

0770/2/2024
P.M.S. A/L

**SOUTH WEST REGIONAL MOCK EXAMINATION
GENERAL EDUCATION**

THE TEACHERS' RESOURCE UNIT (TRU)

IN COLLABORATION WITH

THE REGIONAL INSPECTORATE OF PEDAGOGY FOR SCIENCE EDUCATION

AND

THE SOUTH-WEST ASSOCIATION OF MATHEMATICS TEACHERS

(SWAMT)

MONDAY MORNING, 23/03/2024

ADVANCED LEVEL

Subject Title	Pure Mathematics With Statistics
Paper Number	Paper 2
Subject Code Number	0770

Three Hours

INSTRUCTIONS TO CANDIDATES:

Answer ALL questions.

For your guidance, the approximate mark allocation for parts of each question is indicated in brackets.

You are reminded of the necessity for good English and orderly presentation in your answers.

Mathematical formulae and tables published by the CGCE Board and noiseless, non-programmable calculators are allowed.

TRU/RPI-Sc/PMS/ 0770/P2/MOCK 2024.

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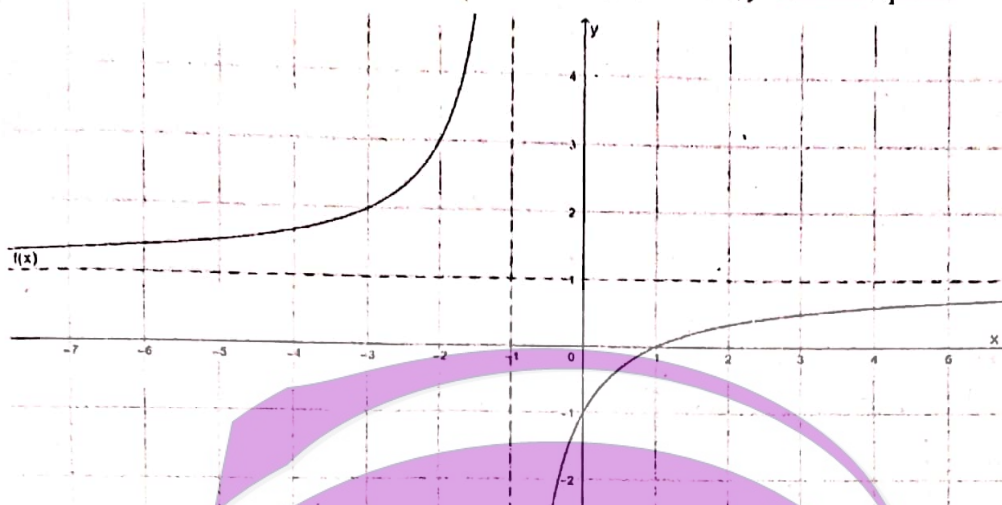


SCAN TO VISIT THE WEBSITE

- 1 (i) Given that the zeros of the polynomial $x^3 - 2x^2 - x - 2b$ are a, b and $a + b$, determine the values of a and b . (6 marks)
- (ii) Two quantities x and y are known to be connected by a law of the form $y = a(x + 2)^n$, where a and n are real constants. Linearize $y = a(x + 2)^n$, stating clearly the gradient and intercept. (4 marks)
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- 2 (i) Given that one of the roots of the equation $3x^2 - (4 + 2k)x + 2k = 0$ are α and β , find the value of k for which $\beta = 3\alpha$ (6marks)
- (ii) A rectangular block has a square base. The area of the base is $(3 - 2\sqrt{2})m^2$ and the volume of the block is $(3 + 2\sqrt{2})m^3$. Find, without using a calculator, the height of the block in the form $(p + q\sqrt{2})m$, $p, q \in \mathbb{Z}$. (Volume of rectangular block, $v = \text{base area} \times \text{height}$) (4 marks)
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- 3 (i) Given that the arithmetic mean and geometric mean of two positive numbers x and y are 10 and 8, respectively, where $x > y$, determine the values of x and y (6 marks)
- (ii) Given that $(x - 1)^2 + 4 > 0$, $\forall x \in \mathbb{R}$, find the set of values of x for which $\frac{(x-1)^2+4}{(x-5)(x-1)} < 0$ (4 marks)
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- 4 (i) (a) Prove that $\cos^2 x + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) = \frac{3}{2}$ (4 marks)
- (b) Hence, find the general solution of $\cos^2 x + \cos^2\left(x + \frac{\pi}{3}\right) + \cos^2\left(x - \frac{\pi}{3}\right) = 3 \sin x$ (3 marks)
- (ii) Determine the number of numbers greater than 1,000,000 that can be formed using the digits 1, 2, 0, 2, 4, 2, 4 if each of the seven digits cannot be used more than once. (3 marks)
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- 5 (i) Given $A = \{1, 2, 3\}$ and $\mathcal{R} = \{(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)\}$,
 (a) show that $\mathcal{R}$ is an equivalence relation, (3 marks)
 (b) write the equivalence classes of the element 1 (1 mark)
 (c) determine $A \times A$ (1 mark)
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- (ii) Given that $f(x) = \sin x$ is differentiable everywhere and that there exists some $c \in]0, 2\pi[$ with $f'(c) = 0$, determine the set values of c in the interval $]0, 2\pi[$ (5 marks)



- 6 (i) The graph below is the curve of the numerical function $f(x)$ in the x, y coordinate plane.



- (a) State the domain of definition of $f(x)$ (1 mark)
 (b) State the coordinates of the y -intercept (1 mark)
 (c) Write the equation of the horizontal asymptote (1 mark)
 (d) Draw the table of variation of $f(x)$ (3 marks)
- (ii) Determine the coefficient of $x^6 y^3$ in the expansion of $(x + 2y)^9$ (4 marks)
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- 7 (i) The points A, B and C are such that $\overrightarrow{AB} = -i - j - 2k$ and $\overrightarrow{BC} = 2i - j + k$. Find
- (a) $\overrightarrow{AB} \times \overrightarrow{BC}$, (3 marks)
 (b) the value of the constant μ for which the line $\vec{r} = i + 2j - k + \lambda(3\mu i - j + 5k)$ is parallel to the plane containing A, B and C . (3 marks)
- (ii) The Circles $C_1: x^2 + y^2 - 2x - 6y + 1 = 0$ and $C_2: x^2 + y^2 - 8x - 8y + 13 = 0$ touch internally at one point only. Determine
- (a) The equation of their common tangent (2 marks)
 (b) The coordinates of the centre and the length of the radius of C_1 (2 marks)

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- 8 (i) Using the substitution $u = \arctan x$, determine $\int \frac{dx}{(1+x^2)(\arctan x)}$ (5 marks)
- (ii) Prove by Mathematical induction that $\forall n \in \mathbb{Z}, n^2 + n$ is always even. (5 marks)



9. (i) Given the matrix $A = \begin{pmatrix} 1 & 1 & 0 \\ 1 & 2 & 2 \\ 0 & -1 & 3 \end{pmatrix}$,

(a) Show that A is invertible.

(2 marks)

(b) Find the inverse of A .

(3 marks)

(ii) Find the locus of the points represented by the complex number z such that $2|z - 3| = |z - 6i|$

(5 marks)

10 (i) Given that $f(x) = x - 5 + x^2 \ln x$,

(a) Show that the equation $f(x) = 0$ has a root in the interval $2 < x < 3$

(2 marks)

(b) Taking $x = 2$ as the first approximation to the root of $f(x) = 0$, use one iteration of Newton

Raphson's procedure to find a second approximation to this root, to two decimal places. (3 marks)

(ii) (a) Find the volume generated when the area of the finite region enclosed by the x -axis and the curve $y = x - x^2$ is rotated completely about the x -axis.

(4 marks)

(b) p : "Mark obeys school rules" and q : "Mark will not be punished" are statements. Write in ordinary English, $\sim(\sim p \vee q)$.

(1 mark)

END
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