

2024 SUPER MOCK ELECTIVE MATHEMATICS 2
MATHEMATICS
PAPER 2
SECTION A

*Answer **all** the questions in this section. [48 Marks]*

1. A binary operation Δ is defined on the set R of real numbers by $a\Delta b = a + b - 5ab$, where $a, b \in R$ and R is closed under Δ . Find the;

a) Identity element e

b) Inverse of $-\frac{1}{4}$

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b).....
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2. In ΔPQR , $PQ = a$, $QR = a + 5$, $PR = a + 3$ and $\angle Q = 60^\circ$. Find the value of a

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3. Express $y = 3x^2 - 6x + 10$ in the form $y = a(x - b)^2 + c$, where a, b and c are integers.
Hence state the minimum value of $y = 3x^2 - 6x + 10$ and the value of x for which it occurs.

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4. A sequence is given by $U_{n+1} = 3 + U_n$, $U_1 = 1$ where $n \geq 1$. Find U_2 , U_3 and hence calculate the sum of the first ten terms of the sequence.

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5. Find the standard deviation, if each of the numbers 2,3,6,10,14 is multiplied by 2 and 3 is added.

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6. If the polynomials $x^3 + x^2 - 4x + 5$ and $x^3 + 3x - 7$, have the same remainder when divided by the factor $x - a$ find the possible values of a

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7. An object of mass 20kg is suspended at a point G by two light inextensible strings $\overline{XG}$ and $\overline{YG}$. The strings are inclined at 55° and 35° respectively to the downward vertical. Find correct to four significant figures, the tensions in the strings. [Take $g = 10\text{ms}^{-2}$]

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8. The probability that Serwa will pass a certain examination is $\frac{3}{4}$ and the probability that her brother Yaw will pass the same examination is $\frac{2}{3}$. Find the probability that exactly one of them will pass the examination.

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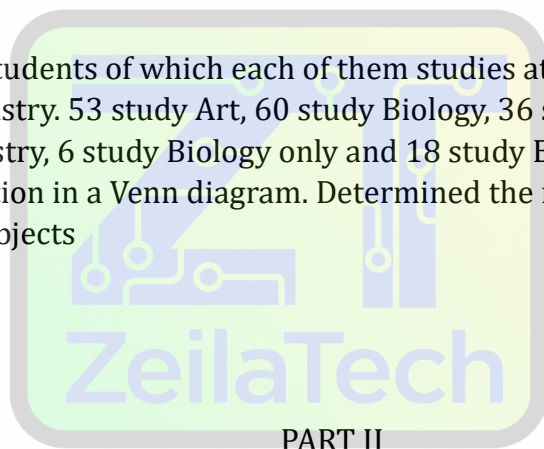
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SECTION B

Answer **four** questions in **all** with at least **one** question from each part

PART I (PURE MATHEMATICS)

9. (a) The function f and g are defined on the set of real numbers by $f: x \rightarrow 1 - x^2$, $g: x \rightarrow 1 + x^2$, find
- $f(\cos x)$
 - $f(\tan x)$
 - $fog(x)$
- (b) Find the truth set of $2^{2x+2} - 5(2^x) + 1 = 0, x \in R$
10. (a) Find the equation of the circle with centre $(2, 0)$ and passes through the point $(5, 4)$
- (b) Two linear transformations N and P are defined by $N: (x, y) \rightarrow (5x + 3y, 6x + 4y)$ $P: (x, y) \rightarrow (4x - 3y, -6x + 5y)$
- Write down the matrix N and P
 - Find the matrix NP
 - Deduce the inverse of P
11. A class consist of 80 students of which each of them studies at least one of the subjects Biology, Arts or Chemistry. 53 study Art, 60 study Biology, 36 study Arts and Biology, 34 study Arts and Chemistry, 6 study Biology only and 18 study Biology but not Chemistry. Illustrate the information in a Venn diagram. Determine the number of students who study
- All the three subjects
 - only Arts
 - Chemistry



PART II (STATISTICS AND PROBABILITY)

12. One thousand candidates sat for an Entrance Examination to a secondary grammar school and their marks in percentages, were distributed as shown in the table below.

Marks	0 - 9	10- 19	20- 29	30- 39	40- 49	50- 59	60- 69	70- 79	80- 89	90- 99
No. of candidates	26	64	112	170	212	192	130	62	22	10

- Draw a cumulative frequency curve for the distribution
- Use your curve to estimate the inter-quartile range
- If it is decided to award a scholarship to the top 10%, use your graph to estimate the least mark a candidate must obtain to be awarded a scholarship.

13. In a village 40% of the men are farmers. If 5 men are randomly selected from the village, what is the probability that
- No farmer is selected?
 - Exactly 4 men are farmers?
 - At most 2 men are farmers?
 - At least there is one farmer?

PART III

(VECTORS AND MECHANICS)

14. (a) Two particles of masses 20kg and 15kg moving with velocities 25ms^{-1} and 20ms^{-1} respectively collide. They move together after collision, find their common velocity, if they were moving in
- The same direction
 - Opposite directions
- (b) Given that $\mathbf{r} = 2\mathbf{p} + \mathbf{s}$, where $\mathbf{p} = \begin{pmatrix} 1 \\ 0 \end{pmatrix}$, $\mathbf{q} = \begin{pmatrix} 1 \\ 4 \end{pmatrix}$. Find $|\mathbf{r}|$
15. (a) If $\mathbf{a} = 3\mathbf{i} + 2\mathbf{j}$, $\mathbf{b} = \mathbf{i} + 4\mathbf{j}$, find the angle between $\mathbf{a}$ and $\mathbf{b}$
- (b) A particle is projected vertically upward with a velocity of 60ms^{-1} from a point $\mathbf{O}$. Find the height reached by the particle. [Take $\mathbf{g} = 10\text{ms}^{-2}$]

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END OF PAPER