

教員養成校（TTC）の理科教科カリキュラム

3学年の各学期（年3学期制）について、専門課程、理科一般、物理、化学、生物の授業項目が示されている。基礎教育レベルのカリキュラムの変更、1年間の教育実習の導入などからこのTTCカリキュラムも見直しされることになる。

YEAR 1 TERM 1

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

PROFESSIONAL STUDIES

1	General Objectives of Teaching Science.	Meas- Time and temp.	Forms of energy Sources	The nature of Matter ✓ - Mixtures/Pure substances - Mention methods of making substances pure	Cells-Plant and animal cells
2	The importance of Primary School Science Teaching.	Meas- Mass, Weight and Volume	Kinetic, Potential Heat light etc.	Practical eg. of making impure substances pure ✓ - solutions, filtration and evaporation	Diffusion and Osmosis
3	The Cognitive Domain- Cover all the 6 levels.	Meas- S.I Standards	Transformations	Sublimation & distillation ✓	Tissues, Organs & systems
4	The Affective Domain Cover all the 5 levels.	Meas- Volume as a unit	Work Energy, Power	Chromatography ✓	Skeletal system
5	The Psychomotor Domain-cover all the 7 levels.	Meas- Density and Relative Density (solids)	Conservation of Energy	Physical and chemical changes	Muscular system
6	The Primary Science Syllabus - First hand experience	Meas- Density and Relative Density (liquids)	Heat Sources, Temperature	Chemical changes ✓ (synthesis & analysis)	Digestive system (theory)
7	The Primary Science Syllabus-Exposure of students to column under Ideas, Skills and Attitudes.	Water- Sources and uses ✓	Heat quantity	Chemical changes ✓ (synthesis & analysis)	Tests for simple and complex sugar, starch, protein, oil
8	The Primary Science Syllabus -Tutors to bring out practical familiarity on Ideas, Skills and Attitudes.	Transfer of Heat - Living things ✓	Conduction/Convection	Gain and loss of mass (copper foil) ✓	Action of enzymes, regions of the tongue
9	Activity Method of Teaching Science- Psychological Foundation.	Water- Purification and Hygiene ✓	Convection/Radiation	Gain & loss of mass (magnesium ribbon and potassium permanganate) ✓	Respiratory system (theory)
10	Activity Method of Teaching Science Planning and Preparation	Water- The three states ✓	Application of transformations of heat	Gain & loss of mass (copper sulphate crystals) ✓	Inspired and expired air, respiratory rate; diaphragm

YEAR 1 TERM 2

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

PROFESSIONAL STUDIES

1.	Conduct of Activity lessons - The Role of the Teacher	Water - Water Cycle ✓	Effects of heat - Expansion of solids	Reactions with oxygen (chemical changes) ✓	Circulatory system (theory) Tadpole
2	Conduct of Activity lessons - The Role of the Learner	Water - Evaporation and its cooling effect ✓	- Expansion of liquids and gases	Reactions with oxygen (metals:eg. zinc) ✓	Circulatory- blood slides, valves, pulse-rate
3	Conduct of Activity lessons - The Place of Materials	Water - Pressure	- Everyday applications	Reactions with oxygen (non-metals) sulphur ✓	Excretory system - Test for salt in sweat
4	Conduct of Activity lessons - Conclusion of the lesson	Water - Pressure as function of depth and siphon	- Change of state	Preparation and test for hydrogen ✓	Simple urine analysis
5	Improvisation and the use of Available Resources	Air - Presence, air occupies space and has mass	- Solubility	Preparation and test for oxygen ✓	Endocrine system
6	Improvisation (in Teaching Primary School Science)	Air - Pressure	Electricity and Magnetism - Sources of electricity	Preparation and test for carbon dioxide ✓	0
7	Improvisation (in Teaching Primary School Science)	Air - Pressure applications and pumps	- Coils in series and parallel	Tests for acids and bases; indicators ✓	Reproductive system (male) & secondary sexual characteristics
8	Micro-teaching	Air - Construction of Barometer	- Simple circuits	Further work on indicators; indicators from flowers ✓	Plantification systems (female) & secondary sexual characteristics
9	Micro-teaching	Air - Construction of wind vane and anemometer	- Simple circuits	Acids and Alkalis Simple characteristics ✓	Diseases - Bilharzia and Guinea worm
10	Micro-teaching	Astronomy - The Universe	- Conductors and Insulators	do	Diseases - Cholera and dysentery

YEAR 1 TERM 3

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

PROFESSIONAL STUDIES

1	Preparation for Learning Record in Primary School	Astronomy- The solar system (stars and planets)	Domestic appliances: (connecting of plugs (3-pin) switch, iron	Everyday acids and alkalis (sources and uses) ✓	Diseases - River blindness and sleeping sickness
2	Further work on lesson notes preparation and Micro-teaching.	Astronomy- The solar system (earth, moon and meteors)	Do	Soil acidity ✓	Diseases - Malaria and Elephantiasis
3	Same as 1 & 2	Astronomy- Eclipse of the sun and moon	Heat and lighting effects	Use of lime to control acidity ✓	Diseases - Influenza and T.B.
4	Further work on improvisation	Astronomy- Rotation and revolution of the Earth	Simple ideas on magnets-north and south poles	Chemical nomenclature (symbols) ✓	Personal hygiene & environmental sanitation
5	Do	Astronomy- Sundials	Light - Sources - transmission in straight lines and speed of light	Metals & non metals ✓	Balanced diet
6	Do	Astronomy- Gravity and Force	Shadows, eclipses	do	Common gynaecological ailments
7	Do	Astronomy- Space exploration	Reflection at plane surfaces	Metallic and non-metallic oxides ✓	Causes of infertility in men and women, miscarriage
8	Further work on content areas.	Rocks - Types	Reflection (properties of image from a plane mirror)	Simple chemical reactions ✓	Contraception & contraceptives
9	Do	Rocks - Weathering	Refraction.	do	Nutritional requirements and parental care
10	Do	Soil formation (factors)	Refraction applications	do	Classification of vertebrates

YEAR 2 TERM 1

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

PROFESSIONAL STUDIES

1.	Preparation for teaching practice	Soils - Types and characteristics	Forces - Types of forces - Units (Newtons)	Distinction between elements & compounds	Classification of invertebrates
2	do	Soils - Importance and uses	- Contact and field forces	* Formulae for compounds	Life cycle of toad
3	Teaching Practice	Teaching Practice	Teaching Practice	Teaching practice	Teaching practice
4	do	do	do	do	do
5	do	do	do	do	do
6	do	do	do	do	do
7	do	do	do	do	do
8	Feedback from Teaching Practice	Soil Fertility (plant nutrients)	Friction and its applications	Formulae for compounds	Life cycle of insects metamorphosis
9	do	Soil Fertility-maintenance (cultural practice)	Simple beam and spring balances	Formulae for compounds	Classification of plants
10	do	Soil Fertility - maintenance (use of fertilizers)	Principle of moments	Formulae for compounds	Flower

1	For more work on content areas.	Soils - Erosion (types & causes)	Centre of gravity determination of position	Simple equations, balancing	Structure and dispersal of fruits and seeds
2	do	Soils - Erosion (Prevention)	Stability of equilibrium	Simple equations, introd examples	Conditions for germination and tropisms
3	do	Fuels - Energy sources	Machines: Levers and their familiar applications	Simple combination or addition reactions	Roots
4	do	Fuels - Solids	Pulleys and their applications	Thermal decomposition	Stem
5	do	Fuels - Liquids and gaseous	Incline plane, wedge & screw	Displacement/replacement	Leaf structure and transpiration
6	do	Mineral oils - Extraction.	Applications of screws, screwdriver, screw jerk etc	Double decomposition	Photosynthesis and respiration
7	do	Mineral oils - Refinery	Gears, CoGs, belts	Oxidation and reduction	Vegetative Reproduction
8	do	Revision	Revision	Useful processes- Extraction of iron from iron ore	Ecosystems *
9	do	Internal Examination	Internal Examination	Useful processes- Extraction of lead from lead oxide	Adaptations *
10	do	Internal Examination	Internal Examination	Useful processes- Extraction of copper from copper sulphate	Defence mechanisms in plants

* NB: Topics with asterisks cannot be completed within a period. Tutors must therefore make use of internal examination periods.

YEAR 2 TERM 3

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

W/ PROFESSIONAL STUDIES

1	For more on other content areas		- Concept of efficiency		Defence mechanism in animals
2	do		- Force ratio & velocity ratio		Food chains and food webs
3	do		Revision		Ecological pyramids
4	do		Revision		Parasitism and Saprophytism
5	do		Examinations		Commensalism and Symbiosis
					Nitrogen and carbon cycles
					Oxygen and energy cycles
					Examinations
					do
					do

1	Other methods of teaching science	Precision and accuracy of measurement - Significant figures	Kinetic theory and heat - explanation of expansions of solids, liquids and gases using the kinetic theory.	Atomic structures, gross features.	Amitosis, Mitosis and Meiosis
2	do	Precision and accuracy of measurement - Standard notation	Change of state. - Melting, evaporation and boiling.	do	Differentiation and specialization of cells.
3	Definition of science as a process and product.	Water - Transmission of pressure.	Cooling by evaporation influence of pressure and of dissolved substances on boiling and melting points.	Qualitative treatment of the evidence for the existence of atomic particles. concepts of atomic number, mass number and isotopes.	Importance of chromosomes and genes in heredity. Sex determination.
4	do	Surface tension - Capillarity & diffusion	Electric current - arrangement of resistances (ie in series and parallel)	do	Mendels laws of inheritance.
5	Methods for the generation of scientific knowledge	Surface tension- viscosity	- Ohm's law and its applications to single conductors and complete circuits.	Relative atomic mass based on $C_{12} = 12$ and the mole concept	Reproductive system - Adaptations for internal fertilization and viviparous reproduction.
6	The importance of objectivity as a fundamental attitude of science.	Sinking and floating.	- Change of resistance with temperature. Transformation of electrical energy into heat energy.	Electron configuration, periodicity and periodic table. Filling of orbitals according to their energy and position in the periodic table.	Advantages of internal fertilization and viviparous reproduction over external fertilization and oviparous reproduction.
7	Science and Technology	Archimedes' Principle	- Transformation of electrical energy into light and sound energy.	do	Nervous system (theory)
8	do	Water as a solvent - Crystallization	Magnetic effect of electric current. Force on a conductor carrying a current in a magnetic field.	Boiling point melting point ionic bonding and covalent bonding	The ear

WK PROFESSIONAL STUDIES GENERAL TOPICS PHYSICS CHEMISTRY BIOLOGY

9	Science and local belief system.	Miscible and immiscible liquids.	- The motor effect D.C. motor moving coil ammeter.	do	The eye
10	Organisation of project work.	Atmospheric pressure	Electrostatics - Changing by friction. Quantity of charge, the coulomb. Conductors/insulators.	Neutralization and salt formation.	Defects of the eye and their corrections
11	Organisation of science clubs/fairs	Air - density of dry air and - compressibility	do	Kinetic theory of matter, liquids, and solids.	Alcohol and nervous system
12	Organisation of field trips	Air - composition	- Simple properties of magnets (ie, north pole, south pole etc) The compass.	do	Persistence of vision and optical illusions.
13	Organisation of field trips.	Air - Preparation of oxygen and Carbon-dioxide.	- Magnetic and non-magnetic metals: Magnetization and demagnetization (temporary and permanent magnets).	Lattice structure of metals, ionic solids and covalent compounds.	The regulation of body temperature.
14	Safety in science classes/labs.	Air - Presence in leaves, soil and water.	- The magnetic field of force Earth's magnetic field.	Energy effects (introduction) and sign convention.	Ringworm, tepe worm and scabies.
15	Inter-relationship of science with other disciplines.	Air - Respiration, rusting and combustion.	Light - Laws of reflection Images formed in spherical mirrors.	Enthalpies of reactions and their applications. Bond dissociation and bond formation energies.	Lice and jigger
16	Assessment and evaluation.	Rock forming minerals	- Snell's law of refraction determination of the refractive index of glass.	do	Chicken pox and small pox

BIOLOGY

CHEMISTRY

PHYSICS

GENERAL TOPICS

WK PROFESSIONAL STUDIES

17	do				do	Preservation of food
18	do			- Determination of the refractive index of a liquid. Total internal reflection. Critical angle. - Image formation by a convex lens. The hand lens.	do	Crustacea, myriapods, insects and arachnids.
19				- Sound The human voice relationship between quality of vibrating sources.	do	Floral design
20				- Sound waves transmission of sound in air		Vegetative reproduction
21				- The speed of sound in air The effects of temperature and air.		Succession
22				do		Conservation of forests and wild life
23				- Reflection of sound waves		Conservation of soil and water and importance to man.
24				Qualitative treatment through activity only of inertia Newton's first law.		Pollution
25				Statics: moments and Couples conditions for static equilibrium.		
26				Motion: Speed, velocity and acceleration.		
27				do		
28				Scalar and vector quantity.		

教員養成校（TTC）の数学シラバス

MATHEMATICS
FOR
TEACHER TRAINING

3 - YEAR POST-SECONDARY COURSE

October 1992

*** IMPORTANT ***

In the following syllabus, there are a number of themes which should be developed continuously and are an integral part of the syllabus. These are:

General Themes

- 1) Students should be made aware of the progression of material through the grades of primary and JSS schools. For example fractions:
 - i) Awareness of wholes, halves, quarter
 - ii) introducing eighths
 - iii) introducing mixed number
 -etc
- 2) The use of the blackboard, wall display, models etc.
- 3) Mathematics at all levels should include
 - * Exposition by the teacher
 - * discussion between teacher and pupils and between pupils themselves.
 - * appropriate practical work
 - * consolidation and practice of fundamental skills and routine
 - * problem solving, including the application of mathematics to everyday situation
 - * investigational work.
- 4) Methods of organising work - group work, individual work, class teaching, project work, discovery, remedial work, use of textbooks, use of workcards.
- 5) Students should regularly be encouraged to design and produce teaching aids, which should be collected to form a personal teaching kit.
- 6) Constant reference should be made to the Primary and JSS syllabuses whenever relevant
- 7) The need for the constant use of practical activities and the development of concepts through concrete materials, pictures and diagrams leading eventually to symbolic representation.
- 8) All topics which appear in this syllabus and which are also included in either the Primary or JSS syllabus should be treated primarily as methodology i.e. teaching how to teach.
- 9) Students should be helped to develop skills to **Observe and Listen, Reflect and Discuss** mathematics with their pupils.

INTRODUCTION

The concern of the teacher training course should be threefold:

- (A) to extend the students own mathematical ability to a level significantly beyond that which he or she is likely to teach mathematics in school.
- (B) to give students an understanding of the mathematical content and processes contained in the Primary and JSS syllabuses,
- (C) to provide professional skills and understanding relating to the methodology of the teaching which is appropriate for basic education.

To achieve these three objectives all students are expected to acquire:

- (1) a sound understanding of the basic mathematics necessary to become efficient and effective teachers of mathematics in first cycle institutions;
- (2) a thorough grasp of the content, scope and sequence of syllabuses used in the first cycle institutions;
- (3) the ability to apply effective methods for teaching at these levels.
- (4) an appreciation of the structure, pattern and power of mathematics;
- (5) the ability to apply mathematics to practical situations in life;
- (6) an appreciation of the use and influence of mathematics in other subject areas;
- (7) an appreciation of the unity of mathematics;
- (8) an increased knowledge of mathematics as specified in Objective (A) above;
- (9) the ability to carry out a mathematical investigation;
- (10) an understanding of a child's formation of mathematical concepts.

The Mathematics Department of the Training College should ensure that the course provided to meet these examination requirements should exemplify the good practice which is the subject of the methodology section.

The Core course for mathematics (Years 1 and 2) is based upon a timetable allocation of four periods per week. Elective Mathematics (Year 3) assumes a minimum of ten periods per week.

Mathematics Syllabus Post Secondary Teacher Training Course

Year One

No.	Title	Core Course (All colleges)	Elective Course (Group 1 colleges only)
1.1	Development of a General Philosophy towards mathematics.	<p>Why we learn/teach mathematics. The place of mathematics in the life of the individual. The importance of a good attitude towards the subject, both by the teacher and by the students; the development of an appropriate attitude, an interest and a liking for the subject.</p> <p>The approach to the learning/teaching of mathematics should be based upon the understanding of mathematical concepts and their applications to real-life situations. Competence in computation stems from understanding not from rote learning.</p> <p>The importance of activity by the student through individual and group work. The teaching of maths in school should include experiments, outdoor activities, games and investigations.</p>	
1.2	Problem Solving & Investigations	<p>Developing mathematical processes as well as teaching mathematical content.</p> <p>The importance of and the steps in problem solving, and investigations. Methods of presentation of mathematical problems, the necessity of using problems based on real, current situations; possible language difficulties.</p> <p>Students should attempt several investigations/problems, either individually or in groups.</p>	<p>The organization of problem solving and investigations using further examples. (8)</p> <ol style="list-style-type: none"> 1. Recognition of situation involving a problem, using language and environments! experiences of children. 2. Recognition of conditions within the problem, relationships such as equality and inequality. 3. Expression of the problem in a mathematical sentence and estimation of suitable results. 4. Solution of the mathematical sentences 5. Verification and interpretation of the result. 6. Strategies for solving problems and doing investigation. eg. Construct a table, make a diagram or graph, look for a pattern, be systematic, make a model, guess & check, fix all variables except one, act it out, work backwards, relax a condition,etc

I	How Children Learn Mathematics	Behavioural and Developmental theories of learning. (3) Piaget's stages of development, the need for concrete materials and activities, how concepts are formed. Skemp - instrumental & relational understanding. Bruner - concrete and abstract activities Dienes - the use of many models.	Complement of a set. Use of Venn diagram to illustrate basic operations with sets; solving problems using set theory (3 sets) (4)
II	Sets	Classifying and ordering, Universal set, subset and complement, disjoint set, equal and equivalent sets, number of elements in a set, notation for this; union and intersection of sets illustrated with Venn diagrams (2 sets). Number of subsets in a set. Problems based on two sets. (6)	
III	Development of number concepts and counting	Reference to the Primary Syllabus to examine the levels of understanding of number concepts and their relationship with primary grades. (6) Application of the fundamental steps to cardinal numbers demonstrated from the syllabus. Pre-number activities: sorting, describing, and matching sets. The number of a set; concept of number, ordering numbers, learning to count. Activities to develop ordinal and measurement aspects of number, eg cuisinaire rods, number track etc. Emphasis must be placed on the idea that the individual child learns and understands number concepts through personal contact with real things.	
IV	The Nature of Basic Arithmetic	The different ways of interpreting the various basic operations of primary school arithmetic and the teaching of these using sets of objects, structural materials and number track/line (8) addition - joining and partitioning subtraction - take away, comparison, missing addends multiplication - repeated addition, sets of sets division - grouping (repeated subtraction),	
V	Introduction to Statistics	Collection of data using the college as a source of data. Methods of collecting data (questionnaires, surveys, tallies). (8) Representation of data using physical objects (e.g. match-boxes, milk tins). Representation of data in graph form using block graphs. Methods of displaying data (tables, bar charts, pie charts, pictograms,	Histograms and frequency polygons using grouped data. (6)

1.8 Use of Calculators	Correct use of calculator through guided (4) examples. Usefulness of calculator as a learning/teaching aid with practical examples.	
1.9 Introduction to Integers	Integers as directed numbers on the number (5) line. Four basic operations involving integers.	
1.10 Classification of Numbers		Evolution of the number (5) system:- Counting numbers (or Natural numbers), Whole numbers, Integers, Rational numbers Ordering numbers using the number line (rational numbers, real numbers and awareness of (but not operations with) imaginary numbers as the solution of equations of the form $x^2 = -a$
1.11 Place Value	Introduction to place value (using history of (10) numbers such as Egyptian, Babylonian, Roman, Hindu/Arabic systems) Reading of Numbers Teaching place value with multi-base and other structural materials. Development of algorithms for 4 operations. Use of other bases less than 10 for consolidation of ideas about place value	
1.12 Teaching Fractions	Introducing the concept of fractions Fractions (8) and their practical applications. Location of fractions with the same denominator on the number line, especially arising in measurement. Equivalent Fractions Addition and subtraction of fractions including mixed numbers Multiplication and division of fractions with emphasis on real life situations.	
1.13 Teaching Decimals Fractions	Introducing decimal notation (5) Decimals and their practical applications (a maximum of 3 decimal places). Place value in the decimal system. Four basic operations applied to decimals. Practical applications using decimal weights and measures, including money. Writing recurring decimals and recognising common occurrences; eg $0.333 = \frac{1}{3}$, $0.666 = \frac{2}{3}$ etc, Rounding off: decimal places, significant figures.	Expressing recurring decimals as (1) a rational number.

- 1.14 Percentages Introducing percentages. Percentages and their (5) practical applications. Equivalence of simple percentages to decimals and fractions (halves, thirds, quarters, fifths, tenths, hundredths).
- 1.15 Teaching about Space Identification of solid objects to familiarise (8) students with their visual mathematical properties, using line segments (edges), planes (faces), vertices (corners). Sketching of solids
- The use of informal activities and improvised materials to help develop an intuitive understanding of space. The importance for students to have and to make their own apparatus e.g. 3-D solids/models, compasses, protractor, trundle wheel, angle finder.
- Making 3-D solids (cube, tetrahedron, cuboid, square-based pyramid, etc) from their nets. Drawing solids to given measurements. Basic steps in the study of measurement of length:
- 1.16 Teaching of Measurement 1. Key words for making comparisons: "longer (10) than" "shorter than" "taller than" etc.
2. Awareness of differences and the use of individual arbitrary units to measure these differences.
3. The need for standardization of the arbitrary unit within the group for the purpose of communication (and comparison).
4. Standardization of the units used nationally and internationally. The re-inforcement of the standard units (metric) - and their different divisions through real experience.
5. Constructing and learning to use a measuring instrument.
- The importance of estimation as applied to both measurement and counting i.e. to continuous and discrete quantities. Students should be aware that all measurement is approximate.
- Application of these steps to area
- 1.17 Angles and their measurement Angles as rotation; using a protractor to (4) measure and to draw angles.
Right angles; acute/obtuse/reflex angles
meaning of perpendicular, angles on a straight line.
- 1.18 Triangles Types of triangles: equilateral, isosceles; (2) scalene; right-angled, obtuse-angled, acute-angled.
- Angle sum of triangle; calculations

- 1.19 Properties of Number and Number Patterns: Odd, even, prime numbers, composite numbers. (6)
 Multiples, common multiples LCM, Tests of divisibility.
 Sets of factors. Prime factorisation using index notation, HCF. Multiplication & Division of numbers in index form: eg $2^3 \times 2^4 = 2^7$, $3^2 + 3^2 = 3^3$
 Students should investigate rectangular numbers, square numbers, triangular numbers and whole number square root as well as examples of other number patterns
 Investigate Fibonacci sequence (5) and Pascal's triangle
- 1.20 Preparing a Lesson plan and scheme of work: Objectives, Previous Knowledge, Materials, (2)
 Teacher's and Pupils' activities, classwork, summary and evaluation, assignments. Stress the use of a lesson plan as a guide only, students must be able to adapt to changing situations in the classroom.
 Alternative lesson formats eg, individual work or group work, investigation or exposition etc.

Year Two

CORE COURSE		ELECTIVE
2.1	Symmetry & Transformations	Identification of symmetrical objects and diagrams. Properties of reflection and symmetry. Rotational symmetry, Translations, Enlargement by scale factor.
2.2	Lines and angles	Properties of parallel lines and their construction using a set square. Parallel lines and a transversal; Complementary, supplementary, vertically opposite, allied angles. Exterior angles of a triangle.
2.3	Quadrilaterals and Areas	Classification of quadrilaterals and their properties (rectangles, squares, rhombus, parallelograms, trapezium, kite). Areas of rectangles, squares, parallelograms, right angled triangles, triangles ($\frac{1}{2} \times \text{height} \times \text{base}$)
2.4	Developing Algebraic Thinking	Developing a sense of pattern. Introducing algebraic notation. Generalising, and abstracting. Variables and unknowns. Rules and formulae. Change of subject. Order of operations.
2.5	Mathematical sentences with one variable	Open sentences; true and false sentences. Solution of simple equations with one unknown
2.6	Mappings, relations and functions	Mapping diagrams to show relationships in real situations; to show numerical relations. Simple inverse mappings. Ordered pairs. Relations and functions as mappings, linear functions. Writing relations using ordered pairs.
2.7	Graphing	Using the co-ordinate axes to plot ordered pairs. Positive and negative axes. Plotting functions. Using an appropriate scale for the range of numbers. Simple linear graphs.

(3) Other transformations; eg stretch. (3) & shear.

(4)

(4)

(8) Elective students should spend (5) further time on this topic

(4) Equations involving inequalities. (6) Notation for solution sets, eg $3 < x < 10$. Solution sets illustrated on a number line.

(6) Equation of a line $y = mx + c$ (10) Midpoint of a line segment, gradient, distance between two points.

Deriving the equation of a line given the coordinates of two points upon it. Distinguish between continuous and discrete functions.

Plotting quadratic and higher order polynomials.

2.8	Teaching Measurement	Mass/weight, volume/capacity, Temperature, Time, money.	(6)	
2.9	Construction	Use of compasses. Construction of angles 60° , 30° , 90° and 45° . Copying an angle. bisecting angles & lines, constructing a perpendicular, constructing triangles constructing parallel lines.	(6)	Easy combination of these, eg 75° Constructing the circumcircle and the inscribed circle of a triangle.
2.10	Rate, Ratio and Proportion	Simple ideas of rate and ratio and the meaning of fraction (and percentage) as a ratio. Comparison of two ratios (proportion). Practical experiments to illustrate direct proportion (unitary method and ratio method).	(10)	
2.11	Scale Drawing	Finding heights and distances by scale drawings	(2)	
2.12	Polygons	Types of polygons and their properties; sum of interior angles; sum of exterior angles; calculations involving these. Angles of regular polygons. Areas of polygons and related activities Angles properties of polygons .	(8)	
		Recognition of similar figures (same shape; all angles equal)		Application of ratio in similar figures. (8)
		Recognition of congruent figures (same shape, same size)		Conditions for congruence in triangles and the use of these in simple problems.
2.13	Teaching about Circles	Activities which generate in children in understanding of the properties of circles. Development of the concept of a circle as a set of points equidistant from a centre. Radius, diameter, circumference, arc, chord. Sector, segment, semi-circle, quadrant. Practical methods of measuring circumference and diameter. Discovering a relationship between C and D, leading to the meaning and value of π Practical methods of measuring area. Development of a formula for area. Problems involving circular circumferences and areas.	(6)	Angle properties of circle e.g. 4 circle theorems, (8) Properties of cyclic quadrilaterals. Relationship between a radius and the tangent drawn at the point where it meets the circumference (they are at right angles) Application of geometric properties of triangles, quadrilaterals, circles and their tangents in solving problems
2.14	Practical uses of percentages	Everyday examples of percentages; profits and loss in trading; discount commission; simple interest.	(4)	Compound interest; hire purchase (4)
2.15	Inverse proportion	Recognising inverse proportion in practical situations	(2)	Problems on inverse proportion (8) involving time/distance/speed. Practical applications of variation.

2.16 Indices	Positive indices. Index notation. (10) Rules of indices (multiplication and division).
	Simple calculations involving positive indices.
	The development of concept of a zero index. Negative indices.
2.17 Developing Pythagoras's theorem	Practical demonstration of Pythagoras's theorem (4) to establish the relationship $a^2+b^2=c^2$ Applications of the theorem
2.18 Simultaneous equations	Graphical solution, Solution by substitution, Solution by elimination (10)
	Word problems involving simultaneous equations.
2.19 Evaluation and Testing	(As an integral part of the Teaching/Learning (8) Process). Correction and evaluation of the daily work done by the pupils. The importance of self-correction, (ie. by the pupil himself), as a source of understanding of error. Group methods and class methods of correcting work, and the importance of encouragement of effort rather than of correctness of answers.
	Modes of Assessment: Formal (e.g. examinations and tests) and informal (particular reference should be made to continuous assessment), Formative and summative, convergent and divergent, norm-referenced or criteria referenced, observation, project work, discussion.
	Reasons for testing:- diagnostic, achievement, selection ... etc
	Types of questions:- essay, structured, short answer, multiple choice, true or false, fill in the blanks ...
	Methods of marking and mark schemes. (Students should be given practice at setting and marking various types of questions)
	Discussion of the purposes of testing; the advantages and disadvantages of those types of tests.
	Validity and Reliability.)
	Methods of moderation
	Practical determination of the (4) validity and reliability of a chosen test.

- 2.20 Probability Simple experiments giving rise to probable out- (6) tree diagrams for two or more (4)
comes; probability expressed as a fraction; combined equally-likely events;
tabulation of two sets of combined equally-likely events, eg tossing a coin and throwing a dice.
- 2.21 Statistics Measures of central tendency: - Calculation of (4)
Mode, Median, Mean for sets of discrete data.
Deciding which average is the most appropriate.

Year Three

Elective

3.1	Standard Form	Scientific notation for very large numbers and very small numbers. Negative indices, fractional indices. Simple calculations and equations involving indices.	(10)
3.2	Surface Area and Volumes of Solids	Surface area and volume of cuboids, prisms, pyramids, cylinders and cones. Practical determination of the volumes of cylinders and cones.	(10)
3.3	Similar Solids	Scale Factor related to solids, Similar solids, Finding volumes and related problems.	(6)
3.4	Relations and functions	Language of relations including domain, range, image, codomain. Functions and the notation: $f: x \rightarrow ax+b$ Inverse functions: $f^{-1}: x \rightarrow \frac{1}{a}(x-b)$ Composition of functions. Graphing functions	(10)
3.5	Factorisation	Binomials, trinomials, and differences of two squares.	(8)
3.6	Remainder and Factor theorems	Applied to factorisation of polynomials up to the third degree only.	(8)
3.7	Quadratic Equations -	Use of factors, graphs, completing the squares and formula.	(10)
3.8	Cubic equations	Solution by factorisations and by graphs.	(6)
* 3.9	Introduction to Trigonometry	Trigonometric Ratios:- tangent, sine, cosine, as applied to right-angled triangles, Students should be able to determine the values of common trigonometric ratios empirically (ie. 30°, 45°, 60° and 90°) Sine and cosine rules and their use to solve problems. Bearings,	(20)
3.10	Indices	Theory of indices, Surds and the meaning of logarithms. Students should be able to convert from index form to logarithm and vice versa and should be aware that: $\log(ab) = \log a + \log b$ and $\log \frac{a}{b} = \log a - \log b$ Solving simple equations involving logarithms, eg $\log_2 8 = x$	(10)
3.11	Sequences and Series	Investigating sequences and series, including the sums of finite number of terms of linear series (A.P. and G.P.). Summative Notation(Σ). Convergence and divergence.	(15)

3.12	Matrices	<p>Basic properties of matrices; addition and multiplication of (10) matrices. Unit matrix. Determinant and inverse of a matrix.</p> <p>Application to the solution of a system of linear equations involving two unknowns.</p>	
3.13	Teaching of Vectors	<p>Teaching of vectors as directed line segments to JSS pupils. (20)</p> <p>Identification of Scalar and Vector quantities.</p> <p>Equivalent vectors, magnitude of a vector, components of vectors, unit vectors i and j in the Cartesian plane.</p> <p>Addition and subtraction of Vectors and their graphical representation. Commutative and Associative properties of addition of Vectors.</p> <p>Multiplication of Vectors by Scalars and its geometrical interpretation (including parallel vectors).</p> <p>Application to simple problems involving displacement, velocity and force.</p>	
3.14	Statistics	<p>Cumulative frequency curves, interpreting cumulative frequency (16) curves, quartiles and percentiles (Determination by calculation and from graphs).</p> <p>Measures of dispersion: Range, Variance and Standard deviation (simple examples only)</p> <p>Scatter diagrams. Understanding and interpreting correlation coefficient. Simple examples of calculating correlation coefficient using formula. (students need not memorise or derive any formulae)</p>	
3.15	Probability	<p>Addition and Multiplication rules for conditional and independent (16) (mutually exclusive) events - e.g drawing balls from a box with or without replacement.</p>	
3.16	Transformations	<p>The use of matrices to describe transformations. (12)</p>	
3.17	Inequalities	<p>Inequalities in one and two variables. (10)</p> <p>Equivalent inequalities.</p> <p>Solving inequalities.</p> <p>Representing inequalities graphically.</p> <p>Using graphs to solve problems involving a system of linear inequalities.</p>	
3.18	Loci	<p>Investigating moving points. (7)</p> <p>Locus of a circle, ellipse and parabola.</p> <p>Finding the equation of a circle.</p>	

319 Introduction to
Calculus

Rates of change, gradients of curves, notation for gradients (dy/dx), estimating gradients numerically, gradient graphs, gradient functions and differentiation. (30)

Optimisation: - maxima and minima of polynomials. application to problems.

Areas under a graph and what they represent (eg velocity/time graphs). Estimating areas, Notation and meaning of integration. Integrating numerically. Integrating algebraically. Problems involving integration.

Integration as the inverse of differentiation.

* Responding to
High-Ability
Pupils

a) Identifying the characteristics of high-ability pupils. (3)

b) Identifying teacher behaviour that enhances learning by high ability pupils including willingness to increase own mathematical knowledge and interest; make adaptation in teaching style; acceptance of different methods for solving problems.

c) Provision in teaching to meet the needs of high ability pupils including giving extra work and enrichment assignments; extending class topics; assignment of individual work; providing extra curricular activities (eg maths clubs, activities, visits to industries, mathematics contests)

Catering for less
able pupils

a) Identifying the characteristics of less able pupils (eg low achievement, negative attitudes, unwillingness to work hard, low motivation) (3)

b) Identifying teacher behaviour and activities that encourage learning by less able pupils (eg. willingness to provide remedial teaching, providing support and encouragement, providing concrete activities, involving pupils in practical activities, leading simple projects, demonstrating mathematical ideas and skills in everyday life). The teacher should avoid stressing memorisation of rules and algorithms; avoid labelling pupils as "no good in maths".

Notes

The order of topics in the syllabus is a suggested teaching order, however tutors may approach topics in any order they wish.

Numbers shown in brackets, after each topic, give a rough guide to the number of periods to be spent on that topic.

The elective material is not split evenly over the first two years. It is likely that Group I tutors will be able to begin the second year topics before the end of Year 1. It may also be possible to begin Year 3 elective topics before the end of Year 2.

It has been assumed that colleges will achieve 54 weeks of actual teaching time over the first two years and a minimum of 20 weeks in year three. This may vary from college to college.

Examinations

The Part I examination will assess the core course.

Part II examinations will examine the elective course but it will be assumed that students have a thorough understanding of the core material. Methodology questions will concentrate on the teaching of mathematics at JSS level.

K170 June
P.S.E. 1997
BASIC SCIENCE
3 HOURS

教員養成カレッジ (TTC) の学生が受けた
1 年次の学年末統一試験問題 (理科)。
ケープコースト大学が問題を作成。

UNIVERSITY OF CAPE COAST
INSTITUTE OF EDUCATION

Three-Year Post-Secondary Teacher Training Colleges
Final Part I Examination, 1997

June 23, 1997

BASIC SCIENCE

2.00p.m. - 5.00p.m.

This Paper Consists of **FIVE** sections.
Answer **FIVE** questions, choosing **ONE** from each section.

SECTION A
PROFESSIONAL STUDIES

Answer **ONE** question from this section

1. (a) The primary science syllabus is intended to achieve a number of objectives. Discuss these objectives under the following headings.
 - (i) Process Skills
 - (ii) Basic Scientific Knowledge
 - (iii) Desirable attitudes and interests.(b) Explain the term **Improvisation** as it relates to the teaching and learning process in science.
2. (a) Show the importance of the following in the preparation of lesson notes:
 - (i) Objectives
 - (ii) Introduction
 - (iii) Core Points
 - (iv) Application
 - (v) Evaluation(b) State any **THREE** advantages and any **TWO** disadvantages of using the Activity Method for teaching science.
3. (a) "The role played by improvised materials has no impact on the teaching and learning process". Discuss.
(b) Show **FOUR** ways by which your pupils would be encouraged to improvise teaching and learning materials.
(c) State **THREE** underlying principles that should be considered in improvising teaching and learning materials.

SECTION B
GENERAL TOPICS

Answer **ONE** question from this section

4. (a) What is soil?
(b) State **FIVE** processes by which soil can be formed.
(c) List the factors that contribute to the loss of soil fertility.
(d) Describe any **THREE** cultural practices which help to conserve soil fertility.

5. (a) Describe the water cycle with only a labelled diagram.
 (b) Explain the following terms in connection with rain formation.
 (i) Dew point
 (ii) Condensation nuclei
 (c) (i) Mention any one factor which may affect the boiling point of water.
 (ii) Explain how the factor you have mentioned can be applied for the benefit of mankind.
 (d) Make a large labelled diagram of the mercury-barometer and briefly describe how it operates.
6. (a) Describe the following:
 (i) the Universe
 (ii) the Solar System
 (b) Differentiate between the following:
 (i) Meteors and Meteorites
 (ii) Stars and Planets
 (iii) Star and Galaxy
 (c) (i) State Newton's Law of gravitation
 (ii) A body of mass m_1 is separated from another body of mass m_2 by a distance d . Deduce the force that exists between these two bodies.

SECTION C

BIOLOGY

Answer ONE question from this section

7. (a) Make a large labelled diagram of the digestive system of a mammal.
 (b) (i) What is an enzyme?
 (ii) List **FOUR** characteristics of enzymes.
 (c) Describe the process and the reagents you will use to test for each of the following food substances.
 (i) Reducing sugar
 (ii) Proteins (the Biuret test)
 (iii) Starch
 (iv) Fat
8. (a) (i) What are Contraceptives?
 (ii) Give the names of the different forms of contraceptives.
 Explain how each of the various forms you have named works.
 (b) Give **FOUR** advantages of spaced births.
 (c) List any **THREE** prenatal factors can cause disabilities in a newly born child.
 Briefly explain how each one affects the newly born child.
9. Give brief accounts of each of the following diseases
 (a) Malaria
 (b) Schistosomiasis
 (c) Onchocerciasis
 (d) Trypanosomiasis
 (e) Guinea Worm

under the following headings:

- (i) Causative agent
 (ii) Method of Transmission
 (iii) Four symptoms of the disease
 (iv) Two modes of preventing the disease.

**SECTION D
CHEMISTRY**

Answer **ONE** question from this section.

10. (a) Give **THREE** differences between the product of a metal burnt in air and that of a non-metal burnt in air.
- (b) Use the following to complete the sentences in (i) - (iv) : an element, a metal, a compound, a non-metal, a metallic oxide, a non-metallic oxide. (Use each term only once)
- (i) is an insulator
 - (ii) consist of atoms having the same chemical properties
 - (iii) is a typical solid at ordinary temperatures
 - (iv) in an aqueous medium neutralizes acids to form salt and water
 - (v) when dissolved in water form an acid solution
- (c) Use chemical symbols to represent the following:
- (i) Ammonium ion
 - (ii) Sulphate ion
 - (iii) Carbonate ion
 - (iv) Sodium ion
 - (v) Ferrous ion
 - (vi) Nitrate ion
11. (a) Balance the equations given below:
- (i) $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O} + \text{O}_2$
 - (ii) $\text{Zn} + \text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$
 - (iii) $\text{N}_2 + \text{H}_2 \rightarrow \text{NH}_3$
 - (iv) $\text{Cu} + \text{O}_2 \rightarrow \text{CuO}$
- (b) Define the terms **OXIDATION** and **REDUCTION** in terms of Hydrogen, and give **TWO** examples in each case.
- (c) A student teacher in a Chemistry Laboratory combined two colourless chemicals (compounds) and realised that two new substances were formed. Basing your judgement on the theory of chemical reactions, name the type of reaction that the two chemicals have undergone. Give two specific examples of such a reaction.
12. (a) What is meant by the term Valency?
- (b) What is the valency of sulphur in each of the following compounds/anions.
- (i) H_2S
 - (ii) SO_4^{2-}
 - (iii) H_2SO_3
 - (iv) SO_2
 - (v) KHSO_4
- (c) Draw a pH scale and indicate the relative positions of the aqueous solutions of the following compounds on it.
- (i) Ca(OH)_2
 - (ii) CH_3COOH
 - (iii) CH_3COONa
 - (iv) H_2SO_4

- (d). Write the IUPAC names of the following compounds.
- (i) Fe_2O_3
 - (ii) CuSO_4
 - (iii) NaHCO_3
 - (iv) PbO
 - (v) PbO_2

SECTION E PHYSICS

Answer ONE question from this section

13. (a) Define Energy and state the S.I. unit in which it is measured.
 (b) Outline the energy transformations that take place when a moving vehicle is brought to rest instantaneously, by the application of its brakes.
 (c) A body of mass 40g moves with a velocity of 2ms^{-1}
 (i) What form of energy does the body possess?
 (ii) Calculate the energy possessed by the body.
 (d) Why is it that the weight of a body varies on the surface of the earth?
14. (a) State THREE sources of light under each of the following headings
 (i) Natural
 (ii) Artificial
 (b) With the aid of well labelled diagrams distinguish between a First Class lever and a Second Class lever.
 (c) A machine is used in raising a cement block of weight 20.0N onto a storey building. If the effort used was 10.0N, calculate the mechanical advantage.
 (d) When will a person riding a bicycle experience a mechanical advantage less than ONE? Explain how this comes about.
15. (a) Distinguish between Heat and Temperature.
 (b) What is meant by Absolute Zero?
 (c) Convert the following to Kelvin.
 (i) 60°C
 (ii) -100°C
 (d) Describe how you would make a permanent magnet by stroking?
 (e) Why do spectacles which are vigorously cleaned with cloth in dry weather soon become dusty again?

中学校卒業資格全国統一試験 理科の問題
 (1997年7月実施)

31 July
 B.E.C.E. 1997
 GENERAL SCIENCE
 1½ hours

Name

Index number

THE WEST AFRICAN EXAMINATIONS COUNCIL
 GHANA

Basic Education Certificate Examination

July 1997

GENERAL SCIENCE

1¾ hours

Do not open this booklet until you are told to do so. While you are waiting, read the following instructions carefully. Write your name and Index number in the spaces provided above.

This paper consists of two sections, A and B. Answer Section A on your Objective Test answer sheet and Section B in your answer book. Section A will last 45 minutes, after which the answer sheet will be collected. Do not start Section B until you are told to do so. Section B will last 1 hour.

SECTION A
 OBJECTIVE TEST

45 minutes

1. Use HB pencil throughout.
2. On the pre-printed answer sheet, check that the following details are correctly printed: Your Surname followed by your other names, the Subject Name, your Index Number, Centre Number, and the Paper Code.
3. In the boxes marked Candidate Number, Centre Number and Paper Code, reshadе each of the shaded spaces.
4. An example is given below. This is for a candidate whose Name is Jones Ahmed KWAO, whose Index Number is 772384188. He is writing the examination at Centre Number 77234 and is offering General Science and the Paper Code is 3110.

THE WEST AFRICAN EXAMINATIONS COUNCIL, GHANA
 BASIC EDUCATION CERTIFICATE EXAMINATION
 OBJECTIVE ANSWER SHEET

CANDIDATE NAME KWAO JONES AHMED	SUBJECT NAME: GENERAL SCIENCE
------------------------------------	----------------------------------

- | | |
|---|--|
| 1. Use HB Pencil. Press firmly.
2. Answer each question by choosing one letter and then, shade through the letter chosen like this <input type="checkbox"/> A <input checked="" type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E | your first mark completely.
4. If only four alternative answers are given for each question, ignore the letter E.
5. Your question paper may have fewer than 60 questions. |
| 3. If you want to change an answer, rub out | |

CANDIDATE NUMBER	CENTRE NUMBER	PAPER CODE	For Supervisors only. If candidate is absent shade this space
772384188	77234	3110	
(0) (0) (0) (0) (0) (0) (0) (0)	(0) (0) (0) (0) (0)	(0) (0) (0) (0)	
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(9) (9) (9) (9) (9) (9) (9) (9)	(9) (9) (9) (9) (9)	(9) (9) (9) (9)	

Answer all the questions in this section.

Each question is followed by five options lettered A to E. Find out the correct option for each question and shade in pencil on your answer sheet the answer space which bears the same letter as the option you have chosen. Give only one answer to each question. An example is given below.

Which of the following substances is not an element ?

- A. Oxygen
- B. Ammonia
- C. Sodium
- D. Chlorine
- E. Aluminium

The correct answer is Ammonia which is lettered B and therefore answer space B would be shaded.

A B C D E

Think carefully before you shade the answer spaces. Erase completely any answers you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

- | | |
|---|---|
| <p>1. Digested food is absorbed into the blood stream through the</p> <ul style="list-style-type: none"> A. duodenum. B. large intestine. C. rectum. D. small intestine. E. stomach. <p>2. Which of the following is a parasite ?</p> <ul style="list-style-type: none"> A. Fruitfly B. Housefly C. Mosquito D. Tick E. Tsetsefly <p>3. Soil acidity can be reduced by adding</p> <ul style="list-style-type: none"> A. acid solution. B. ammonium sulphate. C. fertilizer. D. lime. E. rotten leaves. <p>4. The planet earth is located in a galaxy known as</p> <ul style="list-style-type: none"> A. constellation. B. meteorites. C. milky way. D. satellite. E. supernova. | <p>5. The most productive soil in agriculture is</p> <ul style="list-style-type: none"> A. clayey soil. B. loamy soil. C. sandy soil. D. humus. E. silt. <p>6. A chemical that can be used to test for the presence of protein in food substances is</p> <ul style="list-style-type: none"> A. Benedict's solution. B. Fehling's solution A. C. Eosin solution. D. Iodine solution. E. Millon's reagent. <p>7. According to the principle of conservation of energy, energy can</p> <ul style="list-style-type: none"> A. be created and destroyed. B. be created but not destroyed. C. be destroyed but not created. D. be reduced but not increased. E. neither be created nor destroyed. <p>8. The purpose of vaccination is to</p> <ul style="list-style-type: none"> A. replace poisoned tissues. B. kill disease-producing organisms in the body. C. Increase the activity of white blood cells. D. Induce the production of antibodies. E. cure the disease. |
|---|---|

9. Which of the following planets may be seen as a bright star in early mornings or evenings?
 A. Jupiter
 B. Mars
 C. Saturn
 D. Uranus
 E. Venus
10. Which of the following gives the correct order by which blood circulates continuously through the circulatory system?
 A. Heart → veins → organs → arteries → heart
 B. Heart → arteries → organs → veins → heart
 C. Heart → arteries → veins → organs → heart
 D. Heart → organs → arteries → veins → heart
 E. Heart → veins → arteries → organs → heart
11. The weight of an object is the
 A. force with which the sun pulls it.
 B. force with which the moon pulls it.
 C. force of the object when gravity is not acting on it.
 D. force with which gravity acts on it.
 E. mass of the object.
12. The process of fusion of sperm and ovum is known as
 A. fertilization.
 B. menstruation.
 C. pollination.
 D. reproduction.
 E. lactation.
13. How much work is done when a kerosine tin is pushed with a force of 20N through a distance of 2 m?
 A. 0.01 J
 B. 0.10 J
 C. 10.0 J
 D. 20.0 J
 E. 40.0 J
14. Which of the following form part of the alimentary canal?
 I. Colon
 II. Gullet
 III. Liver
 IV. Pancreas
 A. I and II only
 B. I and IV only
 C. II and III only
 D. II and IV only
 E. I, II and III only
15. An example of a simple lever whose effort is at its centre is
 A. a bottle opener.
 B. a pair of scissors.
 C. a pair of forceps.
 D. the beam balance.
 E. wheelbarrow.
16. Which of the following leaves are sensitive to touch?
 A. Cassava leaves
 B. Mimosa leaves
 C. Orange leaves
 D. Palm leaves
 E. Tomato leaves
17. Which of the following properties is/are common to both liquids and gases?
 A. Fixed shape
 B. Fixed shape and fixed volume
 C. Fixed size
 D. No definite shape.
 E. No definite shape and no definite volume
18. Which of the following plants have suckers?
 A. Onion
 B. Orange
 C. Plantain
 D. Sweet potato
 E. Yam
19. Which of the following activities of man causes both air and water pollution?
 A. Afforestation
 B. Construction of houses
 C. Construction of roads
 D. Deforestation
 E. Industrialization
20. The number of hydrogen atoms present in two molecules of water is
 A. 1.
 B. 2.
 C. 3.
 D. 4.
 E. 5.
21. Decay is an important biological process because it brings about the
 A. formation of nutrients in living organisms.
 B. manufacture of cells of living organisms.
 C. production of oxygen by plants.
 D. release of nutrients from dead organisms.
 E. release of waste substances from bacteria.

Turn over

22. The darkest part of a shadow formed during an eclipse is called-
- annular eclipse.
 - lunar eclipse.
 - penumbra.
 - solar eclipse.
 - umbra.
23. Which of the following particles can be found in the nucleus of an atom?
- Electrons and protons
 - Electrons and shells
 - Neutrons and electrons
 - Neutrons and protons
 - Shells and neutrons
24. Which of the following substances is used to purify water for town supply?
- Alcohol
 - Carbon dioxide
 - Chlorine
 - Nitrogen
 - Sulphur
25. The shedding of leaves by plants during the dry season protects them against
- bush fire.
 - cold weather.
 - plant-eating animals.
 - heat loss.
 - water loss.
26. The volume of water in a container rises when a piece of stone is put into the container. The change in the volume of water is equal to the
- mass of the container.
 - mass of the stone.
 - density of the stone.
 - density of the water.
 - volume of the stone.
27. Which of the following carry deoxygenated blood in the body?
- Arteries
 - Red blood cells
 - Valves
 - Veins
 - White blood cells
28. Which of the following forces will cause an object to move in a circular path?
- Centripetal force
 - Gravitational force
 - Inertial force
 - Reaction force
 - Tensional force
29. The paired fins in fishes are used for
- protection and diving.
 - diving and balancing.
 - balancing and rolling.
 - steering and diving.
 - balancing and steering.
30. In which of the following is urine produced?
- Bladder
 - Kidney
 - Liver
 - Penis and vagina
 - Uterus
31. Photosynthesis occurs only in green plants because they
- absorb water.
 - are found in the tropics.
 - are very active.
 - contain chlorophyll.
 - take in carbon dioxide.
32. The food we eat undergoes slow oxidation in our bodies to produce heat. In this process
- chemical energy is converted to heat energy.
 - electrical energy is converted to heat energy.
 - kinetic energy is converted to heat energy.
 - mechanical energy is converted to heat energy.
 - potential energy is converted to heat energy.
33. Which of the following planets is nearest to the earth?
- Jupiter
 - Mercury
 - Pluto
 - Saturn
 - Venus
34. Which of the following organisms help to improve soil fertility?
- Earthworms
 - Gulneaworms
 - Hookworms
 - Roundworms
 - Threadworms
35. A stone released from a catapult was able to kill a bird because
- the stone had a lot of energy.
 - the stone was sharp.
 - there was tension in the stone.
 - the rubber of the catapult was strong.
 - the stone was big.

36. Which of the following is a plant parasite ?
A. Capsid
B. Caterpillar
C. Dodder
D. Louse
E. Nematode
37. By the end of digestion, lean meat is turned into
A. amino acids.
B. fatty acids.
C. glycerol.
D. glucose.
E. sugar.
38. In which of the following electrical appliances is electrical energy mainly converted to heat energy ?
A. Cooker
B. Fan
C. Refrigerator
D. Tape recorder
E. Television set
39. The energy for lighting a torchlight bulb comes from the
A. bulb.
B. cell.
C. filament.
D. glass.
E. switch.
40. The largest component of sweat is
A. glucose.
B. oil.
C. salt.
D. urea.
E. water.

**DO NOT TURN OVER THIS PAGE UNTIL
YOU ARE TOLD TO DO SO.**

**YOU WILL BE PENALIZED SEVERELY IF YOU ARE
FOUND LOOKING AT THE NEXT PAGE BEFORE YOU
ARE TOLD TO DO SO.**

SECTION B

ESSAY

[60 marks]

1 hour

Answer three questions only from this section.

Illustrate your answers, wherever possible, with large, clear and fully labelled diagrams.

All questions carry equal marks.

1. (a) Define the term *osmosis*. [4 marks]
- (b) State two examples of everyday observations which can be explained in terms of capillary action. [2 marks]
- (c) (i) Name the three processes by which heat can be transferred.
- (ii) Name three electrical appliances which use thermostats. [6 marks]
- (d) (i) What is a *saturated solution* ?
- (ii) State whether each of the following is a solution, suspension or a colloid:
- clay in water,
- sugar in water,
- ammonia in water,
- powdered chalk in water,
- potassium permanganate in water,
- soap in water.
- [8 marks]

2. (a) Copy the table below and write the usual host of each of the parasites given in the spaces provided.

<i>Parasite</i>	<i>Host</i>
Plasmodium	
Capsids	
Tapeworm	
Dodder	

[4 marks]

- (b) (i) Name three classes of food.
- (ii) For each of the following food substances, give the major class of food to which it belongs:
- starch,
- milk,
- margarine,
- sugar.

[5 marks]

- (c) Write the chemical formula for each of the following compounds:

- (i) calcium hydroxide,
- (ii) zinc chloride (zinc(II) chloride),
- (iii) sodium nitrate (sodium trioxonitrate(V)),
- (iv) calcium carbonate (calcium trioxocarbonate(IV)),
- (v) potassium sulphate (potassium tetraoxosulphate(VI)).

[5 marks]

- (d) (i) Define the term *viscosity*.
- (ii) Describe an experiment you performed to compare the viscosity of two liquids A and B.

[6 marks]

3. (a) (i) Define the terms *humidity* and *wind*.
- (ii) Name the instruments used to measure humidity and the speed of wind.

[5 marks]

- (b) (i) What is a *galaxy*?
- (ii) Give one example of a galaxy.

[2 marks]

- (c) State three methods by which food can be preserved.

[3 marks]

- (d) Explain why it is better to wear white clothes than black clothes on a sunny day.

[4 marks]

- (e) Write down the names of the new substances formed when the following substances are allowed to react:

- (i) sodium hydroxide and dilute sulphuric acid,
- (ii) calcium carbonate and dilute hydrochloric acid,
- (iii) ammonia and dilute sulphuric acid.

[6 marks]

4. (a) Define the following terms and give an example of each:
- (i) herbivore. [6 marks]
 - (ii) carnivore.
 - (iii) omnivore.
- (b) Two dry cells connected in parallel are in turn connected in series with a bulb and a switch. Draw a circuit diagram to illustrate this arrangement. [4 marks]
- (c) List four garden tools. [4 marks]
- (d) What property of water causes mosquito larvae to float on it? [1 mark]
- (e) Describe an experiment you prepared to show that some part of air is used in burning. [5 marks]

中学校卒業資格全国统一試験 数学の問題
(1997年7月実施)

30 July
 B.E.C.E. 1997
 MATHEMATICS
 2 hours

Name
 Index Number.....

THE WEST AFRICAN EXAMINATIONS COUNCIL
GHANA

Basic Education Certificate Examination
MATHEMATICS

July 1997

2 hours

Do not open this booklet until you are told to do so. While you are waiting, read the following instructions carefully. Write your name and index number in the spaces provided above.

This paper consists of two sections, A and B. Answer Section A on your Objective Test answer sheet, and Section B in your answer book. Section A will last 1 hour, after which the answer sheet will be collected. Do not start Section B until you are told to do so. Section B will last 1 hour.

Answer all the questions in Section A. An example is given at the beginning of Section A to help you. Read the example carefully before answering the questions.

SECTION A
OBJECTIVE TEST

1 hour

1. Use HB pencil throughout.
2. On the pre-printed answer sheet, check that the following details are correctly printed:
Your surname followed by your other names, the *Subject Name*, your *Index Number*, *Centre Number*, and the *Paper Code*.
3. In the boxes marked *Candidate Number*, *Centre Number* and *Paper Code*, reshade each of the shaded spaces.
4. An example is given below. This is for a candidate whose name is Jones Ahmed KWAO, whose *Index Number* is 772384188. He is writing the examination at *Centre Number* 77234 and is offering *Mathematics* and the *Paper Code* is 3010.

THE WEST AFRICAN EXAMINATIONS COUNCIL, GHANA
BASIC EDUCATION CERTIFICATE EXAMINATION
OBJECTIVE ANSWER SHEET

CANDIDATE NAME KWAO JONES AHMED	SUBJECT NAME: MATHEMATICS
------------------------------------	------------------------------

- | | |
|---|--|
| 1. Use HB Pencil. Press firmly.
2. Answer each question by choosing one letter and then, shade through the letter chosen like this <input type="radio"/> A <input checked="" type="radio"/> B <input type="radio"/> C <input type="radio"/> D <input type="radio"/> E
3. If you want to change an answer, rub out | your first mark completely.
4. If only four alternative answers are given for each question, ignore the letter E.
5. Your question paper may have fewer than 60 questions. |
|---|--|

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2
SECTION A

Work the following problems either in your head or on this question paper.

Each question is followed by five options lettered A to E. Find out the correct option for each question and shade in pencil on your answer sheet the answer space which bears the same letter as the option you have chosen. Give only one answer to each question. An example is given below.

If $3n + 2 = 8$, find the value of n .

- A. 10
- B. 6
- C. $3\frac{1}{3}$
- D. $2\frac{2}{3}$
- E. 2

The correct answer is 2 which is lettered E and therefore answer space E would be shaded.

A B C D E

Think carefully before you shade the answer spaces; erase completely any answers you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

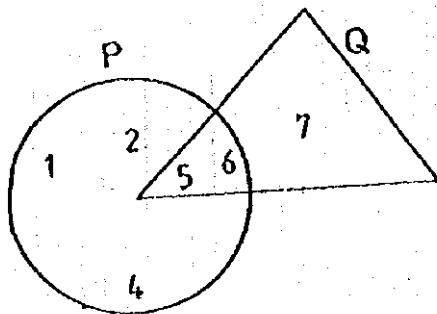
1. Convert $320_{\text{base 7}}$ to a base ten numeral.

- A. 25
- B. 77
- C. 85
- D. 86
- E. 90

2. If $P = \{2, 4, 6, 8\}$ and $Q = \{\text{even counting numbers less than 12}\}$, what is the relationship between P and Q ?

- A. $P = Q$
- B. $P \subset Q$
- C. $P < Q$
- D. $Q \subset P$
- E. $P \in Q$

3. In the diagram below, P is the set of numbers in the circle and Q is the set of numbers in the triangle.



What is $P \cap Q$?

- A. $\{1, 2, 4\}$
- B. $\{5, 6\}$
- C. $\{7\}$
- D. $\{1, 2, 4, 5, 6, 7\}$
- E. $\{ \}$

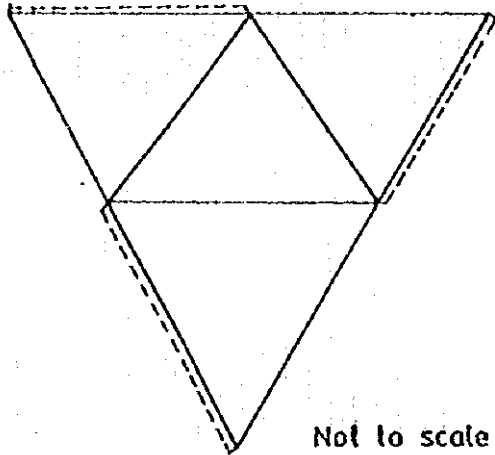
4. The product $6287 \times 543 = 3,413,841$. What is the value of 628.7×5.43 ?

- A. 3,413,841
- B. 341,384.1
- C. 34,138.41
- D. 3,413.841
- E. 341.3841

5. Express 30 cm as a percentage of 2 m.

- A. 0.15%
- B. 1.5%
- C. 6.7%
- D. 15%
- E. 66.7%

6.



What solid can be made from this net?

- A. Triangle
 B. Rectangular pyramid
 C. Triangular prism
 D. Rectangular prism
 E. Triangular pyramid
7. Simplify $3(6b - 9a) + 7(6a - 5b)$.
 A. $17b + 6a$
 B. $-17b + 6a$
 C. $17b + 48a$
 D. $15a - 17b$
 E. $17b - 15a$
8. Arrange the following fractions in descending order, $\frac{9}{18}, \frac{5}{8}, 0.62$.
 A. $\frac{9}{18}, 0.62, \frac{5}{8}$
 B. $0.62, \frac{5}{8}, \frac{9}{18}$
 C. $\frac{5}{8}, \frac{9}{18}, 0.62$
 D. $\frac{5}{8}, 0.62, \frac{9}{18}$
 E. $0.62, \frac{9}{18}, \frac{5}{8}$

$$18 = 2 \times 3^2, 42 = 2 \times 3 \times 7, 90 = 2 \times 3^2 \times 5.$$

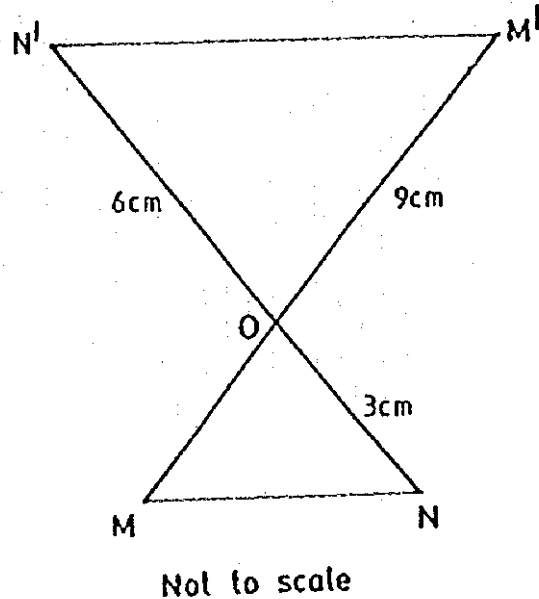
Use the information above to answer Questions 9 and 10.

9. Find the L. C. M. of 18, 42 and 90.
 A. 2×3^2
 B. $2 \times 3 \times 7$
 C. $2 \times 3^2 \times 5$
 D. $2 \times 3 \times 5 \times 7$
 E. $2 \times 3^2 \times 5 \times 7$
10. What is the H. C. F. of 18, 42 and 90?
 A. 21
 B. 18
 C. 9
 D. 6
 E. 3

3

11. Simplify $(\frac{4}{5}) + (\frac{-2}{2}) + (\frac{1}{6})$.
 A. $(\frac{2}{13})$
 B. $(\frac{7}{13})$
 C. $(\frac{5}{13})$
 D. $(\frac{3}{13})$
 E. $(\frac{6}{13})$
12. If $R = \frac{1}{2}(a + b)k$, find k in terms of R, a and b .
 A. $\frac{a + b}{2R}$
 B. $\frac{2R}{a + b}$
 C. $\frac{2R - a}{b}$
 D. $\frac{2R - b}{a}$
 E. $\frac{R}{2(a + b)}$

In the figure below, triangle $M'ON'$ is an enlargement of triangle MON , with centre O .



Use this information to answer Questions 13 and 14.

13. Find the scale factor of the enlargement.
 A. 9
 B. 3
 C. 2
 D. -2
 E. -3

Turn over

14. Find OM .

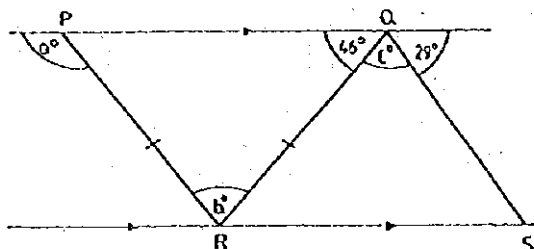
- A. 9
- B. 6
- C. 4.5
- D. 3
- E. 1.5

15. Find the image of the point $(6, 3)$ when translated by the vector $\begin{pmatrix} -1 \\ 1 \end{pmatrix}$.

- A. $(-2, -2)$
- B. $(2, -2)$
- C. $(-2, 2)$
- D. $(2, 2)$
- E. $(10, 4)$

16. A student spends $\frac{17}{33}$ of his pocket money on transport and fruits. He spends $\frac{2}{8}$ of the remainder on sweets. What fraction of his pocket money does he spend on sweets?

- A. $\frac{4}{7}$
- B. $\frac{3}{7}$
- C. $\frac{17}{33}$
- D. $\frac{15}{33}$
- E. $\frac{17}{33}$



In the diagram above, PQ is parallel to RS and $PR = QR$.

Use the diagram to answer Questions 17 to 19.

17. What is a ?

- A. 29
- B. 46
- C. 75
- D. 88
- E. 134

18. Find b .

- A. 29
- B. 46
- C. 88
- D. 92
- E. 105

19. Find the value of c .

- A. 29
- B. 46
- C. 75
- D. 88
- E. 105

20. If $p = 7$, $q = 5$ and $r = 3$, find the value of $p^2 + q - r^3$.

- A. 81
- B. 57
- C. 51
- D. 45
- E. 27

21. Simplify $35x^5y^3 + 7xy^2$.

- A. $5x^6y^5$
- B. $5x^4y$
- C. $5x^6y$
- D. $5x^4y^5$
- E. $5x^4y^2$

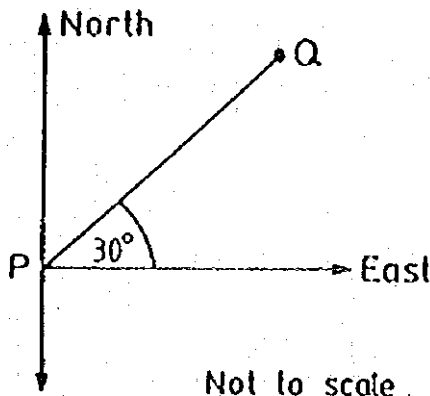
22. The sum of two numbers is 240. If one of them is y , find the other number.

- A. $120y$
- B. $240 + y$
- C. $240 - y$
- D. $240y$
- E. $\frac{240}{y}$

23. Make n the subject of the relation $2n + 5 = 7a$.

- A. $n = \frac{1}{2}(7a + 5)$
- B. $n = \frac{1}{2}(7a - 5)$
- C. $n = 2(7a + 5)$
- D. $n = 2(7a - 5)$
- E. $n = 7a - 5$

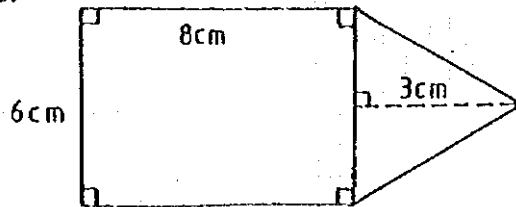
24.



Find the bearing of Q from P in the diagram above.

- A. 030°
- B. 060°
- C. 070°
- D. 090°
- E. 150°

25.



Not to scale

The figure above is made up of a rectangle and a triangle. The dimensions of the rectangle are 8 cm and 6 cm. The triangle has 6 cm as its base and 3 cm as its height. Find the area of the figure.

- A. 33 cm^2
- B. 48 cm^2
- C. 51 cm^2
- D. 57 cm^2
- E. 66 cm^2

The marks obtained by 10 boys in a test are 0, 1, 3, 3, 5, 7, 8, 9, 9, 9.

Use this information to answer Questions 26 to 28.

26. Find the median score.

- A. 3
- B. 5
- C. 6
- D. 7
- E. 8

27. Calculate the mean score.

- A. 4.4
- B. 5.4
- C. 6
- D. 6.4
- E. 9

5

28. What is the probability that a boy chosen at random scored 3?

- A. $\frac{1}{27}$
- B. $\frac{1}{18}$
- C. $\frac{1}{5}$
- D. $\frac{3}{10}$
- E. $\frac{1}{3}$

29. Express 57_{10} as a base two (binary) numeral.

- A. 101011_{10}
- B. 100111_{10}
- C. 110101_{10}
- D. 110111_{10}
- E. 111001_{10}

30. The scale of a map is 1 : 100,000. What is the distance (in kilometres) between two towns 4 cm apart on the map?

- A. 0.04
- B. 0.4
- C. 4.0
- D. 40
- E. 400

31. If 22% of a rope is 55 metres long, find the full length of the rope.

- A. 12.1 m
- B. 25 m
- C. 121 m
- D. 250 m
- E. 2500 m

32. Adwoa and Ama share an amount of ₵6,000.00 in the ratio 3 : 2. Find Adwoa's share.

- A. ₵2,000.00
- B. ₵2,400.00
- C. ₵3,000.00
- D. ₵3,600.00
- E. ₵4,000.00

33. Find the truth set of $5x - 8 \leq 2x + 4$.

- A. $\{x \geq 4\}$
- B. $\{x \geq -4\}$
- C. $\{x \leq 4\}$
- D. $\{x \leq -4\}$
- E. $\{x = 4\}$

34. The diameter of a circular tray is 28 cm. Find the area of the tray. (Take $\pi = \frac{22}{7}$.)

- A. 44 cm^2
- B. 88 cm^2
- C. 154 cm^2
- D. 616 cm^2
- E. 2464 cm^2

Turn over

35. If $a = \begin{pmatrix} 3 \\ 3 \end{pmatrix}$ and $b = \begin{pmatrix} 5 \\ -3 \end{pmatrix}$, find $a + b$.

- A. $\begin{pmatrix} 2 \\ 3 \end{pmatrix}$
- B. $\begin{pmatrix} 8 \\ 3 \end{pmatrix}$
- C. $\begin{pmatrix} 3 \\ 2 \end{pmatrix}$
- D. $\begin{pmatrix} 8 \\ 2 \end{pmatrix}$
- E. $\begin{pmatrix} 8 \\ -2 \end{pmatrix}$

36.
$$\begin{array}{cccccccc} x & 0 & 1 & 2 & 3 & 4 & \dots \\ \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \downarrow & \\ y & 0 & 1 & 4 & 9 & 16 & \dots \end{array}$$

What is the rule for the mapping above?

- A. $x \rightarrow x + 2$
- B. $x \rightarrow x + 1$
- C. $x \rightarrow x - 1$
- D. $x \rightarrow \sqrt{x}$
- E. $x \rightarrow x^2$

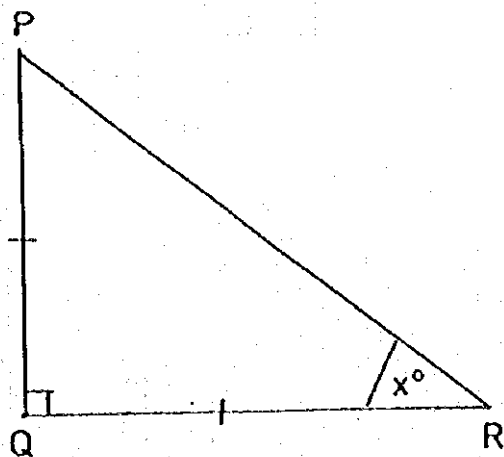
37. If 50 oranges cost ₦2,500.00, how many oranges can be bought for ₦15,000.00?

- A. 3
- B. 30
- C. 60
- D. 300
- E. 360

38. A farmer has 1853 pineapple suckers. He plants 17 pineapples in a row. How many rows can he plant?

- A. 17
- B. 19
- C. 91
- D. 109
- E. 190

39.



Not to scale

In $\triangle PQR$, $PQ = QR$, and angle $PQR = 90^\circ$. Find x .

- A. 30
- B. 45
- C. 60
- D. 90
- E. 180

40. If $a \times b \times c = 1197$ and $a = 21$, $b = 3$, find c .

- A. 19
- B. 49.9
- C. 57
- D. 63
- E. 399

Answer four questions only from this section.

All working must be clearly shown.

Marks will not be awarded for correct answers without corresponding working.

All questions carry equal marks.

1. (a) If $P = 7$, $a = 16$, $b = -5$ and $c = 3$ evaluate $P^2 - \frac{(a-b)}{c}$.
 - (b) Solve the inequality $5x - 3(x - 1) \geq 39$.
Illustrate your answer on the number line.
 - (c) If $x = \begin{pmatrix} -3 \\ 2 \end{pmatrix}$ and $y = \begin{pmatrix} 4 \\ -1 \end{pmatrix}$, find
 - (i) $x + 2y$;
 - (ii) $3x - y$.
2. Using a ruler and a pair of compasses only,
 - (a) (i) construct triangle ABC such that $|AB| = 8$ cm, $|BC| = 8$ cm and $\angle ABC = 60^\circ$;
 - (ii) What type of triangle is triangle ABC ?
 - (b) construct the bisector of $\angle BAC$ to meet \overline{BC} at D . Measure \overline{AD} ;
 - (c) construct the perpendicular bisector of \overline{BA} to meet \overline{AD} at O ;
 - (d) and using O as centre and radius OD , draw a circle to touch the three sides of the triangle.
 3. (a) If $2y - 5x + 10 = 0$, find
 - (i) y , when $x = 2$;
 - (ii) x , when $y = 5$.
 - (b) (i) Using a scale of 2 cm to 1 unit on both axes, draw two perpendicular lines OX and OY on a graph sheet.
 - (ii) On the same graph sheet, mark the x -axis from -5 to 5 and the y -axis from -6 to 6 .
 - (iii) Plot on the same graph sheet, the points $A(0, -5)$ and $B(4, 5)$. Join AB using a ruler.
 - (iv) Find the gradient of the line \overline{AB} .
 - (v) Measure the acute angle the line AB makes with the x -axis, using a protractor.
4. The table below shows the distribution of the ages (in years) of children who were treated in a clinic in a day.

Age (years)	1	2	3	4	5
Frequency	6	4	2	3	5

- (a) Find
 - (i) the mean age;
 - (ii) the modal age.
 - (b) Draw a bar chart for the distribution.
5. (a) The volume of a cylinder is 220 cm^3 , the radius of the cross section is 2.5 cm. Find the height of the cylinder.
{ Take $\pi = \frac{22}{7}$. }
 - (b) Each of the interior angles of a regular polygon is 140° . How many sides has it?

GENERAL SCIENCE

1. GENERAL COMMENTS

The standard of this year's paper seemed to be slightly higher than that of previous years.

There also appeared to be a slight improvement in the performance of candidates compared with that of previous years.

In spite of the marked improvement noticed in the quality of the candidates answers, their performance is yet to meet the standard expected at the BECE. A wide gap still exists between the performance of the urban candidates and their counterparts from rural schools.

2. CANDIDATES' WEAKNESSES

(1) Poor Diagrams

A high proportion of the candidates could not draw accurate diagrams. Of those who drew accurate diagrams too, only a few could label the parts correctly. The quality of the diagrams drawn by most of the candidates gave the impression that they did not know the difference between a biological diagram and an art work or drawing.

J.S.S. Science Teachers need to engage their pupils in exercises involving the drawing and labelling of diagrams. This should be a constant feature of home work, quizzes and terminal examinations. This will provide the pupils with ample opportunities to acquire the required competence in such exercises.

(2) Incomprehensible English

Some of the candidates could not write a single comprehensible sentence in English. A concerted effort should be made by all teachers in the various schools to help the pupils to become proficient in both written and spoken English.

This can be done by the insistence of teachers on the use of English in all verbal activities in the schools. The pupils should also, be encouraged to read often and widely.

(3) Inability to follow Instructions in the Question

J.S. S. Science teachers also need to structure the questions in their exercises in a manner similar to those set by the Council. This will enable the pupils to become conversant with the demands of the questions that are usually set by WAEC in General Science.

(4) Poor Grasp of Some Concepts

Some of the answers provided by the candidates suggested that they might have used some textbooks which did not treat some of the topics well.

One source could be the introduction of some cheap pamphlets into the market by authors who are neither practising teachers nor trained.

J.S.S. Science teachers can reduce the acquisition of wrong concepts by their pupils by monitoring as best as they can the type of science literature the pupils read at the schools.

3. CANDIDATES' STRENGTH

(1) Organization

Some of the candidates gave concise and comprehensible answers to the questions they attempted. In an appreciable number of cases, examples were given to illustrate definitions and explanations.

Some of the candidates also gave accurate and well labelled diagrams. This is an indication of continuous practice and assiduousness in study.

(2) Good Efforts at Calculation

Another commendable feature of candidates' responses was their efforts at solving the computational problem in Question 1 (d) (ii) in Section B. This marked a departure from the former practice where candidates avoided such problem altogether. The candidates gave the correct formula and substitution as well as the correct evaluation and unit.

(3) Large Coverage of the Syllabus

The nature of the responses given by this year's candidates seem to suggest that J.S.S. Science teachers are now making efforts at covering as wide a portion of the syllabus as they could. It also seemed the subject was taught as one unit i.e. integrated. This is very commendable.

4. DETAILED COMMENTS:

Question 1

This question was very popular and most of the candidates who attempted it, scored high marks.

In (a), performance was very good. However, candidates must appreciate the fact that excretion is the removal of metabolic waste from the body and not simply as the removal of waste.

In (b), most candidates provided good examples of erosion and parasite. The (c) part was however not properly done. Many candidates could not draw the female reproductive organ and even when the organ was drawn correctly, many candidates could not label the parts correctly.

The (d) and (f) sub questions did not pose much problems, however the (e) part appeared too much for them probably, because most of the candidates were still unfamiliar with IUPAC system of naming. For example some of the candidates named NH_4Cl as nitrogen hydrogen chloride instead of ammonium chloride and FeCl_3 as iron chloride instead of iron (III) chloride.

Question 2

This question was also treated quite well by those who attempted it.

- (a) Some candidates, however, could not appreciate the fact that the eclipse of the sun occurs when the moon comes between the earth and the sun and drew diagrams with the sun in between the moon and the earth.

Others omitted the arrows in their ray diagrams.

- (b) This part was properly done.
- (c) Some few candidates lost marks by listing the agents of pollination as cross pollination and self pollination. These candidates did not appreciate that wind, bee, insects etc. are the agents of pollination.

The (d) and (e) subquestions were also quite popular with the candidates. However, some of them gave urea as the product excreted by the kidneys. They appeared not to know that the product is URINE which is made up of urea, water and salt. In the same way skin excretes sweat which is made up of water and salt.

In the case of the (f) part, most of the candidates could not write the correct formulae for sodium hydroxide, and hydrochloric acid. Common errors made included:

NaOH_2 , Na_2OH for sodium hydroxide (NaOH) and
 HCl_2 , H_2Cl , HCl for hydrochloric acid (HCl).

Question 3

This question was not properly done by the few candidates who attempted to answer the question.

In the (a), most of the candidates who attempted it, could not deduce the number of protons, electrons and neutrons from the given atomic number and mass number.

The candidates could also, not draw the diagram for the structure of the atom and even where the shape was drawn correctly, the arrangement of the electrons was horrible.

In (b), candidates did not appreciate the fact that when an atom gains two electrons, it becomes an ion with two negative charges.

By far, 3 (c) was the only part of Question 3 that candidates answered satisfactorily.

Most candidates were familiar with the fact that digestion of carbohydrates give glucose/fructose; digestion of proteins give amino acids and fats give fatty acids and glycerol.

The (d) part was poorly done. Most of the candidates could not explain what food preservation was. Candidates did not know that preservation of food is a way of preventing food from spoiling or decaying.

Candidates were able to list the methods of food preservation but they could not explain why the methods were used for food preservation.

Candidates did not appreciate the following facts:

- (i) In boiling, heat destroys the bacteria/germs already in the food.
- (ii) In drying water is taken from food preventing bacteria from acting on the food to make it decay and
- (iii) In salting, water content is reduced and bacteria rendered inactive.

In the (e) part, the diagrams presented as answers were very bad. Most of them did not have arrows and will definitely not result in image formation. The candidates could also not put down the right characteristics of an image formed by a plane mirror.

Question 4

This question was the most popular and happily most candidates scored high marks here. However, the common problem here was spelling mistakes.

As stated elsewhere in this report and the previous ones; teachers must address this problem by organizing regular and frequent spelling drills.

In (c) (i) many candidates could not state that the temperature of water boiling in an open container remains constant. In some instances it was candidates poor English that cost them the mark. Also most of them lost marks in (c) (iii) for not knowing the characteristics of a liquid.

In (f), most candidates were not able to write down the names of the compounds formed. Some of them also wrote formulae instead of the required names of the compounds. However in many cases, even the formulae were wrong. Candidates must note that when names are required, formulae of the same compounds are not acceptable.

31 August
 B.E.C.E. 1996
 GENERAL SCIENCE
 1 $\frac{3}{4}$ hours

Name.....

Index Number.....

THE WEST AFRICAN EXAMINATIONS COUNCIL

GHANA

Basic Education Certificate Examination

August 1996

GENERAL SCIENCE

1 $\frac{3}{4}$ hours

Do not open this booklet until you are told to do so. While you are waiting read the following instructions carefully. Write your name and index number in the spaces provided above.

This paper consists of two sections, A and B. Answer Section A on your Objective Test answer sheet, and Section B in your answer booklet. Section A will last 45 minutes after which the answer sheet will be collected. Do not start Section B until you are told to do so. Section B will last 1 hour.

SECTION A
 OBJECTIVE TEST

45 minutes

- Use HB pencil throughout.
- On the pre-printed answer sheet, check that the following details are correctly printed: Your Surname followed by your other names, the Subject Name, your Index Number, Centre Number, and Paper Code.
- In the boxes marked Candidate Number, Centre Number and Paper Code, reshave each of the shaded spaces.
- An example is given below. This is for a candidate whose name is Jones Ahmed KWAO, whose Index Number is 772384188. He is writing the examination at Centre Number 77234 and is offering General Science and the Paper Code is 3110.

THE WEST AFRICAN EXAMINATIONS COUNCIL, GHANA
 BASIC EDUCATION CERTIFICATE EXAMINATION
 OBJECTIVE ANSWER SHEET

CANDIDATE NAME	SUBJECT NAME:
KWAO JONES AHMED	GENERAL SCIENCE

- Use HB Pencil. Press firmly.
- Answer each question by choosing one letter and then, shade through the letter chosen like this (A) (B) (C) (D) (E)
- If you want to change an answer, rub out your first mark completely.
- If only four alternative answers are given for each question, ignore the letter E.
- Your question paper may have fewer than 60 questions.

CANDIDATE NUMBER	CENTRE NUMBER	PAPER CODE	For Supervisors only. If candidate is absent shade this space
772384188	77234	3110	
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Answer all the questions in this section.

Each question is followed by five options lettered A to E. Find out the correct option for each question and shade in pencil on your answer sheet the answer space which bears the same letter as the option you have chosen. Give only one answer to each question. An example is given below.

Which of the following substances is not an element?

- A. Oxygen
- B. Ammonia
- C. Sodium
- D. Chlorine
- E. Aluminium

The correct answer is Ammonia which is lettered B, and therefore answer space B would be shaded.

A B C D E

Think carefully before you shade the answer spaces; erase completely any answers you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

1. Which of the following is a sexually transmitted disease?
 - A. Cholera
 - B. Rickets
 - C. Tuberculosis
 - D. Syphilis
 - E. Measles
2. The excretory organs in man are the
 - A. kidneys and urethra.
 - B. kidneys and the skin.
 - C. kidneys, lungs and the skin.
 - D. kidneys and the lungs.
 - E. kidneys, bladder and urethra.
3. Which of the following farming practices is the best way of maintaining soil fertility?
 - A. Crop rotation
 - B. Seasonal cropping
 - C. Constant ploughing
 - D. Bush burning
 - E. Monocropping
4. Which of the following is not considered as a reflex action?
 - A. Blinking of the eye
 - B. Moving the hand from a hot object
 - C. Jerking of the knee
 - D. Talking while eating
 - E. Coughing to remove an object from the throat
5. A boy exerts a force of 40.0 N to lift a load into a vehicle. If the work done is 80.0 J, calculate the distance through which the load is lifted.
 - A. 0.5 m
 - B. 2.0 m
 - C. 40.0 m
 - D. 120.0 m
 - E. 3200.0 m
6. Which of the following arrangements is the correct order of increasing complexity of the structure?
 - A. Cells → systems → tissues → organs
 - B. Cells → tissues → systems → organs
 - C. Cells → organs → tissues → systems
 - D. Cells → systems → organs → tissues
 - E. Cells → tissues → organs → systems
7. The law of conservation of energy states that energy can
 - A. be created but not transformed.
 - B. be destroyed but not transformed.
 - C. neither be created nor transformed.
 - D. not be created but can be transformed.
 - E. neither be created nor destroyed, but only be transformed.
8. On the moon, there are large holes called
 - A. valleys.
 - B. gullies.
 - C. spurs.
 - D. craters.
 - E. pits.
9. The darkest part of a shadow formed during an eclipse is called
 - A. lunar eclipse.
 - B. annular eclipse.
 - C. penumbra.
 - D. umbra.
 - E. solar eclipse.
10. The main waste products formed in plants are
 - A. water, carbon dioxide and urea.
 - B. water, carbon dioxide and oxygen.
 - C. water, carbon dioxide and mineral salts.
 - D. water, ammonium compounds and oxygen.
 - E. water, ammonium compounds and carbon dioxide.

11. A mixture of sand and water can be separated through
 A. filtration.
 B. ionization.
 C. condensation.
 D. sedimentation.
 E. evaporation.
12. Which of the following chemical equations is the correct representation of the preparation of carbon dioxide?
 A. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaO} + \text{Cl}_2 + \text{H}_2 + \text{CO}_2$
 B. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{CO}_3$
 C. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaO} + \text{Cl}_2 + \text{H}_2\text{O} + \text{CO}_2$
 D. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2 + \text{CO}_2$
 E. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$
13. Which of the following is not an example of matter?
 A. Hydrogen
 B. Oxygen
 C. Light
 D. Water
 E. Charcoal
14. A stone with mass 80.0 g was put into a measuring cylinder containing water. If the water level rises by 20.0 cm³, calculate the density of the stone.
 A. 0.25 g cm⁻³
 B. 1.20 g cm⁻³
 C. 1.80 g cm⁻³
 D. 3.30 g cm⁻³
 E. 4.00 g cm⁻³
15. The sun is made up of burning
 A. gases.
 B. rocks.
 C. gold.
 D. coal.
 E. sulphur.
16. The force overcome by a machine is known as the
 A. effort.
 B. load.
 C. pivot.
 D. lever.
 E. work.
17. Calculate the work done when a weight of 20.0 N is lifted vertically through a distance of 10.0 cm.
 A. 2000.0 J
 B. 200.0 J
 C. 20.0 J
 D. 2.0 J
 E. 0.2 J
18. Heat travels through a vacuum by a process known as
 A. conduction.
 B. convection.
 C. radiation.
 D. vibration.
 E. transmission.
19. Soil aeration can be improved by
 A. adding minerals to the soil.
 B. application of fertilizer to the soil.
 C. weathering.
 D. activities of earthworms.
 E. manuring.
20. Which of the following does not play any part in digestion?
 A. Mouth
 B. Duodenum
 C. Rectum
 D. Pancreas
 E. Stomach
21. Most machines waste energy because of
 A. old age.
 B. force.
 C. friction.
 D. load.
 E. too much effort.
22. All the following add nitrates to the soil except
 A. okro.
 B. broad beans.
 C. French beans.
 D. groundnuts.
 E. pigeon pea.
23. The blood in mammals is composed of
 A. a red liquid.
 B. red blood cells and white blood cells only.
 C. liquid plasma and solid corpuscles.
 D. blood proteins and glycerol.
 E. sugars and mineral salts only.
24. In a machine, 200.0 J of energy was lost as heat. If the energy input is 600.0 J, what is the efficiency of the machine?
 A. 67%
 B. 40%
 C. 33%
 D. 30%
 E. 12%
25. The type of energy stored in fuels is called
 A. light energy.
 B. solar energy.
 C. electrical energy.
 D. kinetic energy.
 E. chemical energy.

Turn over

- 4
26. An object at rest may have
 A. velocity.
 B. momentum.
 C. kinetic energy.
 D. potential energy.
 E. acceleration.
27. Birds are able to fly because they have
 A. hollow bones.
 B. web legs.
 C. tail feathers.
 D. flat chests.
 E. wide eyes.
28. The chief source of energy in the world today is
 A. coal.
 B. crude oil.
 C. natural gas.
 D. uranium.
 E. water.
29. Which of the following is used by a plant to make its food?
 A. Carbon monoxide
 B. Oxygen
 C. Carbon dioxide
 D. Hydrogen
 E. Nitrogen
30. Sleeping sickness is spread by the
 A. blackfly.
 B. firefly.
 C. mosquito.
 D. housefly.
 E. tsetsefly.
31. An example of a crop that reduces the fertility of the soil rapidly is
 A. beans.
 B. legumes.
 C. groundnuts.
 D. cassava.
 E. plantain.
32. The blackpod disease which attacks cocoa pods is caused by
 A. virus.
 B. bacterium.
 C. plasmodium.
 D. fungus.
 E. protozoa.
33. The organ which enables a fish to breathe in water is the
 A. nostril.
 B. pectoral fin.
 C. dorsal fin.
 D. gall bladder.
 E. gill.
34. Which of the following parts of a flower grows into the seed?
 A. Stamen
 B. Ovule
 C. Ovary
 D. Stigma
 E. Sepal
35. When the palms of the hand are rubbed together, kinetic energy is changed to
 A. thermal energy.
 B. potential energy.
 C. solar energy.
 D. elastic energy.
 E. chemical energy.
36. Trees in desert regions have thick barks which enable them
 A. prevent heat loss.
 B. absorb more light.
 C. prevent water loss.
 D. absorb more water.
 E. absorb more oxygen.
37. Which of the following is true about loamy soil?
 I. It is formed from a mixture of sand and clay.
 II. It is good for plant cultivation.
 III. Its water retention is poor.
 A. I only
 B. I and II only
 C. I and III only
 D. II and III only
 E. I, II and III
38. In which part of the alimentary canal is food finally changed into a form that can be absorbed into the bloodstream?
 A. Small intestines
 B. Oesophagus
 C. Mouth
 D. Stomach
 E. Large intestines
39. In which units are the vast distances between stars in space measured?
 A. Knots
 B. Kilometres
 C. Furlongs
 D. Miles
 E. Light years
40. Which of the following happens during fertilization in humans?
 A. A membrane forms around the egg.
 B. Only one sperm fuses with the egg.
 C. The egg divides into two.
 D. The egg moves down into the egg tube.
 E. The egg moves down into the womb.

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FOUND LOOKING AT THE NEXT PAGE BEFORE
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6
SECTION B
ESSAY
[60 marks]

1 hour

Answer three questions only from this section.

Illustrate your answers, wherever possible with large, clear and fully labelled diagrams.

All questions carry equal marks.

1. (a) Define the following terms:
- (i) erosion,
 - (ii) reproduction,
 - (iii) parasite,
 - (iv) excretion.
- (b) Give one example each of erosion and parasite.
- (c) Draw and label a diagram of the female reproductive organ in a human being.
- (d) (i) Define the term *work*.
- (ii) An amount of 300.0 J of work is done when a force moves through a distance of 10.0 m in the direction of the force. Calculate the value of the force.
- (e) Write down the names of the following compounds:
- (i) NH_4Cl ,
 - (ii) HCl ,
 - (iii) CuSO_4 ,
 - (iv) FeCl_3 .
- (f) Explain how sulphur can be obtained from a mixture of powdered sulphur and iron filings.
2. (a) Draw and label a diagram to show how the eclipse of the sun is formed.
- (b) (i) What is a *lever*?
- (ii) Classify the following, as first class lever, second class lever or third class lever by copying and completing the table below: beam balance, crowbar, wheelbarrow, a pair of scissors, claw hammer, sugar tong, human fore-arm and bottle opener.

First class lever	Second class lever	Third class lever

- (c) (i) What is *pollination*?
 (ii) Give two agents of pollination.
- (d) Name three excretory organs and the products they excrete.
- (e) (i) What is an *alloy*?
 (ii) What are the compositions of each of the following alloys?
 Bronze,
 Brass,
 Steel,
 Duralumin.
- (f) Sodium chloride is prepared by the reaction between dilute hydrochloric acid and sodium hydroxide solution. Write down the equation for this reaction.
3. (a) An atom has an atomic number of 8 and a mass number of 16. State the number of each of the following in the atom:
 (i) protons,
 (ii) electrons,
 (iii) neutrons.
- (b) (i) Draw the structure of the atom in 3(a) above.
 (ii) If the atom in 3 (a) above gains two electrons what will be the charge of the ion?
- (c) State the end-product of the digestion of the following food substances:
 (i) carbohydrates,
 (ii) proteins,
 (iii) fats.
- (d) (i) What is *preservation of food*?
 (ii) List four methods of food preservation. Explain why one of the methods you have listed is used for food preservation.
- (e) (i) An object is placed in front of a plane mirror. Draw a ray diagram to show how the image of the object is formed.
 (ii) State two characteristics of an image formed by a plane mirror.
4. (a) (i) Give the names of the organisms which cause the following diseases:
 sleeping sickness,
 cholera,
 malaria,
 bilharzia.

Turn over

- (ii) Which parts of the following crops does the farmer usually grow?
- Banana,
 - Cocoyam,
 - Tomato,
 - Ginger,
 - Yam,
 - Cassava.
- (b) Name the organs used by the following organisms for respiration:
- (i) tilapia,
 - (ii) toad.
- (c) (i) What happens to the temperature of water that is boiling in an open container?
- (ii) Give two characteristics of a liquid.
 - (iii) Name the three processes by which heat is transmitted.
 - (iv) State two applications of the expansion of solids in everyday life.
- (d) Explain the following terms:
- (i) physical change,
 - (ii) chemical change.
- (e) State whether each of the following is a physical or a chemical change:
- (i) rusting of iron,
 - (ii) freezing of water,
 - (iii) burning of wood,
 - (iv) fermentation,
 - (v) grinding of chalk,
 - (vi) dissolving sugar in water.
- (f) Name the compounds formed when the following elements combine:
- (i) iron and sulphur,
 - (ii) zinc and oxygen,
 - (iii) sodium and chlorine,
 - (iv) calcium and chlorine.

1. GENERAL COMMENTS

Generally, candidates' performance compared with those of previous years has improved.

There were some good scripts and we believe that these are signs for better all round performance in the future.

2. CANDIDATES' STRENGTHS

Candidates showed a lot of improvement in the following areas, which is commendable and should be encouraged.

(1) Drawing of Pie Charts

Using the pair of compasses and the protractor to draw the pie chart was well done by majority of candidates.

(2) Construction

Candidates were able to carry out the constructions correctly and accurately.

(3) Plotting co-ordinates (points) on graph sheet was well carried out by majority of candidates who attempted question five.

3. CANDIDATES' WEAKNESSES

The following are weaknesses of candidates.

(1) Poor handling of algebraic and arithmetic operations.

(2) Candidates seemed not to have understood some of the questions well - an indication of their poor understanding of the English Language.

(3) Non - labelling of axes.

(4) Use of wrong scale.

(5) Poor construction of the mediator of a line; many of the candidates used only one pair of arcs to fix the mediators.

Suggested Remedies

(1) Teachers should take more pains to explain the above weaknesses to their pupils.

(2) Students should be made to work more problems on construction of mediators, handling of algebraic and arithmetic operations etc.

(3) Frequent homework and effective assessment by school teachers.

(4) DETAILED COMMENTSQuestion 1

- (i) Many candidates could not interpret the question to be able to set up the equations to solve for "n". i.e. Candidates could not find how old Kojo was 5 years ago as $(n - 5)$ years and how old he will be in ten years time as $(n + 10)$ years.
- (ii) Attempts here were reasonable. The main errors were:
 - (a) Some candidates used 10 instead of 5 in the conversion.
 - (b) Some also wrote e.g. $(2 \times 5)^3$ instead of 2×5^3
 - (c) Others used the method for conversion from base ten to other bases.
 - (d) Carelessness in multiplication and addition of the various terms.
- (iii) Many were able to substitute the values for f and u correctly but went wrong when it came to cross multiplying to solve for v. They wrote $20 \times v + 5$ instead of $20(v + 5)$. Candidates must learn to use brackets to avoid such errors.

Question 2

- (i) Quite a number of candidates still do not seem to know how to find simple interest. Many of those who were able to find the interest, simply stopped after finding the interest and failed to add the Interest to the Principal to get the Amount at the end of the 4 years.
- (ii) This was a simple question but quite a number of candidates failed to read, understand and interpret the question correctly and only treated it as another simple interest question.

Question 3

Very popular. Candidates should always remember that the calculation of the sectorial angles for the pie chart is not rough work but an important aspect of the question. These calculations should always be shown in the answer booklet. Candidates need to measure the angles as accurately as possible. Some candidates seem confused with the double calibration of the protractor -- one clockwise and the other anti-clockwise so where the reading should be 80° , they took the supplementary angle 100° , instead.

The most serious error was when candidates obtained the values of the sectorial angles which look very ridiculous and yet continued to use them to draw the pie chart, e. g. a candidate who obtained the following values: Nzema = 216° , Ga = 294° , Twi = 114° , Ewe = 216° and Fante = 274° , was able to produce a pie chart.

Question 4

Very popular. In this question, candidates were expected to draw a triangle given the lengths of the three sides of the triangle. Some candidates recognized the lengths as

forming a Pythagorean triple and therefore started constructing 90° at B. This was not the expectation of the question and candidates who did this suffered for it. Candidates need to restrict themselves to the information given in the question. Again, candidates need to carry out their measurements as accurately as possible. There is also the need for candidates to know the units in which they carry out their measurements, e.g. angles are measured in degrees and not in centimetres.

Question 5

Very popular. The main error here is the failure to plot points correctly. Some still make the mistake of plotting (1, 2) when they are to plot (2, 1). Teachers have to ensure that their pupils acquire the correct knowledge and skill.

Many candidates also failed to show the lines of transformation for the enlargement from the origin (0,0), the centre of the enlargement.

Teachers should concentrate on the construction method of locating images at this level rather than on calculation. This will allow the pupils to concentrate more on the properties of the various transformations i.e. in translation, reflection and rotation, both object and image have the same size and shape - lengths and angles remain the same in both object and image. In enlargement, object and image shape are similar i.e. angles are the same but lengths are proportional to scale factor.

Candidates need to be familiar with the conventional way of labelling the axes.

Candidates should also learn to stick to the scale given in the question.

30 August
 B.E.C.E. 1996
 MATHEMATICS
 2 hours

Name

Index Number

THE WEST AFRICAN EXAMINATIONS COUNCIL,
 GHANA

Basic Education Certificate Examination

August 1996

MATHEMATICS

2 hours

Do not open this booklet until you are told to do so. While you are waiting, read the following instructions carefully. Write your name and index number in the spaces provided above.

This paper consists of two sections, A and B. Answer Section A on your Objective Test answer sheet and Section B in your answer book. Section A will last 1 hour after which the answer sheet will be collected. Do not start Section B until you are told to do so. Section B will last 1 hour.

Answer all the questions in Section A. An example is given at the beginning of Section A to help you. Read the example carefully before answering the questions.

SECTION A
 OBJECTIVE TEST

1 hour

- Use HB pencil throughout.
- On the pre-printed answer sheet, check that the following details are correctly printed: Your surname followed by your other names, the Subject Name, your Index Number, Centre Number, and Paper Code.
- In the boxes marked Candidate Number, Centre Number and Paper Code, reshade each of the shaded spaces.
- An example is given below. This is for a candidate whose name is Jones Ahmed KWAQ, whose Index Number is 772384188. He is writing the examination at Centre Number 77234 and is offering Mathematics and the Paper Code is 3010.

THE WEST AFRICAN EXAMINATIONS COUNCIL, GHANA
 BASIC EDUCATION CERTIFICATE EXAMINATION
 OBJECTIVE ANSWER SHEET

CANDIDATE NAME KWAQ JONES AHMED	SUBJECT NAME: MATHEMATICS
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- Use HB Pencil. Press firmly.
- Answer each question by choosing one letter and then, shade through the letter chosen like this A B C D E
- If you want to change an answer, rub out your first mark completely.
- If only four alternative answers are given for each question, ignore the letter E.
- Your question paper may have fewer than 60 questions.

CANDIDATE NUMBER	CENTRE NUMBER	PAPER CODE	For Supervisors only. If candidate is absent shade this space
772384188	77234	3010	
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Work the following problems either in your head or on this question paper.

Each question is followed by five options lettered A to E. Find out the correct option for each question and shade in pencil on your answer sheet the answer space which bears the same letter as the option you have chosen. Give only one answer to each question. An example is given below.

If $3n + 2 = 8$, find the value of n .

- A. 10
- B. 6
- C. $3\frac{1}{3}$
- D. $2\frac{1}{3}$
- E. 2

The correct answer is 2 which is lettered E, and therefore answer space E would be shaded.

A B C D E

Think carefully before you shade the answer spaces; erase completely any answers you wish to change.

Do all rough work on this question paper.

Now answer the following questions.

1. $U = \{0, 1\}$. How many subsets has U ?

- A. 1
- B. 2
- C. 3
- D. 4
- E. 5

2. The following addition is done in base ten. What number represents abc ?

$$\begin{array}{r} 225 \\ 343 \\ \hline abc \\ \hline 1000 \end{array}$$

- A. 324
- B. 342
- C. 423
- D. 432
- E. 234

Use the mapping below to answer Questions 3 and 4.

$$\begin{array}{l} 2^3 \rightarrow 8 \\ 2^2 \rightarrow 4 \\ 2^1 \rightarrow 2 \\ 2^0 \rightarrow a \\ 2^{-1} \rightarrow b \end{array}$$

3. The value of a is

- A. 0.
- B. $\frac{1}{2}$.
- C. 1.
- D. 16.
- E. 32.

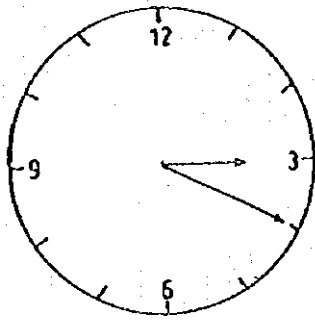
4. What is the value of b ?

- A. -2
- B. $\frac{1}{4}$
- C. $\frac{1}{2}$
- D. 1
- E. 2

5. Write two hundred thousand and fifty seven in figures.

- A. 20057
- B. 200057
- C. 2000057
- D. 20000057
- E. 200570

6.



What time is the clock above showing?

- A. 4.30
 B. 4.15
 C. 3.40
 D. 3.20
 E. 3.04
7. Kojo, Ebo and Ama shared ₦14,000.00 among themselves. Kojo had twice as much as Ebo and Ebo also had twice as much as Ama. How much did Ebo get?
 A. ₦8,000.00
 B. ₦6,000.00
 C. ₦4,000.00
 D. ₦3,000.00
 E. ₦2,000.00
8. At what rate of simple interest will ₦5,000.00 amount to ₦7,500.00 if saved for 5 years?
 A. 5%
 B. $6\frac{2}{3}\%$
 C. $7\frac{1}{2}\%$
 D. 10%
 E. $12\frac{1}{2}\%$
9. Simplify $\frac{1}{3} - \frac{1}{2} + \frac{2}{5}$.
 A. $\frac{17}{30}$
 B. $\frac{13}{30}$
 C. $\frac{7}{30}$
 D. $-\frac{7}{30}$
 E. $-\frac{17}{30}$
10. If $2^x = 8$, what is the value of x ?
 A. $\frac{2}{3}$
 B. 1
 C. $\frac{3}{2}$
 D. 2
 E. 3

Use the following information to answer Questions 11 and 12.

The relation between the Celsius (C) and the Fahrenheit (F) scales of temperature is given by $C = \frac{5}{9}(F - 32)$.

11. If C is 40, F will be
 A. 104.0
 B. 78.4
 C. 72.0
 D. 65.6
 E. 40.0
12. If C is -40 , find the value of F .
 A. -104.0
 B. -78.4
 C. -72.0
 D. -65.6
 E. -40.0

Use the information below to answer Questions 13 to 15.

The ages in years of 9 children at a birthday party are 2, 3, 3, 3, 4, 5, 5, 5, 6.

13. What is the mean age?
 A. 3.0
 B. 3.5
 C. 4.0
 D. 4.5
 E. 5.0
14. What is the median age?
 A. 2.0
 B. 3.0
 C. 3.5
 D. 4.0
 E. 5.0
15. If a child is picked at random, what is the probability that he is 5 years old?
 A. $\frac{2}{9}$
 B. $\frac{1}{3}$
 C. $\frac{4}{9}$
 D. $\frac{5}{9}$
 E. $\frac{2}{3}$

Turn over

16. $P(2, 5)$ and $Q(-2, 3)$ are points in the Cartesian plane. Find the vector \vec{PQ} .

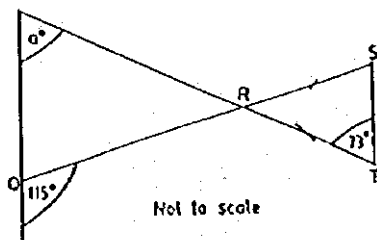
- A. $\begin{pmatrix} 4 \\ 2 \end{pmatrix}$
- B. $\begin{pmatrix} -4 \\ -2 \end{pmatrix}$
- C. $\begin{pmatrix} 4 \\ -2 \end{pmatrix}$
- D. $\begin{pmatrix} -4 \\ 2 \end{pmatrix}$
- E. $\begin{pmatrix} 0 \\ -2 \end{pmatrix}$

17. Find k in the vector equation,

$$\begin{pmatrix} 3 \\ 4 \end{pmatrix} + k \begin{pmatrix} 3 \\ 4 \end{pmatrix} = - \begin{pmatrix} 3 \\ 4 \end{pmatrix}.$$

- A. -3
- B. -2
- C. -1
- D. $-\frac{3}{4}$
- E. 2

18.



In the diagram above, $|RS| = |RT|$. Find a .

- A. 146
- B. 81
- C. 73
- D. 65
- E. 34

19. If $a^2 - b^2 = (a + b)(a - b)$, evaluate $9.32^2 - 0.68^2$

- A. 87.32
- B. 86.4
- C. 74.65
- D. 10.0
- E. 8.64

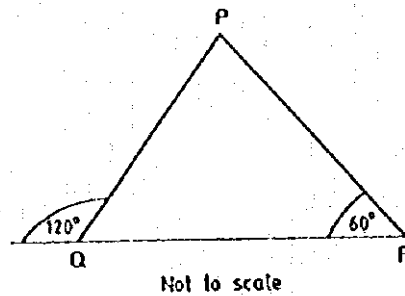
20. Simplify $\frac{6^2}{2^2 \times 3}$.

- A. 1
- B. 2
- C. 3
- D. 6
- E. 9

21. The sum of the ages of Kwaku and Kojo is 30 years. Kwaku is 4 years older than Kojo. How old is Kojo?

- A. 19
- B. 17
- C. 13
- D. 11
- E. 9

22.



What type of triangle is $\triangle PQR$?

- A. Equilateral
- B. Isosceles
- C. Scalene
- D. Right-angled
- E. Obtuse-angled

Use the equation $y = (x + 2)(x - 2)$ to answer Questions 23 and 24.

23. If $x = -1$, find y .

- A. -4
- B. -3
- C. 3
- D. 4
- E. 9

24. Find the set of values of x for which y is zero.
- $\{0\}$
 - $\{0, 2\}$
 - $\{0, -2\}$
 - $\{-2, 2\}$
 - $\{2, 2\}$

Use the information below to answer Questions 25 to 27.



In the diagram above, the cylinder has diameter 4 cm and length 14 cm. [Take $\pi = \frac{22}{7}$]

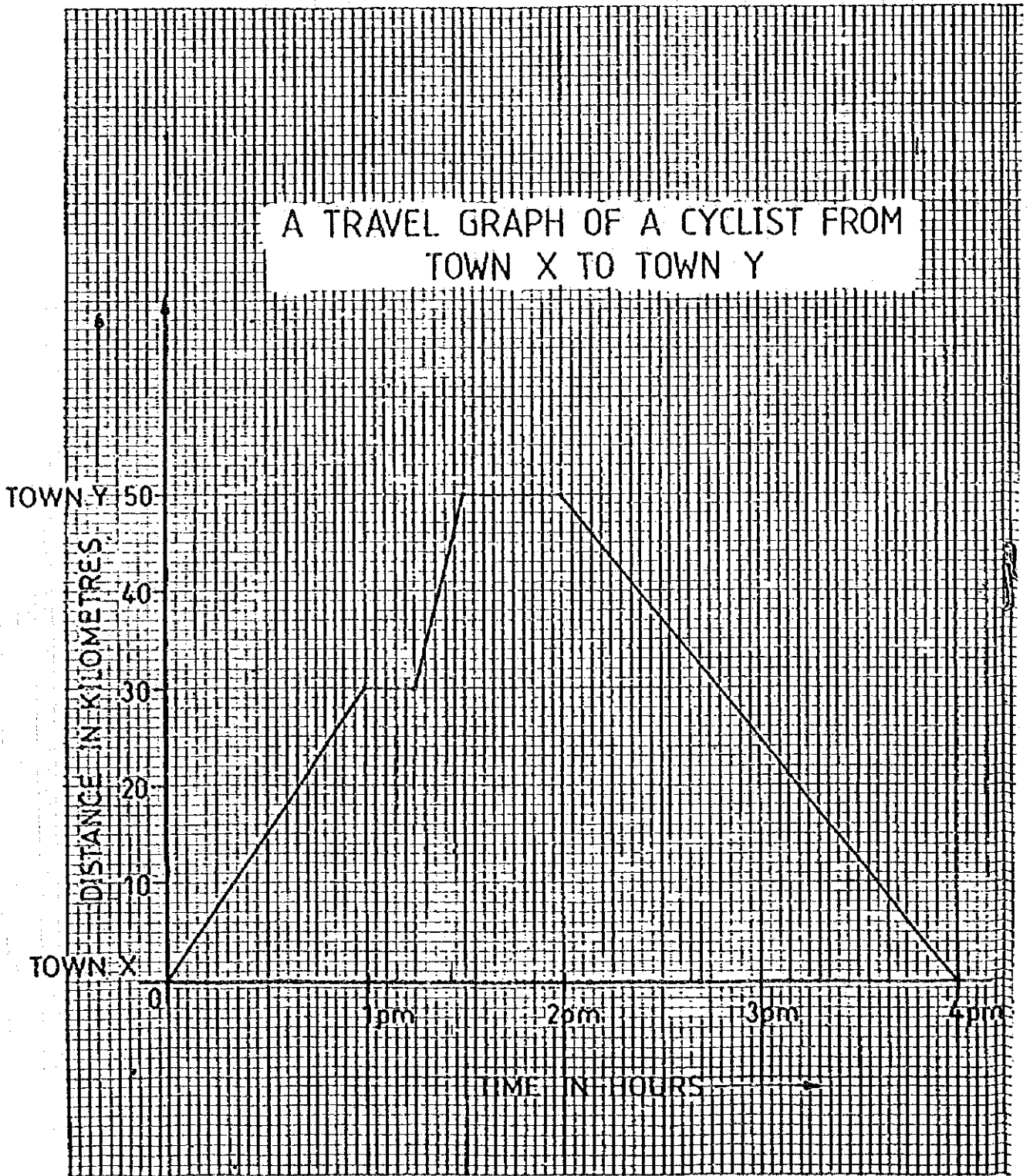
25. Find the circumference of the base.
- $\frac{44}{7}$ cm
 - $\frac{88}{7}$ cm
 - $\frac{176}{7}$ cm
 - 44 cm
 - 176 cm
26. The area of the base is
- 176 cm^2 .
 - 44 cm^2 .
 - $\frac{176}{7} \text{ cm}^2$.
 - $\frac{88}{7} \text{ cm}^2$.
 - $\frac{44}{7} \text{ cm}^2$.
27. What is the volume of the cylinder?
- 176 cm^3
 - 44 cm^3
 - $\frac{176}{7} \text{ cm}^3$
 - $\frac{88}{7} \text{ cm}^3$
 - $\frac{44}{7} \text{ cm}^3$

28. A woman bought 210 oranges for $\text{p}650.00$. She sold all of them at 3 for $\text{p}20.00$. How much profit did she make?
- $\text{p}350.00$
 - $\text{p}450.00$
 - $\text{p}550.00$
 - $\text{p}650.00$
 - $\text{p}750.00$
29. The ratio of boys to girls in a school is 9 : 11. If there are 400 pupils in the school, how many boys are there?
- 80
 - 120
 - 180
 - 220
 - 320
30. Express the product 162.5×0.5 in standard form.
- 81.25×10^{-1}
 - 81.25×10
 - 8.125×10^{-1}
 - 8.125×10
 - 0.8125×10^{-2}
31. What is 16% of $\text{p}500,000.00$?
- $\text{p}80.00$
 - $\text{p}8,000.00$
 - $\text{p}80,000.00$
 - $\text{p}420,000.00$
 - $\text{p}492,000.00$
32. Simplify $\frac{0.24 \times 14.3}{5.2}$.
- 66
 - 6.60
 - 0.70
 - 0.66
 - 0.60
33. The product of $2x$ and 3 is 138. Find x .
- 23
 - 33
 - 68
 - 69
 - 138

Turn over

Use the graph below to answer Questions 34 to 36.

The travel graph describes the journey of a cyclist from Town X to Town Y.

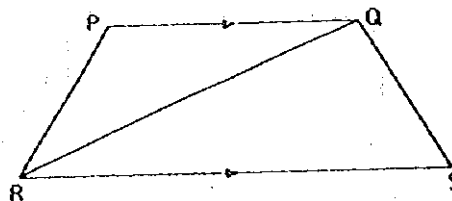


34. What was the average speed for the return journey from Town Y to Town X?
- 100 km h⁻¹
 - 50 km h⁻¹
 - 33.33 km h⁻¹
 - 25 km h⁻¹
 - 20 km h⁻¹
35. State the period within which he travelled to Town Y after his first rest.
- 1.00 pm – 2.00 pm
 - 1.00 pm – 4.00 pm
 - 1.15 pm – 1.30 pm
 - 1.30 pm – 2.00 pm
 - 2.00 pm – 4.00 pm
36. How many minutes did the cyclist spend at Town Y?
- 15 minutes
 - 20 minutes
 - 30 minutes
 - 45 minutes
 - 60 minutes
37. 200 bottles of equal capacity hold 350 litres of water. How much water does each bottle hold?
- 1,750 litres
 - 175 litres
 - 17.5 litres
 - 1.75 litres
 - 0.175 litre
38. Find the solution set of $2x + 4 > -6$.
- $\{x = -5\}$
 - $\{x < 5\}$
 - $\{x > 5\}$
 - $\{x < -5\}$
 - $\{x > -5\}$

39. A rectangular field 50 metres wide and x metres long, requires 260 metres of fencing. Which of the following statements is true?

- $x + 100 = 260$
- $2x + 50 = 260$
- $4x + 200 = 260$
- $2x + 100 = 260$
- $4x + 100 = 260$

40.



Not to scale

In the diagram above PQSR is a trapezium. PQ is parallel to RS. $\hat{PQR} = \hat{QRS}$.

What type of triangle is triangle RQS?

- Isosceles
- Scalene
- Equilateral
- Right-angled
- Obtuse-angled

Turn over

Answer four questions only from this section.

All working must be clearly shown. Marks will not be awarded for correct answers without corresponding working.

All questions carry equal marks.

1. (a) Kojo is n years old now.
 - (i) How old was he 5 years ago?
 - (ii) How old will he be 10 years from now?
 - (iii) If his age in 10 years time will be four times his age 5 years ago, how old is he now?
 - (b) Convert 2342_{five} to a base ten numeral.
 - (c) Given that $f = \frac{Vu}{V+u}$, find V if $f = 20$ and $u = 5$.
2. (a) A man deposited ₵350,000.00 in his account in a bank. A simple interest of 4% per annum was paid on his deposit. Calculate the total amount at the end of 4 years.
 - (b) The cost of sending a telegram is ₵500.00 for the first 12 words and ₵25.00 for every extra word. Find the cost of sending a telegram containing 20 words.
3. The table below shows the distribution of pupils in a JSS Form 1 who speak some of the Ghanaian languages.

Ghanaian Languages	No. of students who speak the language
Nzema	5
Ga	20
Twɪ	30
Ewe	25
Fante	10

- (a) (i) Draw a pie chart for the distribution.
- (ii) What is the modal Ghanaian language?
- (b) If a pupil is selected at random from the form, what is the probability that he speaks Ga?
4. Using a ruler and a pair of compasses only,
- (a) construct triangle ABC , in which $AB = 6$ cm, $AC = 10$ cm and $BC = 8$ cm. Measure $\angle ABC$.
- (b) construct the perpendicular bisectors (mediators) of AB and BC . Let the bisectors meet at O .
- (c) construct a circle with centre O and radius OA . Measure the radius of the circle.
5. (a) Using a scale of 2 cm to 2 units on both axes, draw two perpendicular axes, OX and OY on a graph sheet.
- (b) On this graph sheet, mark the x -axis from -4 to 10 and the y -axis from -6 to 12 .
- (c) Plot on the same graph sheet, the points $A(2, 1)$, $B(3, 4)$ and $C(4, 2)$. Join the points to form triangle ABC .
- (d) Draw the enlargement $A_1B_1C_1$ of triangle ABC with scale factor 2 from the origin $O(0, 0)$, such that $A \rightarrow A_1$, $B \rightarrow B_1$ and $C \rightarrow C_1$. Indicate the coordinates of $\triangle A_1B_1C_1$.
- Show all lines of transformation.
- (e) Using the x -axis as mirror line, draw the image $A_2B_2C_2$ of triangle ABC , where $A \rightarrow A_2$, $B \rightarrow B_2$ and $C \rightarrow C_2$.
- Indicate the coordinates of triangle $A_2B_2C_2$.



Republic of Ghana
Ministry of Education

**BASIC EDUCATION SECTOR IMPROVEMENT PROGRAMME
(BESIP)**

DIGEST

1996-2001

OPERATIONAL PLAN DOCUMENT I

FOR ACHIEVING



FREE, COMPULSORY

**BASIC EDUCATION (FCUBE)
BY THE YEAR 2005**

AND UNIVERSAL

November 28, 1997

Abbreviations

- BALME - University of Ghana Library
- BESIP - Basic Education Sector Improvement Programme
- BS - Basic Stage
- CIDA - Canadian International Development Agency
- CRDD - Curriculum, Research, and Development Division
- CSPIP - Civil Service Performance Improvement Programme
- DAC - District Approval Committee
- DACF - District Assembly Common Fund
- DAE - Donors of African Education
- DDE - District Directors of Education
- DEOCs - District Education Oversight Committee
- DFID - Department For International Development
- Dip. Ed - Diploma in Education
- DMA - District Monitoring Assistant
- EMIS - Educational Management Information System
- GAR - Gross Admission Rate
- GBC - Ghana Broadcasting Corporation
- GER - Gross Enrolment Ratio
- GES - Ghana Education Service
- GLSS - Ghana Living Standards Survey
- GOG - Government of Ghana
- Glz - German Agency for Technical Corporation
- IDA - International Development Association
- IEC - Information, Education and Communication
- IEDE - Institute of Educational Development and Extension
- IEPA - Institute of Educational Planning and Administration
- IOC - Implementation Oversight Committee
- IPPD - Integrated Personnel Payroll Database
- IRR - Implementation Review Report
- JICA - Japan International Co-operation Agency
- JSS - Junior Secondary School
- KfW - German Bank for Reconstruction
- KVIP - Kumasi Ventilated Improved Pit Latrine
- MLG - Ministry of Local Government
- MLGRD - Ministry of Local Government and Rural Development
- MOE - Ministry of Education
- MOF - Ministry of Finance
- MOH - Ministry of Health
- NASCOTE - National Steering Committee of Teacher Education
- NDF - Nordic Development Fund
- NGO - Non-Governmental Organisation
- NIRP - National Institutional Renewal Programme
- ODA - Overseas Development Agency
- PBME - Planning, Budgeting, Monitoring and Evaluation
- PIP - Public Investment Programme
- PLA - Participatory Learning Appraisal
- PMU - Projects Management Unit
- PREP - Primary Education Project
- PTA - Parents' Teacher Association
- PUFMARP - Public Sector Financial Management Improvement Project
- PWD - Public Works Department
- SIP - School Improvement Programme
- SMB - School Management Board
- SMC - School Management Committee
- SMT - Senior Management Team, MOE
- SRIMPR - Statistics, Research, Information Management and Public Relations
- STME - Science, Technology, and Mathematics Education
- TA - Technical Assistance
- TOR - Terms of Reference
- TTC - Teacher Training College
- UCC - University of Cape Coast
- UCEW - University College of Education, Winneba
- UNICEF - United Nations Children's Fund
- USAID - United States Agency for International Development
- VGO - Voluntary Grassroots Organisation

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Introduction

Background and Goals

Basic Education is the fundamental building block of any nation. Given that the long-term vision for Ghana is to become a middle-income country by the year 2020, a lynchpin of the government's development plan is a nation-wide sustained effort to expand, strengthen, and make more relevant its education system. In recognition of this, the government seeks to provide quality Basic Education (BE) for all school-age children as soon as is practicable.

The central goal of the Basic Education (BE) System in Ghana is to ensure that all young people are equipped with the fundamental knowledge, attitudes and skills that will enable them to be active participants in and beneficiaries of national development.

The policy initiatives outlined below are the Government's response to a constitutionally mandated change. Article 39(2) of the 1992 Constitution of the Fourth Republic of Ghana states:

"The Government shall, within two years after Parliament first meets after coming into force of this Constitution, draw up a programme for implementation within the following ten years, for the provision of free, compulsory and universal basic education."

Structure

The restructuring of the education system has been a key element of the reform that started in 1987. The current system consists of Primary (grades 1-6); Junior Secondary (grades 7-9), together forming a nine-year BE cycle; followed by Senior Secondary (3yrs); technical; and several optional forms of Tertiary Education that include universities (4yrs), polytechnics (3yrs) and teacher training colleges (3yrs).

Financing

The Government's emphasis on the importance of education in the development process is unequivocal. The proportion of the national recurrent budget (net of debt servicing and other extra-budgetary items) allocated to education has increased from 31 per cent in 1987 to almost 39 percent as an average over the past five years. Intra-sectoral allocation has been increasingly in favour of Basic Education, which is currently receiving about 65% of MOE's recurrent budget (up from 60 percent in 1989). Government resource commitment to increase proportionately with national economic growth rates and stay at 40 percent of national budget through to year 2000.

Elements of the Basic Education Sector Improvement Programme (BESIP)

The three major goals that form the strategic framework of the Free Compulsory Universal Basic Education (FCUBE) are:

1. Enhanced Quality of Teaching and Learning Outcomes
2. Management Efficiency of the Education System
3. Access to and participation in basic education services

1. Enhanced Quality of Teaching and Learning Outcomes that will enable the majority of Basic Education pupils to meet acceptable standards of achievements; reduce repetition and dropout rates; increase the BE completion rates as well as the pass rate for admission into second cycle (senior secondary and technical) institutions.

Key elements include:

- a) Restructuring both pre-service and in-service teacher training insisting on higher standards of teacher certification, including more emphasis on classroom-based experiences

- b) Introducing low-cost teacher training and pupil instruction arrangements using distance education technology.
- c) Designing and implementing a cost-effective textbook production and distribution system that will ensure universal coverage of texts in all subjects and grades for every student.
- d) Strengthening capabilities in curriculum and learning materials development, procurement, distribution and re-supply; and
- e) Ensuring that the curriculum is pedagogically sound, relevant and implementable in all basic schools.

2. Management Efficiency of the Education System that needs to be improved along several dimensions of system management by strengthening and streamlining overall machinery; and increasing delegation of decision-making authority and responsibility to the district and school levels.

Key elements include:

- a) Redesigning management structures, which suit the roles and responsibility of the MOE and the GES at headquarters, regional and district levels, and which provide for appropriate delegation on operational matters;
- b) Improving mechanisms for monitoring performance at the district and school levels and performance standards and targets for all agencies linked to the strategic goals of FCUBE;
- c) Strengthening personnel management practices, which motivate individuals, groups and departments throughout the system towards achieving better performance;
- d) Installing an Education Management Information System (EMIS) to collect, analyse, process and report educational data for planning, decision making and monitoring purposes;
- e) Upgrading financial management systems to improve budgeting and financial control and generate information to support the delegation of budgetary responsibility; and
- f) Staffing and organisational structures at all levels with appropriately trained and qualified managers in addition to having adequate discretionary budgets in place to ensure that the financial resources available can make significant impact on the quality of education.

3. Access to and participation in basic education services that will be expanded progressively for all school-age population, but especially for girls and for pupils from disadvantaged areas. In pursuance of this, alternative service delivery arrangements to the traditional model will be piloted. One of the most important lessons learned, since the current education reform programme is that continuing to expand access to basic education and to increase physical inputs into the system are not effective, unless the quality of activities at the school level improves significantly.

Key elements include:

- a) Strengthening School Management Committees;
- b) Improving mechanisms for consultation with District Assembly Committees on education to ensure the appropriate allocation of funds to basic education and its deployment in an equitable manner;
- c) Enhancing the system for stakeholder consultation to provide feedback on progress towards programme goals;
- d) Operating a school improvement fund which will be directly accessible to schools; and
- e) A social marketing campaign to promote education, including an emphasis on the benefits of girls' education.

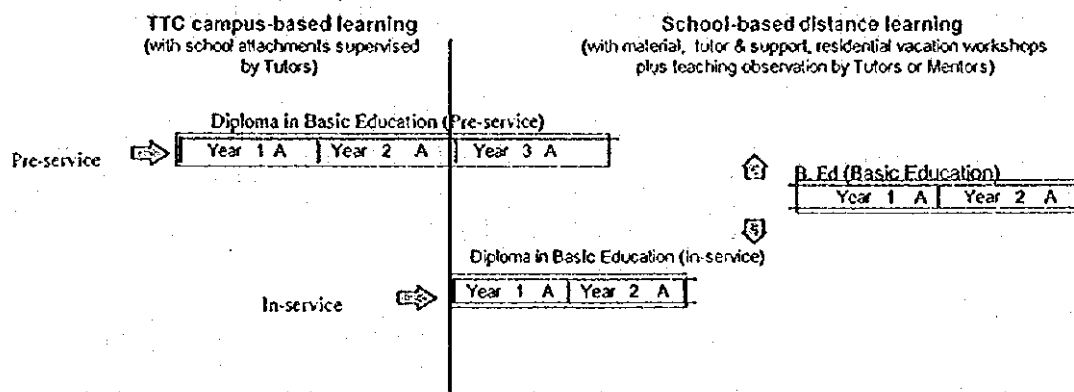
1. Enhanced Quality of Teaching and Learning

Background

A new education structure has been put in place, the proportion of trained staff has grown, the volume of materials and equipment into the sector has increased, and more school facilities have resulted in increased enrolments. Yet the reform has had limited success in delivering quality teaching and learning outcomes. Pupils' achievements continue to be very disappointing. Reasons for learning results include: lack of learning materials and even where available, teachers often do not make effective use of them; inadequate funding of non-salary recurrent expenses; high level of pupil and teacher absenteeism; inefficient use of teacher/pupil instructional contact hours; outmoded pre-service teacher training and inadequate in-service teacher and non-teaching development; unmotivated teachers owing to unattractive incentives, ineffectiveness of sanctions and low social status of teachers; an overly ambitious curriculum, and burdensome to both teachers and pupils.

Against this background, the pedagogical improvement component will promote effective teaching and learning by enhancing specific teaching skills through pre-service and school-based in-service training programmes for updating knowledge and skills, and by improving teacher morale and motivating staff through a teacher incentive programme. Improvement in the quality of learning and student performance will be promoted through curriculum review and adaptation; the reprinting of existing and production of new learning materials, syllabuses and teachers' handbooks; and regular assessment of pupil performance to inform teachers, parents and pupils themselves of their progress and to provide measures to evaluate basic education.

Figure 1: BESIP / FCUBE Teacher Training Programme Structure



The overall teacher education programme structure depicted in figure 1 envisages a 3-year pre-service diploma programme, a two-year in-service diploma and two-year post-diploma Bachelor of Education (B.Ed) degree in Basic Education.

The first two years of the pre-service diploma would be college based, faced with closely monitored and short periods of school attachment for practical training in teaching. The third year would be an in-school programme, with the trainees spending a whole year teaching in a basic school, and studying in their spare time from distance learning materials. This programme is referred to as the IN-IN-OUT scheme.

Details of key activities being undertaken are outlined on the following pages as:

- A. *In-Service Training (INSET)*
- B. *Pre-Service Training*
- C. *Distance Education*
- D. *Institutional Support & Management of Training*
- E. *Learning Assessment and Evaluation*
- F. *Provision of Instructional Material and School Supplies*
- G. *Distribution / Maintenance & Workshop for District Logistics Officers/Storekeepers*
- H. *Curriculum, Syllabus, Textbooks Review and Development*

A. In-Service Training (INSET)

Rationale

Evolve and sustain cost-effective delivery of In-service Training

Purpose And Scope

- i. Evolve and deliver an efficient support system for in-service training programmes including other management personnel e.g. District Directors.
- ii. Develop monitoring mechanisms for reviewing In-service education strategy
- iii. Deliver an effective and cyclical in-service education that covers all head teachers and teachers that use a cascade method of training and makes use of resource persons, Circuit Supervisors and Teacher Training College (TTC) tutors.

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed. The continuing education component commenced in the second quarter of 1997 for specific target groups.

1. Training of Head teachers
2. Training for Circuit Supervisors and Assistant Directors of Education (ADEs) (to prepare Assistant Directors and Circuit Supervisors to be more sensitive and supportive of the needs of the teacher in the classroom and ensure that they are conversant with new policy on teacher education).
3. Workshops / Seminars for District Directors.
4. Support for School Based Teacher Training (including Monitoring and Co-ordination of teacher continuing education/training programme).
5. Seminar for District Key Officials and Community Leaders. (This is aimed at encouraging communities to own and whip up community interest in basic schools (e.g. clad their pavilions etc.).
6. Impact Evaluation of ToT and Head teacher programmes - (This will assess cost effectiveness).

A.1 Training Head teachers

Resource Meeting for Preparation towards the Training of Trainers

There will be resource meetings preceding every phase of the continuing education cycle. Three resource meetings will therefore be organised every year and the number of participants will be the same as the number of centres presented in the Programme for Head teachers' Continuing Education Training in Table T1 on page 9.

Annual Resource Meetings

The number of resource persons will increase as the number of centres for Head teachers Continuing Education increases. There will be 1 resource person in a centre of 4 groups made up of about 25 participants.

Training of Trainers for Head teacher Continuing Education Programme

A 7-Day training of trainers workshop will be held after the resource meeting. This workshop will precede each of the 3 phases of training scheduled annually for Training of Trainers. As with the resource meeting, the number of participants for this workshop will increase as the number of head teachers who participate in continuing education increases.

Head teachers' Continuing Education

Head teachers training will be conducted in April and August during school vacations. The duration of training will be 8 days. In the first training session, 2,000 head teachers will participate. This will increase cumulatively to 4,000 head teachers in the second training session.

Every head teacher is entitled to participate in the continuing education programme. After each cycle of three phases of continuing education training, participants will obtain a certificate of participation that will merit exemption from prescribed and promotion courses. Heads of Primary and Junior Secondary Schools are currently being trained.

A two-year fallow system will be sustained for head teachers who have completed a cycle of continuing education training.

It is envisaged that by the 4th quarter of 1998, there will be at least one centre in each district. A plan of participation is presented in Table.1.

Table T1: Programme for Head teachers' Continuing Education

Year	Quarter	Vacation Period	No. of new participants	No. of 2nd time participants	No. of 3rd time participants	Total no. of participants cumulative	Grandaunts of 3 consec. awaiting next in-serv.	Total Number either in training or have undergone training	No. of Classes	No. of Trainers	No. of Resource Persons	No. of centres
1996	Q2	Apr	2,000			2,000		2,000	80	80	20	20
	Q3	Aug	2,000	2,000		4,000		4,000	160	160	40	40
	Q4	Dec	2,000	2,000	2,000	6,000		6,000	240	240	60	60
1997	Q1			2,000		4,000	2,000	6,000	220	220	55	55
	Q2				2,000	2,000	4,000	6,000	110	110	28	28
	Q3											
	Q4											
1998	Q1		2,000			2,000	6,000	8,000	110	110	28	28
	Q2		2,000	2,000		4,000	6,000	10,000	220	220	55	55
	Q3		2,000	2,000		6,000	6,000	12,000	330	330	84	84
	Q4				2,000							
1999	Q1			2,000		4,000	8,000	12,000	220	220	55	55
	Q2				2,000	2,000	10,000	12,000	110	110	28	28
	Q3					3,000	12,000	15,000	165	165	42	42
	Q4		3,000									
2000	Q1		3,000			6,000	12,000	18,000	330	330	84	84
	Q2			3,000		6,000	12,000	18,000	330	330	84	84
	Q3				3,000	3,000	15,000	18,000	165	165	42	42
	Q4											

• Training of JSS Heads starts as training of the last batch of Primary School Heads ends their first cycle training.

Projected number of head teachers to under-go training

An estimated number of 12,192 primary and 5,247 junior secondary head teachers (1993/94 Annual Education Census, MOE) making a total of 17,439 participants, are expected to undergo continuing education for heads of basic schools.

By the fourth quarter of the year 2000, about 82% of all the head teachers would either be under-going training or would have passed out of training and awaiting their next training, which comes after the fallow period. In 2001, the first batch of head teachers will re-enter the continuing education programme for their second cycle of the three-phased training programme.

Assuming that the annual growth rate of schools is about 3 percent and therefore the growth in the number of head teachers is also about 3 percent. The projected number of head teachers that will require training will be as follows:

1992/93	-	17,439
.....		
1996	-	19,628
1997	-	20,217
1998	-	20,823
1999	-	21,448
2000	-	22,091

Centres

Each centre will have a maximum of 100 participants in 4 groups/classes. Each centre will have 4 trainers and one resource person who will be the master trainer, making 5 trainers per centre.

A.2 Training of Circuit Supervisors and Assistant Directors of Education

A 5 day workshop will be organised by the Training Division annually for an estimated 775 Circuit Supervisors and 110 Assistant Directors of Education. This training is part of the support system for classroom teachers and head teachers. The training being envisaged as a support system for head teachers and teachers in the schools, should come before the first phase of head teachers training and school based continuing education programme for teachers.

The training will be run on zonal basis. The country will be zoned into four areas as follows:

- Zone 1 - Upper West, Upper East and Northern regions
- Zone 2 - Ashanti and Brong-Ahafo
- Zone 3 - Western and Central
- Zone 4 - Greater Accra, Eastern and Volta regions

Each zone will have 2 centres made up of 4 groups/classes of about 25 to 35 participants. There will be 8 resource persons per zone made up of lecturers from IEDE, IEPA, UCC etc. as well as experienced retired educationists. Resource persons will meet a day prior to the proposed commencement date on the timetable. Circuit supervisors will have shared accommodation.

Annual Number of Circuit Supervisors and Assistant Directors of Education (ADEs) to be trained.

Year	Number ADEs for Training	Number of Circuit Sup.
1997	110	650
1998	110	1,040
1999	110	1,072
2000	110	1,105

Projections in Number of Circuit Supervisors

Under the INSET programme, Circuit Supervisors will be trained to carry out effective supervision of schools. Adequate and sufficient supervision by Circuit Supervisors is therefore imperative if the effects of INSET programme at the school level in contributing to the improvement of quality of classroom teaching and learning are reported to decision makers.

Based on a norm of 20 basic schools per Circuit Supervisor, the cumulative number of Circuit Supervisors required to monitor school based INSET by head teachers¹ is projected as follows:

Year	Quarter	Cumulative estimated HTs requiring during for School Based NSET	No of Circuit Supervisors	Circuit Sup. to be recruited
1996	Q2	2000	100	
	Q3	4000	200	
	Q4	6,000	300	
1997	Q2	9,000	450	
	Q3	11,000	550	
	Q4	13,000	650	
1998	Q2	18,500	925	150
	Q3	20,800	1,040	265
	Q4	20,800	1,040	265
1999	Q2	21,448	1,072	297
	Q3	21,448	1,072	297
	Q4	21448	1,072	297
2000	Q2	22,091	1,105	330
	Q3	22,091	1,105	330
	Q4	22,091	1,105	330

There are presently 775 Circuit Supervisors and up to the end of 1997, there will be no need to recruit more. There will be enough Circuit Supervisors to monitor school based INSET by head teachers who have undergone Head teachers' Continuing Education. By the end of the year 2000, an additional 330 Circuit Supervisors will need to be recruited.

A.3 Workshops / Seminars for District Directors

1. Training on Governance of Basic Education Schools
2. Training in Financial Management for Basic Education Programmes

A.4 Support for School-based Teacher Training

Training of teachers will be school based. It will be organised by head teachers with the support of Circuit Supervisors and Regional Training Officers who have been included in the Training of Trainers workshops. School based continuing education teacher training will take place during the school term - 2 afternoons and after classes as follows:

- After the first phase of head teachers' training in April - From May to July
- After the second phase of head teachers' training in August - From Sept. to Nov.

Twice a term, the head teacher trainers will meet at cluster centres with circuit supervisors and Assistant Directors to share experiences and discuss problems and review programme activities.

Circuit Supervisors will visit schools regularly, at least once a month to support head teachers in the continuing education training for teachers.

¹ Please refer to col. 8 in Table I: Programme for Head teachers' Continuing Education.

A.5 Seminar(s) for District Key Officials & Community Leaders

A 2-day awareness creation and orientation workshop will be organised once a year to encourage community ownership of basic schools. This will include pavilions so that they are clad.

Two Day Orientation/Mobilisation workshops will be organised for 1 District Director, 1 District Co-ordinating director, 1 Chair person and District Social Services Committees, Presiding Officer, District Assembly, General Managers of Schools and Managers of units. An average total of 22 participants will undertake orientation from each district. In each region there will be an average of 220 participants.

Resource persons will be selected from the Universities, MOE and other Ministries. The workshops will take place at the regional and district centres. There is an average of 2 centres per region.

Orientation/Mobilisation Workshops targeted participants

Year	Number of District Official and Heads of Pavilion Schools
1996	2,440
1997	2,440
1998	2,740
1999	3,040
2000	3,340

A.6 Impact Evaluation

The change of behaviour of head teachers in the supervision of teachers and learning in schools will be evaluated for the purpose of reviewing objectives determining cost-effectiveness of the activities.

Implementing Agency (ies): Training Division, MOE, UCC/UCEW, PMU.

Risk And Constraints

- i. Implementation could be rushed, missing critical trial stages.
- ii. Training may not be done to higher levels of efficiency
- iii. Content of modules and other material could become watered down and inaccurate
- iv. Insufficient Support Systems to head teachers and teachers

Source(s) of Funding: IDA, DFID, GOG.

Output/(Key Performance Indicators)

Improved teaching/learning at school level and higher learning achievement of pupils.
% of teachers Improved skills to acceptable standards

² Number of District Officials (4) will not change over the project period but the number of head teachers of pavilion schools will increase annually by 300 which is the number of school to be replaced annually under the access component. This increase will be effective in 1997 when sufficient data will become available on the condition of basic schools facilities.

B. Pre-Service Training

Rationale

- i. Adopt the strategy of district sponsorship of teacher trainees to make teachers more willing to accept posting to remote/difficult areas
- ii. To develop skills of teacher trainers which are sufficient to produce quality teachers for basic schools
- iii. Emphasis and Integrate pedagogy and subject content
- iv. Develop School-Based and Child-Centred Training of Teachers

Purpose And Scope

1. To develop a cost-effective programme for Teacher Trainers.
2. Redevelop and provide relevant and appropriate methodology for Teacher Training based on the review of curriculum and the development of training materials.
3. Provide access courses for teachers prepared to accept posting to remote/difficult areas.
4. Strengthen Institutional capacity of Teacher Training Institutions by training TTC tutors to articulate current policy on teacher education and improve the efficiency of TTC tutors
5. Develop alternative delivery methods

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed:

1. Strategic Planning for Training (STAGE 1)
2. National Teacher Training Conference
3. Redesign Pre-service Programme
4. Training of TTC Tutors for New Training Programme
5. Sponsorship Programme
6. Implementation of Access Courses
7. Monitoring/evaluation system for pre-service training

B.1 Strategic Planning for Training (STAGE 1)

The Strategic Planning Group and its core team were established in October 1996. Four sub-groups were formed to focus on programming design, training needs for teacher educators, management training and the role of the Training Division. A summary of the findings of these subgroups was reported in the Draft Interim Report of the Strategic Planning Group on Training in January 1997.

In a second phase of planning, the emphasis has been on building on this work and developing it into a final strategic plan in preparation for implementation. It was realised that a number of key issues would have to be addressed as part of this planning operation. A series of panels have been established to carry forward the planning to address the issues.

Its purpose is to develop and agree the outline plan for the overall structure of the teacher training programme. Basically the panel will work on the following objectives:

1. To review the current thinking on the programme
2. To examine proposals for each of the components to the programme so as to
 - produce an initial component plan taking into account the strengths and limitations of the current proposals in the context of a changing environment.
 - produce a final component plans by developing the initial component plan in detail and considering its implications for the implementation of the programme.
- 10 To combine the final component plan into one strategic plan for the structure of the programme.
- 20 In the light of the programme structure plan, map out the planning tasks for the remaining five panels on curriculum, delivery methods, providers, incentives and management.

At the end of its work, a programme structure plan will be submitted for formal approval and a set of agreed tasks for the remaining five panels programmed.

Work of the strategic planning group will end with a debriefing workshop in a form of National Teacher Training Conference. The work of the core team of the SPG (Training); however, will continue, so that the training

division will be supported with their training activities and programme development including curriculum development.

B.2 National Teacher Training Conference

The conference is aimed at collecting views and recommendations from a sizeable representation of stakeholders which will ultimately affirm the structure, content and implementation of Innovative Teacher Education or Training Programme for Ghana.

B.3 Redesign Pre-service Programme

It will be necessary to undertake a study of TTCs to among other things, assess both institutional and staff requirements and also for determining infrastructure and further training needs of TTCs. A consultant will design Access Courses for trainees who do not have the requisite qualifications but who are ready to accept postings to remote/difficult areas.

The Pre-service programme will cover a period of three years. The completion of the programme will be a pre-requisite for new teachers wishing to teach in either primary (BE1-6) or junior secondary (BE7-9) schools. Its aim will be to prepare new teachers to provide high quality education in primary and junior secondary schools within the context of FCUBE. The courses for the programme will be launched in September 1998.

Those wishing to take this course will apply through the District Education Office of the district, in which they live and/or wish to teach. An Interviewing Board convened and chaired by the District Director and including members of nearby primary and JS Teacher Training Colleges will carry out selection. Minimum entry requirements will be as follows:

- a) SSCE with credits in core subjects of Science, Maths and English Language and an aggregate of not more than 24, or
- b) Five 'O' Level credits including Maths and English Language.

Successful applicants will be sponsored by their District office and will be bonded to teach in that district for a specified number of years.

The universities (UCC/UCEW), Teacher Training Colleges, CRDD, representatives of primary and JS teachers and the Training Division will draw up the curriculum. The course content will include:

- a) Teaching methodology integrated with academic development
- b) Practical teaching skills.

There will be a strong practical component throughout the course and an emphasis on integrating the teacher's practical experience with theory.

The course will be modular, and student teachers will accumulate credits for each module successfully completed. There will be a common core of modules for all learners, and specialist modules for those opting for either primary or junior secondary levels (many of the modules will be common to both pre- and in-service versions of the Diploma course. Credits acquired from either versions of the course will count towards the B. Ed degree for those teachers wishing to continue their studies to that level).

There will be continuous assessment throughout the course, the result will count for an agreed percentage of the final assessment. In addition, there will be internal assessment at the end of year one and external assessment at the end of years two and three. These assessments will include both theoretical and practical performance in the classroom. Student teachers who fail to achieve the required standard at each of the annual assessments will not be permitted to continue with the course or to attain the Diploma (although borderline and special cases may be allowed to repeat a year).

The first two years of the course will be conducted at an appropriate Teacher Training College in, or as near as possible to, the sponsoring district. During this period, teaching will be through a combination of conventional face-to-face methods, guided individual study and a structured programme of school visits and practical teaching experience. Students teachers will spend substantial periods teaching under the supervision of TTC

tutors and experienced and qualified school staff, and will be given progressively increasing teaching loads and responsibilities in the second year.

At the end of the second year, with the assumption of satisfactory performance in the external assessment, student teachers will be posted to schools in their sponsoring district. Posting will be the responsibility of the District Director. In the third year of the course, student teachers will be given full (or slightly reduced) teaching loads and responsibilities, and will study in their spare time using the following distance learning methods:

- specially developed self-study texts and other media (including audio cassettes and radio programmes).
- written assignments and projects marked and commented on by tutors from the Teachers Training Colleges.
- regular (monthly) seminars with a tutor and other student teachers in a local 'cluster' of schools to be organised, monitored and supported by District staff.
- possible access to a local (or district) resource/study centre with reference materials and media facilities
- possible guidance from a 'Mentor' (a Head Teacher or more senior experienced practising or retired teacher living/working within easy reach of the student teacher's school and identified by district staff).
- at least one residential workshop held at the Teacher Training College attended in years one and two. The workshop or workshops will be held during vacation times and will include a final six week period at the end of year three which will start with face-to-face discussions of classroom experience, consolidation and course revision, and will conclude with examinations.

Moderation of the final theory and practice assessments, together with the accreditation of the Pre-service Diploma will be the responsibility, possibly, of UCC.

Teachers who successfully complete the Diploma course will be paid a full salary from the end of year three, but their professional qualification will be confirmed only after they have completed one additional, probationary year of teaching to a satisfactory level of performance. On successful completion of that fourth year, teachers would be eligible to apply to take the B. Ed (Basic Education) degree.

B.4 Training of TTC Tutors for New Training Programme

Primary Teacher Training (TTC Tutors)

Ten short-term local training courses are planned for TTC tutors in 1998. Local courses will be organised after the TTCs study, which will assess institutional staff needs.

B.5 Sponsorship Programme

Under the new pre-service teacher training system, it is planned to attempt to meet the challenge of qualified teacher shortages in rural and other disadvantaged areas. Districts experiencing difficulties in meeting their demand for teachers would be allowed to sponsor candidates for training. Such candidates would be contracted to teach in the sponsoring districts for a period of three to five years on completion of their training.

Ideally, candidates to be sponsored may have to come from districts, where their services will be needed after training. However, it should be possible for candidates from other districts to enter into contract with districts in need of teachers and gain sponsorship. The only condition is that all sponsored candidates should be able to speak the language spoken in the sponsoring district so that, if it becomes necessary, they can use the language to teach in the lower primary classes.

B.6 Implementation of Access Courses

Access Courses for candidates without the requisite entry qualifications will be advertised before the Easter holidays in April/May. Forms will be sent to the District Directors of Education and candidates who satisfy the set criteria for selection will obtain the forms from the District Directors of Education after signing the necessary agreements with the district.

The Access Courses will commence at the beginning of the long vacation that is usually in July. This will ensure that at least 6 weeks of intensive tuition can be given. After the course, there will be an examination to evaluate candidates for entry into the pre-service training programme.

One external consultant will be required to advise on and help operationalize the redesigned model of pre-service teacher education.

B.7 Monitoring/evaluation system for pre-service training

A systematic and regular monitoring of the pre-service teacher training programme is essential for its effective implementation. Teacher education policy planners, that is the ministry of education, NASCOTE and the Training Division will need information to use in determining the progress and success of the implementation of all programmes provided to initial training of teachers and make recommendations for improvement.

The Training Division in collaboration with the Universities and the Inspectorate Division at the National, Regional, and District levels, would be responsible for monitoring and conducting evaluation studies on different aspects of teacher education programme implementation. The monitoring and evaluation would be targeted at systematic follow-up of the graduates, who have gone through the programmes, in schools to determine the impact of such teachers on the teaching and learning, which takes place in the schools.

Implementing Agency (ies): Training Division (GES), Manpower Division (GES), CRDD, TTCs, UCEW, UCC

Risk And Constraints

Likely resistance from UCC, UCEW to take up role of supporting TTCs

Likely resistance to mechanisms of alternative delivery

In-adequate professional/skills of TTCs to support programme

Likely lapses in collaboration with Manpower Division (GES) on the professional attachment of teacher trainees

Source(s) of Funding: K/W, GTZ, DFID, GOG.

Output/(Key Performance Indicators)

Improved teaching/learning in TTCs and higher achievement levels of teacher trainees

Teachers more willing to accept posting to rural areas due to district sponsorship and professional attachments.

C. Distance Education

Rationale:

Qualified teachers are required in the schools and 4000 teachers are on study leave every year. Replacements for them are not easily found, if ever. Distance learning is the most appropriate means for training teachers without the requisite qualification of Diploma in Basic Education

Purpose and Scope:

a) The In-Service Diploma in Basic Education

Teachers programmed for Distance Learning will be based on matrix of qualifications, accreditation and the need to attain minimum qualification for teaching in basic schools. Distance Education covers in-service diploma in Basic Education and the B. Ed. Degree.

The course duration is a two-year period for all practising teachers in primary and junior secondary schools. It is designed to enable teachers to understand and contribute to the realisation of FCUBE policies. All teachers who have not taken the Pre-service Diploma in Basic Education (including teaching staff roped in district and regional administration) will eventually be required to do this course. It is expected that this will be launched in September 1999.

The selection of teachers for each year's intake will be carried out by a board, convened and chaired by the District Director of the district in which they are teaching.

Conditions for entry include:

- a) qualified teacher status under the former teacher training provisions.
- b) academic achievements as for entry to the Pre-service Diploma.
- c) a good record of performance in their schools.

Successful applicants will be sponsored by their district office and will be bonded to teach in that district for a specified number of years.

The universities (UCC/UCEW), Teacher Training Colleges, CRDD, representatives of primary and JS teachers and the Training Division will draw up the curriculum. The course content will include:

There will be a strong practical component throughout the course and an emphasis on integrating the teacher's practical experience with theory.

The processes are the same as outlined under Pre-Service Diploma In Basic Education Programme.

Teachers who successfully complete the In-service Diploma will receive a salary increase. They will also be eligible to apply immediately for the B Ed degree course.

b) The B Ed (Basic Education)

This will be a two-year course, although the degree programme also incorporates the Pre-service and In-service Diploma courses, which are compulsory components of the programme. Its aim is to provide practising teachers with the opportunity to further their studies, improve their professional skills, increase their salaries and further their chances of promotion. The course will be launched in 2001.

Those wishing to take this course will apply through the District Education Office of the district in which they are teaching. Preliminary selection will be carried out by interview by a Board convened and chaired by the District Director and including members of nearby primary and JS Teacher Training Colleges. The resulting short listed applicants will be screened by UCC/UCEW.

Entry requirements will be as follows:

- a good pass in either the Pre-service or In-service Diploma course (teachers with a Pre-service Diploma will be required to teach for one year after obtaining the Diploma before starting the B Ed programme), and
- a good record of performance in their schools

The universities (UCC/UCEW), Teacher Training Colleges, CRDD, representatives of primary and JS teachers and the Training Division will draw up the curriculum. The course content will include:

- Teaching methodology integrated with academic development
- Practical teaching skills.

The processes are the same as outlined in section B1 under The Pre-Service Diploma in Basic Education.

Moderation of the final theory and practice assessments, together with the accreditation of the Pre-service Diploma will, possibly, be the responsibility of UCC. The B. Ed will be fully equivalent in status to a conventional university degree.

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed:

1. Distance Learning Materials Preparation (based on the matrix of qualifications, accreditation and the need to attain minimum qualification for teaching in basic schools of the target group).
2. Student Support System.
3. Marketing of Distance Education Programme

C.1 Distance Learning Materials Preparation

Teachers pursuing the Diploma (both Pre- and In-service) and the Bed will use self-study distance education materials while they continue to teach. These materials will be based on the new curriculum for teacher education in Ghana and will be subject developed by teams and individuals from the universities, the TTCs, GES (CRDD), Subject associations and the Ministry of Education.

It is expected that both local and foreign consultants will be used at various stages of the planning and course development.

Quality assurance measures will be built into the materials development and production processes. It is planned to have print as the main medium of instruction; audio will be used where possible as support medium.

C.2 Student Support System

a. Staff Development

Development of professional support systems for both pre-service and continuing education will be pursued. This will ensure that resource centres are in place and are providing the necessary support for teachers on professional attachments and distance education courses. Some TTC tutors will be released to visit schools to provide the necessary support. Professional support systems will have to be in place by the time the TTCs have been rehabilitated and the new in-take of the proposed model of pre-service has been done. With the distance education courses for teachers who do not have the minimum qualification of DipEd., professional support will have to be in place after the completion of the study on training needs of teachers at the end of December, 1997.

The support system will enable the student:

- receive learning materials in time
- have a tutor / counsellor / mentor to provide him with academic and personal counselling.
- have someone to talk to, to provide guidance in time of need.
- counselling to have his/her assignments marked and returned on time.
- have a place to go to for residential sessions
- possibly have a study centre not too far away from his school / residence.

b. Technical Assistance

One external consultant will also be required for UCEW/UCC. The consultant will consider the necessary support for strengthening UCEW and UCC, and establish linkages with the TTCs and the Training Division of the GES. This will give the necessary support to pre-service and continuing education of the teacher.

C.3 Marketing of Distance Education Programme

The use of distance education on the scale planned is new in Ghana. It is therefore necessary to market the programme in terms of its aims and methods well ahead of the launching of each of the following:

- Pre-service diploma
- In-service diploma
- Bed

In this connection, workshops, durbars, advertisements and public awareness lectures and discussions will be held with all stakeholders, including the general public to provide them with information about the programme and build their reactions / concerns into the final document, thereby enriching it.

Implementing Agency (ies): Training Division (GES), Manpower Division (GES), CRDD, TTCs, UCEW, UCC

Risk And Constraints

Likely resistance from UCC, UCEW to take up role of supporting TTCs

Likely resistance to mechanisms of alternative delivery

In-adequate professional/skills of TTCs to support programme

Likely lapses in collaboration with Manpower Division (GES) on the professional attachment of teacher trainees

Source(s) of Funding: KIW, GTZ, DFID, GOG.

Output/(Key Performance Indicators)

- Improved teaching/learning in TTCs and higher achievement levels of teacher trainees
- Teachers more willing to accept posting to rural areas due to district sponsorship and professional attachments
- Pass rate of graduates

D. Institutional Support & Management of Training

Rationale

Evolve a class of management that provides an efficient delivery of services.

Purpose and Scope

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed.

1. Strengthening of Training Division
2. Strategic Planning (Stage 2): Implementation of Teacher Education Policies.
3. Support To Teacher Training Colleges (TTCs)
4. Establishment of National Steering Committee on Teacher Education (NASCOTE)

D.1 Strengthening of Training Division

Provision of Human Resources

The Training Division will be responsible for pre-service and continuing teacher education and other training needs. Divisional staff training will be undertaken under the management component and will require that a staff needs assessment be undertaken.

Provision of equipment and other material resources.

This will consist of procurement of equipment, books and other materials to strengthen the Training Division. Basic material requirements to support in-service training are already factored into in-service training courses and workshops.

D.2 Strategic Planning for Training (Stage 2)

D.3 Support to Teacher Training Colleges (TTCs)

- a. Rehabilitation of TTCs (Civil works: see Component (3) under Infrastructure Development and Maintenance)
- b. Books, Equipment, and Other Materials

This will consist of institutional support in terms of the procurement of teaching and learning materials as well as training for TTC tutors. Teaching /learning materials required for 38. The following will be required:

Basic Education Textbooks, Syllabuses, Handbooks, etc.

Basic Education Syllabuses BS1-9 all subjects	50 sets/subj./class
Basic Education Teachers' Handbooks BS1-9 all subjects	50 sets/subj./class
Basic Textbooks BS1-9 all subjects	50 sets/subj./class
Basic Copybooks/Workbooks BS1-9 all subjects	50 sets/subj./class

TTC Textbooks, Manuals, etc.

Mathematics for TTCs Student Activities	12,000 copies
Mathematics for TTCs Tutor Support	12,000 copies
Science Manuals (physics, chemistry, biology)	12,000 copies
English Materials (rev. and printing)	12,000 copies
Technical Skills (rev. and printing)	12,000 copies

A detailed list of TTC procurement needs are:

Goods	# of Unit
1. Communication System	
Motorola with Solar Power	40
Fax/telephone	38
2. Photo-copier	38
3. Computers	38
4. Printer Laser	38
5. UPS	38
6. Generators (75KVA)	3
7. Buses (2 X 35 Seater)	38
8. Pick-up(double cabin)	38
9. Motor cycles	38
10. Cassette recorders	38
11. TV(29")	38
12. Video Decks	38
13. Overhead Projector/Screen	38
14. Duplicating machine (Gestetner)	38
15. Filing Cabinets (8 per TTC)	114

D.4 Establishment of National Steering Committee on Teacher Education (NASCOTE)

It is recognised that policy making for teacher education should be the responsibility of the Minister of Education. But in carrying out this function, the Minister will be advised by the National Teaching Council (NTC). Prior to the establishment of the NTC a National Steering Committee on Teacher Education will be set up to perform the functions of NTC. NTC as well as NASCOTE will collaborate with the National Accreditation Board (NAB) and offer advice on professional standards and content of teacher education to guide the training of trainers.

NASCOTE will establish a sub-committee for In-service Training and assigned the responsibility for advising on post-qualification continuing education of teachers and non-teachers in education. In this regard the sub-committee will receive proposals for in-service training from all agencies in education and prepare an annual programme for in-service training.

D.5 Establishment of District Training Teams

Implementing Agency (ies): Training Division (GES), Manpower Division (GES), CRDD, TTCs, UCEW, UCC

Risk And Constraints

- Likely resistance from UCC, UCEW to take up role of supporting TTCs
- Likely resistance to mechanisms of alternative delivery
- In-adequate professional/skills of TTCs to support programme
- Likely lapses in collaboration with Manpower Division (GES) on the professional attachment of teacher trainees

Source(s) of Funding: KfW, GTZ, DFID, GOG.

Output/(Key Performance Indicators)

- Improved teaching/learning in TTCs and higher achievement levels of teacher trainees.
- % of Teachers more willing to accept posting to rural areas due to district sponsorship and professional attachments.
- % of graduates

E. Learning Assessment and Evaluation

Rationale

1. Develop evaluation mechanisms that reflect learning achievements.
2. Identify shortfalls in curriculum to facilitate revision of curriculum.
3. Identify teacher limitations in effective teaching of new curriculum.
4. Feedback constraints based on CRT and other supervision reports into teacher training institutions.
5. Continuous support for BECE..

Purpose And Scope

1. Establish linkages between CRT / Continuous Assessment and new curriculum.
2. Establish CRT instruments for testing learner achievement by gender among other categories
3. Administer CRT on selected schools and classes ensuring equal representation of girls and boys
4. Disseminate outcomes of CRT to CRDD/Training Division/Basic Education Division to be the basis for remedial strategies.
5. Evaluate the practical ease of teaching the new curriculum.
6. Evaluate improvement in quality of learning in basic education.
7. Provision of supplementary funding for BECE.
8. Monitor and assess pupils' learning achievements from fixed baseline indicators.

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed.

1. Student Performance
2. Establishment of Item Bank for Diagnostic reporting
3. Support for Basic Education Certificate Examination
4. Baseline Studies on Literacy and Numeracy.

E.1 Student Performance

E. 11 REVISION OF CRT TO REFLECT NEW CURRICULUM

When the new syllabuses and textbooks are in use, tests based on the new curriculum will be developed in English and Mathematics for BS3, BS6, and BS8. It is planned that tests will be administered in three different phases. The test for BS3 will be administered in May/June; BS6 in June/July; and BS8 in July/August. All will be administered in 2000. GES personnel at regional level will be used as test administrators.

Development of Test Material

Development of test material based on the new curriculum will be done by 2 local consultants for 2 months each. One local consultant for BS3, BS6 and BS8 English and another for BS3, BS6 and BS8 Mathematics.

E. 12 ADMINISTER, ANALYSE AND REPORT CRT (PREPARE REPORT FOR TEACHERS)

Training of test administrators will be carried out in an annual Test Administrators' Training Workshop before the test is administered.

Sample for CRT

5% of the projected enrolment for BS3, BS6 and BS8 will be tested annually from 2000 onwards.

Year	BS3	BS6	BS8	5% Sample	No. of Admin. \$ sch/admin	
2000	516,433	408,835	357,894	64,158	1,604	321
2001	520,000	400,000	360,000	64,000	1,500	320

Based on the assumption of 40 pupils per class and 5 schools per evaluator, the number of evaluators required are given in the above table. Each evaluator will administer tests in 5 schools, 1 school each day depending on the quality of some schools.

CRDD will organise the Test Administrators' Training Workshop with the CRT unit which will become part of CRDD.

Distribution of Question Booklets and Answer Sheets

Question Booklets and Answer Sheets will be sent to the Training Workshop for Test Administrators and distributors. Since Test Administrators will leave the workshop straight to the field, they will take along the packages. Their T&T provision is adequate to cater for the excess baggage.

Monitoring of CRT

Retrieval of Test Material

Test materials will be retrieved from regional collection points by CRDD staff.

Data Analysis

Data processing will be done using equipment at CRT Office in PMU (including scanner). Analysis of test results will be done by a consultant in collaboration with CRDD/CRT staff.

In 1999, however, tests will have to be designed for BS3, BS6 and BS8 in English and Mathematics based on the new Curriculum for basic schools for which textbooks will be printed in 1999. Skills transferred in 1998 will enable CRDD staff to carry out CRT administration in subsequent years.

In 2000, skills transferred by consultant will enable CRDD/CRT staff to analyze CRT data.

Operating Costs

Stationery for pupils writing CRT will be supplied out of operating costs. Stationery at different levels will also be supplied out of operating costs (e.g. stationery for dissemination of reports).

Administer CRT to a 5% sample of pupils in BS3, BS6 and BS8 annually

E.2 Support for Basic Education Certificate Examination (BECE)

Under a protocol agreement between WAEC and Government of Ghana, the Government will continue to provide subsidy for funding the cost of conducting the BECE.

E.3 Baseline Study on Literacy and Numeracy

The implementation strategy comprises the following activities for the various beneficiaries listed:

1. Train Inspectors and Circuit Supervisors in test development
2. Train Circuit Supervisors in test administration, supervisory skills / recognising defects in the delivery of education in Basic Schools for timely intervention.
3. Review of test administration
4. Publicise results and circulate widely
5. Conduct SPAM to set new targets at School, Circuit, District, Regional and National level to help communities own their schools.

Implementing Agency (ies): Inspectorate, CRDD, Basic Education Division and PMU.

Risks And Constraints

1. Selection of CRT sample may not be good enough to capture particular problems of achievement in various communities
2. Inadequate personnel to organise training of test-administrators and carrying out implementation may hamper test administration.

Source(s) of Funding: IDA, UNICEF, USAID, GoG

Output/(Key Performance Indicators)

1. Relevance of tests developed to new curriculum
2. % of Improved learning achievement of pupils.

3. Community awareness aroused
4. Teacher's accountability to their Communities strengthened
5. Commitment of various Divisions fulfilled
6. Regular reports issued to relevant Divisions
7. Reformulation of policies and targets enhanced.

F. Provision of Instructional Material and School Supplies

Rationale

- i. Develop network of reliable printing houses for the timely production of textbooks and other teaching materials.
- ii. Establish textbook production fund for regular and timely reprinting of all educational materials.
- iii. Ensure adequate inputs for academic work in all schools by providing resources for recurrent expenditure.
- iv. Provide financial autonomy to School Management Committees for the production of school consumable.
- v. Timely distribution of textbooks, teachers' handbooks, workbooks, copy books,

Purpose And Scope

The objective is to efficiently deliver textbooks and other teaching and learning materials to schools, so as to maintain an achievement of textbook pupil ratio indicators as projected. However, when the quantities of a given title delivered to the warehouse is less than the national enrolment, percentage coverage ratio will be used to chart supplies to schools and topped up later to reach the maximum coverage of hundred percent, as and when deliveries are made.

This will guarantee national capacity for timely and efficient production of all teaching materials including:

1. Reprinting of Existing usable textbooks and exemplary textbooks to be used until review is completed.
2. Shifting financing of Basic Education away from a salary budget to a budget that ensures enough basic inputs for effective teaching and learning to take place.
3. Ensure that each academic year is adequately launched with the requisite textbook/pupil ratios.
4. Ensure that all teachers and teacher training colleges are provided with the relevant learning and teaching materials.

Implementation Strategy

The implementation strategy comprises the following activities for the various beneficiaries listed:

1. Procure and Distribute School Supplies.
2. Procurement of Globes, Maps, Newsprints, Tally Cards for Schools.
3. Reprinting of Existing usable Textbooks etc.

The steps involved are:

- Preparation of Bidding document
- Request for no objection
- Release of Bidding document
- Submission of bid
- Bid evaluation report
- Approval of recommendation
- Signing of contracts
- Payment schedule
- Expected delivery

F.1 Procure and Distribute School Supplies

After a careful study of items been procured, a committee made up of the following members was formed to review the list of items, with regard to their relevance, the quantities required and total costs:

- Director, Basic Education
- Director, Supplies and Logistics Division
- Director, Training Division
- Director, Curriculum Division (CRDD)
- Procurement Consultant

The Supplies and Logistics Division worked out required quantities using projected enrolment and schools numbers (Appendix 1) and norms agreed upon (Appendix 2).

Items to be procured are:

Description	Quantity			
	1997	1998	1999	2000
Exercise books	3,600,000	23,266,4001	24,352,502	25,644,774
Exercise books square	1,464,970	2,603,3430	2,793,321	2,996,697
Exercise books ruled	2,441,616	4,338,905	4,655,535	4,994,495
Graph Exercise Book	767,992	801,170	832,316	865,847
Chalk (white)	1,056,780	1,814,130	1,868,565	1,924,605
Chalk (coloured)	352,260	362826	373,713	384,921
Crayon	1,171,019	1,242,808	1,330,115	1,429,088
Other Items				
Attendance Registers	117,420		124,571	128,307
Teachers Notebooks	132,700		138,345	141,295
Report Cards (Primary)	2,200,000	2,200,000	3,199,893	3,390,207
Report Cards (JSS)	770,000			
Cumulative Record Book	431,188			528,224
Continuous Assessment	117,420		124,571	128,307

Procurement arrangements are made in advance through either International or Local Competitive Bids (ICB or LCB). The Project Management Unit is charged with the responsibility of managing credits/grants being used to procure goods and services.

Library Books

In 1998, a total of 1,460,000 books of 30 different titles of 2 copies/title for 15,000 BS1-6 schools and 35 different titles of 2 copies/school for 8,000 BS 7-9 schools) will be procured for distribution to schools. In all, a total of 65 titles will be procured for basic schools.

Details

BS 1-6 (2 Copies of 30 titles = 60 copies per school for 15,000 schools in 1998)

BS 7-9 (2 copies of 35 titles = 70 copies per school for 8,000 schools in 1998)

Replacement of Library Books: 1999-2000

Between 1999 and 2000, 5% of total library books procured and distributed to schools will be replaced every year.

BS1-6: 5% of 1,500,000 library books replacement per year = 75,000/annum

BS7-9: 5% of 1,200,000 library books replacement per year = 60,000/annum

School Storage Facilities

1997-2000

To step up proper storage of textbooks and other logistics in the schools all basic schools will be supplied with one big wooden cupboard per class and 1 per school for the head teacher's office starting in 1997. Assuming that the number of schools in 1996 increases by 3 percent, the projected number of classes will be as follows:

Year	1997	1998	1999	2000
BS1-6 classes	92,700	95,481	98,345	101,295
BS7-9 classes	24,720	25,461	26,226	27,012
BS1-9 schools	23,690	24,401	25,133	25,887
No of Cupboards required/cumm	141,110	145,343	149,704	154,194

F.2 Procurement of Globes, Maps, News-prints, and Tally Cards for Schools.

Procurement arrangements are made in advance through either International or Local Competitive Bids (ICB or LCB). The Project Management Unit is charged with the responsibility of managing credits/grants being used to procure goods and services.

F.3 Reprinting of Existing usable Textbooks etc.

1. Through local and international competitive bidding, MOE/PMU will procure the production of all relevant teaching materials.
2. By an identification of a network of competent local publishers, MOE will encourage private participation in the production of teaching materials.
3. The association of local publishers will be assisted to improve their management capacity in textbook production.
4. Maintain strict financial discipline in management of educational finances.
5. Ensure strict adherence to financial norms.
6. Encourage creative alternative strategies to improving teaching practice and learner achievement.

The number of textbooks and materials required for distribution to pupils and students increase as enrolments increase. To keep pace with increasing enrolments, the Supplies and Logistics Division has programmed that between 1999 and 2000, when new textbooks will be ready for printing, reprinting of existing textbooks, workbooks, copybooks, syllabi and teachers' handbooks will be on-going. The Projects Management Unit (PMU) will undertake procurements and the Supplies/Logistics division of GES will manage deliveries to districts in collaboration with publishers.

However, before the re-printing of some of the textbooks starts in July 1996, the current stock balances in the warehouses will be distributed to the districts.

Textbook requirements by the year 2000 are based on projected enrolments and projected school numbers given in Appendix 1³.

In the first cycle of printing for BS1-7 textbooks starting in 1996, a 3-year life span will be used. The next cycles of printing will therefore be in 1999, when the review work is expected to have finished and new textbooks, syllabi and teachers' handbooks printed. In subsequent years, BS1-9 textbooks will have an estimated life span of 3 years.

1996/1997

From July to December, 1996 the following will be re-printed: Since the textbooks etc. will be in the classroom in the 1997 academic year, basic education enrolments for 1997 are used. However, financial constraints and stock levels have limited the quantities to be reprinted, hence the figures provided below. Unit cost of textbooks varies from subject to subject and level to level. It, however, averages less than \$1.00

The following textbooks, syllabi and teachers' handbooks are being reprinted:

i. Textbooks		Qty
English (BS1 only)	-	250,000
Mathematics 1	-	65,000
Mathematics 2	-	93,000
Mathematics 3	-	205,000
Mathematics 4	-	360,000
Mathematics 5	-	205,000
Mathematics 6	-	225,000
Social Studies5	-	107,000
English (BS6 only)	-	50,000
ii. Syllabi BS1-6		
Agric / Garden	-	93,000
Physical Education	-	93,000
Cultural Studies	-	46,000
Ghanafan Language	-	93,000
Social Studies	-	46,000
Mathematics	-	93,000
Science	-	46,000
English	-	93,000
Life Skills	-	93,000

³ As more current and refined projected data become available, enrolment projections will change accordingly.