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

THE ROUND TWO INTER-HOUSE MATHEMATICS CONTEST

TIME;

$[IXIV.VIIIVIVIIIIIIIIXVIII\ldots]^2$

SECONDS

JUNIOR 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 sum of the digits in **s** given that;

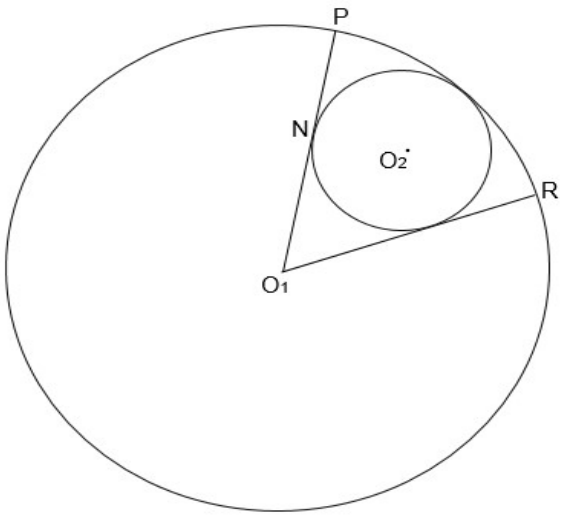
$$\mathbf{s} = \underbrace{777777\cdots777}_{\textbf{(2023 Numbers)}}^{2} - \underbrace{22222\cdots2223}_{\textbf{(2023 Numbers)}}^{2}.$$

2. Given that $\mathbf{E} = 1^1 + 1^2 + 1^3 + 2^1 + 2^2 + 2^3 + \cdots + 2023^1 + 2023^2 + 2023^3$.By deriving a function to determine the sum of infinite terms of the sequence **E**, determine the exact value of **E.**

3. One Monday afternoon, two mathematicians were talking. Gikonyo said to Nyaberi "If you give me one dollar, then we will have the same amount of money." Nyaberi replied, "If you give me one dollar, I will have double the amount of money you are left with." How much money does each of the disturbed mathematicians have?

SECTION II

4. Given that the circles with centres $\mathbf{O_1}$ and $\mathbf{O_2}$ touch internally at **N** and angle $\mathbf{PO_1R} = 60°$. If the radius of the larger circle is 12cm, calculate the radius the smaller circle correct to seven significant figures.



5. Given that,

$$a^1 + b^1 + c^1 = 1$$

$$a^2 + b^2 + c^2 = 2$$

$$a^3 + b^3 + c^3 = 3$$

Determine the exact value of $a^5 + b^5 + c^5$.

SECTION III

6. In **Figure 1** below, a semicircle of radius **r** is drawn with center **V** and diameter **UW**. The line **UW** is then extended to the point **X**, such that the **UW** and **WX** are of equal length. An arc of the circle with center **X** is then drawn so that the line **XY** is a tangent to the semicircle at **Z**, as shown. Determine in terms of **r** the area of triangle **YVW**?

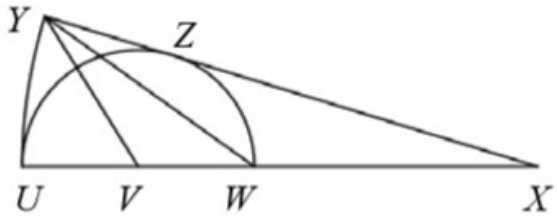
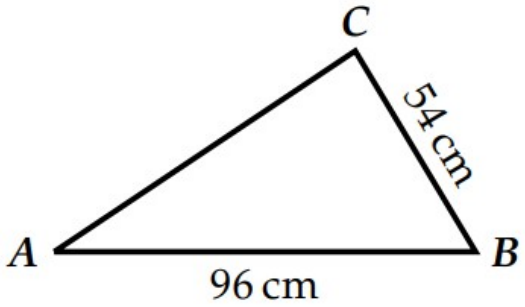


Figure 2

7. In the figure below, ΔABC is such that $\angle C = 3\angle A$, $AB = 96cm$ and $BC = 54cm$. Determine the exact length of **AC**.



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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).