UNIVERSITY OF SWAZILAND
FACULTY OF EDUCATION
SUPPLEMENTARY EXAMINATION PAPER 2007

TITLE OF PAPER:	CURRICULUM STUDIES IN MATHEMATICS
COURSE CODE:	EDC 281
STUDENTS:	B.ED 2 AND PGCE
TIME ALLOWED:	THREE (3) HOURS
INSTRUCTIONS:	ANSWER ANY FOUR QUESTIONS. EACH QUESTION IS WORTH 25 MARKS.
ADDITIONAL MATERIALS:	IGCSE MATHEMATICS SYLLABUS CHAPTER FROM A SCHOOL BOOK

Question 1

(a) Prepare a detailed practical lesson plan for the topic 'Locus' and subtopic 'Locus of a point whic is a given distance from a fixed point'. [20]

(b) Using a rural Swazi context write one homework task for the learners. [5]

Question 2

Using Bloom's mathematics objectives in the cognitive domain and the teaching learning methods stud indicate, with support, which method would best achieve which objectives. [25]

Question 3

(a) State the **five** principles of constructivism. [5]

(b) Describe each of the following approaches to teaching/learning:

- (i) Mechanistic [5]
- (ii) Empiristic [5]
- (iii) Structuralist [5]
- (iv) Realistic [5]

Question 4

(a) What is meant by Realistic Mathematics Education? [5]

(b) "Realistic Mathematics Education is only applicable at primary school" write an essay to suppo or refute this statement. [20]

Question 5

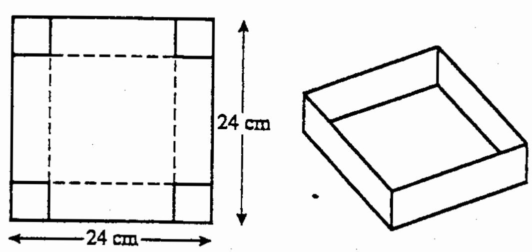
(a) Give **five** reasons for using problem solving and /or investigations in the teaching/learning of mathematics.[10]

(b) In the current Swaziland education system how would you incorporate problem solving and /or investigations in your classes? [5]

(c) Solve the problem 18 below and state the mathematical concepts or skills one needs to solve it.[10]

Problem 18

(a) You have a square sheet of card 24 cm by 24 cm. You can make a box (without a lid) by cutting squares from the corners and folding up the sides.



(i) Try different sizes for the corners and record the results in a table as shown below:

Length of the side of the corner square (cm)	Dimensions of the open box (cm)	Volume of the box (cm^3)
1	$22 \times 22 \times 1$	484
2		
-		
-		

(ii) What size corners should you cut out so that the volume of the box is as large as possible?

(iii) Is there a connection between the size of the corners cut out and the size of the square card?

(b) (i) Now consider boxes made from 15 cm by 15 cm and 20 cm by 20 cm cards.

(ii) What size corners should you cut out this time so that the volume of the box is as large as possible?

(iii) Does the answer you gave in (a) (iii) give you the largest possible volume for these cards as well?

MATHEMATICS 0580/0581
IGCSE
2007

IMPORTANT NOTICE

University of Cambridge International Examinations (CIE) in the UK and USA

University of Cambridge International Examinations accepts entries in the UK and USA only from students registered on courses at CIE registered Centres.

UK and USA private candidates are not eligible to enter CIE examinations unless they are repatriating from outside the UK/USA and are part way through a course leading to a CIE examination. In that case a letter of support from the Principal of the school which they had attended is required. Other UK and USA private candidates should not embark on courses leading to a CIE examination.

This regulation applies only to entry by private candidates in the UK and USA. Entry by private candidates through Centres in other countries is not affected.

Further details are available from Customer Services at University of Cambridge International Examinations.

Exclusions

Syllabus **0580** must not be offered in the same session with any of the following syllabuses:

0581 Mathematics (with coursework)
4021 Mathematics A (Mauritius)
4024 Mathematics D (Calculator version)
4026 Mathematics E (Brunei)
4029 Mathematics D (Calculator version) (Mauritius)

Syllabus **0581** must not be offered in the same session with any of the following syllabuses:

0580 Mathematics
4021 Mathematics A (Mauritius)
4024 Mathematics D (Calculator version)
4026 Mathematics E (Brunei)
4029 Mathematics D (Calculator version) (Mauritius)

You can find syllabuses and information about CIE teacher training events on the CIE Website (www.cie.org.uk).

Mathematics Syllabus

Syllabus codes: 0580 (without Coursework)
0581 (with Coursework)

CONTENTS

INTRODUCTION

International General Certificate of Secondary Education (IGCSE) syllabuses are designed as two-year courses for examination at age 16-plus.

All IGCSE syllabuses follow a general pattern. The main sections are:

Aims
Assessment Objectives
Assessment
Curriculum Content.

The IGCSE subjects have been categorised into groups, subjects within each group having similar Aims and Assessment Objectives.

Mathematics falls into Group IV, Mathematics, of the International Certificate of Education (ICE) subjects together with Additional Mathematics.

Candidates wishing to offer Coursework **must** be entered for Syllabus 0581. Teachers at Centres offering Syllabus 0581 will be required to undergo training in assessment before entering candidates.

An examination in Additional Mathematics (0582) is available to IGCSE Centres in June and November. The syllabus is published in a separate booklet available from CIE. Results in Additional Mathematics can count towards the ICE, either in place of Mathematics in Group IV or as a seventh subject. Entries for Additional Mathematics may be made on the IGCSE entry form.

AIMS

The aims of the curriculum are the same for all students. The aims are set out below and describe the educational purposes of a course in Mathematics for the IGCSE examination. They are not listed in order of priority.

The aims are to enable students to:

1. develop their mathematical knowledge and oral, written and practical skills in a way which encourages confidence and provides satisfaction and enjoyment;
2. read mathematics, and write and talk about the subject in a variety of ways;
3. develop a feel for number, carry out calculations and understand the significance of the results obtained;
4. apply mathematics in everyday situations and develop an understanding of the part which mathematics plays in the world around them;
5. solve problems, present the solutions clearly, check and interpret the results;
6. develop an understanding of mathematical principles;
7. recognise when and how a situation may be represented mathematically, identify and interpret relevant factors and, where necessary, select an appropriate mathematical method to solve the problem;
8. use mathematics as a means of communication with emphasis on the use of clear expression;
9. develop an ability to apply mathematics in other subjects, particularly science and technology;
10. develop the abilities to reason logically, to classify, to generalise and to prove;
11. appreciate patterns and relationships in mathematics;
12. produce and appreciate imaginative and creative work arising from mathematical ideas;
13. develop their mathematical abilities by considering problems and conducting individual and co-operative enquiry and experiment, including extended pieces of work of a practical and investigative kind;
14. appreciate the interdependence of different branches of mathematics;
15. acquire a foundation appropriate to their further study of mathematics and of other disciplines.

ASSESSMENT OBJECTIVES

The abilities to be assessed in the IGCSE Mathematics examination cover a single assessment objective, technique with application. The examination will test the ability of candidates to:

1. organise, interpret and present information accurately in written, tabular, graphical and diagrammatic forms;
2. perform calculations by suitable methods;
3. use an electronic calculator;
4. understand systems of measurement in everyday use and make use of them in the solution of problems;
5. estimate, approximate and work to degrees of accuracy appropriate to the context;
6. use mathematical and other instruments to measure and to draw to an acceptable degree of accuracy;
7. interpret, transform and make appropriate use of mathematical statements expressed in words or symbols;
8. recognise and use spatial relationships in two and three dimensions, particularly in solving problems;
9. recall, apply and interpret mathematical knowledge in the context of everyday situations;
10. make logical deductions from given mathematical data;
11. recognise patterns and structures in a variety of situations, and form generalisations;
12. respond to a problem relating to a relatively unstructured situation by translating it into an appropriately structured form;
13. analyse a problem, select a suitable strategy and apply an appropriate technique to obtain its solution;
14. apply combinations of mathematical skills and techniques in problem solving;
15. set out mathematical work, including the solution of problems, in a logical and clear form using appropriate symbols and terminology.

SPECIFICATION GRID

Objectives	Short-answer questions	Structured/Longer answer questions	Coursework	Core/Extended
1 to 8	✓	✓	✓	Both
9	✓	✓	✓	Greater emphasis at Core
10	✓	✓		Both
11		✓	✓	Both
12 and 13		✓	✓	Greater emphasis at Extended
14	✓	✓	✓	Both
15		✓	✓	Greater emphasis at Extended

Commentary on specification grid

A rigid association between particular assessment objectives and individual examination components is not appropriate since any of the objectives can be assessed in any question or piece of coursework. Nevertheless, the components of the scheme will differ in the emphasis placed on the various objectives. A difference in emphasis will be apparent between the Core and the Extended papers; for example the assessment of candidates' response to relatively unstructured situations (Objective 12) is particularly important on Paper 4 (Extended). The grid above is for general guidance only and illustrates where particular objectives might receive most emphasis in the various components. Ticks are placed in the grid only where there is likely to be emphasis although the objective will also be met in other components.

The short-answer questions fulfil a particularly important function in ensuring syllabus coverage and allowing the testing of knowledge, understanding and manipulative skills, while greater emphasis is placed on applications to the processes of problem solving in the structured/longer answer papers. For candidates for 0581, the teacher should aim to design coursework tasks which place emphasis on the problem-solving objectives.

ASSESSMENT

Scheme of assessment

Candidates who have followed the Core curriculum and take the relevant papers are eligible for the award of grades C to G only. Candidates who have followed the Extended curriculum are eligible for the award of grades A* to E only.

SYLLABUS 0580 (WITHOUT COURSEWORK)

All candidates will take two written papers as follows:

(i) Short-answer questions (Paper 1 or Paper 2);

(ii) Structured questions (Paper 3 or Paper 4).

Core curriculum Grades available: C-G	*Extended curriculum* Grades available: A*-E
Paper 1 (1 hour) short-answer questions	**Paper 2** ($1\frac{1}{2}$ hours) short-answer questions
Paper 3 (2 hours) structured questions	**Paper 4** ($2\frac{1}{2}$ hours) structured questions

Weighting of papers

Paper	*Weighting*
1 2	35% 35%
3 4	65% 65%

NOTES

1. There will be no choice of question.

2. The syllabus assumes that candidates will be in possession of an electronic calculator for all papers, possibly used in conjunction with four-figure tables for trigonometric functions. Algebraic or graphical calculators are not permitted. Three significant figures will be required in answers except where otherwise stated.

3. Candidates are encouraged to use the value of π from their calculators if their calculator provides this. Otherwise, they should use the value of 3.142 given on the front page of the question paper only.

4. Tracing paper may be used as an optional additional material for each of the written papers.

SYLLABUS 0581 (WITH COURSEWORK)

All candidates will take two written papers as follows:

(i) Short-answer questions (Paper 1 or Paper 2);

(ii) Structured questions (Paper 3 or Paper 4).

In addition candidates will submit Coursework for school-based assessment (Paper 5 or Paper 6).

Core curriculum Grades available: C-G	*Extended curriculum* Grades available: A*-E
Paper 1 (1 hour) short-answer questions	**Paper 2** ($1\frac{1}{2}$ hours) short-answer questions
Paper 3 (2 hours) structured questions	**Paper 4** ($2\frac{1}{2}$ hours) structured questions
Paper 5 Coursework*	**Paper 6** Coursework*

*Teachers may not undertake school-based assessment of Coursework without the written approval of CIE. This will only be given to teachers who satisfy CIE requirements concerning moderation and they will have to undergo special training in assessment before entering candidates.

CIE offers schools such in-service training via Distance Training Packs.

Please note that 0581 is not available to private candidates.

Weighting of papers

Paper	*Weighting*
1 2	*30%* *30%*
3 4	*50%* *50%*
5 6	*20%* *20%*

NOTES

1 There will be no choice of question in any written paper.

2 The syllabus assumes that candidates will be in possession of an electronic calculator for all papers, possibly used in conjunction with four-figure tables for trigonometric functions. Algebraic or graphical calculators are not permitted. Three significant figures will be required in answers except where otherwise stated.

3 Candidates are encouraged to use the value of π from their calculators if their calculator provides this. Otherwise, they should use the value of 3.142 given on the front page of the question paper only.

4 Tracing paper may be used as an additional material for each of the written papers.

5 The school-based components (Paper 5 for the Core curriculum, Paper 6 for the Extended curriculum) consist of Coursework assessed according to the given criteria and will be marked by teachers trained by CIE using guidelines and instructions provided by CIE. The work will be externally moderated by CIE and will be weighted at 20% of the assessment, with a corresponding reduction in the weightings of the written papers (as shown above) for candidates offering Coursework.

6 The award rules are such that a candidate's Coursework grade cannot lower his or her overall result. Candidates entered for Syllabus 0581 are graded first on Components 1+3+5 or 2+4+6 and then graded again on Components 1+3 or 2+4. If the grade achieved on the aggregate of the two written papers alone is higher then this replaces the result achieved when the Coursework component is included. In effect, no candidate is penalised for taking the Coursework component.

CURRICULUM CONTENT

Students may follow either the Core curriculum only or the Extended curriculum which involves both the Core and Supplement. Students aiming for grades A* to C should follow the Extended curriculum.

As well as demonstrating skill in the following techniques, candidates will be expected to apply them in the solution of problems.

THEME OR TOPIC	CORE	SUPPLEMENT
	All students should be able to:	Extended curriculum students, who are aiming for Grades A* to C, should, in addition be able to:
1. Number, set notation and language	- identify and use natural numbers, integers (positive, negative and zero), prime numbers, square numbers, common factors and common multiples, rational and irrational numbers (e.g. π, $\sqrt{2}$), real numbers; continue a given number sequence; recognise patterns in sequences and relationships between different sequences, generalise to simple algebraic statements (including expressions for the *n*th term) relating to such sequences	- use language, notation and Venn diagrams to describe sets and represent relationships between sets as follows: Definition of sets, e.g. $A=\{x: x \text{ is a natural number}\}$ $B=\{(x,y): y=mx+c\}$ $C=\{x: a \leqslant x \leqslant b\}$ $D=\{a,b,c\ldots\}$ Notation Number of elements in set *A* — n(*A*) "...is an element of ..." — $\in$ "...is not an element of..." — $\notin$ Complement of set *A* — A' The empty set — $\varnothing$ Universal set — $\mathscr{E}$ *A* is a subset of *B* — $A \subseteq B$ *A* is a proper subset of *B* — $A \subset B$ *A* is not a subset of *B* — $A \nsubseteq B$ *A* is not a proper subset of *B* — $A \not\subset B$ Union of *A* and *B* — $A \cup B$ Intersection of *A* and *B* — $A \cap B$
2. Squares, square roots and cubes	- calculate squares, square roots, cubes and cube roots of numbers	
3. Directed numbers	- use directed numbers in practical situations (e.g. temperature change, flood levels)	
4. Vulgar and decimal fractions and percentages	- use the language and notation of simple vulgar and decimal fractions and percentages in appropriate contexts; recognise equivalence and convert between these forms	
5. Ordering	- order quantities by magnitude and demonstrate familiarity with the symbols $=, \neq, >, <, \geqslant, \leqslant$	
6. Standard form	- use the standard form $A \times 10^n$ where *n* is a positive or negative integer, and $1 \leqslant A < 10$	
7. The four rules	- use the four rules for calculations with whole numbers, decimal fractions and vulgar (and mixed) fractions, including correct ordering of operations and use of brackets	
8. Estimation	- make estimates of numbers, quantities and lengths, give approximations to specified numbers of significant figures and decimal places and round off answers to reasonable accuracy in the context of a given problem	
9. Limits of accuracy	- give appropriate upper and lower bounds for data given to a specified accuracy (e.g. measured lengths)	- obtain appropriate upper and lower bounds to solutions of simple problems (e.g. the calculation of the perimeter or the area of a rectangle) given data to a specified accuracy

THEME OR TOPIC	CORE	SUPPLEMENT
10. Ratio, proportion, rate	- demonstrate an understanding of the elementary ideas and notation of ratio, direct and inverse proportion and common measures of rate; divide a quantity in a given ratio; use scales in practical situations; calculate average speed	- express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities; increase and decrease a quantity by a given ratio
11. Percentages	- calculate a given percentage of a quantity; express one quantity as a percentage of another; calculate percentage increase or decrease	- carry out calculations involving reverse percentages, e.g. finding the cost price given the selling price and the percentage profit
12. Use of an electronic calculator	- use an electronic calculator efficiently; apply appropriate checks of accuracy	
13. Measures	- use current units of mass, length, area, volume and capacity in practical situations and express quantities in terms of larger or smaller units	
14. Time	- calculate times in terms of the 24-hour and 12-hour clock; read clocks, dials and timetables	
15. Money	- calculate using money and convert from one currency to another	
16. Personal and household finance	- use given data to solve problems on personal and household finance involving earnings, simple interest and compound interest (knowledge of compound interest formula is not required), discount, profit and loss; extract data from tables and charts	
17. Graphs in practical situations	- demonstrate familiarity with cartesian co-ordinates in two dimensions, interpret and use graphs in practical situations including travel graphs and conversion graphs, draw graphs from given data	- apply the idea of rate of change to easy kinematics involving distance-time and speed-time graphs, acceleration and deceleration; calculate distance travelled as area under a linear speed-time graph
18. Graphs of functions	- construct tables of values for functions of the form $ax + b$, $\pm x^2 + ax + b$, a/x $(x \neq 0)$ where a and b are integral constants; draw and interpret such graphs; find the gradient of a straight line graph; solve linear and quadratic equations approximately by graphical methods	- construct tables of values and draw graphs for functions of the form ax^n where a is a rational constant and $n = -2, -1, 0, 1, 2, 3$ and simple sums of not more than three of these and for functions of the form a^x where a is a positive integer; estimate gradients of curves by drawing tangents; solve associated equations approximately by graphical methods
19. Straight line graphs	- interpret and obtain the equation of a straight line graph in the form $y = mx + c$; determine the equation of a straight line parallel to a given line	- calculate the gradient of a straight line from the co-ordinates of two points on it; calculate the length and the co-ordinates of the midpoint of a straight line segment from the co-ordinates of its end points
20. Algebraic representation and formulae	- use letters to express generalised numbers and express basic arithmetic processes algebraically, substitute numbers for words and letters in formulae; transform simple formulae; construct simple expressions and set up simple equations	- construct and transform more complicated formulae and equations
21. Algebraic manipulation	- manipulate directed numbers; use brackets and extract common factors	- expand products of algebraic expressions; factorise where possible expressions of the form $ax + bx + kay + kby$, $a^2x^2 - b^2y^2$; $a^2 + 2ab + b^2$; $ax^2 + bx + c$; manipulate algebraic fractions, e.g. $\frac{x}{3} + \frac{x-4}{2}$, $\frac{2x}{3} - \frac{3(x-5)}{2}$, $\frac{3a}{4} \times \frac{5ab}{3}$, $\frac{3a}{4} - \frac{9a}{10}$, $\frac{1}{x-2} - \frac{2}{x-3}$ factorise and simplify expressions such as $\frac{x^2 - 2x}{x^2 - 5x + 6}$

THEME OR TOPIC	CORE	SUPPLEMENT
32. Trigonometry	- interpret and use three-figure bearings measured clockwise from the North (i.e. 000°-360°) - apply Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles to the calculation of a side or of an angle of a right-angled triangle (angles will be quoted in, and answers required in, degrees and decimals to one decimal place)	- solve trigonometrical problems in two dimensions involving angles of elevation and depression, extend sine and cosine values to angles between 90° and 180°, solve problems using the sine and cosine rules for any triangle and the formula area of triangle = $\frac{1}{2}ab \sin C$, solve simple trigonometrical problems in three dimensions including angle between a line and a plane
33. Statistics	- collect, classify and tabulate statistical data; read, interpret and draw simple inferences from tables and statistical diagrams; construct and use bar charts, pie charts, pictograms, simple frequency distributions, histograms with equal intervals and scatter diagrams (including drawing a line of best fit by eye); understand what is meant by positive, negative and zero correlation; calculate the mean, median and mode for individual and discrete data and distinguish between the purposes for which they are used; calculate the range	- construct and read histograms with equal and unequal intervals (areas proportional to frequencies and vertical axis labelled 'frequency density'); construct and use cumulative frequency diagrams; estimate and interpret the median, percentiles, quartiles and inter-quartile range; calculate an estimate of the mean for grouped and continuous data; identify the modal class from a grouped frequency distribution
34. Probability	- calculate the probability of a single event as either a fraction or a decimal (not a ratio); understand and use the probability scale from 0 to 1; understand that: *the probability of an event occurring = 1 - the probability of the event not occurring*; understand probability in practice, e.g. relative frequency	- calculate the probability of simple combined events, using possibility diagrams and tree diagrams where appropriate (in possibility diagrams outcomes will be represented by points on a grid and in tree diagrams outcomes will be written at the end of branches and probabilities by the side of the branches)
35. Vectors in two dimensions	- describe a translation by using a vector represented by $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ or **a**; add and subtract vectors; multiply a vector by a scalar	- calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$. (Vectors will be printed as $\overrightarrow{AB}$ or **a** and their magnitudes denoted by modulus signs, e.g. $\mid\overrightarrow{AB}\mid$ or $\mid$**a**$\mid$. In their answers to questions candidates are expected to indicate **a** in some definite way, e.g. by an arrow or by underlining, thus $\overrightarrow{AB}$ or $\underline{a}$) - represent vectors by directed line segments; use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors; use position vectors
36. Matrices		- display information in the form of a matrix of any order; calculate the sum and product (where appropriate) of two matrices; calculate the product of a matrix and a scalar quantity; use the algebra of 2 x 2 matrices including the zero and identity 2 x 2 matrices; calculate the determinant and inverse $\mathbf{A}^{-1}$ of a non-singular matrix **A**
37. Transformations	- reflect simple plane figures in horizontal or vertical lines; rotate simple plane figures about the origin, vertices or mid points of edges of the figures, through multiples of 90°; construct given translations and enlargements of simple plane figures; recognise and describe reflections, rotations, translations and enlargements	- use the following transformations of the plane: reflection (M); rotation (R); translation (T); enlargement (E); shear (H); stretching (S) and their combinations (if M(a) = b and R(b) = c the notation RM(a) = c will be used; invariants under these transformations may be assumed.) - identify and give precise descriptions of transformations connecting given figures; describe transformations using co-ordinates and matrices (singular matrices are excluded)

THEME OR TOPIC	CORE	SUPPLEMENT
32. Trigonometry	- interpret and use three-figure bearings measured clockwise from the North (i.e. 000°-360°) - apply Pythagoras' theorem and the sine, cosine and tangent ratios for acute angles to the calculation of a side or of an angle of a right-angled triangle (angles will be quoted in, and answers required in, degrees and decimals to one decimal place)	- solve trigonometrical problems in two dimensions involving angles of elevation and depression, extend sine and cosine values to angles between 90° and 180°, solve problems using the sine and cosine rules for any triangle and the formula area of triangle = $\frac{1}{2}ab \sin C$, solve simple trigonometrical problems in three dimensions including angle between a line and a plane
33. Statistics	- collect, classify and tabulate statistical data; read, interpret and draw simple inferences from tables and statistical diagrams; construct and use bar charts, pie charts, pictograms, simple frequency distributions, histograms with equal intervals and scatter diagrams (including drawing a line of best fit by eye); understand what is meant by positive, negative and zero correlation; calculate the mean, median and mode for individual and discrete data and distinguish between the purposes for which they are used; calculate the range	- construct and read histograms with equal and unequal intervals (areas proportional to frequencies and vertical axis labelled 'frequency density'); construct and use cumulative frequency diagrams; estimate and interpret the median, percentiles, quartiles and inter-quartile range; calculate an estimate of the mean for grouped and continuous data; identify the modal class from a grouped frequency distribution
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35. Vectors in two dimensions	- describe a translation by using a vector represented by $\begin{pmatrix} x \\ y \end{pmatrix}$, $\overrightarrow{AB}$ or **a**; add and subtract vectors; multiply a vector by a scalar	- calculate the magnitude of a vector $\begin{pmatrix} x \\ y \end{pmatrix}$ as $\sqrt{x^2 + y^2}$. (Vectors will be printed as $\overrightarrow{AB}$ or **a** and their magnitudes denoted by modulus signs, e.g. $\lvert\overrightarrow{AB}\rvert$ or $\lvert\mathbf{a}\rvert$. In their answers to questions candidates are expected to indicate **a** in some definite way, e.g. by an arrow or by underlining, thus $\overrightarrow{AB}$ or $\underline{a}$) - represent vectors by directed line segments; use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors; use position vectors
36. Matrices		- display information in the form of a matrix of any order; calculate the sum and product (where appropriate) of two matrices; calculate the product of a matrix and a scalar quantity; use the algebra of 2 x 2 matrices including the zero and identity 2 x 2 matrices; calculate the determinant and inverse $\mathbf{A}^{-1}$ of a non-singular matrix **A**
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GRADE DESCRIPTIONS

A **Grade A** candidate should be able to:

- express any number to 1, 2 or 3 significant figures. Relate a percentage change to a multiplying factor and vice versa, e.g. multiplication by 1.03 results in a 3% increase.
- relate scale factors to situations in both two and three dimensions. Calculate actual lengths, areas and volumes from scale models. Carry out calculations involving the use of right-angled triangles as part of work in three dimensions.
- add, subtract, multiply and divide algebraic fractions. Manipulate algebraic equations - linear, simultaneous and quadratic. Use positive, negative and fractional indices in both numerical and algebraic work. Write down algebraic formulae and equations from a description of a situation.
- process data, discriminating between necessary and redundant information. Make quantitative and qualitative deductions from distance/time and speed/time graphs.
- make clear, concise and accurate mathematical statements, demonstrating ease and confidence in the use of symbolic forms and accuracy in algebraic or arithmetic manipulation.

A **Grade C** candidate should be able to:

- apply the four rules of number to positive and negative integers, and vulgar and decimal fractions. Calculate percentage change. Perform calculations involving several operations. Use a calculator fluently. Give a reasonable approximation to a calculation involving the four rules. Use and understand the standard form of a number.
- use area and volume units. Find the volume and surface area of a prism and a cylinder. Use a scale diagram to solve a two-dimensional problem. Calculate the length of the third side of a right-angled triangle. Find the angle in a right-angled triangle, given two sides. Calculate angles in geometrical figures.
- recognise, and in simple cases formulate, rules for generating a pattern or sequence. Solve simple simultaneous linear equations in two unknowns. Transform simple formulae. Substitute numbers in more difficult formulae and evaluate the remaining term. Use brackets and extract common factors from algebraic expressions.
- construct a pie-chart from simple data. Plot and interpret graphs, including travel graphs, conversion graphs and graphs of linear and simple quadratic functions.

A **Grade F** candidate should be able to:

- perform the four rules on positive integers and decimal fractions (one operation only) using a calculator where necessary. Convert a fraction to a decimal. Calculate a simple percentage. Use metric units of length, mass and capacity. Understand the relationship between mm, cm, m, km, g and kg. Continue a straightforward number sequence.
- recognise and name simple plane figures and common solid shapes. Find the perimeter and area of a rectangle and other rectilinear shapes. Draw a triangle given three sides. Measure a given angle.
- substitute numbers in a simple formula and evaluate the remaining terms. Solve simple linear equations in one unknown.
- extract information from simple timetables. Tabulate numerical data to find the frequency of given scores. Draw a bar chart. Plot given points. Read a travel graph. Calculate the mean of a set of numbers.

Grade Descriptions are provided to give a general indication of the standards of achievement likely to have been shown by candidates awarded particular grades. The grade awarded will depend in practice upon the extent to which the candidate has met the assessment objectives overall. Shortcomings in some aspects of a candidate's performance in the examination may be balanced by a better performance in others.

COURSEWORK (SCHOOL-BASED ASSESSMENT)

1. **Introduction**

The Coursework component exists to provide candidates with an additional opportunity to show their ability in Mathematics.

This opportunity is valuable in relation to all Assessment Objectives, but especially to the last five, where an extended piece of work can demonstrate ability more fully than an answer to a written question.

Coursework should aid development of the ability

to solve problems,

to use mathematics in a practical way,

to work independently,

to apply mathematics across the curriculum,

and if suitable assignments are selected, it should enhance interest in, and enjoyment of, the subject.

In view of the above it is recommended that Coursework assignments form an integral part of all IGCSE Mathematics courses. Whether some of this Coursework should be submitted for assessment, or not, is a matter for the teacher and the candidate to decide. The award rules are such that a candidate's Coursework grade cannot lower his or her overall result.

2. **Procedure**

(a) Candidates should submit one Coursework assignment.

(b) Coursework can be undertaken in class, or in the candidates' own time. If the latter, the teacher must be convinced that the piece is the candidate's own unaided work, and must sign a statement to that effect (see also Section 5 Controlled Elements).

(c) A good Coursework assignment is normally between 8 and 15 sides of A4 paper in length. These figures are only for guidance; some projects may need to be longer in order to present all the findings properly, and some investigations might be shorter although all steps should be shown (see Section 4).

(d) The time spent on a Coursework assignment will vary, according to the candidate. As a rough guide, between 10 and 20 hours would seem to be reasonable.

3. **Selection of Coursework Assignments**

(a) The topics for the Coursework assignments may be selected by the teacher, or (with guidance) by the students themselves.

(b) Since individual input is essential for high marks it is preferable that the students work on different topics. However, it is possible for the whole class to work on the same topic, provided that account is taken of this in the final assessment.

(c) Teachers should exercise care in ensuring that each topic selected corresponds to the ability of the student concerned. On the one hand, topics should not restrict the students, and should enable them to show evidence of attainment at the highest level of which they are capable. On the other hand, topics should not be chosen which are clearly beyond the student's ability.

(d) The degree of open-endedness of each topic is at the discretion of the teacher. However, each topic selected should be capable of extension, or development beyond any routine solution, so as to give full rein to the more imaginative student.

(e) The principal consideration in selecting a topic should be the potential for mathematical activity. With that proviso, originality of topics should be encouraged.

(f) Some students may wish to use a computer at various stages of their Coursework assignment. This should be encouraged, but they must realise that their work will be assessed on personal input, and not what the computer does for them. It is also important that all software sources are acknowledged.

CHAPTER FROM A BOOK

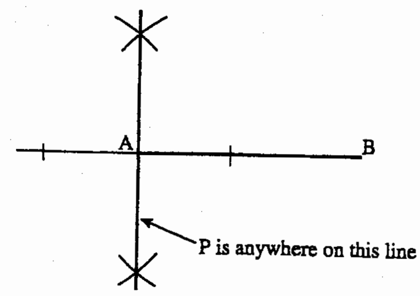
The locus of a point

The **locus** of a point is the path (line, curve or plane) followed by the point when it travels according to a given rule. ('Loci' is the plural of 'locus'.)

Example

Draw a line AB of length 8 cm.
Construct the locus of a point P which moves so that $B\hat{A}P = 90°$.

Construct the perpendicular at A.
This line is the locus of P.



These are the basic loci you will come across:
1. Given distance from a given point. Locus is a circle.
2. Given distance from a straight line. Locus is a parallel line.
3. Equidistant from two given points. Locus is the perpendicular bisector of the line joining the two points.
4. Equidistant from two intersecting lines. Locus is the angle bisector of the two lines.

Exercise 14

1. Draw a line XY of length 10 cm. Construct the locus of a point which is equidistant from X and Y.

2. Draw two lines AB and AC of length 8 cm, where $B\hat{A}C$ is approximately 70°. Construct the locus of a point which is equidistant from the lines AB and AC.

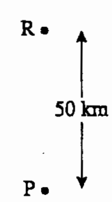
3. Draw a circle, centre O, of radius 5 cm and draw a radius OA. Construct the locus of a point P which moves so that $O\hat{A}P = 90°$.

4. Draw a line AB of length 10 cm and construct the circle with diameter AB. Indicate the locus of a point P which moves so that $A\hat{P}B = 90°$.

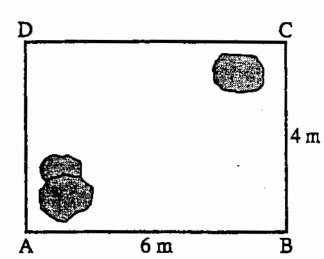
5. (a) Describe in words the locus of M, the tip of the minute hand of a clock as the time changes from 3 o'clock to 4 o'clock.
(b) Sketch the locus of H, the tip of the hour hand, as the time changes from 3 o'clock to 4 o'clock.
(c) Describe the locus of the tip of the second hand as the time goes from 3 o'clock to 4 o'clock.

6. Inspector Clouseau has put a radio transmitter on a suspect's car, which is parked somewhere in Paris. From the strength of the signals received at points R and P, Clouseau knows that the car is
(a) not more than 40 km from R, and
(b) not more than 20 km from P.

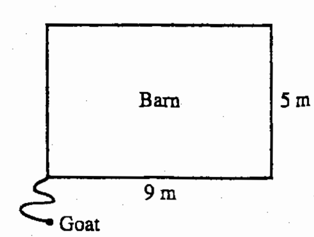
Make a scale drawing [1 cm ≡ 10 km] and show the possible positions of the suspect's car.



7. A treasure is buried in the rectangular garden shown. The treasure is: (a) within 4 m of A and (b) more than 3 m from the line AD. Draw a plan of the garden and shade the points where the treasure could be.

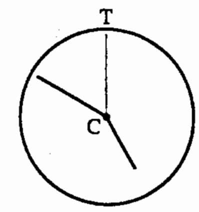


8. A goat is tied to one corner on the outside of a barn.
The diagram shows a plan view.
Sketch two plan views of the barn and show the locus of points where the goat can graze if
(a) the rope is 4 m long,
(b) the rope is 7 m long.



9. Draw a line AB of length 10 cm. With AB as base draw a triangle ABP so that the *area* of the triangle is 30 cm^2.
Describe the locus of P if P moves so that the area of the triangle ABP is always 30 cm^2.

10. As the second hand of a clock goes through a vertical position, a money spider starts walking from C along the hand. After one minute the spider is at the top of the clock T. Describe the locus of the spider.



11. Sketch a side view of the locus of the valve on a bicycle wheel as the bicycle goes past in a straight line.