UNIVERSITY OF SWAZILAND

FACULTY OF EDUCATION

FINAL EXAMINATION PAPER DECEMBER 2009

TITLE OF PAPER: CURRICULUM STUDIES IN MATHEMATICS

COURSE CODE: EDC 281

PROGRAMME: PGCE

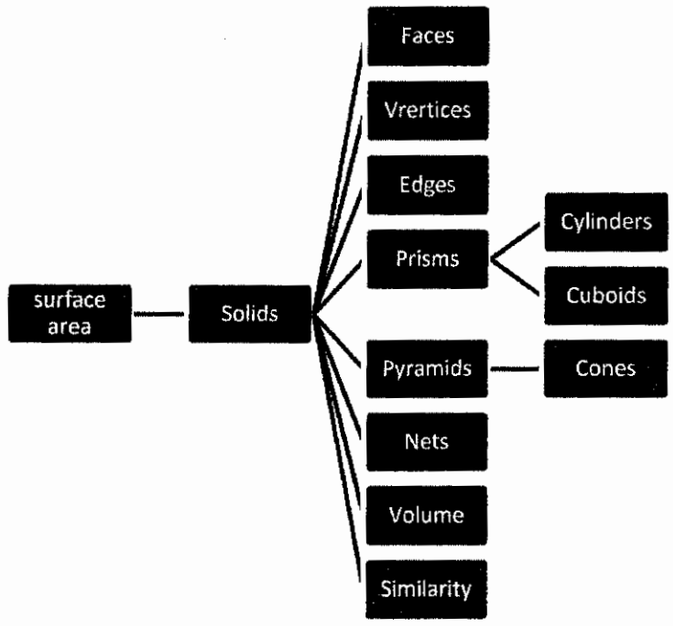
TIME ALLOWED: THREE (3) HOURS

INSTRUCTIONS: ANSWER ANY FOUR QUESTIONS. EACH QUESTION IS WORTH 25 MARKS.

ADDITIONAL MATERIALS: SGCSE MATHEMATICS SYLLABUS

Question 1

(a) The figure is a concept map for solid shapes in the SGCSE syllabus. Provide linking words for the lines on the map [5].



(b) Using examples from mathematics explain Boud and Walker (1996)'s **three** stages of the reflective thinking process [6].

(c) With respect to the reflective thinking process what is meant by ***reflection on*** and ***reflection in***?[4]

(d) Briefly outline the important elements of Ausubel's meaningful learning philosophy [10].

Question 2

(a) Name and give a short explanation of each of the **five** basic characteristics of Realistic Mathematics Education (RME) [10].

(b) Compare and contrast the locus of learning in the other **five** learning theories you studied in this course [10].

(c) "You have to give 1 tenth of your day, 2hour 40minutes, to God" identify and discuss the source of the misconception in the above statement [5].

Question 3

(a) Using examples from mathematics explain the following:

i. Conceptualizing [4]

ii. Curriculum differentiation [5]

iii. Backtracking [4]

(b) Give **two** examples of each of primary and secondary concepts in the secondary mathematics curriculum [4].
(c) Compare and contrast extrinsic and intrinsic motivation [8].

Question 4

"Examinations reduce Bloom's cognitive taxonomy to Knowledge, Comprehension, and Application." Debate the statement by considering both the affirmative and the opposing sides. Your discussion should only use mathematics education as an example and should display your understanding of Bloom's cognitive taxonomy [25].

Question 5

Write an essay entitled: "Content Oriented examinations privilege behaviourists' approaches to the teaching and learning of mathematics" [25].

Swaziland General Certificate of Secondary Education

Mathematics

2009-2010 Syllabus

SWAZILAND GENERAL CERTIFICATE OF SECONDARY EDUCATION

Broad Guidelines

The Ministry of Education is committed, in accordance with the National Policy Statement on Education, to provide a Curriculum and Assessment System (Form 4 and Form 5) so that at the completion of secondary education, learners will

- be equipped to meet the changing needs of the Nation, and
- have attained internationally acceptable standards.

Swaziland's National Education Policy Directives

SGCSE syllabuses for studies in Form 4 and Form 5 will individually, and collectively, enable learners to develop **essential skills** and provide a broad **learning experience** which

- inculcates values and attitudes as well as knowledge and understanding,
- encourages respect for human rights and freedom of speech,
- respects the values and beliefs of others, relating to issues of gender, culture and religion.
- develops desirable attitudes and behaviour towards the environment,
- provides insight and understanding of global issues which affect quality of life in Swaziland and elsewhere, e.g., the AIDS pandemic; global warming; maldistribution of wealth; and technological advances.

The National Curriculum for Form 4 and Form 5

Learners will be given opportunities to develop **essential skills** which will overlap across the entire range of subjects studied. These skills are listed below.

- Communication and language skills
- Numeracy skills: mathematical ideas, techniques and applications
- Problem-solving skills
- Technological awareness and applications
- Critical thinking skills
- Work and study skills
- Independent learning
- Working with others

To develop these skills, learners must offer **four compulsory subjects** and at least **three elective subjects** chosen from one or more Field of Study.

Compulsory Subjects
- SiSwati – either First Language or Second Language
- English Language
- Mathematics
- Science

Fields of Study
- Agriculture Field of Study
- Business Studies Field of Study
- Home Economics Field of Study
- Social Sciences and Humanities Field of Study
- Technical Field of Study

ASSESSMENT OBJECTIVES

There is a single Assessment Objective in Mathematics

TECHNIQUE WITH APPLICATION

A description of the assessment objective follows.
Learners should be able 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.

ASSESSMENT

Scheme of Assessment

All candidates must enter for two papers. These will be Paper 1 and Paper 2. In addition, those candidates who are expected to achieve a Grade C or above should be entered for Paper 3.

<table>
<tr><td>Core Curriculum
Grades C to G available</td><td>Extended Curriculum
Grades A* to G available</td></tr>
<tr><td colspan="2">Paper 1 (1 hour and 30 minutes)
Compulsory short-answer paper consisting of 60 marks, with questions designed to discriminate between grades C to G. The questions will be based on the Core Curriculum.

This paper will be weighted at 40% of the final total available marks.</td></tr>
<tr><td colspan="2">Paper 2 (2 hours)
Compulsory structured/longer answer paper consisting of 90 marks, with questions designed to discriminate between grades C to G. The questions will be based on the Core Curriculum.

This paper will be weighted at 60% of the final total available marks.</td></tr>
<tr><td>Not taken by Core Curriculum candidates</td><td>Paper 3 (2 hours)
Compulsory structured/longer answer paper consisting of 100 marks, with questions designed to discriminate between grades A to C. The questions will contain material from the Extended Curriculum as well as the Core.

This paper will be weighted at 100% of the final total available marks.</td></tr>
</table>

Notes:

1. Use of an Electronic Calculator and Mathematical Tables:
   (i) All candidates should be able to use an electronic calculator efficiently and apply it appropriately to the required degree of accuracy.
   (ii) The syllabus assumes that candidates will be in possession of a scientific electronic calculator for Papers 2 and 3. Algebraic or graphical calculators are not permitted. Three significant figures will be required in answers except where otherwise stated.
   (iii) The use of electronic calculators or mathematical tables is prohibited in Paper 1.
2. Use of Mathematical Instruments:
   Apart from the usual mathematical instruments, candidates may use flexicurves in this examination.
3. Candidates are encouraged to use the value of pi (π) from their calculators if their calculator provides this. Otherwise, they should use the value of π as given in the question or on the front page of the question paper.
4. Tracing paper may be used as an optional additional material for each of the written papers.

CURRICULUM CONTENT

Learners will follow the Core plus the Extended Curriculum. The curriculum content that follows is divided into topics covering four areas: Number; Shape, Position and Space; Algebra; and Data Handling. An indication of the area covered by a topic is provided in brackets after the topic heading. The table below shows the approximate weighting of these areas in each of the components of the examination.

Paper	Number	Shape Position Space	Algebra	Data Handling
1	30%	35%	25%	10%
2	20%	35%	30%	15%
3	10%	35%	35%	20%

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

Appropriate teaching time for the Mathematics syllabus should be equivalent to seven (7) periods of forty (40) minutes each over a period of sixty (60) weeks/cycles.

CORE	EXTENDED
1. Types of Numbers and their Sequences, Sets and Set Notation and Language *[Topic Area: Number]*	
All learners should be able to: 1.1 Identify sets of primes, multiples, factors, squares, cubes in natural numbers. *Identify includes listing and describing.* 1.2 Express natural numbers as products of their prime factors. 1.3 Identify common multiples and common factors (e.g., LCM and HCF). 1.4 List directed numbers. 1.5 Identify sets and subsets of real numbers. (i.e., natural numbers, primes, factors, rational and irrational numbers) in a sequence. 1.6 Find missing numbers in a sequence of: (i) composite numbers (ii) triangle numbers (iii) rectangle or square numbers (iv) Pascal's triangle. 1.7 Find rules for simple number patterns. 1.8 For 2 sets and a universal set, draw Venn diagrams and use the language and notation of sets (i.e., subsets, union, intersection complement number of elements).	1.10 List and describe elements of the real number system. 1.11 Complete and generate number patterns. 1.12 Generalise to simple algebraic statements. 1.13 Form an equation by generalisation (*n*th term) of a given sequence. 1.14 List and describe elements and use set symbols. 1.15 For more than 2 sets and a universal set, draw Venn diagrams and use the language and notation of sets (i.e., subsets, union, intersection complement number of elements).

3.12 Find squares, cubes, square roots and cube roots of numbers. 3.13 Understand the four operations of directed numbers. 3.14 Apply appropriate checks of accuracy. 3.15 Order quantities by magnitude and demonstrate familiarity with the symbols =, ≠, <, >, ≤, ≥.	
4. Percentages *[Topic Area: Number]*	
All learners should be able to: 4.1 Calculate a percentage of a given quantity or constant. 4.2 Calculate one quantity as a percentage of another. 4.3 Calculate (i) the percentage change given the new and original value, (ii) the new value given the original and percentage change. 4.4 Calculate: (i) the percentage profit or loss given the buying and the selling price (ii) the selling price, given the buying price and the percentage loss and profit. 4.5 Calculate the simple interest due to a customer after a certain period of time, given the percentage interest per annum and the amount deposited. 4.6 Calculate the total cost given the percentage sales tax.	4.7 Calculate repeated percentage change e.g., compound interest, depreciation and population increase. 4.8 Reverse percentages e.g., finding the cost price given the selling price and the percentage profit.
5. Personal and House-hold Finance *[Topic Area: Number]*	
All learners should be able to: 5.1 Calculate using money and convert from one currency to another including conversion graphs. 5.2 Use given data to solve problems on simple interest. 5.3 Extract and interpret tables and charts e.g., rates and bills.	5.4 Calculate compound interest (knowledge of compound interest formula is not required).
6. Ratio and Proportions *[Topic Area: Number]*	
All learners should be able to: 6.1 Demonstrate understanding of the elementary ideas and notation of ratio, direct and inverse proportions (variation). 6.2 Divide quantities in a given ratio. 6.3 Use scale in practical situations 6.4 Complete tables for simple direct variation.	6.5 Express direct and inverse variation in algebraic terms and use this form of expression to find unknown quantities. 6.6 Increase and decrease a quantity by a given ratio.

10. Geometrical terms and Constructions *[Topic Area: Shape, Position and Space]*	
All learners should be able to: 10.1 Understand and use the geometrical terms, point, line, parallel, bearing, right angle, acute, obtuse, reflex, perpendicular, isosceles, equilateral, similarity congruence. 10.2 Understand and use the vocabulary of triangles, quadrilaterals, circles, polygons and simple figures including nets. 10.3 Measure lines and angles. 10.4 Construct a triangle given the three sides using ruler and compasses only. 10.5 Construct other simple geometrical figures from given data using protractors and set squares as necessary. 10.6 Construct angle bisectors and perpendicular bisectors using straight edges and compasses only. 10.7 Read and make scale drawings.	
11. Loci *[Topic Area: Shape, Position and Space]*	
All learners should be able to: 11.1 Construct and describe loci, in 2-dimensions, of points equidistant from (a) a point, (b) two points, (c) a line, (d) two parallel lines, (e) two intersecting lines.	11.2 Describe loci, in 3-dimensions, of points equidistant from: (a) a point, (b) two points, (c) a line, (d) two parallel lines, (e) two intersecting lines. 11.3 Solve problems involving loci.
12. Transformations *[Topic Area: Shape, Position and Space]*	
All learners should be able to: 12.1 Reflect simple plane figures in horizontal or vertical lines. 12.2 Rotate simple plane figures about any point, with given coordinates, through multiples of 90°. 12.3 Construct given translations and enlargements of simple plane figures on a grid. 12.4 Recognise and give precise descriptions of reflections, rotations, enlargements and translations on a grid.	12.5 Reflect simple plane figures in sloping lines. 12.6 Use a stretch and shear on simple figures. 12.7 Carry out combined transformations. 12.8 Use function notation to represent transformations (i.e., reflection (M), rotation (R), translation (T), enlargement (E), shear (H), stretch (S) and their combinations (e.g., $RM(A)$). 12.9 Use matrices in transformations (singular matrices are excluded). 12.10 Recognise and give precise descriptions of transformations connecting given figures. 12.11 Describe transformations using coordinates and matrices (singular matrices are excluded).

16. Graphs in Practical situations *[Topic Areas: Algebra and Shape, Position and Space]*

All learners should be able to:

16.1 Draw and use simple graphs in practical situations including conversion graphs and distance time graphs.
16.2 Calculate speed from a distance-time graph.
16.3 Construct/draw a speed-time graph.
16.4 Interpret speed-time graphs including acceleration and area under the graph being distance.

17. Vectors *[Topic Areas: Algebra and Shape, Position and Space]*

All learners should be able to:

17.1 Understand representation of vectors by a directed line segment.
7.2 Represent a vector by $\begin{pmatrix} x \\ y \end{pmatrix}$ or $\overrightarrow{AB}$ or $\underline{a}$.
17.3 Add and subtract vectors.
17.4 Multiply a vector by a scalar.
17.5 Calculate the magnitude/ length of a vector and use the notation $|\underline{a}|$ to represent vector magnitude or length of vector.
17.6 Use the sum and difference of two vectors to express given vectors in terms of two coplanar vectors.
17.7 Identify parallel vectors as those that are scalar multiples of each other.
17.8 Simplify vector expressions.
17.9 Use base vectors to represent any vector on the plane.
17.10 Use position vectors.
17.11 Identify collinear points using vectors.

18. Algebraic representation and formulae *[Topic Area: Algebra]*

All learners should be able to:

18.1 Use letters for numbers to express generalised numbers and expressions algebraically.
18.2 Substitute numbers for words and letters in formulae.
18.3 Change the subject of simple formulae.
18.4 Construct simple algebraic expressions and set up simple equations.
18.5 Expand brackets including double brackets
18.6 Simplify algebraic expressions
e.g., $5(x + 3) - 2(x - 5)$.
18.7 Factorise two-term expressions using a common factor.
18.8 Factorise expressions of the form $x^2 + bx + c$.
18.9 Simplify algebraic fractions of the form
$\frac{ax}{k_1} \pm \frac{bx}{k_2}$ or $\frac{x \pm a}{k_1} \pm \frac{x \pm b}{k_2}$, $k_1, k_2 \neq 0$
e.g., $\frac{2x}{3} - \frac{x}{4}$, $\frac{2}{3a} + \frac{4}{5a}$,
or of the form e.g., $\frac{2}{3a} \times \frac{4}{5a}$, $\frac{2x}{3} \div \frac{x}{4}$.
18.10 Construct and simplify more complicated formulae and equations (square and cubic).
18.11 Change the subject of a formula;
(i) when the new subject appears on both sides by collecting like terms and factorizing.
(ii) when there is a square root or a square or a cube.
18.12 Simplify algebraic fractions of the form
$\frac{k}{x - a} \pm \frac{w}{x + b}$
(two term denominator)
18.13 Factorise expressions of the form
$ax + bx + kay + kby$, $a^2x^2 - b^2y^2$,
$p^2 + 2pq + q^2$ and $ax^2 + bx + c$, where $a \neq 1$
(i.e., a can be negative or greater than 1).
18.14 Simplify algebraic fractions where numerator and denominator are quadratic expressions such as
$\frac{hx^2 - kx}{ax^2 - bx + c}$, e.g., $\frac{x^2 - 2x}{x^2 - 5x + 6}$.

21. Matrices *[Topic Areas: Algebra, Data Handling and Shape, Position and Space]*

All learners should be able to:

21.1 Display information in the form of a matrix of any order.
21.2 Calculate the product of a matrix and a scalar.
21.3 Perform basic operations: addition, subtraction and multiplication (except division) on matrices of any order (where compatible).
21.4 Understand and use the zero and identity 2 x 2 matrices.
21.5 Use equality of matrices in simple matrix equations.
21.6 Use the algebra of 2 x 2 matrices including the zero and identity matrices.
21.7 Calculate and use the determinant and inverse of a 2 × 2 matrix (non-singular matrix).
21.8 Solve simultaneous equations using matrices.
21.9 Use matrices in transformations.

22. Linear programming *[Topic Areas: Algebra, Data Handling and Shape, Position and Space]*

All learners should be able to:

22.1 Represent graphically single linear inequalities in one or two variables. *The convention of using broken lines for < and > and solid lines for ≤ and ≥ will be expected.*
22.2 Form inequalities from graphs of single regions by first determining the equation of the boundary line.
22.3 Represent graphically the solution set to 2 or more simultaneous inequalities in one or two variables. *The convention of using broken lines for < and > and solid lines for ≤ and ≥ will be expected.*
22.4 Form inequalities from graphs of regions by first determining the equations of the boundary lines.
22.5 Solve simple linear programming problems by representing the information in inequality form and drawing graphs of these inequalities.

23. Statistics *[Topic Area: Data Handling]*

All learners should be able to:

23.1 Collect classify and tabulate data.
23.2 Read, interpret and draw simple inferences from tables and diagrams.
23.3 Find the mean and median from ungrouped data.
23.4 Construct and use bar charts for qualitative and numerical data (discrete and grouped with equal intervals).
23.5 Construct and use pie charts.
23.6 Construct scatter diagrams (including drawing a line of best fit).
23.7 Understand what is meant by positive, negative and zero correlation.
23.11 Distinguish the purpose for which mean, median and mean are used.
23.12 Draw frequency polygons from frequency tables.
23.13 Construct and use histograms (equal and unequal intervals). *Frequency Density is expected on the vertical axis.*
23.14 Construct a cumulative table for ungrouped and grouped data.
23.15 Draw cumulative frequency diagrams.

GRADE DESCRIPTIONS

The scheme of assessment is intended to encourage positive achievement by all candidates. 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 on the extent to which the candidate has met the assessment objectives overall.

Criteria for the standard of achievement likely to have been shown by candidates awarded Grades A, C and F are shown below.

A Grade A candidate should be able to:

- Use positive, negative and fractional indices in both numerical and algebraic work. Interpret and use fractional indices, both numerical and algebraic.
- 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.
- Obtain appropriate upper and lower bounds for solutions to simple problems given data to a specified accuracy.
- Solve problems involving solids including nets of solids.
- Relate scale factors to situations in both two and three dimensions.
- Calculate actual length, 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.
- Write down algebraic formulae and equations from a description of a situation.
- Form and solve double linear inequalities.
- Recognise and interpret graphs of the functions $f(x) = ax^n$, and $g(x) = a^x$
- Plot, recognise and interpret graphs of functions of the form $f(x) = ax^n + bx + c$
- Draw the tangent, estimate and interpret gradients of a curve at a point.
- Solve problems involving the sine formula, cosine formula and the use of the area formula for a triangle $A = \frac{1}{2} ab \sin C$
- Use the relationships between lengths of line segments, areas, surface area, volume of similar shapes or solids to solve problems.
- Construct and interpret histograms with unequal intervals.
- Calculate the probability of simple combined events, using addition or multiplication of probabilities as appropriate.
- Recognise, describe and generalise in algebraic format patterns of non-linear sequences.
- Process data, discriminating between necessary and redundant information. Make quantitative and qualitative deductions 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.
- Give clear mathematical justifications for the conjectures made in problem solving.

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.
- 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 travel graph.
- Calculate the mean of a set of numbers.
- Manipulate simple algebraic expressions.
- Recognise and name plane shapes ad solids.
- Recognise, describe and reflect plane shapes on a coordinate grid in lines parallel to the axes.
- Translate plane shapes on a plane grid.
- Identify and use reflectional symmetry in two dimensional shapes.
- Represent, add and subtract vectors. Multiply column vectors by a scalar.
- Read tables, graphs (including travel graphs) and diagrams.