**SUBSIDIARY-MATHEMATICS**

**Date: 20 JUNE 2024**
**Period: 08H30-11H30**

# END OF TERM III EXAMINATIONS QUESTION PAPER

**GRADE:** **SENIOR FIVE**

**COMBINATIONS:**
- HISTORY – GEOGRAPHY-LITERATURE IN ENGLISH **(HGL)**
- HISTORY – LITERATURE IN ENGLISH - PSYCHOLOGY **(HLP)**
- LITERATURE IN ENGLISH – FRENCH – KINYARWANDA - KISWAHILI **(LFK)**

**DURATION:** **2 HOURS**

**MARKS:** /30 **CAMIS** /30

**INSTRUCTIONS:**

1) This paper consists of **two** sections:
   **Section A**: Attempt **all** questions. **(20 marks)**
   **Section B**: Attempt **two** questions only. **(10 marks)**
2) **You may use mathematical instruments and a calculator** where necessary.
3) Use a **blue or black ink pen only** to write your answers and a **pencil** to draw diagrams.

4) Show clearly all the working steps. **Marks will not be awarded for the answer without all working steps.**

**SECTION A: ATTEMPT ALL QUESTIONS.** **(20 marks)**

1) What is a "tautology" in mathematical logic? **(3 marks)**

2) In mathematics, what is a "sequence"? **(3 marks)**

3) Write down the true value (T or F) of the following statements. **(3 marks)**
   a) The number $17$ is a prime number.
   b) Every square is a rectangle.
   c) The number $\pi = 3.14$ is a naturel number.

4) Classify the functions below as "even", "odd" or "neither". **(3 marks)**
   a) $f(x) = -x^3 + 5x - 5$
   b) $g(x) = x^3 + 5x$
   c) $h(x) = -x^2 + 7$

5) The line $L_1$ passes through the points $(2,4)$ and $(5,-2)$. The line $L_2$ passes through the point $(1,-1)$ with gradient $-2$.
   Find the equation of each of the two lines. **(4 marks)**

6) Classify each of the functions below in the following types of functions: constant, identity, irrational, modulus, polynomial or rational functions. **(4 marks)**
   a) $f(x) = x^3 + 2x^2 - 3x + 1$
   b) $g(x) = -1$
   c) $h(t) = \dfrac{t^3 + 2t - 8}{t^2 + 1}$
   d) $f(x) = \sqrt{x^2 - 3x + 5}$

**SECTION B: ATTEMPT TWO QUESTIONS ONLY.** **(10 marks)**

7) Construct the truth table of $(p \vee q) \Leftrightarrow r$. **(5 marks)**

8) The length of a rectangle is $3cm$ greater than its width.
Find its perimeter if its area is $28cm^2$. **(5 marks)**

9) Without using a table of values, find the vertex, intercept with axis, axis of symmetry, and then, sketch the graph of $y = x^2 - 4x + 3$. **(5 marks)**

10) A student draws a rectangle with a length of $6cm$. The student draws a second rectangle with a length of $11cm$. The student continues drawing more rectangles, where for each rectangle drawn, the student uses a length that is $5$ more centimeters than the length of the previous rectangle. If this pattern continues, what will be the length of the $21^{st}$ rectangle? **(5 marks)**

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**SECTION A: ATTEMPT ALL QUESTIONS.** **(20 marks)**

1) A tautology is statement whose true value is T and only T in the last column of its true table. **(3 marks)**

   In other words, a tautology is a propositional function whose truth values are all true.

2) A sequence is a function whose domain is the set of natural numbers. The terms of a sequence are the range elements of the function. It is denoted by $u_1, u_2, u_3, ..., u_n$. **(3 marks)**
   In other way, a sequence is an arrangement of numbers in a particular order.

3) a) The statement has true value T. **(1 mark)**
   b) The statement has true value T. **(1 mark)**
   c) The statement has true value F. **(1 mark)**

4) A) $f(x) = -x^3 + 5x - 5$: $-x \in domf \Rightarrow f(-x) = -(-x)^3 + 5(-x) - 2 = x^3 - 5x - 5 \neq f(x)$ and $f(-x) \neq -f(x)$

   $f(x)$ *is NEITHER even nor odd.* **(1 mark)**

   b) $g(x) = x^3 + 5x : -x \in domg \Rightarrow g(-x) = (-x)^3 + 5(-x) = -x^3 - 5x = -g(x)$

   $g(x)$ *is ODD.* **(1 mark)**

   d) $h(x) = -x^2 + 7 : -x \in domh \Rightarrow h(-x) = -(-x)^2 + 7 = -x^2 + 7$

   $= h(x)$ $h(x)$ *is EVEN.* **(1 mark)**

5) a) $f(x) = x^3 + 2x^2 - 3x + 1$: Polynomial function **(1 mark)**
   b) $g(x) = -1$: Constant function **(1 mark)**
   c) $h(t) = \dfrac{t^3 + 2t - 8}{t^2 + 1}$: Rational function **(1 mark)**
   d) $m(x) = \sqrt{x^2 - 3x + 5}$ : irrational function **(1 mark)**

6) *For* $L_1 : (x_1, y_1) = (2,4)$ *and* $(x_2, y_2) = (5,-2)$ $L_2$ *: gradient* $= -2$ *and passes through* $(1,-1)$

$$L_1 \equiv y - y_1 = \frac{y_2 - y_1}{x_2 - x_1}(x - x_1)$$ **(0.5 marks)**

$L_1 \equiv y-4=\frac{-2-4}{5-2}(x-2)$ **(0.5 marks)**

$L_1 \equiv y-4=-2(x-2)$ **(0.5 marks)**

- $L_1 \equiv y=-2x+8$ **(0.5 marks)**

$L_2 \equiv y=-2x+c$ **(0.5 marks)**

$(1,-1)\in L_1 \Rightarrow -1=-2+c$ **(0.5 marks)**

$\Rightarrow c=1$ **(0.5 marks)**

- $L_2 \equiv y=-2x+1$ **(0.5 marks)**

**SECTION B: ATTEMPT TWO QUESTIONS ONLY.** **(10 marks)**

7) **(5 marks)**

| $p$ | $q$ | $r$ | $p\vee q$ | $(p\vee q)\Leftrightarrow r$ |
|---|---|---|---|---|
| $T$ | $T$ | $T$ | $T$ | $T$ |
| $T$ | $T$ | $F$ | $T$ | $F$ |
| $T$ | $F$ | $T$ | $T$ | $T$ |
| $T$ | $F$ | $F$ | $T$ | $F$ |
| $F$ | $T$ | $T$ | $T$ | $T$ |
| $F$ | $T$ | $F$ | $T$ | $F$ |
| $F$ | $F$ | $T$ | $F$ | $F$ |
| $F$ | $F$ | $F$ | $F$ | $F$ |

8) Let $x$ be the width

$x+3$ is the length

$x\times(x+3)=28$ **(1 mark)**

$x^2+3x-28=0$

$\Delta=9+4\times 28=121$ **(1 mark)**

$x_1=\frac{-3+11}{2}=\frac{8}{2}=4$ **(1 mark)**

$x_2=\frac{-3-11}{2}=\frac{-14}{2}=-7 \prec$ rejected **(1 mark)**

The width is $4cm$.

The length is $4cm+3cm=7cm$ **(1 mark)**

9) $y=x^2-4x+3$

The coefficients are $a=1, b=-4$ *and* $c=3$

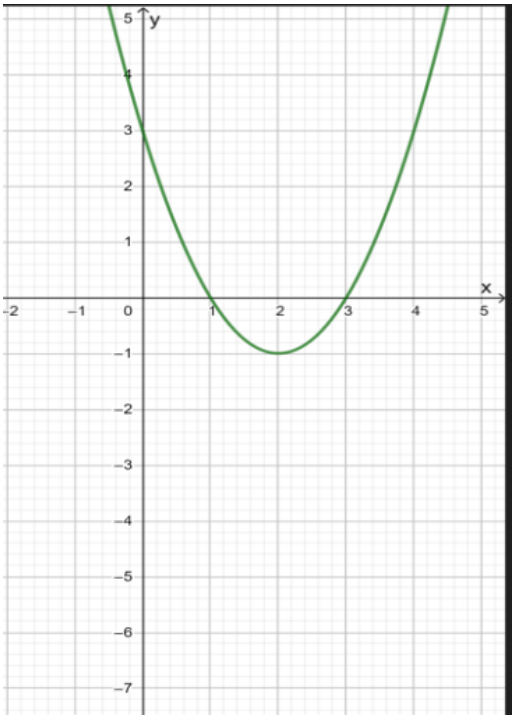
- The vertex $v\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)=\left(-\frac{-4}{2},(4-8+3)\right)=(2,-1)$ **(1 mark)**

  *And the axis of symmetry* : $x=2$
- *Y*-intercept: $x=0 \Rightarrow y=3$ and the point is $(0,3)$ **(1 mark)**
- When $y=0,\ x^2-4x+3=0$

  $\Leftrightarrow (x-1)(x-3)=0 \Leftrightarrow x=1 or\ x=3$

  *Thus, we have* $(1,0)$ *and* $(3,0)$ **(1 mark)**

  The graph is as below. **(2 marks)**




10) The pattern is an arithmetic sequence whose the 1st term $a_1=6$, the second is $a_2=11$ and the number of terms is $n=21$ .

$a_1=6$, the common difference is $d=5$. **(1 mark)**

The arithmetic sequence is $6,11,.....,a_{21}$

The $n^{th}$ term is $a_n=a_1+(n-1)d=6+20\times 5=106$ **(3 marks)**

The length of the 21st rectangle will be $106cm$. **(1 mark)**