THE UNITED REPUBLIC OF TANZANIA

NATIONAL EXAMINATION COUNCIL

DIPLOMA IN SECONDARY EDUCATION EXAMINATION

740 **MATHEMATICS**

Time: 3 Hours. **SOLUTIONS** **Year: 2014**

Instructions

1. This paper consists of sections A, B and C.

2. Answer **all** questions from Section A and **two (2)** questions from each of section B and C.

3. Section A carries **40** marks, Section B and C carry 30 marks each.

4. Cellular phones are **not** allowed inside the examination room.

5. Write your **Examination Number** on every page of your answer booklet

1. Use scientific calculator to determine the value of $\left(\frac{\sqrt{0.02e^2}}{\tan 66^\circ}\right)$ correct to three significant figures.

   $\sqrt{(0.02e^2)} = e \times \sqrt{0.02} \approx 2.71828 \times 0.1414 \approx 0.3847$
   $\tan 66° \approx 2.246$
   Value = $0.3847 / 2.246 \approx 0.171$

2. With aid of diagrams state any two conditions for two triangles to be similar.

   Two triangles are similar if their corresponding angles are equal (AAA condition).

   Two triangles are similar if their corresponding sides are in proportion (SSS condition).

3. (a) Using common symbols give three examples of connectives in Logic statements.

   $\wedge$ (AND), $\vee$ (OR), $\neg$ (NOT)

   (b) Draw the electrical circuit represented by the proposition $(p \wedge q) \vee (r \vee s)$.

   The circuit has two series branches: first branch p AND q in series, second branch r OR s in parallel. Both branches connected in parallel to form the overall OR ($\vee$) circuit.

4. Write three general equations of the figures obtained from the conic sections.

   Circle: $x^2 + y^2 + 2gx + 2fy + c = 0$

   Ellipse: $x^2/a^2 + y^2/b^2 = 1$

   Parabola: $y^2 = 4ax$ or $x^2 = 4ay$

5. Using the standard scores below write interpretation regarding performance of each student.

Student	Anne	Bahati	Chichi
Standard Scores	0	+1.64	-1.36

Anne: score 0 → average performance, exactly at the mean.

Bahati: score +1.64 → above average, performed better than most students.

Chichi: score -1.36 → below average, performed worse than most students.

6. Give three reasons why teaching materials motivate students in learning mathematics.

Teaching materials make abstract concepts concrete. Many mathematical ideas, such as fractions, 3-D shapes, or algebraic expressions, can be difficult for students to visualize mentally. By using models, charts, or physical objects, students can see and manipulate these concepts, which increases understanding and makes learning more engaging.

Teaching materials increase student engagement. Visual aids, diagrams, manipulatives, and interactive materials attract students' attention and involve them actively in the learning process. This active participation helps sustain interest and curiosity in the subject.

Teaching materials promote active learning and participation. When students use materials themselves, such as solving problems with models or performing experiments, they take part in learning rather than just listening. This involvement encourages exploration, experimentation, and critical thinking, which motivates learners to continue learning mathematics.

7. Mention six criteria for selecting teaching and learning mathematics methods.

The method must be suitable for the learning objectives and lesson content. For example, a method that emphasizes practical activities is suitable for geometry or measurement topics, while explanation and demonstration may be better for abstract concepts.

The level of difficulty should match students' abilities. Methods chosen should neither be too easy nor too challenging, to prevent boredom or frustration.

Time required for implementation. The method should be practical within the available lesson time, ensuring that activities can be completed effectively without rushing.

Availability of resources and materials. Methods that require specific teaching aids or technology should only be chosen if these materials are accessible and functional.

Student learning style and preferences. Some students learn better through visual aids, some through discussion or practice. Selecting methods that accommodate these styles improves learning outcomes.

Effectiveness in promoting understanding and critical thinking. The method should actively engage students in reasoning, problem-solving, and applying mathematical concepts, not just memorizing procedures.

8. Briefly explain the relationship between syllabus and scheme of work.

The syllabus is a broad outline of what students are expected to learn in a subject, specifying topics, skills, and learning objectives over a term or academic year. The scheme of work is a detailed plan that breaks the syllabus into smaller, manageable units and lessons, specifying the sequence, teaching methods, and time allocation for each topic. Essentially, the scheme of work organizes the syllabus content into a practical plan for daily or weekly teaching, ensuring that all syllabus objectives are covered systematically.

9. Outline three characteristics of good mathematics test items.

Clarity and unambiguity. Good test items should be easy to understand and free from confusing language or misleading wording, so that students' performance reflects their knowledge rather than misinterpretation of the question.

Alignment with learning objectives and syllabus content. Questions should assess the specific skills and knowledge intended by the syllabus. This ensures that the test is valid and measures what it is supposed to measure.

Appropriate level of difficulty and variety. A good test includes questions of varying difficulty to differentiate between students of different abilities, and includes different types of questions such as multiple choice, short answer, and problem-solving to assess a range of skills.

10. Differentiate a textbook from a supplementary book as a source of learning materials.

A textbook is a primary source designed to follow the curriculum systematically. It provides structured explanations of concepts, examples, exercises, and practice questions that align with the syllabus. Teachers and students rely on it for core learning content.

A supplementary book, on the other hand, is used in addition to the textbook. It provides extra practice questions, alternative explanations, or additional examples. It does not follow the syllabus strictly but enhances understanding, supports revision, and can clarify difficult concepts that students may not fully grasp from the main textbook.

SECTION B (30 Marks)

11. (a) Given that P(E) is a probability that an event E will happen and P(E') is a probability that an event E does not happen. Show that P(E) + P(E') = 1.

By definition, either E occurs or does not occur. Therefore, P(E) + P(E') = 1 because the total probability of all possible outcomes equals 1.

(b) The probability of two events A and B are such that P(A) = 0.3, P(B) = 0.4, and P(A ∪ B) = 0.5; show that A and B are neither independent nor mutually exclusive.

Mutually exclusive: $P(A \cap B) = 0 \rightarrow P(A \cup B) = P(A) + P(B) = 0.3 + 0.4 = 0.7 \neq 0.5$, so not mutually exclusive.

Independent: $P(A \cap B) = P(A) \times P(B) = 0.3 \times 0.4 = 0.12 \rightarrow P(A \cap B) = P(A) + P(B) - P(A \cup B) = 0.3 + 0.4 - 0.5 = 0.2 \neq 0.12 \rightarrow$ not independent.

12. (a) Deduce the double angle formula for cosine from compound angle formula.

$\cos(2A) = \cos(A + A) = \cos A \cos A - \sin A \sin A = \cos^2 A - \sin^2 A$

(b) Determine the solution of the equation $\sin 3x + \sin x = 0$ for value of x from -180° to 180°.

$\sin 3x + \sin x = 2 \sin(2x) \cos x = 0 \rightarrow \sin(2x) \cos x = 0$
$\cos x = 0 \rightarrow x = \pm 90°$
$\sin 2x = 0 \rightarrow 2x = 0°, \pm 180° \rightarrow x = 0°, \pm 90°$
Unique solutions: x = -90°, 0°, 90°

(c) Given that $\cos \theta = 1/\sqrt{5}$ evaluate $\cos(\theta + 5\pi/2)$.

$\cos(\theta + 5\pi/2) = \cos(\theta + 2\pi + \pi/2) = \cos(\theta + \pi/2) = \cos\theta \cos\pi/2 - \sin\theta \sin\pi/2 = 0 - \sin\theta \times 1 = -\sin\theta$

$\sin^2\theta + \cos^2\theta = 1 \rightarrow \sin\theta = \sqrt{(1 - 1/5)} = \sqrt{(4/5)} = 2/\sqrt{5} \rightarrow \cos(\theta + 5\pi/2) = -2/\sqrt{5}$

13. (a) Find $\int \sin 3x \cos 2x \, dx$.

Use identity: $\sin A \cos B = 1/2[\sin(A+B) + \sin(A-B)]$

$\int \sin 3x \cos 2x \, dx = 1/2 \int [\sin 5x + \sin x] \, dx = 1/2 [-\cos 5x/5 - \cos x] = -1/10 \cos 5x - 1/2 \cos x + C$

(b) Using the knowledge of integration prove that the volume of a cone of height h and base r is $1/3 \pi r^2 h$.

Consider cone along x-axis with base radius r at x=h. Volume $V = \int_0^h \pi y^2 \, dx$, $y = (r/h)x \rightarrow V = \int_0^h \pi (r^2 x^2 / h^2) \, dx = \pi r^2 / h^2 \int_0^h x^2 \, dx = \pi r^2 / h^2 \times h^3/3 = 1/3 \pi r^2 h$

14. (a) Find a unit vector to the direction of vector $a = 2i + j - 2k$.

Magnitude $|a| = \sqrt{(2^2 + 1^2 + (-2)^2)} = \sqrt{(4 + 1 + 4)} = \sqrt{9} = 3$

Unit vector $= a/|a| = (2/3)i + (1/3)j - (2/3)k$

(b) Use cross product to find the formula for finding the area of the parallelogram ABCD. Hence deduce the area of a triangle ABC.

Area of parallelogram $= |AB \times AC|$

Area of triangle ABC $= 1/2 |AB \times AC|$

15. Describe teaching and learning activities to use when leading students to the proof of the theorem of intersecting chords.

Begin by drawing a circle on the board and sketch two intersecting chords, labeling the points of intersection and the endpoints clearly. This visual representation helps students understand the geometric setup.

Ask students to measure or identify the lengths of the segments of each chord, guiding them to observe patterns or relationships. This encourages learners to actively engage and notice connections.

Lead students to express the observed relationships algebraically, for example, using segment multiplication: (segment1 × segment2) of one chord equals (segment1 × segment2) of the other chord. This step links visual observation with symbolic reasoning.

Finally, guide learners step by step to deduce the equality formally, showing that the product of the segments of one chord equals the product of the segments of the other chord. Encourage students to explain each step to reinforce understanding and reasoning skills.

16. By giving four points in each explain the uses, advantages, and disadvantages of lecture method in teaching Mathematics.

Uses:

- To introduce new mathematical concepts and definitions to students in a structured manner.
- To present summaries of large content efficiently.
- To explain problem-solving methods and solution strategies.
- To clarify theoretical foundations before practical exercises.

Advantages:

- Covers a large amount of content within limited time, suitable for dense topics.
- Provides clear and structured delivery controlled by the teacher.
- Ensures consistency in teaching for large classes.
- Easy for teachers to prepare and deliver using notes or slides.

Disadvantages:

- Limits student participation and interaction, reducing engagement.
- Encourages passive learning rather than active problem-solving.
- Makes it difficult to assess students' understanding in real-time.
- May not address individual students' learning needs or pace.

17. State six ways a teacher may use to develop students interest towards mathematics learning.

Use real-life examples to show how mathematics applies to everyday life, such as budgeting, construction, or technology, making learning relevant.

Incorporate teaching aids, visual materials, or manipulatives to make abstract concepts tangible.

Encourage group work, peer discussions, and collaborative problem-solving to create an interactive learning environment.

Use problem-solving activities, puzzles, or challenges to stimulate curiosity and critical thinking.

Provide positive feedback and reinforcement to motivate students and build confidence in their abilities.

Relate lessons to students' prior knowledge and experiences to help them connect new concepts with what they already understand.

18. Explain six advantages of analysing syllabus, textbook, and teachers guide before teaching Mathematics.

Ensures comprehensive coverage of all required topics and learning objectives, preventing omissions during teaching.

Helps in planning effective teaching strategies and selecting appropriate methods for each topic.

Facilitates the selection of suitable teaching aids, resources, and examples to enhance understanding.

Allows the teacher to identify prerequisite knowledge and skills that students must have before introducing new concepts.

Improves time management by allowing the teacher to allocate adequate time for each topic or activity.

Reduces errors, confusion, or inconsistency during teaching, ensuring a smoother lesson flow and better learning outcomes.