"We believe in God the inventor of Mathematics and the greatest mathematician of all time"

THE ROUND TWO INTER-HOUSE MATHEMATICS CONTEST

TIME;

[IXIV.VIIIVIVIIIIIIIIXVIII…]²

SECONDS

SENIOR TEST

INSTRUCTIONS TO PARTICIPANTS

1. Read all questions **CAREFULLY.**
2. A silent scientific calculator is **ALLOWED** if they may be of any help.
3. Mathematical tables are **ALLOWED** if they may be of any help.
4. Give only the exact answers to every problem e.g. $\sqrt[\pi]{7}$, 11^{φ}
5. **DO NOT WRITE ANY MARKS ON THIS TEST BOOKLET.**
6. Crying is allowed but silently.
7. Screaming is allowed but outside.
8. **DO NOT OPEN THIS TEST BOOKLET UNTIL YOU ARE TOLD TO DO SO.**
9. There is a penalty for unanswered problems but not wrong answers.
10. You are expected to answer all the **SEVEN QUESTIONS.**
11. Each question is worth **4 POINTS.**
12. This is a test of both **SOLUTIONS AND ANSWERS**. Write the **WORKING WITH THE ANSWERS** in the **PLAIN SHEET** provided. Use a visible **PENCIL OR PEN** and arrange your work **NEATLY.**

NOTE:

- The Executive Committee of The Alliance High School Mathematics Club (ECAHSMC) reserves the right to disqualify all scores of any participant if it determines that the required security procedures have not been followed.

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PROBLEMS

SECTION I

1. Determine the exact values of k that completely satisfy the following equation.

$$\mathbf{81}^{\sin^2 k} + \mathbf{81}^{\cos^2 k} = \mathbf{30}$$

Where $\mathbf{0}° \leq \mathbf{k} \leq \mathbf{2023}°$
And $\mathbf{k}$ and $\sin k$ are positive values.

2. Given that $\sin\{4x + 5y\} = \cos\{2\frac{1}{2}x + 4y\}$ and $x : y = 3 : 2$.determine the exact values of $\mathbf{x}$ and $\mathbf{y}$.

3. Solve for the exact value of k in the following equation.

$$(\log_k 2) \times (\log_2 3) \times (\log_3 4) \times \cdots \times (\log_{2022} 2023) = 2023^{2023}$$

SECTION II

4. Solve for $\mathbf{m}$ in the following equation.

$$(7m)^{\log 7} = (11m)^{\log 11}$$

5. Khisa's grandson is about as many days as Khisa's son is weeks. Also, Khisa's grandson is as many months as Khisa is in years. Khisa's grandson, Khisa's son and Khisa altogether are 90 years. Calculate the age of Khisa in years.

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SECTION III

6. Mukoya has installed a network plan of **1000Mbps** in his house. Soita visited his home one day and wanted to use the network plan, but, in order to access the internet, one must key in a password. The password to this network plan is simply the exact value of the following integral;

$$\int_{\sqrt[3]{\log 6}}^{\sqrt[3]{\log 7}} \frac{x^2 \sin x^3}{\sin x^3 + \sin(\log 42 - x^3)} dx$$

Determine the password to the network plan and suggest whether Soita was able to use the network plan or not.

7. The **Figure 2** below shows Mukoya's land which is in the shape of a regular dodecagon **M**. Mukoya gave a portion of his land to his son as his inheritance such that from every vertex of the dodecagon he drew a line segment that is perpendicular from the proceeding edge resulting in a smaller regular dodecagon **K**. Given that each side of the dodecagon **M** measures **777km**, determine the ratio of the area of **K** to the area of **M**.

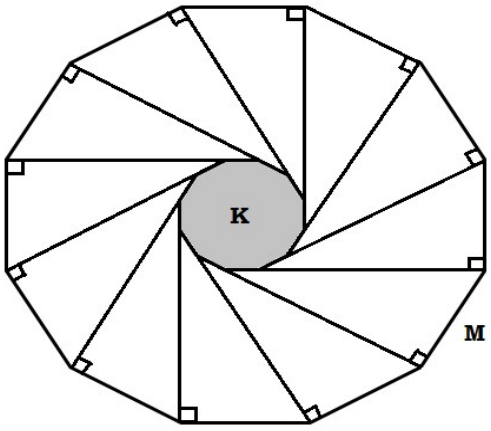

Figure 2

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MATHEMAGICS CLUB EXECUTIVE COMMITTEE

1. MUKOYA KHISA	**CHAIRMAN**	5. SAMWEL WAREGA	FORM **3 REP 1**
2. MATILU MUYEKU	**VICE CHAIRMAN**	6. ALLAN NZIOKA	FORM **3 REP 3**
3. IVAN MAYABI	**SECRETARY**	7. GEOFFREY GIKONYO	FORM **3 REP 2**
4. NIMROD NYABERI	**ORGANISING SECRETARY**		

EXAMINER – MUKOYA KHISA {**Head of the Examination and Analysis Department**}

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Approval signature,

Sir Jonathan Mbithi,

Mathematics Club Patron.

Courtesy of The Alliance High School Mathematics Club in partnership with The Alliance High School Mathematics Department and The Alliance High School Mathematics Community (AHSMC).