

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Section I: Introduction

The 2009 National Assessment of Mathematics involves the assessment of pupils' mathematics achievement in Second and Sixth classes. Prior to this, national assessments were carried out in 1999 and 2004, at Fourth class level (Shiel & Kelly, 2001; Shiel, Surgenor, Close & Millar, 2006). Hence, preparation for the 2009 assessment involved extending and modifying the earlier framework to include test specifications that cover the Primary School Mathematics Curriculum (PSMC) for Second and Sixth classes (DES/NCCA 1999).

An assessment framework normally describes: (i) the mathematical knowledge to be assessed, usually in terms of the mathematical content and cognitive processes of the curriculum or subject domain; (ii) test specifications in terms of item type and format to be used, and test structures and conditions; and, where relevant, (iii) questionnaire instruments used. Some frameworks, such as those for the National Assessment of Educational Progress in the United States (NAEP) (National Assessment Governing Board, 2008), the Trends in International Mathematics and Science Survey (TIMSS) (Mullis et al., 2005, 2009) and the OECD Programme for International Student Assessment (PISA) (OECD 2003, 2006), also describe reporting methods such as proficiency levels. This document describes the revised framework for the 2009 NAM assessment and the issues which were considered in developing it.

Schools and pupils participating in the 2009 NAM were also asked to participate in the 2009 National Assessment of English Reading (NAER), which was administered in parallel with mathematics (i.e., the same pupils were invited to take part in both assessments).

The 2009 NAM was implemented by the Educational Research Centre on behalf of the Department of Education and Science. The Centre is supported in its work by a National Advisory Committee comprising representatives of the Department of Education and Science, the Catholic Primary School Managers Association, the Irish Primary Principals' Network, the Irish National Teachers' Organisation, the National Council for Curriculum and Assessment, the National Parents Council – Primary, An Foras Patrúntachta and Gaelscoileanna.

The Centre was also assisted in its work on the 2009 NAM by a Mathematics Expert Group. This group consists of members of the Inspectorate, teachers, lecturers in mathematics education, and ERC staff members.

The aims of the 2009 National Assessment in Mathematics are

- to establish current mathematics standards of Second and Sixth class pupils;
- to provide high quality and reliable data for the Department of Education and Science to assist in policy review and formulation and in decisions regarding resource allocation related to mathematics;
- to examine school, teacher, home background, and pupil characteristics, and teaching methods which may be related to mathematics achievement;

- to provide information and advice to schools and teachers in order to assist in school planning designed to improve teaching and learning in mathematics;
- to provide a basis with which to compare future assessments of mathematics achievement at Second and Sixth classes.

Section II: The 2004 NAM Framework

This section briefly describes the development of the framework used in NAM 2004 when Fourth class was the target grade level.

Development of the Fourth Class Test for the 2004 NAM

Coverage of Fourth Class PSMC Objectives

The 1999 and 2004 national assessments of mathematics achievement assessed performance at the Fourth Class level. The test items used in these years assessed almost all of the 78 listed objectives of the PSMC for Fourth class, with a greater emphasis on higher order skills such as reasoning, integrating and connecting, and applying and problem-solving. A few objectives (e.g. measuring weights or capacities or constructing 3-D shapes) were not assessed as they are difficult to assess by pen and paper group test and can be assessed by other means. A few other Fourth Class objectives which were assessed (e.g. recalling meaning of the symbols $>$ and $<$ or applying the associative property of addition) are formally listed as objectives in the Second Class curriculum but not in the Fourth Class curriculum, although pupils in Fourth class are expected to know them (c.f. Appendix I, Table 1 for the full list of the Fourth Class assessment objectives derived from the PSMC).

Coverage of Content Strands

To facilitate the emphasis on higher order skills, the items in the 2004 test were classified using two dimensions – mathematical *content strand* and *cognitive process skill* category, as set out in the Fourth Class PSMC. Tables 1 and 2 show the results of the classification of the 2004 NAM items by content strand and process skill. Due to a lack of suitable items, the Shape and Space strand had a somewhat smaller proportion of test items than that reflected in its weighting in the assessment objectives of PSMC for Fourth Class, with the Measures section consequently containing a correspondingly higher proportion of the items in the test.

Table 1: *Distribution of the 2004 NAM Main Study Items for Fourth Class and PSMC Objectives, by Mathematics Content Strand*

Content Strand	Number of Items in NAM 2004	Percent of Items in NAM 2004	Number of Objectives in PSMC 4 th Class	Percent of Objectives in PSMC 4 th Class
Number/Algebra	65	43.4	35	44.9
Shape & Space	21	14.0	16	20.5
Measures	48	32.0	21	26.9
Data	16	10.6	6	7.7
Total	150	100.0	78	100.0

Coverage of Process Skills

For the purposes of NAM 2004, items were also classified by process in terms of *Process Skill Category*. Items were also classified, though not on a formal basis, by *context*, that is, as *Environmental* (the mathematics is embedded in a practical or applied context) or *Mathematical* (the item or problem is purely mathematical). It was

planned to have the majority of items in an environmental context to reflect the structure and principles of the PSMC.

One of the more contentious aspects of an item classification system is the classification of items by process skill. Efforts have been made in various national and international assessments to develop a well-defined and objective system for classifying the cognitive process skills involved in mathematical tasks but with limited success (cf. NAEP 2008, TIMSS 2007, PISA 2003). The types of process skills to be developed as per the PSMC are as follows:

- Applying and problem-solving
- Communicating and expressing
- Integrating and connecting
- Reasoning
- Implementing
- Understanding and recalling

Table 2 below shows the distribution of the 2004 NAM Field Trial items across the process skill categories of the PSMC. One category, Communicating and expressing, is not included as it was not feasible to assess it using a paper and pen test.

Table 2: *Distribution of the 2004 NAM Main Study Items for Fourth Class by Mathematics Process Skill**

Process Skill	Number of Items	Percent of Items
Understand and Recall	19	12.7
Implement	42	28.0
Integrate/Connect	31	20.7
Reason	10	6.7
Apply and Problem Solve	48	32.0
Total	150	100.0

** PSMC objectives are not categorised in this way. The above categorisation was carried out by a curriculum specialist*

Test Specifications – Main Study

A calculator block (Block F), consisting of 25 items, was included in the 2004 assessment in line with the PSMC for Third and Fourth Classes which recommends introduction of calculators at this level. Pupils were allowed to use a calculator to do the more computationally complex tasks which were contained in this block. The calculator items were spread across the content strands and process skill categories.

A little over half of the 150 items in 2004 test were multiple-choice (53%), while the remainder were short answer (constructed response). The 150 items were divided into 6 blocks of 25 items each, with each pupil taking 3 blocks in a single booklet i.e. 75 items per pupil (Table 3).

Table 3: *Structure of Test Booklets – 2004 NAM*

Booklet	First Block	Second (Common) Block	Third Block
1	A	B	C
2	C	B	D
3	D	B	E
4	E	B	F*
5	F*	B	A

*Calculator block (Pupils had access to calculator for this block only)

Details of the methodology and results of the 2004 NAM can be found in Shiel et al 2006.

Section III: The 2009 NAM Framework

To facilitate the extension of the 2004 assessment framework and item specifications to the Second and Sixth classes in 2009 NAM, a review of the PSMC for these class levels was undertaken. The results of this review were used to inform framework development.

Development of the Second Class Test for the 2009 NAM

Coverage of Second Class PSMC Objectives

As with the national assessments in mathematics in 1999 and 2004, the assessment framework for the 2009 NAM is based on the revised PSMC which was introduced in 2000, but implemented from 2002 onwards. Table AI2 in Appendix I lists the 59 assessment objectives for Second class. In the case of objectives 1, 4, 5, 9, 25, and 56 on the list, we can assume they have been mastered by the vast majority of Second class pupils as they are relatively easy and are generally covered in Senior Infants or First class at the latest, and so do not need to be tested at Second class level (e.g., Objective 9 – recall of addition facts – is an obvious prerequisite for Second class objectives where multi-digit addition is involved, and the other 5 objectives can be regarded as prerequisites for other Second class objectives). Objectives 3, 7, 36, 39, 43, 44, 45, 47, 49, and 52 are difficult to assess by pen and paper group test and should be assessed by other means. All the remaining objectives were tested in the 2009 NAM Second class assessment.

Item Development

A set of items based on the remaining objectives was prepared for the Field Trial, conducted in May 2008. The items were developed by individual members of the Mathematics Expert Group and were reviewed by the group in plenary session. The items, 120 in all, were categorised by content area and process skill.

Coverage of Content Strands

Table 4 below shows the distribution, by content strand, of NAM items in the Field Trial, along with the distribution of the PSMC objectives for Second class. The distribution of items across the content strands represents a reasonable reflection of the distribution of objectives across strands in the PSMC.

Table 4: *Distribution of the 2009 NAM Field Trial Items and PSMC Objectives for Second Class, by Mathematics Content Strand*

Content Strand	No. of Items 2009 NAM Field Trial	Percent of Items 2009 NAM Field Trial	Number of Objectives in PSMC	Percent of Objectives in PSMC
Number/Algebra	51	42.5	24	41.0
Shape and Space	24	20.0	13	22.0
Measure	36	30.0	20	34.0
Data	9	7.5	2	3.0
Total	120	100.0	59	100.0

Coverage of Process Skills

The approach to classifying process skills in the 2009 NAM was similar to the 2004 NAM. Table 5 shows the distribution of the Field Trial items across the process skill categories of the PSMC.

Table 5: *Distribution of the 2009 NAM Field Trial Items for Second Class, by Mathematics Process Skill*

Process Skill	Number of Items 2009 NAM Field Trial	Percent of Items 2009 NAM Field Trial
Understand & Recall	20	16.7
Implement	16	13.3
Integrate/Connect	21	17.5
Reason	35	29.2
Apply & Problem Solve	28	23.3
Total	120	100.0

About 60 percent of the 120 items involved tasks embedded in a practical or environmental context of some sort (e.g. shopping, home or social activities), while the remainder involved tasks of a purely mathematical nature. This reflects the emphasis on problem-solving in the PSMC.

Test Specifications – Field Trial

For the field trial of the 2009 NAM at Second class level, conducted in May 2008, there were 120 items in 6 blocks of 20 items each (called Blocks A to F), distributed across 5 pupil booklets so that each pupil took a core block and two other blocks, i.e. 60 items (Table 6).

Table 6 *Structure of Test Booklets – 2009 NAM Field Trial, Second Class*

Booklet	First Section	Second (Core) Section	Third Section
1	B	A	C
2	C	A	D
3	D	A	E
4	E	A	F
5	F	A	B

About one-third of the items in the field trial were multiple choice (39 items) and about two-thirds were constructed response (81 items).

Summary of Results of Field Trial

The mean percent correct scores on each of the six blocks of items field tested are given in Table 7 below. Although the mean percent score on all 120 items was approx. 61% , which is near enough to the intended figure of 60%, there was considerable variation in mean percent scores for each block, with block C being the lowest at 49% and block A being the highest at 69% – a difference of 20%. This was not the case with the five 3 x 20 item pupil booklets where mean percent scores range from 58% to 66% – a difference of 8% (Table 8).

Table 7: Mean Percent Correct Scores by Block, 2009 NAM Field Trial, 2nd Class

Block	<i>A</i>	<i>B</i>	<i>C</i>	<i>D</i>	<i>E</i>	<i>F</i>
Mean Percent Correct	69	56	49	53	61	67

Table 8: Mean Percent Correct Scores by Booklet, 2009 NAM Field Trial, 2nd Class

Booklet	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>
Blocks	<i>BAC</i>	<i>CAD</i>	<i>DAE</i>	<i>EAF</i>	<i>FAB</i>
Mean Percent Correct	58	57	61	66	64

These results suggested that revisions to the test in preparation for the main study should, in general, aim to increase somewhat the difficulty levels of the easier blocks and reduce the difficulty levels of the more difficult blocks, while maintaining the distribution of items across content strands and process skills.

Problem Items: Analysis of the performance of the field trial pupils on each of the 120 items in the test yielded measures of the quality of the items, including: (i) difficulty level; (ii) ability to discriminate between high achievers and low achievers; and, (iii) the functioning of alternate responses in the multi-choice items. These measures were then used to identify problematic items in the test which would need to be modified or replaced. Overall, 28 items out of a total of 120 were identified as being problematic, with 12 of these considered very easy (with over 85% obtaining a correct response) and 3 considered very difficult (with less than 20% obtaining a correct response). Two items discriminated poorly (Point Biserial less than 0.3), 2 had faulty distractors, and 9 others which had a variety of other faults.

Test Specifications – Main Study

Based on the results of the Field Trial outlined in the above sections, the following revisions to the test were made:

1. Block F was deleted as it was (with A) one of the two easiest blocks based on mean percent correct per block.
2. The good items from Block F (there are just two poorly performing items) were used to replace the poor items deleted from blocks A, B, C, D, and E so as to maintain the distribution of items across content strands and process skills as per the Second class mathematics framework and to narrow the spread in mean performance across the remaining 5 blocks. Twelve items across these five blocks were replaced with more suitable items (either more difficult or easier items) from Block F.
3. The design of the test for the Main Study involved 4 booklets, each containing 3 blocks of 20 items, so each pupil was presented with 60 items as part of a rotated booklet design as follows:

Table 9: Structure of Test Booklets – 2009 NAM Main Study, Second Class

Booklet	First Section	Second (Common) Section	Third Section
1	A	C	B
2	B	C	D
3	D	C	E
4	E	C	A

Block C was the common block and appeared in all four booklets. Each of the other four blocks, A, B, D, and E, appeared in two booklets – once in the initial position, and once in the final position.

When these revisions were incorporated into the test the distribution of items across the curriculum content strands and process skill categories was as per Tables 10 and 11 below.

Table 10: Classification of Items by Content Strand – 2nd Class, 2009 NAM Main Study

Content Area	Number	Shape & Space	Measure	Data	Total
Number of Items (Main Study)	44	16	34	6	100
Percent of Items (Main Study)*	44	16	34	6	100
Percent of Objectives (PSMC)	41	22	34	3	100

*Numbers of items (N = 100) correspond with reported percentages

Table 11: Classification of Items by Process Skill – 2nd Class, 2009 NAM Main Study

Process Skill	Understand & Recall	Implement	Integrate & Connect	Reason	Apply & Problem Solve	Total
Number of Items (Main Study)	11	17	16	28	28	100
Percent of Items (Main Study)*	11.0	17.0	16.0	28.0	28.0	100.0

*Numbers of items (N = 100) are the same as the percentages

The revised test maintained a satisfactory distribution of items across the content strands and process skills of the PSMC.

Development of the Sixth Class Test for 2009 NAM

Coverage of Sixth Class PSMC Objectives

There are 72 objectives in the PSMC for Sixth class (c.f. list in Table AI3, Appendix I). Many of the more complex objectives needed to be tested by two or more items.

Item Development

A set of items based on the objectives was prepared for the Field Trial, conducted in May 2008. The items were developed by individual members of the Mathematics Expert Group and were reviewed by the group in plenary session. The items, 175 in all, were categorised by content area and process skill.

Coverage of Content Strands

Table 12 below shows the distribution of the 175 Field Trial items and PSMC objectives, by content strand. The distribution of items across the content strands represents a reasonable reflection of the distribution of objectives across the same strands in the PSMC.

Table 12: *Distribution of the 2009 NAM Field Trial Items and PSMC Objectives for Sixth Class, By Mathematics Content Strand*

Content Strand	2009 NAM Field Trial		PSMC	
	Number of Items	Percent of Items	Number of Objectives	Percent of Objectives
Number/Algebra	75	43.0	31	43.1
Shape and Space	40	23.0	15	20.8
Measure	40	23.0	17	23.4
Data	20	11.0	9	12.5
Total	175	100.0	72	100.0

Coverage of Process Skills

Table 13 below shows the distribution of the 2009 NAM Field Trial items across the process skills of the PSMC. This is reasonably well balanced with an emphasis on higher order skills such as reasoning and problem-solving, although the proportion of Reasoning items could be reduced somewhat. About half of the items were embedded in a practical context while the other half were purely mathematical contexts.

Table 13: *Distribution of the 2009 NAM Field Trial Items by Mathematics Process Skill*

Process	Number of Items	Percent of Items
Understand and Recall	18	10.7
Implement	31	14.7
Integrate/Connect	9	10.7
Reason	55	38.7
Apply and Problem Solve	62	25.3
Total	175	100

Test Specifications - Field Trial

For the pilot study of the 2009 NAM Field Trial at Sixth class level, 175 items were distributed over 7 blocks (ABCDEFG), each consisting of 25 items. The blocks were,

in turn, divided into 10 pupil booklets so that each pupil took a non-calculator block and two other blocks (for which calculators were permitted), i.e. 75 items (Table 14).

Table 14: *Structure of Test Booklets – Sixth Class, 2009 NAM Field Trial*

Booklet	First Section (Non-Calculator)	Second Section (Calculator)	Third Section (Calculator)
1	A	C	E
2	B	C	F
3	A	D	G
4	B	D	C
5	A	E	D
6	B	E	F
7	A	F	G
8	B	F	D
9	A	G	C
10	B	G	E

Sixty-six (38%) of the 175 items were multiple choice and 109 (62%) were constructed response, which was near enough to the target ratio of two constructed response items to one multiple choice item.

Summary of Results of the Field Trial

The mean percent correct scores on each of the seven blocks of items field tested are given in Table 15 below. Although the mean percent score on all the blocks was approx. 51.3%, which is a little below the intended figure of around 55%, there was considerable variation in mean percent scores between blocks with blocks D and G being the lowest at 46% and block A the highest at 61% – a difference of 15%. The two non-calculator blocks were at about the same level of difficulty. Table 16 shows that, despite differences in difficulty across blocks, the booklets were evenly balanced with mean scores falling between 52 and 54%.

Table 15: *Mean Percent Correct by Block, 2009 NAM Field Trial – Sixth Class*

Block	A	B	C	D	E	F	G
Mean Percent Correct	61	60	50	46	49	47	46

Table 16: *Mean Percent Correct by Booklet, 2009 NAM Field Trial – Sixth Class*

Booklet	1	2	3	4	5	6	7	8	9	10
Blocks	ACE	BCF	ADG	BDC	AED	BEF	AFG	BFD	AGC	BGE
Mean Percent Correct	54	52	52	53	53	53	52	52	53	52

These results suggested that revisions to the test in preparation for the main study should, in general, aim to reduce somewhat the difficulty level of the harder blocks while to a lesser extent increasing the difficulty level of the easier blocks.

Problem Items. Analysis of the performance of the field trial pupils on each of the 175 items in the test yielded measures of the quality of the items, including: (i) difficulty level; (ii) ability to discriminate between high achievers and low achievers; and (iii) the functioning of alternate responses in the multi-choice items. These measures were then used to identify problematic items in the test that need to be modified or replaced.

Overall, 30 items out of a total of 175 were identified as being problematic. Four of these were considered very easy (with over 85% obtaining correct response); 13 were considered very difficult (with less than 20% obtaining correct response), with most of these discriminating poorly (Point Biserial normally less than 0.3); and 5 had faulty distracters.

Close, Millar and Shiel (2009) examined a selection of problematic items from the Field Trial. Four items that were dropped following the Field Trial are considered here.

Item C9 requires pupils to know that pentagons are the only shapes among the four shapes listed that cannot tile a flat surface without leaving space in between the shapes. Responses could result from reasoning based on drawing and examining tilings of the four shapes or on previous experience in tiling shapes by manipulation. This item proved to be very difficult for the pilot study sample with only 22% of pupils choosing the correct response from the four options. The rather low point-biserial level (0.27) suggested that a good proportion of those who obtained the correct answer guessed it instead of responding correctly on the basis of knowledge of tessellations. Hence the item was eliminated from the test as it was seen to be contributing very little to the value of the test as a measure of the mathematics achievement of 6th Class pupils.

Item C9

PSMC Objective: Tessellate combinations of 2-D shapes. Content: Shape & Space Skill/Process: Reasoning

Which of these shapes cannot be used to tile (tessellate) a flat surface?

A) Hexagon B) Parallelogram C) Kite D) Pentagon

Difficulty: .0 .22 Point-biserial: 0.27

Item G8 (Difficulty: 0.27 Point-biserial: 0.20) tested same objective and was deleted for similar reasons

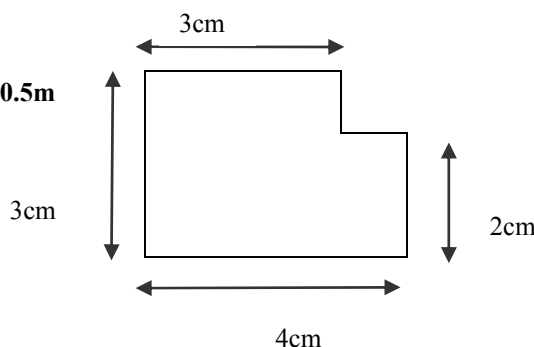
Since the objective on tessellations is on both the 3rd/4th Class and 5th/6th Class programmes of the PSMC, the elimination of this item raises the question of whether or not it is receiving adequate instructional emphasis in the classroom at the level of complexity required to answer item C9 correctly.

Item G17 requires pupils to calculate the area of a room from a plan giving the dimensions in centimetres and a scale for converting centimetres to metres. To solve the problem pupils could convert the centimetre dimensions to metres using the scale (the scale 1cm:50cm could be used instead) and then calculate the area in square metres, e.g. $(1.5\text{m} \times 2\text{m}) - (0.5\text{m} \times 0.5\text{m}) = 2.75 \text{ sq m}$ or $2\frac{3}{4} \text{ sq m}$. This task was so difficult it seemed to be beyond the capabilities of even the most able pupils and so was deleted.

Item G17

PSMC Objective: Find the area of a room from a scale plan. Content: Measures (Area). Skill/Process: Applying & Problem Solving

This is a plan of bathroom. The scale is 1cm: 0.5m



What is the area of the bathroom?

Difficulty:0.02 Point-biserial: 0.20

Item G20 involves calculating the original price of an appliance given its sale price and the percentage reduction. Pupils need to have a good understanding of percentage change and calculating methods involved. The key to the solution is recognising that the sale price is 70% and then using that information to calculate 100%. The calculation is then relatively simple particularly if the Unitary Method is used (e.g. $70\% = \text{€}455$; $10\% = \text{€}65$; $100\% = \text{€}650$). Surprisingly, few students seemed to be able to do this question with 12% getting correct answer, perhaps because, although textbooks for 6th Class tend to cover percentage increases and decreases in prices of goods, questions such as G20, where pre-reduction prices are asked for, appear relatively infrequently.

Item G20

PSMC Objective: Compare prices to identify value for money Content: Measures (Money); Skill/Process: Applying & Problem Solving

During a sale the price of a washing machine was reduced by 30%. The sale price is €455. What was the price before the sale? _____

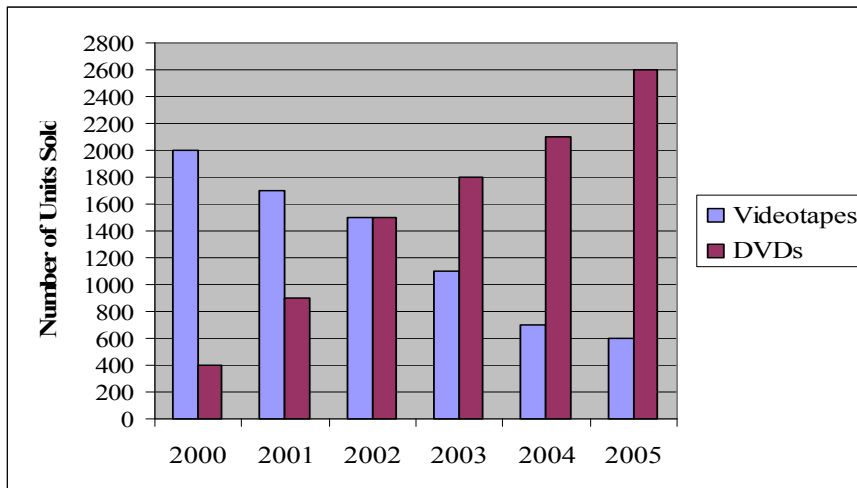
Difficulty: 0.12 Point-biserial 0.49

Item E24 involves reading multiple bars in a bar chart to identify the 2002 and 2005 sales of CDs (1500 and 2600, respectively). The difference, 1100, is divided by 1500 (100%) and expressed as a percentage, 73.3% of the 2002 sales. This is a complex multi-step problem but should be within the capabilities of the more able 6th Class pupils. However, only 5% got the correct answer (answers between 73% and 74% were accepted) and the item was deleted. The item proved to be more difficult than

expected. The PSMC handbook lists this kind of data handling task for 5th and 6th classes as: “read and interpret pictograms, single and multiple bar charts, and pie charts”. It may be that pupils do not get sufficient practice in calculating percentage change in data trend graphs.

Item E24

PSMC Objective: Read and interpret trend graphs and pie charts. Content: Data; Skill/Process: Applying & Problem Solving



What was the percentage increase in sales of DVDs from 2002 and 2005? _____

Difficulty: .05 Point-biserial .27

Test Specification – Main Study

Based on the results of the Field Trial outlined in the above sections, the following revisions to the test were made for the Main Study:

1. Block G was deleted as it had the greatest number of statistically poor performing items (10) and it was also the most difficult block (with D which had 5 poor items).
2. The good items from G were then used to replace the poor items deleted from the blocks C, D, E and F, so as to maintain the balance of items across content strands and process skills. Five items in these four blocks needed only minor tweaking to improve them, but 12 of them needed to be replaced with more suitable items (in terms of content and difficulty).
3. The two Non-Calculator blocks, A and B, which contained items for which calculator use was considered inappropriate, performed well with just minor adjustments to a few items needed.
4. The design for the Main Study test was then 6 booklets, each containing 3 blocks of 25 items, so each pupil was presented with 75 items as part of a rotated booklet design, as per Table 17.

Table 17: *Structure of Test Booklets – Sixth Class, 2009 NAM Main Study*

Booklet	First Section (Non-Calculator)	Second Section (Calculator)	Third Section (Calculator)
1	A	C	D
2	B	C	E
3	A	C	F
4	B	C	D
5	A	C	E
6	B	C	F

A and B were the Non-Calculator blocks. C was the core block taken by all pupils. Each of the other 3 blocks (D, E, and F) appeared twice.

When these revisions were incorporated into the test, the distribution of items across the curriculum content strands and process skill categories was as per Tables 18 and 19 below.

Table 18: *Classification of Items by Content Strand – Sixth Class, 2009 NAM Main Study*

Content Area	Number	Shape & Space	Measure	Data	Total
Number of Items (Main Study)	69	32	31	18	150
Percent of Items (Main Study)	46.0	21.3	20.7	12.0	100
Percent of Objectives (PSMC)	43.0	21.0	24.0	12.0	100

Table 19: *Classification of Items by Process Skill – Sixth Class, 2009 NAM Main Study*

Process Skill	Understand & Recall	Implement	Integrate & Connect	Reason	Apply & Problem Solve	Total
Number of Items	15	30	8	47	50	150
Percent of items	10.0	20.0	5.3	31.3	33.3	100

The revised test maintained a satisfactory distribution of items across the content strands and process skills of the Primary School Mathematics Curriculum, with about half of the items involving a practical or environmental context.

Section IV: Questionnaire Development

As well as assessing mathematics achievement, the 2009 NAM gathered contextual information about pupils, their homes and the schools in which they were enrolled. Table 20 summarises the types of instruments used to gather such information. All the instruments listed include questions that relate to both mathematics and reading. All were developed in advance of the field trial, and were subsequently revised in preparation for the main study. Irish language versions of the sections relating to mathematics in each questionnaire were prepared, in addition to the English versions.

The content of the questionnaires was selected with reference to the aims of the 2009 NAM, and draw on items used in earlier national assessments, as well as on suggestions by members of the National Advisory Committee and Mathematics Expert Group.

Table 20: *Instruments included as part of the National Assessments of English Reading and Mathematics (2009)*

Instrument	Completed by . . .
School Questionnaire	Principal
Teacher Questionnaire (2 nd and 6 th class versions)	Class teacher
Parent Questionnaire (2 nd and 6 th class versions)	Parent / guardian
Pupil Questionnaire (2 nd and 6 th class versions)	Pupil
Pupil Rating Form	Class teacher

School Questionnaire

This questionnaire was targeted at principal teachers. Six pages in length, it sought information on the following areas:

- Background characteristics, including school size, location and enrolment profile.
- Additional support, including numbers of pupils in need or receipt of learning or language support, or resource teaching (for English and mathematics).
- Resources, including access to and deployment of physical (e.g., library books, computers) and human resources (e.g., special needs posts).
- School policies and practices for assessment and planning for teaching reading and mathematics.

Teacher Questionnaire

Teacher Questionnaires have been developed for both Second and Sixth class teachers. Although covering the same broad content areas, some questions referred to teaching practices and curriculum coverage that were specific to one or other grade. The following were the main areas covered:

- Background, including qualifications and teaching experience.
- Instructional practices and resources used for the teaching of reading and mathematics.
- Planning for the teaching of reading and mathematics
- Classroom organization and grouping practices.
- Assessment practices.
- Access to resources (e.g., interactive whiteboards) and support (e.g., the special education team).

Parent Questionnaire

Parents were asked to complete a short questionnaire (three pages), with slightly different versions for Second and Sixth class, in addition to English and Gaeilge. The questionnaire was also available in a small number of other languages (based on the language needs identified by school principals). The main topics covered were:

- Homework, including frequency of, and assistance provided to the child.
- Contact with the school.
- Parental engagement in leisure reading.
- Resources in the home, including access to books and computers.
- Demographic information, including parental educational attainment, employment status, and family size.

Pupil Questionnaire

There were two Pupil Questionnaires – a simple version for Second class pupils (mainly Yes/No questions), and a more complex version for Sixth class pupils. The main topics covered, at both class levels, were:

- Attitudes to reading and mathematics.
- Behaviour in reading and mathematics lessons.
- Free time activities (e.g., playing computer games, watching TV, playing sport).
- Background information, including country of birth, language spoken in the home, and resources in the home.

Pupil Rating Form

A Pupil Rating Form in respect of each selected pupil was provided to the pupil's class teacher. It was a single-page form with a pre-filled list of pupil names. Teachers were asked to provide information about each pupil, including:

- Attendance record for the preceding term.
- Receipt of additional support for reading and / or mathematics.
- General academic ability and the grade level of materials used with pupil in mathematics and English classes.

Section V: Reporting Outcomes of NAM 2009

As indicated earlier, an important aim of NAM 2009 was to provide a basis with which to compare future assessments of mathematics at Second and Sixth classes. Hence, the study was to generate baseline data rather than trends in performance. Following scaling using Item Response Theory, it is intended to report performance separately for 2nd and 6th classes as follows:

- *Mean scores.* In line with earlier national assessments of mathematics, mean scores for overall mathematics, and for mathematics content areas and skill processes will be set to 250, and the accompanying standard deviations to 50.
- *Percent correct scores.* Percent correct scores will be generated for overall performance, and for performance by content strand and skill process.
- *Proficiency scales.* As with NAM 2004, proficiency scales will be developed for overall performance. Whereas in NAM 2004, the response probability convention (the probability associated with pupils at the bottom of a level getting items at the bottom of a level correct) was 0.50, in 2009 it will be 0.625, to reflect a stronger mastery perspective. Two broad approaches to constructing the proficiency scales will be explored: an empirical approach (where clusters of related items are identified using factor analysis), and a more pragmatic approach, such as that used in TIMSS, where the boundaries between proficiency levels are identified before describing their content. Sample items will be provided to illustrate the tasks that are typical of each proficiency level.

Analysis of questionnaire data will involve the following:

- *Development of scales.* Factor analysis will be used to establish scales using items that measure the same underlying constructs (e.g., mathematics self-concept).
- *Descriptive statistics.* Associations between variables (including composite scales) and mathematics performance will be reported for key variables in two ways – mean scores in mathematics for different levels of a variable (e.g., male and female pupils), and correlations between variables and achievement.
- *Multi-level models of performance.* Given the complex nature of the NAM samples, multi-level models of performance involving two (school, pupils) or three (school, teachers, pupils) levels will be developed. Such models will help explain the relative contributions of school, teacher and pupil variables to achievement.

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Appendix I: Assessment Objectives Based on PSMC

The following are lists of assessment objectives for each of the three class levels involved in the 2009 NAM. They are derived from the lists of objectives provided in the PSMC but in some cases are attenuated or slightly reworded. Within each list, the objectives are divided into the major content strands of the curriculum and then within these strands they are further subdivide into strand units, again, as per the curriculum handbook.

Table AI1: Assessment Objectives for Fourth Class

Number and Algebra
<i>Numeration and Place Value</i> <ol style="list-style-type: none">1. Identify place value in whole numbers, 0-99992. *Read, write and order four-digit numbers3. Round whole numbers to the nearest thousand4. Identify place value in decimal numbers to two places of decimals.
<i>Operations with Whole Numbers</i> <ol style="list-style-type: none">5. Add and subtract, without and with renaming, within 99996. *Recall addition and subtraction facts7. Solve word problems involving addition and subtraction8. *Understand multiplication as repeated addition and vice versa9. Understand the zero, commutative and distributive properties of multiplication10. Recall multiplication facts within 10011. Multiply a two-digit or three-digit number by a one or two-digit number12. Solve problems involving multiplication of whole numbers13. Understand division as sharing and as repeated subtraction, without and with remainders14. Recall division facts within 10015. Divide a three-digit number by a one-digit number without and with remainders16. Use a calculator to check estimates17. Solve problems involving division of whole numbers
<i>Fractions and Decimals</i> <ol style="list-style-type: none">18. Identify fractions and equivalent forms of fractions with denominators 2, 3,4,5,6,8,9,10, and 1219. Compare and order fractions with appropriate denominators and position on the number line20. *Calculate a fraction of a set using concrete materials21. Understand the relationship between fractions and division22. Calculate a number, given a multiple fraction of the number23. Express one number as a fraction of another number24. Solve and complete practical tasks and problems involving fractions25. Express tenths and hundredths in fraction or decimal form26. Identify place value of whole numbers and decimals (two places) and write in expanded form27. Order decimals on the number line28. Add and subtract whole numbers and decimals (two places)29. Multiply and divide a decimal number (two places) by a one-digit whole number30. Solve problems involving decimals.

Algebra and Pattern

31. Recognise and record patterns in number, 0-999
32. Extend and describe sequences
33. Translate a number sentence into a word problem
34. Translate a one-step word problem into a number sentence
35. Solve one-step number sentences

Shape and Space

2-D Shapes

36. Identify, describe and classify 2-D shapes
37. Compare the properties of 2-D shapes
38. *Draw 2-D shapes
39. Combine tessellate and make patterns with 2-D shapes
40. Identify the use of 2-D shapes in the environment
41. Solve practical problems involving 2-D shapes.

3-D Shapes

42. Identify, describe and classify 3-D shapes
43. Describe and compare the properties of 3-D shapes
44. Describe the relationship of 3-D shapes with constituent 2-D shapes
45. *Construct 3-D shapes
46. Solve problems involving 2-D and 3-D shapes.

Lines and Angles

47. Identify line symmetry in the environment
48. Identify and draw lines of symmetry in 2-D shapes, pictures or patterns
49. Identify, describe and classify oblique and perpendicular and intersecting lines
50. Classify angles as greater than, less than or equal to a right angle
51. *Solve problems involving lines and angles.

Measures

Length and Area

52. *Estimate, compare, measure and record lengths (m, cm)
53. Rename units of length using decimal or fraction form
54. Estimate and measure the perimeter of regular 2-D shapes
55. Solve problems involving calculations with lengths (m, cm, km)
56. Estimate, compare and measure the area of regular and irregular shapes

Weight

57. *Estimate, compare, measure and record the weight of objects (kg, g)
58. Rename units of weight in kg and g
59. Rename units of weight using decimal or fraction form
60. Solve problems involving calculation with weights (kg and g)

Capacity

61. *Estimate, compare, measure the capacity of objects (l, ml)
62. Rename units of capacity in l and ml
63. Rename units of capacity using decimal and fraction form
64. Solve problems involving calculation with capacities (l, ml)

Time

- 65. * Read time in five-minute intervals on analogue and digital clock (12-hour)
- 66. Read time in analogue and digital forms (12 hour)
- 67. Read and interpret simple timetables
- 68. Rename minutes as hours and hours as minutes
- 69. Read dates from calendars and express weeks as days and vice versa
- 70. Solve and complete practical tasks problems involving times and dates

Money

- 71. Rename amounts of euro or cents and record using symbols and decimal point
- 72. Solve one-step problems involving calculation with money.

Data and Chance

Data

- 73. * Collect, organise and represent data using pictograms, block graphs and bar charts
- 74. Read and interpret tables, pictograms, block graphs and simple pie charts
- 75. Use data sets to solve problems

Chance

- 76. Use vocabulary of uncertainty and chance:
- 77. Order events in terms of likelihood of occurrence
- 78. Identify and record outcomes of simple random processes

*Objectives not assessed in NAMA 2004

Table A12: Assessment Objectives for Second Class

Number and Algebra
<p><i>Numeration and Place Value</i></p> <ol style="list-style-type: none">1. Count the number of objects in a set2. Read, write and order numerals, 0 to 1993. Estimate the number of objects in a set4. Compare equivalent and non-equivalent sets5. Use the language of ordinal number6. Identify and record place value 0 to 199
<p><i>Addition</i></p> <ol style="list-style-type: none">7. Recognise addition as combining or partitioning sets8. Apply the commutative, associative and zero properties of addition9. Recall addition facts10. Construct addition number sentences and number stories11. Solve simple word problems involving addition12. Add numbers without and with renaming within 9913. Use repeated addition and group counting
<p><i>Subtraction</i></p> <ol style="list-style-type: none">14. Recognise subtraction as deducting, as complementing and as difference15. Recall subtraction facts16. Construct subtraction number sentences and number stories17. Solve simple word problems involving subtraction18. Estimate sums and differences within 9919. Subtract numbers without and with renaming within 9920. Use the symbols +, -, =, <, >21. Solve simple word problems involving addition and subtraction.
<p><i>Fractions and Pattern</i></p> <ol style="list-style-type: none">22. Identify half and a quarter of sets to 2023. Recognise and extend patterns in numbers24. Use patterns in addition facts
Shape and Space
<p><i>Spatial Awareness and 2-D Shapes</i></p> <ol style="list-style-type: none">25. Use the vocabulary of spatial relations26. Give and follow simple directions within classroom and school settings27. Describe, compare and name 2-D shapes28. Construct 2-D shapes29. Combine and partition 2-D shapes30. Identify halves and quarters of 2-D shapes31. Identify use of 2-D shapes in the environment
<p><i>Symmetry and Angles</i></p> <ol style="list-style-type: none">32. Identify line symmetry in shapes and in the environment33. Recognise angles in the environment

3-D Shapes

- 34. Describe, compare and name 3-D shapes
- 35. Identify use of 3-D shapes in the environment
- 36. Solve problems involving 2-D and 3-D shapes
- 37. Recognise the relationship between 2-D and 3-D shapes.

Measures

Length and Area

- 38. Estimate, compare, measure and record length using non-standard units
- 39. Select appropriate non-standard measuring units and instruments for length
- 40. Estimate, measure and record length using standard unit (metre and cm)
- 41. Solve simple word problems involving length
- 42. Estimate and measure area using non-standard units

Weight

- 43. Estimate, compare, measure and record weight using non-standard units
- 44. Select appropriate non-standard measuring units and instruments for weight
- 45. Estimate, measure and record weight using standard unit (the kilogram)
- 46. Solve simple word problems involving measures of weight

Capacity

- 47. Estimate, compare, measure and record capacity using non-standard units
- 48. Select appropriate non-standard measuring units and instruments for capacity
- 49. Estimate, measure and record capacity using standard unit (the litre)
- 50. Solve simple word problems involving measures of capacity

Time

- 51. Use the vocabulary of time to sequence events
- 52. Read and record time using simple devices
- 53. Read time in hours and half-hours on 12-hour analogue and digital clock
- 54. Read day, date month and season using calendar
- 55. Solve simple word problems involving measures of time

Money

- 56. Recognise, exchange and use coins
- 57. Calculate how many items may be bought with a given sum.

Data

Data

- 58. Sort and classify objects by two and three criteria
- 59. Represent, read and interpret block graphs

Table AI3: Assessment Objectives for Sixth Class

Number and Algebra
<p><i>Numeration and Place Value</i></p> <ol style="list-style-type: none">1. Read, write and order whole numbers and decimals2. Identify place value in whole numbers and decimals3. Round decimals
<p><i>Operations</i></p> <ol style="list-style-type: none">4. Estimate sums, differences, products and quotients of decimals5. Add and subtract whole numbers and decimals (three places) without and with a calculator6. Multiply a decimal by a decimal, without and with a calculator7. Divide a four-digit number by a two-digit number, without and with a calculator8. Divide a decimal number by a decimal, without and with a calculator
<p><i>Fractions, Decimals and Percentages</i></p> <ol style="list-style-type: none">9. Compare and order fractions and identify equivalent forms of fractions10. Express improper fractions as mixed numbers and position them on the number line11. Add and subtract simple fractions and simple mixed numbers12. Multiply a fraction by a fraction13. Express tenths, hundredths and thousandths in both fractional and decimal form14. Divide a whole number by a unit fraction15. Use simple ratios16. Use percentages and relate them to fractions and decimals17. Compare and order percentages of numbers18. Solve problems relating to profit and loss, discount, VAT, interest
<p><i>Number Theory</i></p> <ol style="list-style-type: none">19. Identify simple prime and composite numbers20. Identify square numbers21. Identify simple square roots22. Identify common factors and multiples23. Write whole numbers in exponential form 24. Identify positive and negative numbers on the number line25. Add simple positive and negative numbers on the number line26. Know simple properties and rules about brackets and priority of operation27. Identify relationships and record symbolic rules for number patterns28. Use a variable in the context of simple patterns, tables and simple formulae29. Substitute values for variables30. Translate word problems with a variable into number sentences31. Solve one-step number sentences and equations

Shape and Space

2-D Shapes

32. Make informal deductions about 2-D shapes and their properties
33. Use angle and line properties to classify and describe triangles and quadrilaterals
34. Construct triangles from given sides or angles
35. Identify the properties of the circle
36. Construct a circle of given radius or diameter
37. Tessellate combinations of 2-D shapes
38. Classify 2-D shapes according to their lines of symmetry
39. Plot simple co-ordinates
40. Use 2-D shapes and properties to solve problems.

3-D Shapes

41. Identify 3-D shapes and analyse relationships, including octahedron
42. Draw the nets of simple 3-D shapes and construct the shapes.

Lines and Angles

43. Recognise, classify and describe angles and relate angles to shape
44. Recognise angles in terms of a rotation
45. Estimate, measure and construct angles in degrees
46. Explore the sum of the angles in a quadrilateral

Measures

Length

47. Select and use appropriate instruments of measurement
48. Rename measures of length
49. Estimate and measure the perimeter of regular and irregular shapes
50. Use and interpret scales on maps and plans
51. Know that the length of the perimeter of a rectangular shape does not determine its area

Area

52. Calculate the area of regular and irregular 2-D shapes
53. Measure the surface area of specified 3-D shapes
54. Calculate area using acres and hectares
55. Identify the relationship between square metres and square centimetres
56. Find the area of a room from a scale plan

Weight and Capacity

57. Rename measures of weight
58. Rename measures of capacity
59. Find the volume of a cuboid experimentally

Time

60. Solve problem involving international time zones
61. Know the relationship between time, distance and average speed

Money

62. Compare prices to identify value for money
63. Convert foreign currencies to euros and vice versa

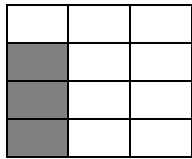
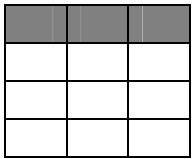
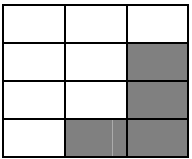
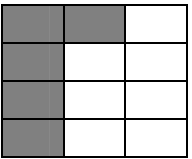


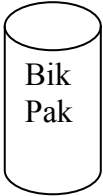
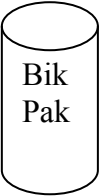

Data
<p><i>Data</i></p> <ul style="list-style-type: none">64. Collect, organise and represent data using pie charts and trend graphs65. Read and interpret trend graphs and pie charts66. Compile and use simple data sets67. Calculate averages of simple data sets68. Use data sets to solve problems. <p><i>Chance</i></p> <ul style="list-style-type: none">69. Identify and list all possible outcomes of simple random processes70. Estimate the likelihood of occurrence of events;71. Order on a scale from 0 to 100%, 0 to 172. Construct and use frequency charts and tables

Appendix II: Sample Items

In this appendix, sample items for the Fourth, Second and Sixth classes are presented. Items for Fourth class are similar to those that appeared in the 2004 NAM in Fourth class, and are included here for illustrative purposes. Items for the Second and Sixth classes are similar to those that appeared in the 2009 NAM in Second and Sixth classes, respectively.

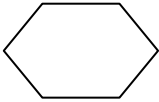

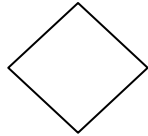

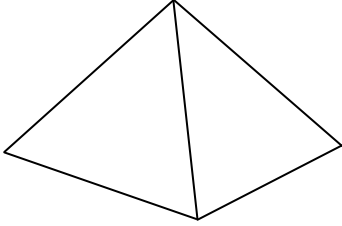
2004 NAM Sample Items – Fourth Class

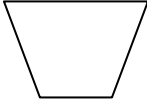
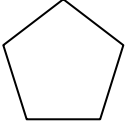
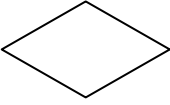
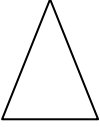
Number and Algebra

Number Apply & Problem-Solve	<p>1. Mum has a box of 36 chocolates. She divides them among 9 children so that each gets the same number of chocolates. How many chocolates does each child get?</p> <p><i>Objective: Solve routine problems involving division of whole numbers</i></p>
Number Implement	<p>2. How many odd numbers are there between 6 and 16?</p> <p><i>Objective: Recognise and record patterns in number</i></p>
Number Integrate & Connect	<p>3. Which of these figures has a third shaded? (Circle one letter, A, B, C, or D)</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>A</p> </div> <div style="text-align: center;">  <p>B</p> </div> <div style="text-align: center;">  <p>C</p> </div> <div style="text-align: center;">  <p>D</p> </div> </div> <p><i>Objective: Identify fractions and equivalent form of fractions</i></p>
Number Apply & Problem-Solve	<p>4. There are 40 biscuits in 5 packets of biscuits. How many biscuits in two packets?</p> <div style="display: flex; justify-content: center; gap: 20px; margin: 10px 0;">      </div> <p><i>Objective: Solve routine problems involving Unitary Method</i></p>

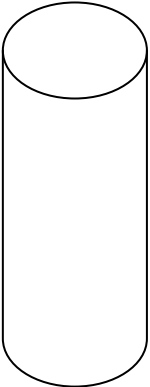
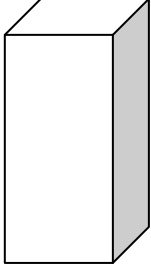
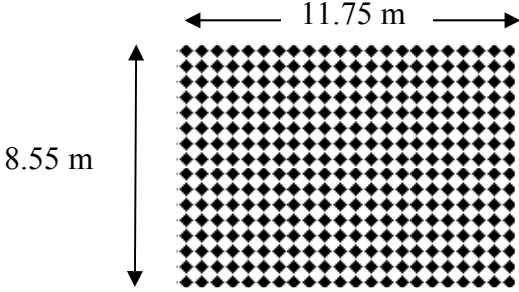
<p>Number</p> <p>Apply & Problem-Solve</p>	<p>5. Peter ordered a pizza. He ate $\frac{1}{4}$ of it. His sister Niamh ate $\frac{1}{3}$ of it.</p> <p>What fraction of the pizza was left?</p> <p><i>Objective: Solve routine problems involving fractions</i></p>
<p>Algebra</p> <p>Integrate & Connect</p>	<p>6. <input type="text"/> holds the number of press-ups Eva does every morning.</p> <p>Which of these shows the total number of press-ups Eva does in a week?</p> <p>A $7 +$ <input type="text"/> B $7 \times$ <input type="text"/></p> <p>C <input type="text"/> $\div 7$ D $5 \times$ <input type="text"/></p> <p><i>Objective: Translate a one-step problem into a number sentence</i></p>

Shape and Space

<p>Shape & Space</p> <p>Understand & Recall</p>	<p>7. Which of these shapes has perpendicular lines?</p> <p>A </p> <p>B </p> <p>C </p> <p>D </p> <p><i>Objective: Identify perpendicular lines</i></p>
<p>Shape & Space</p> <p>Reason</p>	<p>8. You can see 5 edges of the square pyramid. How many edges has the square pyramid altogether?</p>  <p><i>Objective: Describe and compare properties of 3-D shapes</i></p>

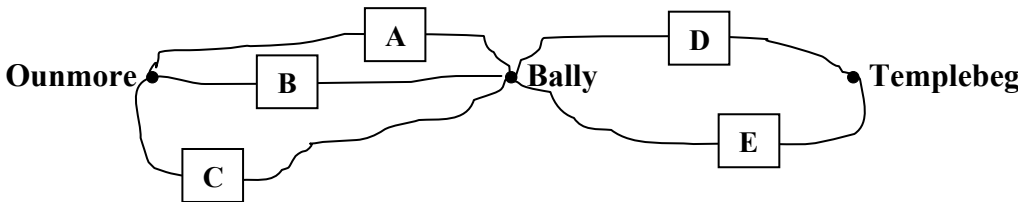
<p>Shape & Space</p> <p>Understand & Recall</p>	<p>9. Which shape is a parallelogram?</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  A </div> <div style="text-align: center;">  B </div> <div style="text-align: center;">  C </div> <div style="text-align: center;">  D </div> </div> <p><i>Objective: Identify, classify and describe 2-D shapes</i></p>
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Measures

<p>Measures</p> <p>Apply & Problem-Solve</p>	<p>10. How much taller is the cylinder than the box?</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  25 cm </div> <div style="text-align: center;">  18.5cm </div> </div> <p><i>Objective: Solve routine problems involving calculations of lengths</i></p>
<p>Measures</p> <p>Apply & Problem-Solve</p>	<p>11. This is a diagram of a tiled floor. What is the distance all around the outside of the tiled floor?</p> <div style="text-align: center;">  </div> <p><i>Objective: Solve routine problems involving perimeter</i></p>

<p>Measures</p> <p>Apply & Problem-Solve</p>	<p>12. A case of peaches and two cases of bananas weigh 15.5kg. A case of bananas weighs 4.75kg. What is the weight of the case of peaches?</p> <p><i>Objective: Solve non-routine problems involving calculations with weights</i></p>
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Data and Chance

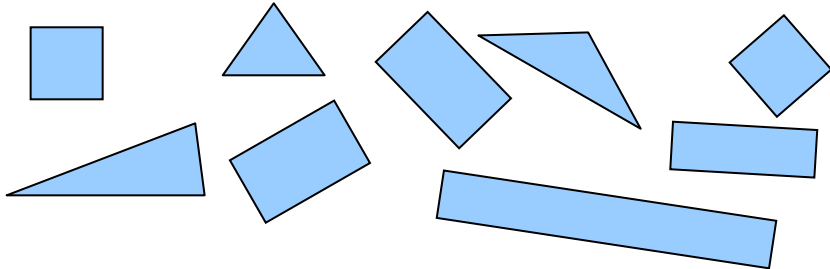
<p>Data & Chance</p> <p>Reason</p>	<p>13. This part of a map shows five roads, A, B, C, D, E. What are all the different ways you can drive from Ounmore to Templebeg?</p>  <p>A CD, BD and AE B CD, AD, BD and AE C AE, CD, BD, AD, and BE D AE, AD, BD, BE, CD, and CE</p> <p><i>Objective: List all possible outcomes</i></p>
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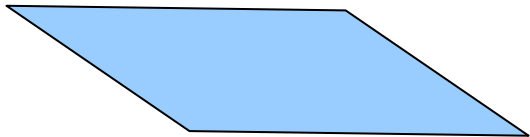
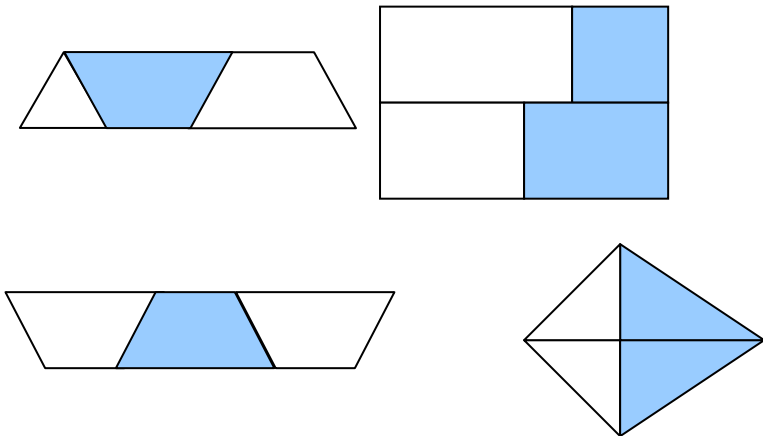
2009 NAM Sample Items – Second Class

Number and Algebra

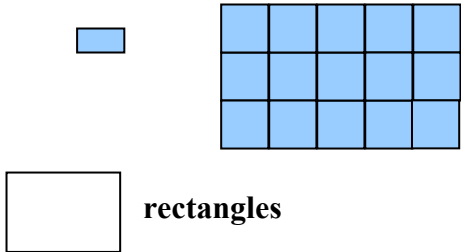
Operations Reason	<p>1. Write the missing number in the box.</p> $27 + 6 = 30 + \boxed{}$ <p><i>Objective: Apply the commutative, associative and zero properties of addition</i></p>
Operations Implement	<p>2.</p> $23 + 16 + 37 = \boxed{}$ <p><i>Objective: Add numbers with and without renaming</i></p>
Operations Apply & Problem-Solve	<p>3. There are 15 people in a shop. 9 people leave and then 5 more come in. How many people are there in the shop now?</p> <p style="text-align: center;"><input style="width: 60px; height: 20px;" type="text"/> people</p> <p><i>Objective: Solve simple word problems involving subtraction</i></p>

Shape and Space

2-D Shapes Recall	<p>4. How many squares can you find?</p> <div style="text-align: center;">  </div> <p style="text-align: center;"> 2 4 6 9 0 0 0 0 </p> <p><i>Objective: Describe, compare and name 2-D shapes</i></p>
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<p>2-D shapes</p> <p>Reason</p>	<p>5. Draw a line that divides this shape into two triangles.</p>  <p><i>Objective: Combine and partition 2-D shapes</i></p>
<p>2-D Shapes</p> <p>Reason</p>	<p>6. Which of these shapes has more than a half of it coloured blue?</p>  <p><i>Objective: Identify halves and quarters of 2-D shapes</i></p>

Measures

<p>Area</p> <p>Reason</p>	<p>7. Look at the small rectangle. How many of these rectangles would be needed to cover the big rectangle?</p>  <p>rectangles</p> <p><i>Objective: Estimate and measure area using non-standard units</i></p>
<p>Time</p> <p>Apply & Problem-Solve</p>	<p>8. Swimming lessons end at a quarter past five. If it is a quarter to five now, how many minutes until swimming ends?</p> <p> <input type="radio"/> 15 minutes <input type="radio"/> 30 minutes <input type="radio"/> 45 minutes <input type="radio"/> 60 minutes </p> <p><i>Objective: Solve simple word problems involving measures of time</i></p>

Data

Data

The block graph shows the favourite colours of pupils in 2nd Class.

9.
Implement

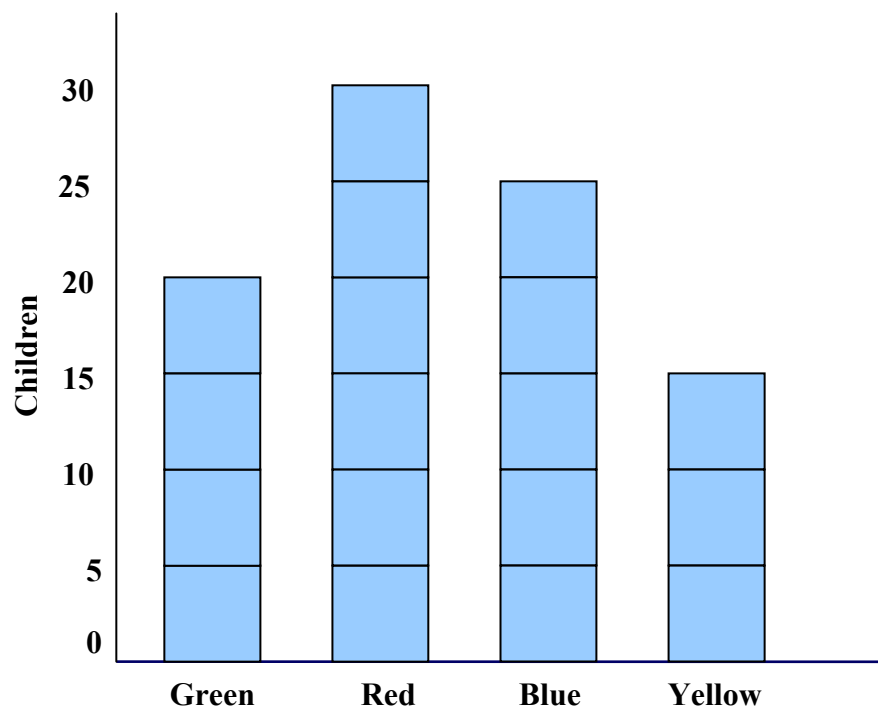
9. What is the most popular colour in the class?

10.
Integrate
& Connect

10. How many more children prefer blue than green?

11.
Integrate
& Connect

11. How many children in 2nd Class altogether?



Objective: Represent, read, and interpret block graphs

2009 NAM Sample Items – Sixth Class

Number and Algebra

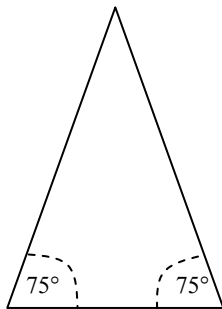
<p>Operations</p> <p>Reason</p>	<p>1. Which of these is the best estimate of 11.147×19.6?</p> <p>A 190 B 200 C 220 D 240</p> <p><i>Objective: Estimate sums, differences, products and quotients of decimals</i></p>
<p>Operations</p> <p>Apply & Problem-solve</p>	<p>2. 126 pupils in a school are going on a trip to the museum. A coach holds 48 children. A minibus holds 16. Which of these should the school hire so that there are as few empty seats as possible?</p> <p>A 2 coaches B 2 coaches and 1 minibus C 2 coaches and 2 minibuses D 3 coaches</p> <p><i>Objective: Add and subtract whole numbers and decimals without and with a calculator</i></p>
<p>Decimals & Percentages</p> <p>Implement</p>	<p>3. What percentage of 25 is 5?</p> <p>A 5% B 10% C 20% D 25%</p> <p><i>Objective: Use percentages and relate them to fractions and decimals</i></p>
<p>Decimals & Percentages</p> <p>Apply & Problem-solve</p>	<p>4. Aoife bought a bike for €170. When she later sold it, she made a profit of 25%. What price did she sell it for?</p> <p>€ <input style="width: 100px; height: 30px; border: 1px solid black;" type="text"/></p> <p><i>Objective: Solve problems relating to profit and loss, discount, VAT, interest</i></p>
<p>Directed Numbers</p> <p>Apply & Problem-Solve</p>	<p>5. The temperature of a packet of frozen fruit was -11°C. After 2 hours defrosting it was $+10^{\circ}\text{C}$. By how many degrees did its temperature change?</p> <p>A -21 B -1 C +19 D +21</p> <p><i>Objective: Add simple positive and negative numbers on the number line</i></p>

Shape and Space

2-D Shapes

6. Two angles in a triangle are 75° each. What size is the third angle?

Reason



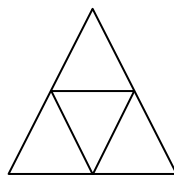
degrees

Objective: Use 2-D shapes and properties to solve problems.

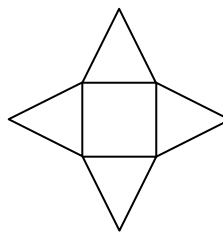
3-D Shapes

7. Which of these folds up to make a triangular prism?

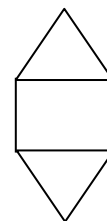
Reason



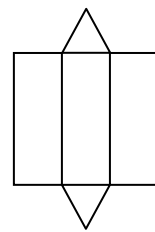
A



B



C




D

Objective: Draw the nets of simple 3-D shapes and construct the shapes.

Measures

Weight Apply & Problem- Solve	<p>8. A chef uses 150 g of flour for every apple tart he makes. He has a 4 kg bag of flour. How many apple tarts can he make from this?</p> <p style="text-align: center;"><input type="text"/> tarts</p> <p><i>Objective: Rename measures of weight</i></p>
Time Apply & Problem- Solve	<p>9. The time in Hong Kong is 8 hours ahead of Dublin. For example, mid-day in Dublin is 20.00 in Hong Kong. Sheila left Dublin for Hong Kong at 08:00. Her trip time was 13 hours. What was the local time in Hong Kong when she arrived?</p> <p style="text-align: center;"><input type="text"/></p> <p><i>Objective: Solve problems involving international time zones</i></p>

Data

Chance Reasoning	<p>10. If Maria rolls a fair dice 60 times, how many times would she be expected to roll a 6?</p> <p style="text-align: center;">A 6 B 10 C 12 D 20</p> <p style="text-align: right;"></p> <p><i>Objective: Estimate the likelihood of occurrence of events</i></p>
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Appendix III

Mathematics Proficiency Levels NAM 2004 – Fourth Class

<p>Level 5 (≥ 1.05) Advanced Level of Mathematics Achievement Implement procedures for estimating sums and quotients Connect decimal and fraction notation in measure contexts Extend more complex patterns in number Hypothesise and test answers for correctness (mixed operations number sentences) Apply concepts of ratio and proportion in practical contexts Solve non-routine multi-step problems involving fractions and measures</p>
<p>Level 4 ($< 1.05 \geq 0.35$) High Level of Mathematics Achievement Recall and use definitions of parallel and perpendicular lines Identify angle types in 2-D shapes Partition 2-D shapes using fractions Add measures of length Identify missing information in problems Identify a fraction between two fractions Make informal deductions about properties of 2-D shapes Apply concept of scale to reading maps Hypothesise and test answers for correctness in multiplication or division sentences Convert fractions to decimals Solve routine problems involving calculation of perimeter</p>
<p>Level 3 ($< 0.35 \geq - 0.25$) Moderate Level of Mathematics Achievement Calculate a fraction of a number Divide a decimal by a whole number Round four-digit numbers Estimate products of whole numbers Implement procedure for division of whole numbers Order fractions in terms of magnitude Identify fractional areas of regular 2-D shapes Visualise properties of 3-D shapes from 2-D nets Complete number sentences involving associative and distributive properties Connect verbal, diagrammatic and symbolic representations of problems Hypothesise and test answers for correctness (single operation number sentence) Solve non-routine one-step problems involving operations with fractions and measures</p>
<p>Level 2 ($< - 0.25 \geq - 0.95$) Basic Level of Mathematics Achievement Calculate area of regular shapes using a grid Identify decimal between two decimals Implement procedures for multi-digit subtraction and long multiplication Select appropriate units of measure Connect diagrammatic and verbal representations of problems Visualise and identify properties of 2-D and 3-D shapes Extend decimal number patterns Reason with place value and notation of four-digit numbers and decimals Hypothesise answers and test them for correctness (addition number sentences) Apply Unitary Method in everyday contexts Make informal deductions about simple graphical data Analyse tables of data to solve routine and non-routine problems Solve routine problems involving operations with whole numbers, fractions, and measures Solve non-routine problems involving operations with whole numbers</p>

Level 1 ($< -0.95 \geq -2.05$) Minimum Level of Mathematics Achievement

Recall basic multiplication and division facts

Identify place value in four-digit numbers and in two-place decimals

Identify properties of 2-D shapes

Implement procedures for multi-digit addition and short multiplication

Order simple events in terms of likelihood of occurrence

Read and interpret bar charts, line graphs, tables, decimal scales, and area diagrams

Identify and extend simple number patterns

Combine and partition 2-D shapes into sets of specified shapes

Solve simple, routine word problems involving multiplication/division facts; calendar; subtraction; chance

Below Level 1 (< -2.05) Level of mathematics knowledge not assessed by this test