



**Coimisiún na Scrúduithe Stáit
State Examinations Commission**

JUNIOR CERTIFICATE EXAMINATION 2003

MATHEMATICS

CHIEF EXAMINER'S REPORT FOUNDATION LEVEL

CHIEF EXAMINER'S REPORT ORDINARY LEVEL

CHIEF EXAMINER'S REPORT HIGHER LEVEL

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MATHEMATICS

1. GENERAL INTRODUCTION

1.1 THE SYLLABUS

The syllabus was introduced in September 2000. It was examined for the first time in June 2003. Sample Papers on all three levels were issued to all Second-level schools. Guidelines for Teachers were also issued in conjunction with the introduction of the new syllabus. The use of calculators in the Junior Certificate examination was allowed for the first time in 2003. The Department of Education and Science issued a set of guidelines on the use of calculators to all Second-level schools. This document was prepared in co-operation with the National Council for Curriculum and Assessment, and includes a chapter on the use of calculators in the Certificate Examinations.

The aims of the Junior Certificate Mathematics Syllabus state that mathematics education should contribute to the personal development of the students and help to provide students with the mathematical knowledge, skills and understanding needed for continuing their education for life and work. These aims can be translated into the following general objectives:

- Students should be able to *recall* basic facts
- Students should be able to demonstrate *instrumental understanding*
- Students should have acquired *relational understanding*
- Students should be able to *apply* their knowledge of facts and skills
- Students should be able to *analyse* information, including information presented in cross-curricular and unfamiliar contexts
- Students should be able to *create* mathematics for themselves
- Students should have developed the *psychomotor* skills necessary for the above objectives
- Students should be able to *communicate* mathematics, both verbally and in written form
- Students should *appreciate* and be *aware* of the history of mathematics.

To support the above aims and objectives of the Junior Certificate Mathematics Syllabus, the Junior Certificate Mathematics Support Service was set up to provide additional in-service for teachers of mathematics and to supplement this with workshops where local needs exist. The Junior Certificate Mathematics Support Service was launched in September 2000. Presentations and materials of the Support Service can be accessed on the web at www.ncte.ie/curriculum/support/.

1.2. THE EXAMINATION

Structure of Examination for Foundation Level

The examination consists of one paper, comprising six questions. All questions must be attempted to obtain full marks. Each question carries 50 marks. The duration of the paper is 2 hours. The question paper is the answerbook.

Structure of Examination for Ordinary Level

The examination consists of two papers, each comprising six questions. All questions must be attempted on each paper to obtain full marks. Each question carries 50 marks. The duration of each paper is 2 hours. In each case, the question paper is the answerbook.

Structure of Examination for Higher Level

The examination consists of two papers, each comprising six questions. All questions must be attempted on each paper to obtain full marks. Each question carries 50 marks. The duration of each paper is $2\frac{1}{2}$ hours.

3. Candidate numbers and percentages

The following table shows the number of candidates taking each level of the subject this year and over the past three years. The number of candidates taking each level is also given as a percentage of the total number of candidates taking Mathematics for that year.

The number of candidates taking Junior Certificate Mathematics decreased from last year by 855 candidates. However, the number taking Higher Level Mathematics in 2003 compared to 2002 increased by 1913 candidates. The percentage taking Higher Level Mathematics increased to 40.6%. This is first time that the percentage has exceeded 40% of the total cohort taking Junior Certificate Mathematics.

Year	2000	2001	2002	2003
Total number of Mathematics Candidates	60019	59184	59295	58440
Number of Candidates at Higher Level (as a % of total number taking Mathematics)	21926 (36.5)	21113 (35.7)	21821 (36.8)	23734 (40.6)
Number of Candidates at Ordinary Level (as a % of total number taking Mathematics)	30585 (51.0)	30162 (51.0)	29588 (49.9)	27382 (46.9)
Number of Candidates at Foundation Level (as a % of total number taking Mathematics)	7508 (12.5)	7909 (13.3)	7886 (13.3)	7324 (12.5)

2. FOUNDATION LEVEL

2.1. INTRODUCTION

The examination consists of one paper, comprising six questions.
All questions must be attempted to obtain full marks. Each question carries 50 marks.
The duration of the paper is 2 hours.
The question paper is the answerbook.

2.2. PERFORMANCE OF CANDIDATES

The following table shows the number and percentage of candidates achieving each grade in 2003.

2003	A	B	C	D	E	F	NG	Total Candidates
Number of Candidates								7324
% of Number	15.4	37.8	29.5	13.6	3.2	0.4	0.0	

The average mark per question and its topic is shown in the table below.

Question	Average mark	Topic
1	46.3	Applied Arithmetic
2	34.2	Sets and Applied Arithmetic
3	31.5	Statistics
4	31.1	Measure
5	31.7	Algebra
6	31.0	Geometry

From an analysis of a random sample of scripts it was found that 100% of candidates attempted the first 4 questions, and over 99% attempted questions 5 and 6.

The average mark per question, for questions 3 to 6, was very similar, between 31-32. An award of zero marks for a question occurred in less than 1% of the questions attempted, whereas almost 7% of question attempts scored 50 marks. These full scores were predominantly, but not exclusively, for question 1.

2.3. ANALYSIS OF CANDIDATE PERFORMANCE

Question 1.

Average mark: 46.3

- (a) (i) It is assumed that calculators were used for this arithmetical section, as only very rarely was rough work shown.
- (ii) As in part (i) it is assumed that calculators were used. Few, if any, errors occurred.
- (b) (i) Candidates answered this question very well, indicating a good understanding of place value.
- (ii) The majority of candidates read and wrote down the greatest four-digit number. On occasions, candidates selected non four-digit numbers and sometimes did not use the given digits.
- (c) (i) Appropriate use of the calculator was again evident in this section with only occasional decimal or arithmetical slips.
- (ii) The change was generally given correctly. Very often work was not shown despite the pen in hand symbol. When this symbol is present supporting work must be shown to obtain full marks.

Question 2.

Average mark: 34.2

- (a) (i) The pre-printed brackets, complete with commas, assisted the candidates in understanding what was required, without having to rely on the written word.
- (ii) The elements of set A were given correctly.
- (ii) This section was always attempted and errors were few, but $\{1, 9\}$ was given from time to time.
- (b) (i) It is clear that candidates find fractions difficult to manipulate. Many of those candidates who obtained a correct common denominator had errors in finding the numerator.
- (ii) Correct answers were only ever obtained with the calculator. No candidates succeeded using division by hand.
- (c) (i) This part was nearly always correctly answered. However, quite often, supporting work was not shown, despite the presence of the pen-in-hand symbol.
- (ii) As with part (i), this was generally answered correctly, but often supporting work was not shown.

- (iii) Expressing the profit as a percentage of the total amount spent caused difficulties for the candidates. Profit as a fraction and hence as a percentage is not understood. This section was omitted by approximately 10% of the candidates. If a fraction was formed, it was rarely correct. Decimal errors were common. Few candidates got more than the attempt mark.

Question 3.

Average mark: 31.5

- (a) This part was answered well. Some candidates did not show supporting work and were therefore unable to obtain full marks.
- (b) (i) Completing the table for the number of teams who scored the various numbers of goals posed no problems for the candidates. There were only occasional slips in transferring the data.
- (ii) Most candidates had the general idea of getting a mean, but not the mean of a frequency distribution. Most candidates did make an attempt. Most used the data from the table, rather than the original data set, in their attempt, but rarely did they obtain \bar{x} .
- (iii) In calculating the fraction of the teams who scored exactly two goals, candidates did not refer to the original information that there were 20 teams. Forming fractions seems to cause difficulties for candidates.
- (c) While this part was always attempted, there was little effort made at calculating angles. Sometimes the given numbers were used as angle measurements. A freehand sketch was the norm, usually a circle with three random sectors.

Question 4.

Average mark: 31.1

- (a) Most candidates understood what was required and were able to find the time of arrival at school. Sometimes, candidates equated 1 hour with 100 minutes.
- (b) (i) Finding the average speed of the car was correctly found by the majority of candidates. Some candidates mistakenly multiplied 150 by 2.5.
- (ii) Again, many answered this part correctly. However, some candidates incorrectly divided the average speed by the time.
- (c) (i) Apparently not all candidates understood the meaning of the word "diameter". More familiarity with relevant terminology is evidently needed.
- (ii) The word "perimeter" caused difficulties for a number of candidates. This section was omitted by approximately 10% of the candidates. In most cases, πr^2 was used, although a formula was rarely written down. Many incorrect answers with no supporting work also appeared.

Question 5.**Average mark: 31.7**

- (a) Most candidates substituted correctly for x to find the value of $3x + 2$ when $x = 4$. A common error was simply to add $3+4+2 = 9$.
- (b) (i) A trial-and-error method was commonly used in solving for x in $x + 5 = 12$. Errors included transposition and unsuccessful trial-and-error methods.
- (ii) A trial-and-error method was commonly used when solving for x in $3(x - 1) = 9$ showing, as in part (i), an understanding of what was required, but, in this instance, not the knowledge of how to achieve the result efficiently. Distribution and transposition errors were evident.
- (c) This part was omitted by approximately 10% of candidates.
- (i) The majority of candidates completed the table and gave supporting calculations.
- (ii) Those candidates who correctly completed the table generally continued on to draw the graph. Sometimes the points were not joined.

Question 6.**Average mark: 31.0**

- (a) The most common correct approach adopted by candidates was to write down $180^\circ - 135^\circ = 45^\circ$. Some candidates used 360° instead of 180° . Others measured the angle with a protractor.
- (b) The image triangle drawn by the candidates, in so far as possible, was the same size and shape as the given triangle. There is evidence of "hands-on" practice in construction. However its location was not very precise. A variety of transformations and combinations of transformations were sometimes applied by candidates.
- (c) (i) Rulers and protractors were used in this construction, showing that candidates are quite comfortable with practical work. Some candidates drew triangles with all sides equal in length.
- (ii) The length of $[bc]$ was nearly always correct when attempted.

2.4 CONCLUSIONS

- The new format of the paper allowed candidates to show their mathematical skills, knowledge and understanding. It was student friendly which made the tasks less intimidating. Candidates made far more attempts than was usual under the previous format. It helped the candidates to focus on each task and remain engaged with their tasks to the end of the paper. Two examples of where candidates were significantly helped to attempt the questions were the shopping bill Q1(c) and the grid and axes in Q5(c)(ii). The disengagement and tapering off of effort in the latter part of the examination, which was normal in the past, was not in evidence this year.
- The use of calculators has meant fewer arithmetic errors, which is to be expected and welcomed, but in some cases answers were written without supporting work. This can cause marks to be lost. Two examples are Q2(c) (i) and (ii) and Q6(a). Penalties in this respect were light this year, because the format is new, but may be more severe in the future.
- Sections that were particularly well answered were:

Q1 Computation

Q2 (a) Sets. Q2(c) (i) and (ii) (Applied arithmetic)

Q3(a) (Arithmetic) Q3 (b) (i) (Tabulating data)

Q4(a) (Time)

Q5(a) (Evaluating an expression)

Q6(a) (Calculating an angle) Q6(c) (ii) (Measuring a line segment), when (i) was done.

The drawing of the image triangle and the construction of the triangle in Q6(b) and 6(c) (i) respectively, were either very well drawn or very badly drawn. Perhaps some candidates did not have the required drawing instruments with them.

- Sections that were not well answered were:

Q2 (b) (i) (Addition of fractions)

Q2(b) (ii) (Conversion of fraction to decimal and rounding the decimal)

Q2(c)(iii) (Finding % profit)

Q3(b) (ii) (Finding mean of frequency distribution.)

Q3 (b) (iii) (Forming a fraction). Q3(c) (Calculations for pie chart)

Q4 (c) (Finding perimeter of circle).

2.5. RECOMMENDATIONS TO TEACHERS AND STUDENTS

Teachers

- The marking scheme reflects the aims and objectives of the revised syllabus, in particular those concerned with relational understanding and communication (*Guidelines for Teachers*). It endeavours to reward students for the mathematical knowledge, skills and understanding that they have. It is, therefore, very important that candidates offer supporting work throughout the examination paper. The 'pen-in-hand' symbol is a reminder to include supporting work and marks will be lost if that work is not shown. However, even if the pen-in-hand symbol is not there, it is important to encourage students to show their work throughout. An incorrect answer without supporting work will be awarded 0 marks, in general.

Stress the significance of the 'pen-in-hand' symbol.

- The revised syllabus, with its emphasis on the learning process, and the new examination format, seems to have engaged the students to a greater degree than heretofore. It is hoped that this will encourage teachers to continue to use and further develop their use of various methodologies. The *Guidelines for Teachers* has many examples of methodologies and the Junior Certificate Support Service offers much practical help and advice.
- The main areas of difficulty for candidates were:
 - addition of fractions,
 - converting fractions to decimals,
 - forming fractions and finding percentages.

While the idea of showing data on a pie chart was understood, how to convert the given information to sectors of the circle was not understood. This also involves the formation of fractions and finding equivalent fractions [$35/60 = 210/360$]. These are difficult concepts for students at Foundation Level, so concrete and practical methods should be used in trying to develop their understanding.

- Review the marking scheme carefully.

Note the types of errors that occur and the penalties incurred.

Note how the marking scheme differentiates between grades.

Note that a penalty is incurred where an answer is given without any supporting work when the pen-in-hand symbol is present.

Students

- Make sure you show all your work.
 - If the pen-in-hand symbol, ✎, is present, you must show work to get full marks, even if your answer is correct.
 - If there is no pen-in-hand symbol, show your work anyway. Then, even if you make a mistake, it is still possible get some marks.

- Have your ruler, compass and protractor with you for the examination. It is very likely you will need them for certain parts of questions. This Year, there was drawing to be done in six different parts of the paper.
- Have a calculator with you.

3. ORDINARY LEVEL

3.1. INTRODUCTION

The examination consists of two papers, each comprising six questions. All questions must be attempted on each paper to obtain full marks. Each question carries 50 marks. The duration of each paper is 2 hours. In each case, the question paper is the answerbook.

3.2. PERFORMANCE OF CANDIDATES

The following table shows the number and percentage of candidates achieving each grade in 2003.

2003	A	B	C	D	E	F	NG	Total Candidates
Number of Candidates								27382
% of Number	9.2	31.0	31.3	20.8	5.8	1.8	0.1	

The table below shows the individual % results for both Paper 1 and Paper 2.

2003	A	B	C	D	E	F	NG
Paper 1 (% results)	19.2	34.3	25.5	14.5	5.1	1.0	0.0
Paper 2 (% results)	6.7	22.5	31.7	25.1	10.4	3.3	0.3

The average mark per question and its topic is shown in the table below for each paper.

Paper 1:

Question	Average mark	Topic
1	41.8	Sets
2	42.7	Applied Arithmetic
3	40.5	Applied Arithmetic
4	28.3	Algebra
5	22.7	Algebra
6	31.8	Functions and Graphs

Paper 2:

Question	Average mark	Topic
1	32.5	Measure
2	31.1	Measure
3	38.6	Statistics
4	20.3	Geometry(synthetic+ transformation)
5	32.9	Geometry(co-ordinate)
6	21.8	Trigonometry

From an analysis of a random sample of scripts it was found that 100% of candidates attempted the first 3 questions on Paper 1, over 99% attempted questions 4 and 5, and 97% attempted question 6. Overall, 79% of candidates achieved grades of C+, while 6.1% achieved grades less than D grade.

Similarly, following an analysis of scripts on Paper 2, it was found that 60.9% of candidates achieved a C+ grade, while those who achieved less than a D grade was considerably higher than on Paper 1 at 14.0%. This reflects the difficulty posed by the compulsory elements of questions 4 and 6. Frequently parts of these two questions were left unanswered.

3.3. ANALYSIS OF CANDIDATE PERFORMANCE

PAPER 1:

Question 1.

Average mark: 41.8

- (a) The majority of candidates filled in correctly the elements into the Venn diagram. A small number of candidates omitted an element while others omitted 3 and 5, reading 1, 2, 4, 6, 8.
- (b) Here, candidates were given the elements in the Venn diagram and the elements of each set were also listed.
- (i) Candidates listed the elements of $P \cap Q$ nearly always correctly. A common error was $P \cap Q = 2$, omitting 8 as it was an element of R .
- (ii) $R \setminus Q$ was well answered by candidates. Sometimes the answer was given as $\{1, 3, 4, 6\}$, that is, the elements of Q were removed from both P and R .
- (iii) Many candidates did not understand the concept of set complement. Some candidates ignored the complement sign and simply wrote down the elements of Q .
- (iv) Candidates experienced difficulty when two operations were involved, as in $P \setminus (Q \cup R)$. There was little evidence of candidates finding $Q \cup R$ and then finding the final answer. However, many candidates did answer this part correctly.
- (c) Candidates were asked to interpret statements and then use a Venn diagram or otherwise, to answer questions. Candidates who correctly filled in the Venn diagram generally went on to answer all four parts.
- (i) Answered correctly by the vast majority of candidates.
- (ii) Similar to (i). Candidates understood what was required.
- (iii) Where the number 3 was incorrectly entered on the diagram, candidates tended to give the number 5 as the answer, that is, $11 + 4 + 23 = 33$.
- (iv) Candidates' interpretation of the wording led to difficulties for them in this part. A common error was to either give 4 as the answer or $30 (4 + 7 + 19)$.

Question 2.

Average mark 42.7

- (a) The common approach to this part on sharing money between three people was $\text{€}2400 - \left(\frac{2400}{2} + \frac{2400}{3} \right)$. There were few errors in answering this part.
- (b) (i) Candidates correctly divided 3000 by 120. A small number multiplied

3000×120 .

- (ii) In being asked to estimate the value of an expression, most rounded to the nearest whole number or to one place of decimals. However, an instruction to candidates to estimate to the nearest whole number would have led to more consistent answers.

Some candidates who gave an exact value for the estimate did not go on to answer part (iii). This showed a lack of understanding of the difference between estimation of an expression and calculation of its exact value.

- (iii) The only errors to occur were in incorrect use of the calculator.
- (c) (i) Candidates were asked, using a calculator, to find the exact value of $(6.54)^2$, and there was a good standard of answering.
- (ii) Similar to (i), for $\sqrt{94.09}$, also with a high standard of answering.
 - (iii) Many candidates lost some marks through mishandling the reciprocal in this part, which involved evaluating an expression included the numbers from (i) and (ii). A common error was failure to round correctly.

Question 3.

Average mark 40.5

- (a) In this part, finding the profit was well answered by the majority of candidates, but calculating the profit as a percentage of the cost price was successfully managed only by the better candidates.
- (b) (i) Common errors included:
- mishandling of the 22%;
 - incorrect cancellation;
 - errors in decimal point;
 - adding 5280(tax at 22%) to the credit to find the tax due;
 - adding 5280, the tax credit and the tax due to find the take-home pay.
- (ii) Finding the cost for an adult and two children for a train journey from Cork to Dublin caused very few problems. Some quite weak candidates confused the costs as they had difficulty in extracting the data from the wording of the question.
- (c) It is evident that calculation of percentages is problematic for many candidates. A teaching methodology that uses calculator work to build sound understanding and accurate skill is recommended here.
- (i) Calculating 3% of 4000 was generally answered correctly by candidates.
 - (ii) Calculating the interest rate at 2.5% resulted in errors by candidates in cancellation and decimal point. Here, some candidates only found 2.5% of

€1000, forgetting to first add this to the amount from part(c)(i).

Question 4.

Average mark 28.3

- (a) This involved substitution for x in a quadratic equation. While the standard of answering was, in general, correct, incomplete substitution was evident in some cases. Also evident was $(3)^2 = 6$.
- (b) (i) Multiplication of linear terms in algebra still causes difficulties for candidates. Errors encountered included:
adding unlike terms, e.g., $2x+1=3x$;
incorrect multiplication, e.g., $2x \times -5 = -10$;
errors in indices, e.g., $2x \times 3x = 6x$.
- (ii) A number of candidates ignored this section or simply plotted numbers on the number line without any work. There were also errors in transposition and adding unlike terms.
- (c) (i) Expressing two algebraic fractions as a single fraction and then expressing this fraction in its simplest form proved far too difficult for many candidates. Errors occurred in the distributive law when simplifying the numerator, e.g., $5(x + 2) - 3(x - 3) = 5x + 10 - 3x - 9$.
- (ii) Solution of simultaneous equations still causes great difficulty to many candidates. Very few candidates show any knowledge of method or layout. Some did not even recognise the problem as a problem in simultaneous equations. A common error was to add the two equations and then drop one variable. Not finding the second variable was common.

Question 5.

Average mark 22.7

This question had the lowest average mark of the six questions.

- (a) The common approach to solving this equation in x was to multiply out and continue, arriving at the correct value for x . Errors occurred in transposition and the distributive law.
- (b) This part involved factorising four different algebraic expressions. A large number of candidates did not attempt this part. It was clear from some answers that other candidates did not understand what was being asked of them. The answering of questions on factorisation illustrates the wide divergence of algebraic ability among ordinary level candidates. Some candidates were well prepared and had little difficulty.
- (i) Common errors included adding unlike terms, taking out a common term which is not common.
- (ii) Candidates had difficulty factoring the pairs correctly, and this led them to not having a common factor for the final step. Errors in sign often led to the "manufacture" of a common factor.

- (iii) In this quadratic expression, $x^2 + 2x - 8$, candidates often wrote down factors of -8 that did not lead to the correct cross term, such as, $(x + 2)(x - 4)$. Candidates did not detect this error because no effort was made to verify the answer.
 - (iv) In endeavouring to factorise $36 - y^2$, many candidates simply wrote down $36 = (6)^2$ and went no further. Others gave only the factors of y^2 as $y \times y$.
- (c) This part involved interpreting what was written, transforming it into algebraic expressions, writing an equation in x to represent this information, and solving same.

Candidates had difficulty trying to abstract mathematical formulations from the wording of the question. A sizeable number of candidates could not proceed algebraically and so introduced numbers at random.

- (i) Many candidates wrote down $5x$ instead of $x + 5$.
- (ii) A common error was to offer the answer $2x + 3x = 35$.
- (iii) Many candidates had no equation in x to solve or had an equation in x^2 or x^3 . Sometimes candidates gave a single equation in x and y , such as $2x + 3y = 35$.
- (iv) A large number of candidates did not attempt this part, as they had no answer from part (iii). It was also evident that many candidates did not understand the process of verification.

Question 6.

Average mark 31.8

- (a) Many candidates displayed an understanding of functions and correctly answered part (a). However, there is a large number of candidates who appear not to understand the concept of a function. It was common to treat the question as an equation to be solved, (that is, to solve $f(x) = 2$ or $f(x) = -1$). Also common was to write $2[f(x)] = 6x - 10$ or $-1 [f(x)] = -3x + 5$.
- (b) Many candidates achieved full marks for this graph question. The common approach was for candidates to construct a table.

Some numerical errors occurred in the calculation of $g(x)$. A small number of candidates did not have uniform gradations on the axes, while others reversed the co-ordinates.
- (c) (i) Many candidates apparently did not comprehend the concept of 'axis of symmetry', since this was only answered by a very small number of candidates.
- (ii) Candidates were asked to estimate the value of $g(x)$ when $x = 1.5$ using the graph. The common approach was graphical indication, though some used direct substitution and the calculator. This was penalised, since it failed to answer the question asked.

PAPER 2.

Question 1.

Average mark 32.5

- (a) The most frequent mistake was in conversion from metres to centimetres or centimetres to metres.
- (b) (i) The formula for calculating average speed was often not written down correctly. The answer was in many instances not given in km/hr. Taking 1 hour to be 100 minutes appeared on occasions.
(ii) Finding how many minutes the journey home took caused difficulties when the incorrect formula was used or when 1 hour was equated to 100 minutes.
(iii) The most common error was in introducing an arbitrary time unrelated to the answer calculated in part (ii).
- (c) (i) The correct formula, πr^2 , was generally presented. Errors arose in the substitution into the formula using the given diameter length of the small pizza, instead of the radius. Candidates often did not round their answers to the nearest cm^2 .
(ii) Parts (i) and (ii) tested the same skill. Thus the same errors that candidates made in part (i) occurred again in part (ii).
(iii) A common mistake was in to subtract one small pizza, instead of two small pizzas, from the large pizza.

Question 2.

Average mark 31.1

- (a) Many candidates substituted correctly for the radius of the sphere and for π in calculating the surface area of the ball.
- (b) (i) In finding the length of one of the semi-circular ends of the track, many candidates used the formula for a full circle and failed to divide by 2. Another common error was taking r as 28.
(ii) In calculating the length of a straight side of the track, many candidates omitted to take account of the lengths of the semi-circular ends of the track. Also, many used the figure 28 instead of their answer from part (i).
- (c) (i) Calculating the volume of juice in the rectangular carton presented no difficulties.
(ii) Finding the volume of each glass when 18 glasses were filled with the juice also presented no difficulties to candidates.
(iii) This final part proved too difficult for the majority of candidates. Few candidates managed to set up the equation to find the height.

A common answer was $\frac{132}{3}$, (note that 132 cm^3 was the volume of each glass and 3 was the given radius.

Question 3.

Average mark 38.6

- (a) In finding the average age of the three children, the most common error to occur was omitting division by 3.
- (b) Candidates displayed a good knowledge of the pie-chart in this question.
 - (i) The measure of the angle for German was correctly found by the majority.
 - (ii) Some errors occurred in relation to incorrect ratio methods.
 - (iii) Students who completed parts (i) and (ii) correctly were able to find the number of students in the class. Errors did occur in relation to incorrect ratio methods used.
 - (iv) Many candidates simply wrote down the number of candidates who studied Spanish, instead of the number who did not study Spanish,
- (c) (i) Apart for occasional slips in counting frequencies when completing the frequency table, this part was answered accurately by almost all candidates.
 - (ii) Calculating the mean from the frequency table proved difficult for many candidates. Many divided the number of pupils (30) by 7, or added the numbers in the top row of the table to get 21, and divided this by 7.
 - (iii) The fact that this part was independent of part (ii) gave candidates the opportunity to return to their table in part (i) and a large number of candidates were able to answer it correctly.

Question 4.

Average mark 20.3

The average mark for this question was the lowest of the six questions. This was also reflected in that 53.2% of candidates achieved less than 20 marks out of 50 marks in this question.

- (a) Where a proper construction of the triangle was attempted, it was reasonably well drawn. Many candidates just drew a sketch.
- (b) Many candidates did not answer this part. In parts (iii) and (iv) the answer offered was not even a triangle. For example, the line ac was offered as the answer to part (iii) and the line db as the answer to part (iv).
- (c) In all four parts, candidates found it very difficult to articulate a reason for their answers. When answers were given, they were often written on the diagram and

not related to a particular part.

- (i) This was the only part in which candidates made a reasonable attempt.
- (ii) The angle $\angle acd$ was a common answer. Candidates obviously did not see the isosceles triangles.
- (iii) No coherent geometrical approach was evident in answers here to this part.
- (iv) As in part (iii), no coherent geometrical approach was evident in the answers presented.

Question 5.

Average mark 32.9

- (a) Candidates wrote down correctly the co-ordinates of the point a . Switching of co-ordinates was not common.
- (b) Candidates displayed understanding and use of the relevant formulae for the three sections.
 - (i) Common errors were incorrect signs in substitution.
 - (ii) As in (i), the formula was used correctly, apart from sign errors.
 - (iii) Common errors were: taking $(-4)^2 = -16$, and omission of the square root in calculations.
- (c)
 - (i) This part was frequently not answered. A common incorrect approach was substitute $x = 0$ and then try to find a corresponding y value.
 - (ii) This involved direct substitution into formula for the equation of a line. Sign errors in substitution occurred, as did failure to substitute for the slope.

Question 6.

Average mark 21.8

The average mark for this question was the second lowest of the six questions.

Application of trigonometric ratios clearly needs attention.

47.9% of candidates achieved less than 20 marks out of 50 for this question, a similar statistic to that for question 4.

- (a)
 - (i) Many candidates wrote down the correct formula for the cosine of an angle, but did not proceed to substitute in values. Another error was an inverted ratio.
 - (ii) The comments in (i) apply here also.
- (b)
 - (i) For many candidates, this was the only part correctly answered. It did not involve use of trigonometry, but an understanding and application of given information.

- (ii)** Candidates generally did not introduce trigonometric ratios. An arbitrary degree measure was sometimes given as the answer.
- (c)**
 - (i)** This part was frequently left unanswered. Trigonometric ratios were seldom introduced. Lack of trigonometric application was evident.
 - (ii)** The comments in **(i)** apply equally to this part.

3.4. CONCLUSIONS

- The new format for the examination papers was effective in helping candidates in their answering. The provision of answer boxes served to concentrate candidates' minds on the tasks at hand and also helped weaker students to lay out their answers. Very few candidates needed extra paper or used the blank pages at the back of the booklet. Examiners reported that the absence of choice was beneficial, since it encouraged full coverage of the syllabus. The 'hand symbol' was a help and guide to candidates, and where it appeared few gave an answer without supporting work.
- While candidates displayed competence in calculator use, this did not disguise the inability of many to calculate percentages or to add fractions. Candidates had difficulty selecting a value for π appropriate to the circumstances.
- Candidates who achieved high grades presented clear and accurate answers showing good understanding of the concepts being tested. However, candidates who achieved lower grades experienced difficulty in coping with algebra in particular. All facets of algebra gave rise to concern. Geometry and trigonometry will also require further attention, since the highest grade can no longer be achieved without knowledge and understanding of all sections of the syllabus.
- Sections that were particularly well answered by candidates were:

On Paper 1:

All sections of questions 1, 2 and 3, with many candidates achieving their highest marks on these questions.
Question 6 was well answered by the better candidates.
In other words, the topics sets, applied arithmetic and graphs were answered well, as was, in the case of better candidates, functions.

On Paper 2:

Question 3, involving pie-chart analysis and statistics.
Co-ordinate geometry in question 5.
Question 2, the volume of the rectangular carton.
Also well done was the construction of the triangle from the given information in question 4(a).

Correct use of the calculator eliminated many basic numerical errors. This applied to both papers.

- Sections that were not answered well by candidates were:

On Paper 1:

Questions 4 and 5 on algebra with some parts not being attempted at all.

Functions caused problems for some candidates in question 6. In relation to question 6(c), handling questions based on the use of the drawn graph also created problems for some candidates. It was apparent that question 6 was avoided in some centres.

On Paper 2:

Question 1(b), incorrect unit conversion, particularly hours to minutes, and formulae for speed/distance/time calculations and their application.

Question 2(c)(iii) which involved setting up and manipulation of equations.

Question 4(b) and 4(c), which involved the use of central and axial symmetries and the geometry of the triangle. Refer to the syllabus pages 23-25, Synthetic geometry for "Facts" and Theorems, and page 25 with Transformation geometry for symmetries.

Question 5 (c)(i), co-ordinate geometry.

Question 6(a), b(ii) and (c), knowledge of trigonometric ratios and their correct application.

3.5. RECOMMENDATIONS TO TEACHERS AND STUDENTS

Teachers

- Cover the entire course.
- Take advantage of the power of the calculator as a learning aid, particularly in the areas of percentages and compound interest. Build accurate calculation skills in these areas, including estimation skills, and develop conceptual understanding of percentages.
- Use real-life situations to enhance students' understanding of speed/distance/time calculations and formulae.
- Use the idea of the 'Function Machine' or other approaches which aid or improve students' concept and understanding of functions.
- Spend time on the formation of equations from word-based problems.
- Addition of algebraic fractions requires much attention and is needed for senior cycle.
- Develop the vocabulary and language of mathematics among the students. Encourage discussion and explanation on the part of students and writing down of reasons and explanations.
- Provide plenty of practice at interpreting graphs and using them to solve problems.
- Use co-ordinate geometry to stimulate the solving of simultaneous equations.
- Stress the significance of the 'hand symbol'.
- Encourage students to reread their answers and to verify their answers during the examination.
- Give practical examples of symmetries, e.g., sports fields and courts, tiling patterns, art, etc.
- Engage in practical activities using trigonometric ratios, both indoors and outdoors.
- Review the marking schemes carefully.

Note the types of errors that occur and the penalties incurred.

Note how the marking schemes differentiate between grades.

Note that a penalty is incurred where an answer is given without any supporting work when the hand symbol is present.

- Where possible, make Mathematics fun.

Students

- Read each part of each question carefully.
- Attempt each part of each question.
- Stay in the examination hall until the end of the allotted time. Use any spare time to revise all questions.
- When the 'hand symbol' is present, you must show supporting work clearly. When it is not present, supporting work is encouraged but not compulsory.
- Do not round numbers during a calculation, unless specifically directed to do so.
- It is important to understand the words and phrases used in mathematics and on mathematical papers and to be able to use such words and phrases correctly.

4. HIGHER LEVEL

4.1. INTRODUCTION

The examination consists of two papers, each comprising six questions. All questions must be attempted on each paper to obtain full marks. Each question carries 50 marks.

The duration of each paper is $2\frac{1}{2}$ hours.

4.2. PERFORMANCE OF CANDIDATES

The following table shows the number and percentage of candidates achieving each grade in 2003.

2003	A	B	C	D	E	F	NG	Total Candidates
Number of Candidates								23734
% of Number	17.20	33.60	28.60	17.00	3.10	0.50	0.00	100

The table below shows the individual % results for both Paper 1 and Paper 2.

2003	A	B	C	D	E	F	NG
Paper 1 (% results)	17.8	35.6	30.1	12.9	3.1	0.5	0.0
Paper 2 (% results)	20.0	30.2	24.6	17.5	6.5	1.1	0.1

The average mark per question and its topic is shown in the table below for each paper.

Paper 1:

Question	Average mark	Topic
1	40.7	Applied Arithmetic
2	35.9	Applied Arith./Number Systems/Sets
3	37.2	Algebra
4	29.1	Algebra
5	33.4	Functions and Graphs
6	34.7	Functions and Graphs

Paper 2:

Question	Average mark	Topic
1	32.5	Measure
2	31.1	Measure
3	38.6	Statistics
4	20.3	Geometry(synthetic+ transformation)
5	32.9	Geometry(co-ordinate)
6	21.8	Trigonometry

The overall standard of answering on Paper 1 was high with candidates displaying understanding in depth of many different content areas. It was evident that a large number of candidates had fulfilled the objectives of the syllabus. From an analysis of scripts, in almost all cases candidates attempted all questions.

Question 1 on applied arithmetic had the highest average mark, although part (c)(ii) presented the most difficulty to candidates. Other questions or parts of questions which presented difficulty to candidates were question 2 part (b)(ii) on indices, question 3 part (a) on formula transformation, question 4 part (a) on inequalities and part (c) on writing and solving an expression in x from relevant given information in the question. Candidates answered the various parts of other questions with knowledge and understanding of what was required.

Following an analysis of scripts on paper 2, it was found that 74.8% achieved a C+ grade. However, 7.6% of candidates achieved less than a D grade. A noticeable strength of candidates' answering was the formal layout of the proofs for theorems in questions 3(b)(ii) and 4(b). Another area which showed improvement compared to previous years was that of trigonometry, question 5. However, rounding to a given number of decimal places and significant figures, and converting centimetre cubed to metre cubed, proved problematic to a number of candidates. With respect to angle measure, some candidates worked with their calculators in the wrong mode. Others needlessly converted angles from decimal form to degree-and-minutes form.

4.3. ANALYSIS OF CANDIDATE PERFORMANCE

PAPER 1:

Question 1.

Average mark: 40.7

- (a) Candidates experienced little difficulty with expressing 45 cm as a fraction of 15 m. The most common error was some incorrect cancellation, often resulting in answers like $\frac{1}{33.3}$ or similar.
- (b) Candidates had a good knowledge and understanding of compound interest.
- (i) The most common error was stopping at the interest and not calculating the final amount.
- (ii) Some candidates who started with an incorrect principal encountered problems in calculating the rate.
- (c) (i) Only a small number of errors were made in part (i). The most common were in mishandling the tax credits, for example, 20% of 31 650 or 42% of 157, or not even using the standard rate cut-off.
- (ii) It was estimated that only 2.5% of candidates achieved full marks for part (ii). Many methods of solution were presented, including the two methods offered in the marking scheme. A number of candidates attempted to solve using algebraic methods, but these were generally unsuccessful.

Question 2.

Average mark 35.9

- (a) (i) The majority of candidates correctly wrote down the first six multiples of 3 and 5.
- (ii) The only error of note was to give 0 as the lowest common multiple.
- (b) (i) The most common error to occur was that of precedence. This error occurred most often in the estimation.
- (ii) A number of candidates did not attempt this part on indices. Candidates had difficulty in handling the cube root of 27 and the square root of 9. The answer was often not given in the required form. Candidates level of understanding of indices was insufficient to answer questions of this nature.
- (c) (i) A small number of candidates confused union of sets with intersection of sets. Many candidates, while presenting correct answers, were not awarded full marks, due to not showing work even though the hand symbol was present.
- (ii) The majority of candidates correctly presented the information on a Venn diagram, but made little progress in setting up and solving the equation.

Question 3.**Average mark 37.2**

- (a) Some candidates experienced difficulty in transposition. A few made errors in signs.
- (b) (i) The most common error in multiplying the quadratic by the linear expression in x was to evaluate $3x$ by $2x^2$ as $6x^2$.
- (ii) The substitution $x = -2$ into the expression obtained in part (i) was handled competently by the majority of candidates. Some had a problem evaluating $(-2)^3$ correctly.
- (c) (i) Solving this straight-forward quadratic equation posed very few problems for candidates, with the majority obtaining full marks.
- (ii) Candidates experienced difficulty in linking the two parts of (c). A small number of candidates attempted to multiply out the given expression, resulting in numerous errors. Some let t equal to the answer from part (i) and attempted to substitute into the given equation, with no further progress. Some candidates who correctly reached $\frac{1}{t} = 7$, then indicated $t = 7$.

Question 4.**Average mark 29.1**

- (a) A significant number of candidates encountered difficulties handling this inequality. Many candidates failed to change the sign of the inequality when dividing across by a negative number. A majority incurred a blunder for failing to produce a solution set.
- (b) (i) The difference of two squares was factorised correctly by nearly all. The most frequent error was in giving the answer as $(4x + 7)(4x - 7)$.
- (ii) Many candidates correctly grouped the terms in this factorisation. The errors that occurred were mainly related to the minus sign outside one of the factors.
- (c) (i) Setting up the equation in x proved beyond the capabilities of many candidates. It was estimated that less than 10% of candidates obtained full marks here. Many were unable to distinguish between *now* and *next week*.
- (ii) It was estimated that less than 2% of candidates on average achieved full marks in this section. Even among the candidates who arrived at the correct equation, $\frac{400}{x-8} - \frac{400}{x} = \frac{5}{2}$, there were many who were unable to tidy up,

arrive at a quadratic equation and obtain a solution for x .

Question 5.

Average mark 33.4

- (a) While the area of a side of the box was required, some candidates instead found the surface area or the base area of the box. Very few candidates were successful in finding correctly the area of a side of the box.
- (b) Most candidates opted to make a table rather than evaluate the values of the function. Calculating correct values for $-2x^2$ caused difficulties for some candidates. While the graph was drawn accurately by the majority of candidates, the maximum point was often not clearly drawn.
- (c) (i) Candidates lost marks for failing to show work. That is, no lines were indicated on the graph.
- (ii) The common error was failing to show any work on the graph.
- (iii) The common error was again failing to show any work on the graph.
- (iv) Only a small number of candidates made the connection between the various sections in the question. The great majority did not seem to understand what was required in this part.

Question 6.

Average mark 31.8

- (a) The only error of significance in this linear equation in x was failure to verify the final answer.
- (b) (i) This question on simultaneous equations was answered reasonably well by candidates. The errors that did occur were the same that occur each year with this type of question:
- distributive law errors
 - transposition errors
 - failure to multiply every term in an equation by the appropriate constant
 - failure to find the value of the second variable.
- (ii) Candidates experienced difficulty in drawing an accurate graph of the two lines, as both lines crossed the axes very close to the origin. Where candidates chose to calculate the points intersecting the axes, this caused problems, in that the resulting numbers were small fractions. Candidates found it difficult to graph these accurately. Another common error was failing to name the point of intersection.
- (c) (i) The majority of candidates solved the quadratic equation correctly to obtain the x co-ordinates for the points a and b , but omitted to find the y co-ordinates of the points. Candidates appeared to have greater difficulty in finding the co-ordinates of c , the point where the graph cut the y -axis.

- (ii) Of those who attempted this part, few made the connection between this part and their answers in part (i). Also, rather than giving the range of values for x , as an inequality in the real numbers requires, a number of candidates listed only the integer values in the range.

PAPER 2.

Question 1.

Average mark 35.5

- (a) Many candidates obtained full marks for this part. The most common errors were of omitting the $\frac{1}{3}$ from the formula for the volume of the cone and failure to give the answer in terms of π .
- (b) (i) This part was answered correctly by the majority of candidates.
- (ii) This part posed problems for many. In most cases, candidates used an incorrect formula; many others calculated and then multiplied by 4.
- (iii) Changing kilogrammes to grammes presented difficulties for candidates. Many ignored the 90 cm^3 , the volume of the block. Instead, they divided the total mass of the blocks, in kilogrammes, by the mass of one cm^3 of the metal, in grammes, to get 13.5 , a relatively meaningless number in the context of the question.
- (c) (i) Many candidates applied the correct formulae to find the surface area of the capsule, but failure to correctly was quite common. Often the answer was left in terms of π .
- (ii) Whereas candidates succeeded in finding the volume of the capsule in cm^3 , conversion to m^3 caused significant problems. Those who converted from centimetre to metre at the start of their calculations fared best. There were also problems with rounding.

Question 2.

Average mark 32.4

- (a) The only error of note was incorrect identification of the angles in the isosceles triangle, that is, $x^\circ + x^\circ + y^\circ = 180^\circ$, leading to $y^\circ = 80^\circ$.
- (b) (i) Those candidates who had a knowledge of translation found the correct co-ordinates of q . However, some candidates lost marks for failure to show work in support of the correct answer.
- (ii) Many candidates used the distance formula and applied it correctly twice. Others worked with the slope formula and incorrectly concluded that the

distances were equal because the slopes were equal. A number of candidates failed to verify the given statement.

- (c) (i) As the equation of the line was given as $x - 2y - 3 = 0$, a number of candidates who used the formula $y = mx + c$ to find the slope failed to handle the sign correctly, giving an answer of $-\frac{1}{2}$.
- (ii) The majority of candidates filled in the formula for equation of a line correctly. A few omitted to invert the slope from part (c)(i).
- (iii) This 'point of intersection' required the use of simultaneous equations and a number of candidates did not make this connection. Where simultaneous equations were used, a common error was failure to multiply across correctly. If there were errors from previous work, awkward fractions appeared in candidates' equations and many were unable to cope with this.
- (iv) Only candidates with a knowledge of symmetry and translation correctly found the image of $(-2, 5)$, using their answer from part (c)(iii). Attempts included reflecting $(-2, 5)$ in $(0, 0)$ or the x -axis or y -axis.

Question 3.

Average mark 38.8

- (a) The majority of candidates obtained full marks for this part, with the only error of consequence being $y^\circ = 180^\circ - 54^\circ$.
- (b) (i) A few candidates did not show any construction lines and hence did not obtain full marks.
- (ii) Most candidates showed the requisite number of steps in the proof of this theorem. In some cases, the "to prove" line was omitted.
- (c) (i) Only a few candidates stated the correct number of axes of symmetry of a hexagon. The most common incorrect answer was 4.
- (ii) Most candidates copied, as accurately as possible, the diagram of the hexagon into their answerbook and drew in the number of axes of symmetry that they had specified in part (c)(i).
- (iii) Candidates not familiar with the concept of rotations did not attempt this part. The most common incorrect answers were 30° , 60° and 90° .
- (iv) Many candidates made no attempt at this part. While some candidates mentioned a transformation such as a translation, central symmetry or axial symmetry, they were not specific in what they wrote down.

Question 4.

Average mark 29.5

- (a) (i) This proved a testing start to the question for many candidates. Many took the sum of the angles in a parallelogram to be 180° .

- (ii) Full marks were obtained by many for this part. A common mistake was to treat the rectangle as a triangle giving $h = 15$.
- (b) Most candidates scored high marks in the theorem. The steps "To prove" and "Construction" were sometimes incorrect or omitted. The condition for congruency was also incorrect in some cases. A number of candidates stopped without stating which triangles were congruent, and did not finish properly. A small number proved a different theorem from the one asked.
- (c) (i) While the correct answer of 90° was common, the reason given was often incorrect or omitted. An example of an incorrect reason was $|ab| = |ac|$.
- (ii) Many candidates correctly found $|\angle cdb| = 45^\circ$.
- (iii) In finding $|bc|$, candidates displayed a good knowledge of either trigonometry or Pythagoras' Theorem to obtain their answer. A common algebraic error was to deduce from $2x^2 = 144$, that $2x = 12$ and $x = 6$.
- (iv) Candidates who attempted this part usually had parts (c)(i) and (iii) correctly done. Many either ignored this final part or gave an incorrect formula, the most common being $\frac{1}{2} |ab||bc|$.

Question 5.

Average mark 32.9

- (a) Many candidates were able to obtain the length of the hypotenuse in this triangle and proceed to find $\sin A$ and $\cos A$. However, a number did not give their answers in surd form. It is possible that they did not understand what 'in surd form' meant.
- (b) (i) In some cases of difficulty the "sin" was omitted. Confusion was evident between degrees and minutes and degrees in decimal form and sometimes the calculator was in the wrong angle-measure mode. Some candidates rounded too early, thus affecting their final answer. It was evident, even though the angle at p was stated in the question and given in the diagram, there were some candidates who took it to be right-angled.
- (ii) A majority of candidates correctly found the area of Δpqr . A number again considered this triangle to be right-angled. Errors mentioned in part (b)(i) apply to this part as well.
- (c) (i) Candidates used a variety of the three methods in the marking scheme in finding the height of the mast, $|xy|$. The sine rule was used most often. Some candidates initially obtained $|yt|$ and then used Pythagoras' theorem to get the answer. In this instance, rounding caused problems. Other candidates merely got $|\angle tyx| = 33.69$ and stopped.
- (ii) This final part was not attempted by as many candidates as part (c)(i). Some candidates saw 50 and 100 as being in the same triangle and tried using the

cosine ratio or Pythagoras' theorem. For those candidates who tried to find $|\angle ykt|$, early rounding, incorrect final rounding, or failure to round was in evidence.

Question 6.

Average mark 35.5

- (a) (i) While most candidates answered correctly and showed work, others ignored the "hand symbol" and simply repeated that the mean was 13.
- (ii) Some candidates used the mean to find the total of the six numbers and then subtracted the known five to find x . Others set up an equation in x and solved it. The error $65 + x = 65x$ also occurred.
- (b) (i) Candidates had difficulty drawing the histogram. Some drew all the rectangles with the same width. Others drew rectangles whose heights, rather than areas, were proportional to their to the numbers given. Many made both of these errors.
- (ii) This part simply required addition of the numbers in the table. However, those who simply wrote down the answer without any work lost marks, as the "hand symbol" was present.
- (iii) Many candidates stated the class interval in which the median lay, but without showing any other work. Some took the highest number of log-ons and divided it by 2, concluding that 9 – 15 was the correct class interval. Others found the mean using mid-interval values.
- (c) (i) Many obtained full marks for completing the cumulative frequency table. Some candidates just copied the table from part (b) while others only filled in the first number correctly and stopped. Addition errors also occurred.
- (ii) Constructing the ogive produced errors of such a nature as to show lack of understanding of graph procedures. The *duration* scale often showed equal distances between the numbers 3, 6, 9, 15, 21 and 30.
- (iii) Finding the median from the graph caused few difficulties for candidates. Again, writing down the correct answer without showing how it was obtained caused many candidates to lose marks, as the "hand symbol" was present.
- (iv) Most candidates started at 10 minutes on the correct axis and correctly read the corresponding value of 20 log-ons and then stopped. That is, they failed to subtract the 20 from 70 to get 50.

4.4. CONCLUSIONS

- The papers covered a wide range of the syllabus. While the format of the new papers was somewhat different from previous years, lack of familiarity did not impede candidates in achieving grades appropriate to their skills and ability levels.
- The overall standard of answering was high on both papers with an A-grade being achieved on each paper by 17-20% of candidates. It was evident from the presentation of candidates' work, which was more coherent than in previous years, that they had knowledge and understanding of what was required in the questions asked. The absence of choice did not appear to be a problem for candidates. Indeed, it appears to have been helpful to them. It was also noted that many candidates answered the questions in numerical order. The 'hand symbol' guided candidates effectively, in that its presence implied that an answer alone would not gain full marks.
- Sections that were particularly well answered by candidates were:

On Paper 1:

Question 1, excluding part (c)(ii), on applied arithmetic with evidence of calculator use.

Question 2(a) and (b)(i) on multiples, estimation and evaluation.

On algebra, the better answered parts were question 3 part (b) and part (c)(i) on multiplication of two algebraic expressions and solving a quadratic equation; question 4, part(b) on factorisation; question 5, parts (b) and (c); question 6, parts (a), (b)(i) and (c)(i) generally.

On Paper 2:

Question 5 on trigonometry. The use of calculators eased the burden of calculating giving the candidate more time to concentrate on what was required in the question.

Questions 3 part (b)(ii) and 4 part (b) on proofs of theorems. In general, the formal layout of the proofs of the theorems is to be commended.

Question 6 on statistics. Most candidates exhibited a good basic knowledge of this topic.

The knowledge and application of formulae in question 2 on co-ordinate geometry and in question 5 on trigonometry using the sine rule, demonstrated an understanding by candidates of the correct selection and application of a relevant formula.

- Sections that were not answered well by candidates were:

On Paper 1:

Question 1 part (c)(ii). It was estimated that only 2.5% of candidates got this part fully correct.

Knowledge of indices needs further strengthening for candidates to answer, in a more confident manner, questions such as question 2 part (b)(ii).

There was some improvement in relation to algebraic skills, but further improvement is still needed. Questions 3 and 4 relating to algebra demonstrated that the algebraic skills of candidates need to be enhanced so that they can handle with ease such topics as manipulation of formulae, quadratic equations, question 3 part (c)(ii); solving inequalities, setting up equations and solving as per question 4 part (c)(i) and (ii).

Graphing a pair of straight lines as in question 6 part (b)(ii), where fractional values occurred in the calculations was also not well answered.

On Paper 2:

Question 1 part (b)(iii) and part (c)(ii) which involved conversion of different units, showed that candidates are not confident in routinely going from grammes to kilogrammes or centimetre cubed to metre cubed. Question 1 part (c) also involved rounding to a given number of decimal places and significant figures, and this too caused difficulties.

Question 2 part (b) and part (c) and question 3 part (c): both questions involved some parts on transformations. The answers to this latter question were not specific: a translation would be mentioned without specifying the translation, or a central symmetry without specifying the centre of symmetry.

4.5. RECOMMENDATIONS TO TEACHERS AND STUDENTS

Teachers

- Concentrate on further improvement of candidates' skills in algebra, particularly manipulation of formulae, simplifying algebraic expressions, transposition and use of the distributive law, laws of indices solving inequalities and handling of functions. Build all of these around solid conceptual understanding, and avoid "tricks" and incorrect or sloppy language, such as "change the sign when you bring it over the equals".
- Explain fully the significance of the 'hand symbol': that candidates will not obtain full marks for any question or part of question where supporting work is not shown and this symbol is present.
- Units conversion: develop more facility and confidence among candidates when converting from, for example, g to kg or cm^3 to m^3 .
- Do not neglect correct rounding procedures, when asked with respect to either decimal places or significant figures.
- Where transformations are involved, encourage candidates to be specific regarding the exact nature of the transformation involved.
- As all questions are compulsory on the examination papers, ensure full coverage of the syllabus, so that candidates have the confidence to attempt all parts of all questions, and so that they have a solid basis for their senior-cycle studies.
- Review the marking schemes carefully.

Note the types of errors that occur and the penalties incurred.

Note how the marking schemes differentiate between grades.

Note that a penalty is incurred where an answer is given without any supporting work when the hand symbol is present.

Students

- Read the question papers carefully.
- Attempt all questions and all parts in each question..
- When the 'hand symbol' is present, provide supporting work with your answer.
- Be careful that you work with the correct mode for angle measure on your calculator.
- Be specific when answering questions involving transformations.

- Develop an understanding and skill in how to extract algebraic equations from information given in a question.
- Be cognisant of the properties of inequalities, and in particular, note that the direction changes when you multiply across by a negative quantity.

