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**GENERAL MATHEMATICS/MATHEMATICS (CORE)**

1. **AIMS OF THE SYLLABUS**

The aims of the syllabus are to test candidates’:

1. mathematical competency and computational skills;
2. understanding of mathematical concepts and their relationship to the   acquisition of entrepreneurial skills for everyday living in the global world;
3. ability to translate problems into mathematical language and solve them      using appropriate methods;
4. ability to be accurate to a degree relevant to the problem at hand;
5. logical, abstract and precise thinking.

This syllabus is not intended to be used as a teaching syllabus. Teachers are advised to use their own National teaching syllabuses or curricular for that purpose.

1. **EXAMINATION SCHEME**

There will be two papers, Papers 1 and 2, both of which must be taken.

**PAPER 1**: will consist of fifty multiple-choice objective questions, drawn from the common areas of the syllabus, to be answered in 1½ hours for 50 marks.

**PAPER 2**: will consist of thirteen essay questions in two sections – Sections A and B**,** to be answered in 2½ hours for 100 marks. Candidates will be required to answer ten questions in all.

Section A - Will consist of five compulsory questions, elementary in nature carrying a total of 40 marks. The questions will be drawn from the common areas of the syllabus.

Section B - will consist of eight questions of greater length and difficulty. The questions shall include a maximum of two which shall be drawn from parts of the syllabuses which may not be peculiar to candidates’ home countries. Candidates will be expected to answer five questions for 60marks.

1. **DETAILED SYLLABUS**

The topics, contents and notes are intended to indicate the scope of the questions which will be set. The notes are not to be considered as an exhaustive list of illustrations/limitations.

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| **TOPICS** | **CONTENTS** | **NOTES** |
| **A. NUMBER AND       NUMERATION**  ( a ) Number bases | ( i ) conversion of numbers from       one base to another  ( ii ) Basic operations on number        bases | Conversion from one base to base 10 and vice versa.  Conversion from one base to another base .  Addition, subtraction and multiplication of number bases. |
| (b) Modular Arithmetic | (i) Concept of Modulo Arithmetic.  (ii) Addition, subtraction and      multiplication operations in      modulo arithmetic.  (iii) Application to daily life | Interpretation of modulo arithmetic e.g.  6 + 4 = k(mod7),  3 x 5 = b(mod6),  m = 2(mod 3), etc.  Relate to market days, clock,shift duty, etc. |
| ( c ) Fractions, Decimals and        Approximations | (i) Basic operations on fractions     and decimals.  (ii) Approximations and      significant figures. | Approximations should be realistic e.g. a road is not measured correct to the nearest cm. |
| ( d ) Indices | ( i ) Laws of indices  ( ii ) Numbers in standard form  ( scientific notation) | e.g. *ax* x *ay* = *ax* + *y* , *axay* = *ax* – *y*, (*ax*)*y* = *axy*, etc where *x*, *y* are real numbers and *a* ≠0.  Include simple examples of negative and fractional indices.  Expression of large and small numbers in standard form  e.g. 375300000 = 3.753 x 108  0.00000035 = 3.5 x 10-7  Use of tables of squares, square roots and reciprocals is accepted. |
| ( e) Logarithms | ( i ) Relationship between indices       and logarithms e.g. *y* = 10*k*      implies log10*y* = *k*.  ( ii ) Basic rules of logarithms e.g.         log10(*pq*) = log10*p* + log10*q*         log10(*p*/*q*) = log10*p* – log10*q*         log10*pn* = *n*log10*p*.  (iii) Use of tables of logarithms      and antilogarithms. | Calculations involving multiplication, division, powers and roots. |
| ( f ) Sequence and Series | (i) Patterns of sequences.  (ii) Arithmetic progression (A.P.)  Geometric Progression (G.P.) | Determine any term of a given sequence. The notation Un = the nth termof a sequence may be used.  Simple cases only, including word problems. (Include sum for A.P. and exclude sum for G.P). |
| ( g ) Sets | (i) Idea of sets, universal sets,     finite and infinite sets,     subsets, empty sets and     disjoint sets.  Idea of and notation for union,     intersection and complement     of sets.  (ii) Solution of practical problems      involving classification using      Venn diagrams. | Notations: { }, , P’( the compliment of P).  ♦• properties e.g. commutative, associative and distributive  Use of Venn diagrams restricted to at most 3 sets. |
| ( h ) Logical Reasoning | Simple statements. True and false statements. Negation of statements, implications. | Use of symbols: use of Venn diagrams. |
| (i) Positive and negative           integers, rational numbers | The four basic operations on rational numbers. | Match rational numbers with points on the number line. Notation: Natural numbers (N), Integers ( Z ), Rational numbers ( Q ). |
| ( j ) Surds (Radicals) | Simplification and rationalization of simple surds. | Surds of the form , a and *a* where a is a rational number and b is a positive integer.  Basic operations on surds (exclude surd of the form ). |
| •**\*** ( k ) Matrices and           Determinants | ( i ) Identification of order,           notation and types of           matrices.  ( ii ) Addition, subtraction,        scalar multiplication and        multiplication of        matrices.  ( iii ) Determinant of a matrix | Not more than 3 x 3 matrices. Idea of columns and rows.  Restrict to 2 x 2 matrices.  Application to solving simultaneous linear equations in two variables. Restrict to 2 x 2 matrices. |
| ( l ) Ratio, Proportions and       Rates | Ratio between two similar quantities.  Proportion between two or more similar quantities.  Financial partnerships, rates of work, costs, taxes, foreign exchange, density (e.g. population), mass, distance, time and speed. | Relate to real life situations.  Include average rates, taxes e.g. VAT, Withholding tax, etc |
| ( m ) Percentages | Simple interest, commission, discount, depreciation, profit and loss, compound interest, hire purchase and percentage error. | Limit compound interest to a maximum of 3 years. |
| **\***( n) Financial Arithmetic | ( i ) Depreciation/ Amortization.  ( ii ) Annuities  (iii ) Capital Market Instruments | Definition/meaning, calculation of depreciation on fixed assets, computation of amortization on capitalized assets.  Definition/meaning, solve simple problems on annuities.  Shares/stocks, debentures, bonds, simple problems on interest on bonds and debentures. |
| ( o ) Variation | Direct, inverse, partial and joint variations. | Expression of various types of variation in mathematical symbols e.g. direct (z n ), inverse (z ), etc.  Application to simple practical problems. |
| **B. ALGEBRAIC PROCESSES**  ( a ) Algebraic expressions | (i) Formulating algebraic     expressions from given     situations  ( ii ) Evaluation of algebraic        expressions | e.g. find an expression for the cost C Naira of 4 pens at *x* Naira each and 3 oranges at *y* naira each.  Solution: C = 4*x* + 3*y*  e.g. If *x* =60 and *y* = 20, find       *C*.  *C* = 4(60) + 3(20) = 300 naira. |
| ( b ) Simple operations on        algebraic expressions | ( i ) Expansion  (ii ) Factorization  ♦•♣♠ (iii) Binary Operations | e.g. (*a* +*b*)(*c* + *d*), (*a* + 3)(*c* - 4), etc.  factorization of expressions of the form ax + ay,  *a*(*b* + *c*) + *d*(*b* + *c*), *a*2 – *b*2,  *ax*2 + *bx* + *c* where *a*, *b*, *c* are integers.  Application of difference of two squares e.g. 492 – 472 =  (49 + 47)(49 – 47) = 96 x 2 = 192.  Carry out binary operations on real numbers such as: a\*b = 2*a* + *b* – *ab*, etc. |
| ( c ) Solution of Linear        Equations | ( i ) Linear equations in one       variable  ( ii ) Simultaneous linear        equations in two variables. | Solving/finding the truth set (solution set) for linear equations in one variable.  Solving/finding the truth set of simultaneous equations in two variables by elimination, substitution and graphical methods. Word problems involving one or two variables |
| ( d ) Change of Subject of a        Formula/Relation | ( i ) Change of subject of a       formula/relation  (ii) Substitution. | e.g. if = + , find v.  Finding the value of a variable e.g. evaluating *v* given the values of *u* and *f*. |
| ( e ) Quadratic Equations | ( i ) Solution of quadratic       equations  (ii) Forming quadratic equation      with given roots.  (iii) Application of solution of       quadratic equation in       practical problems. | Using factorization i.e. *ab* = 0 either *a* = 0 or *b* = 0.  •**\***♣♠By completing the square and use of formula  Simple rational roots only e.g. forming a quadratic equation whose roots are -3 and (*x* + 3)(*x* - ) = 0. |
| (f) Graphs of Linear and      Quadratic functions. | (i) Interpretation of graphs,     coordinate of points, table of     values, drawing quadratic     graphs and obtaining roots     from graphs.  ( ii ) Graphical solution of a pair         of equations of the form:  y = ax2 + bx + c and y = mx + k  **\***♣♠(iii) Drawing tangents to curves to determine the gradient at a given point. | Finding: (i) the coordinates of maximum and minimum points on the graph.  (ii) intercepts on the axes, identifying axis of symmetry, recognizing sketched graphs.  Use of quadratic graphs to solve related equations e.g. graph of *y* = *x*2 + 5*x* + 6 to solve *x*2 + 5*x* + 4 = 0.  Determining the gradient by drawing relevant triangle. |
| ( g ) Linear Inequalities | (i) Solution of linear inequalities     in one variable and     representation on the number     line.  **\***(ii) Graphical solution of linear      inequalities in two variables.  **\***(iii) Graphical solution of      simultaneous linear      inequalities in two variables. | Truth set is also required.  Simple practical problems  Maximum and minimum values. Application to real life situations e.g. minimum cost, maximum profit, linear programming, etc. |
| ( h ) Algebraic Fractions | Operations on algebraic fractions with: ( i ) Monomial denominators  ( ii ) Binomial denominators | Simple cases only e.g. + = ( x0, y 0).  Simple cases only e.g. + = where *a* and*b* are constants and *xa* or *b*. Values for which a fraction is undefined e.g. is not defined for *x* = -3. |
| ♦•♣♠(i) Functions and Relations | Types of Functions | One-to-one, one-to-many, many-to-one, many-to-many.  Functions as a mapping, determination of the rule of a given mapping/function. |
| **C. MENSURATION**  ( a ) Lengths and  Perimeters | (i) Use of Pythagoras theorem,     **\***♣♠sine and cosine rules to     determine lengths and     distances.  (ii) Lengths of arcs of circles,     perimeters of sectors and      segments.  ♦**\***♣♠(iii) Longitudes and Latitudes. | No formal proofs of the theorem and rules are required.  Distances along latitudes and Longitudes and their corresponding angles. |
| ( b ) Areas | ( i ) Triangles and special        quadrilaterals – rectangles,        parallelograms and        trapeziums  (ii) Circles, sectors and segments      of circles.  (iii) Surface areas of cubes,             cuboids, cylinder, pyramids,       righttriangular prisms, cones       andspheres. | Areas of similar figures. Include area of triangle = ½ base x height and ½absinC.  Areas of compound shapes.  Relationship between the sector of a circle and the surface area of a cone. |
| ( c ) Volumes | (i) Volumes of cubes, cuboids,     cylinders, cones, right     pyramids and spheres.  ( ii ) Volumes of similar solids | Include volumes of compound shapes. |
| **D. PLANE GEOMETRY**  (a) Angles | (i) Angles at a point add up to     360o.  (ii) Adjacent angles on a straight      line are supplementary.  (iii) Vertically opposite angles are       equal. | The degree as a unit of measure.  Consider acute, obtuse, reflex angles, etc. |
| (b) Angles and intercepts on      parallel lines. | (i) Alternate angles are equal.  ( ii )Corresponding angles are       equal.  ( iii )Interior opposite angles are        supplementary  **\***♣♠(iv) Intercept theorem. | Application to proportional division of a line segment. |
| (c) Triangles and Polygons. | (i) The sum of the angles of a triangle is 2 right angles.  (ii) The exterior angle of a      triangle equals the sum of      the two interior opposite       angles.  (iii) Congruent triangles.  ( iv ) Properties of special         triangles - Isosceles,        equilateral, right-angled, etc  (v) Properties of special      quadrilaterals –      parallelogram, rhombus,      square, rectangle, trapezium.  ( vi )Properties of similar        triangles.  ( vii ) The sum of the angles of a          polygon  (viii) Property of exterior angles        of a polygon.  (ix) Parallelograms on the same       base and between the same       parallels are equal in area. | **\***The formal proofs of those underlined may be required.  Conditions to be known but proofs not required e.g. SSS, SAS, etc.  Use symmetry where applicable.  Equiangular properties and ratio of sides and areas.  Sum of interior angles = (n - 2)180o or (2n – 4)right angles, where n is the number of sides |
| ( d ) Circles | (i) Chords.  (ii) The angle which an arc of a      circle subtends at the centre      of the circle is twice that      which it subtends at any      point on the remaining part      of the circumference.  (iii) Any angle subtended at the       circumference by a diameter       is a right angle.  (iv) Angles in the same segment      are equal.  (v) Angles in opposite segments       are supplementary.  ( vi )Perpendicularity of tangent        and radius.  (vii )If a tangent is drawn to a        circle and from the point  of        contact a chord is drawn,        each angle which this chord        makes with the tangent is        equal to the angle in the        alternate segment. | Angles subtended by chords in a circle and at the centre. Perpendicular bisectors of chords.  **\***the formal proofs of those underlined may be required. |
| ♦**\***♣♠( e ) Construction | ( i ) Bisectors of angles and line       segments  (ii) Line parallel or perpendicular      to a given line.  ( iii )Angles e.g. 90o, 60o, 45o,       30o, and an angle equal to a       given angle.  (iv) Triangles and quadrilaterals       from sufficient data. | Include combination of these angles e.g. 75o, 105o,135o, etc. |
| ♦**\***♣♠( f ) Loci | Knowledge of the loci listed below and their intersections in 2 dimensions.  (i) Points at a given distance from     a given point.  (ii) Points equidistant from two      given points.  ( iii)Points equidistant from two      given straight lines.  (iv)Points at a given distance             from a given straight line. | Consider parallel and intersecting lines.  Application to real life situations. |
| **E. COORDINATE     GEOMETRY OF     STRAIGHT LINES** | (i) Concept of the x-y plane.  (ii) Coordinates of points on the x-y plane. | Midpoint of two points, distance between two points i.e. |PQ| = , where P(x1,y1) and Q(x2, y2), gradient (slope) of a line m= , equation of a line in the form y = mx + c and y – y1 = m(x – x1), where m is the gradient (slope) and c is a constant. |
| **F. TRIGONOMETRY**  (a) Sine, Cosine and Tangent       of an angle. | (i) Sine, Cosine and Tangent of     acute angles.  (ii) Use of tables of trigonometric      ratios.  (iii) Trigonometric ratios of 30o,       45o and 60o.  (iv) Sine, cosine and tangent of angles from 0o to 360o.  ( v )Graphs of sine and cosine.  (vi)Graphs of trigonometric  ratios. | Use of right angled triangles  Without the use of tables.  Relate to the unit circle.  0o x 360o.  e.g.*y* = *a*sin*x*, *y* = *b*cos*x*  Graphs of simultaneous linear and trigonometric equations.  e.g. y = asin x + bcos x, etc. |
| ( b ) Angles of elevation and        depression | (i) Calculating angles of elevation and depression.  (ii) Application to heights and distances. | Simple problems only. |
| ♦**\***♣♠( c ) Bearings | (i) Bearing of one point from another.  (ii) Calculation of distances and angles | Notation e.g. 035o, N35oE  Simple problems only. Use of diagram is required.**\***♣♠Sine and cosine rules may be used. |
| **\*G. INTRODUCTORY       CALCULUS** | (i) Differentiation of algebraic     functions.  (ii) Integration of simple Algebraic functions. | Concept/meaning of differentiation/derived function, , relationship between gradient of a curve at a point and the differential coefficient of the equation of the curve at that point. Standard derivatives of some basic function e.g. if y = x2, = 2x. If s = 2t3 + 4, = v = 6t2, where s = distance, t = time and v = velocity. Application to real life situation such as maximum and minimum values, rates of change etc.  Meaning/ concept of integration, evaluation of simple definite algebraic equations. |
| **H. STATISTICS AND PROBABILITY.**  ( A ) Statistics | (i) Frequency distribution  ( ii ) Pie charts, bar charts, histograms and frequency polygons  (iii) Mean, median and mode for both discrete and grouped data.  (iv) Cumulative frequency curve (Ogive).  (v) Measures of Dispersion: range, semi inter-quartile/inter-quartile range, variance, mean deviation and standard deviation. | Construction of frequency distribution tables, concept of class intervals, class mark and class boundary.  Reading and drawing simple inferences from graphs, interpretation of data in histograms.  Exclude unequal class interval.  Use of an assumed mean is acceptable but not required. For grouped data, the mode should be estimated from the histogram while the median, quartiles and percentiles are estimated from the cumulative frequency curve.  Application of the cumulative frequency curve to every day life.  Definition of range, variance, standard deviation, inter-quartile range. Note that mean deviation is the mean of the absolute deviations from the mean and variance is the square of the standard deviation. Problems on range, variance, standard deviation etc.  **\***♣♠Standard deviation of grouped data |
| ( b ) Probability | (i) Experimental and theoretical probability.  (ii) Addition of probabilities for      mutually exclusive and      independent events.  (iii) Multiplication of probabilities      for independent events. | Include equally likely events e.g. probability of throwing a six with a fair die or a head when tossing a fair coin.  With replacement.  **\***♣♠without replacement.  Simple practical problems only. Interpretation of “and” and “or” in probability. |
| ♦♣♠**I. VECTORS AND                TRANSFORMATION**   1. Vectors in a Plane 2. Transformation in the Cartesian Plane | Vectors as a directed line segment.  Cartesian components of a vector  Magnitude of a vector, equal vectors, addition and subtraction of vectors, zero vector, parallel vectors, multiplication of a vector by scalar.  Reflection of points and shapes in the Cartesian Plane.  Rotation of points and shapes in the Cartesian Plane.  Translation of points and shapes in the Cartesian Plane.  Enlargement | (5, 060o)  e.g. .  Knowledge of graphical representation is necessary.  Restrict Plane to the *x* and *y* axes and in the lines *x* = k, *y* = x and y = k*x*, where k is an integer. Determination of mirror lines (symmetry).  Rotation about the origin and a point other than the origin.  Determination of the angle of rotation (restrict angles of rotation to -180o to 180o).  Translation using a translation vector.  Draw the images of plane figures under enlargement with a given centre for a given scale factor.Use given scales to enlarge or reduce plane figures. |

1. **UNITS**

Candidates should be familiar with the following units and their symbols.

**( 1 ) Length**

1000 millimetres (mm) = 100 centimetres (cm) = 1 metre(m).

1000 metres = 1 kilometre (km)

**( 2 ) Area**

10,000 square metres (m2) = 1 hectare (ha)

**( 3 ) Capacity**

1000 cubic centimeters (cm3) = 1 litre (l)

**( 4 ) Mass**

1. milligrammes (mg) = 1 gramme (g)

1000 grammes (g) = 1 kilogramme( kg )

1. ogrammes (kg) = 1 tonne.

**( 5) Currencies**

The Gambia – 100 bututs (b) = 1 Dalasi (D)

Ghana - 100 Ghana pesewas (Gp) = 1 Ghana Cedi ( GH¢)

Liberia - 100 cents (c) = 1 Liberian Dollar (LD)

Nigeria - 100 kobo (k) = 1 Naira (N)

Sierra Leone - 100 cents (c) = 1 Leone (Le)

UK - 100 pence (p) = 1 pound (£)

USA - 100 cents (c) = 1 dollar ($)

French Speaking territories: 100 centimes (c) = 1 Franc (fr)

Any other units used will be defined.

1. **OTHER IMPORTANT INFORMATION**

**( 1) Use of Mathematical and Statistical Tables**

Mathematics and Statistical tables, published or approved by WAEC may be used in the examination room. Where the degree of accuracy is not specified in a question, the degree of accuracy expected will be that obtainable from the mathematical tables.

1. **Use of calculators**

The use of non-programmable, silent and cordless calculators is allowed. The calculators must, however not have the capability to print out **nor to receive or send any information. Phones with or without calculators are not allowed.**

1. **Other Materials Required for the examination**

Candidates should bring rulers, pairs of compasses, protractors, set squares etc required for papers of the subject. They will **not** be allowed to borrow such instruments and any other material from other candidates in the examination hall.

Graph papers ruled in 2mm squares will be provided for any paper in which it is required.

**( 4) Disclaimer**

In spite of the provisions made in paragraphs 4 (1) and (2) above, it should be noted that some questions may prohibit the use of tables and/or calculators.

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