National Examination Paper:
MATHEMATICS

Level: ORDINARY LEVEL (S3)

NESA NATIONAL EXAMINATION AND SCHOOL INSPECTION AUTHORITY

MOCK FOR THE 2024/2025 NATIONAL EXAMINATIONS

QUESTION PAPER

COMBINATIONS/ OPTION/TRADE:	.....

CANDIDATE NAMES: .....

INDEX NUMBER: .....

DURATION: 3 HOURS

INSTRUCTIONS TO CANDIDATES:

1. **Read and understand** all instructions before answering.
2. For multiple-choice questions, **choose only one correct answer** and clearly **circle the letter or number**.
3. **Erasing or altering** answers is strictly prohibited and will lead to **zero mark** for the affected question.
4. All answers for **open-Ended questions** must be written in the spaces provided herein.
5. Use **only blue or black ink pens** (no pencils or colored pens).

May 2025

SECTION A: ANSWER ALL QUESTIONS. (55 marks)

1) Given set $E = \{2, 3, 5, 7, 11, 13, 17, 19, 23\}$. **(4 marks)**

Complete with $(\in, \notin, \subset, \text{or } \not\subset)$ the following:

a) 3.....E
b) 4.....E
c) {1, 3, 7}.....E
d) E.....{prime numbers}

2) Answer by true or false on the statements below. **(4 marks)**

If the sides of a triangle measure 16 cm, $16\sqrt{2}$ cm and 16 cm respectively;

a) The triangle is right-angled: .....
b) The triangle is isosceles: .....
c) The area of the triangle is $128\sqrt{2}$ cm^2: .....
d) The area of the triangle is 128 cm^2: .....

3) Answer by true or false on the following statements. **(4 marks)**

a) Every linear inequality has exactly one solution: .....
b) A linear equation has always a constant term: .....
c) The graph of a linear equation is always a straight line: .....
d) When simultaneous linear equations have one solution, the lines representing the equations intersect at a point: .....

4) Work out the following and circle the correct answer. **(3 marks)**

$23.97 + 2(11.44 - 6.44) - 16 =$

a) 1.97
b) 17.97
c) 24.41
d) 43.73

5) Write the restrictions to apply in roster form of a set and calculate the value of $E = \frac{x^2 + x}{x^2 - 1} \div \frac{3x}{x - 1}$. **(4 marks)**

Circle the **best** answer.

a) $x \notin \{0, 1\}$ and $E = \frac{1}{3}$

b) $x \notin \{-1, 1\}$ and $E = \frac{1}{3}$

c) $x \in \{-1, 0, 1\}$ and $E = \frac{1}{3}$

d) $x \notin \{-1, 0, 1\}$ and $E = \frac{1}{3}$

6) Convert 514_8 to binary number and circle the correct answer. **(4 marks)**

a) $514_8 = 101001100_2$

b) $514_8 = 110001100_2$

c) $514_8 = 011001100_2$

d) $514_8 = 101001010_2$

7) Rationalize the denominator: $\frac{\sqrt{3}}{\sqrt{6} - \sqrt{3}}$ **(4 marks)**

Circle the correct answer.

a) $1 + \sqrt{2}$

b) $1 - \sqrt{2}$

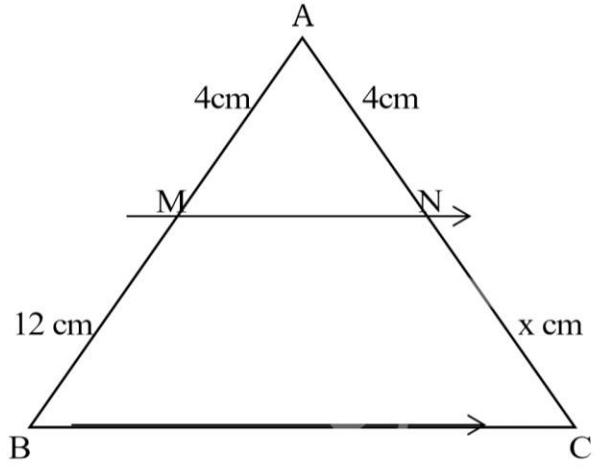
c) $\sqrt{2} - 1$

d) $-(1 + \sqrt{2})$

8) A cylindrical fuel tank has a diameter of $4\,\text{m}$. Its height is $7\,\text{m}$.
Using $\pi = \frac{22}{7}$, calculate its volume (V) and circle the right answer. **(3 marks)**

a) $V = 352\ \text{m}^3$
b) $V = 176\ \text{m}^3$
c) $V = 88\ \text{m}^3$
d) $V = 88\ \text{dm}^3$

9) In the figure below, MN is parallel to BC, find the value of x. **(3 marks)**



Circle the correct answer.

a) $x = 1\text{cm}$
b) $x = \frac{4}{3}\ \text{cm}$
c) $x = 4\ \text{cm}$
d) $x = 12\ \text{cm}$

10) It has been observed that in a certain region, five out of every 100 children die at an age below five years. What is the probability (P) that a child born in the region will live for more than five years? **(4 marks)**

Circle the correct answer.

a) $P = 0$

b) $P = \frac{1}{20}$

c) $P = \frac{19}{20}$

d) $P = 1$

11) Solve the simultaneous equations: $\begin{cases} 3x + 4y = 23 \\ 2x - 4y = 2 \end{cases}$ **(4 marks)**

Circle the correct solutions set (S).

a) $S = \{5, 2\}$

b) $S = \{(5, 2)\}$

c) $S = \{(-1, -1)\}$

d) $S = \left\{\left(8, -\frac{1}{4}\right)\right\}$

12) A rectangle with a length (L) of $10\,cm$ and width (W) of $6\,cm$ is enlarged by a scale factor of 2.5. What are its new dimensions? **(3 marks)**

Circle the correct answer.

a) $L = 4\,cm$ and $W = 2.4\,cm$

b) $L = 5\,cm$ and $W = 3\,cm$

c) $L = 10\,cm$ and $W = 6\,cm$

d) $L = 25\,cm$ and $W = 15\,cm$

13) Solve the equation $2x^2 - 3x - 9 = 0$ and circle the correct solutions set. **(3 marks)**

a) $\left\{-\frac{3}{2}, 3\right\}$

b) $\left\{\frac{3}{2}, -3\right\}$

c) $\left\{\frac{3}{2}, 3\right\}$

d) $\left\{-\frac{3}{2}, -3\right\}$

14) Mrs Mitako had a beauty shop in City of Kigali. She employed a sales agent to sell the beauty products around the City. The sales agent earned a salary of 74,260 Frw and a commission of 6% for all the goods sold. In one month, the sales from the agent were 50,429,000 Frw . How much did she pay the agent? Circle the correct answer. **(3 marks)**

a) 3,100,000 Frw

b) 3,025,740 Frw

c) 30,257,400 Frw

d) 50,429,000 Frw

15) A right triangle has hypotenuse of 17 cm long. If one of the two shorter sides is 8 cm long.

a) Find the length of the third side. **(3 marks)**

b) Calculate the area of the triangle. **(2 marks)**

SECTION B: ATTEMPT THREE QUESTIONS ONLY. **(45 marks)**

16) Given that $Q(x) = 2x^3 - 5x^2 - 9x + 18$

a) Calculate $Q(-2)$. **(4 marks)**

b) Factorize completely $Q(x)$. **(6 marks)**

c) Solve the equation $Q(x) = 0$. **(5 marks)**

17) Out of 17 teachers in a school, 10 teach Economics and 9 teach Mathematics. The number of teachers who teach both subjects is twice that of those who teach none of the two subjects. With the aid of a Venn diagram, find the number of teachers who teach:

a) None of the two subjects. **(9 marks)**

b) Both subjects. **(3 marks)**

c) Only one subject. **(3 marks)**

18) The table below shows the ages in years of 81 students.

Ages (years)	14	15	16	17	18	19	20
Frequency	12	8	10	20	10	11	10

a) Complete the frequency table below. **(8 marks)**

Age (x)	Frequency (f)	fx
14	12	168
	$\Sigma f =$	$\Sigma fx =$

b) Write the mode age. **(2 marks)**

c) Find the median age. **(3 marks)**

d) Calculate the mean age. **(2 marks)**

19) A man invested 10,000 Frw at 10% compounded interest.

a) Find the interest for the first year. **(3 marks)**
b) Calculate the amount after the second year. **(8 marks)**
c) Find the total amount of money accumulated after 3 years. **(4 marks)**

20) Given the points A, B and C on Cartesian plane such that $A(-2, 5)$, $B(4, -3)$ and $C(-3, 3)$, find the equation of:

a) The line AB that passes through the points A and B. **(5 marks)**

b) The line through the point C and is parallel to the line AB. **(5 marks)**

c) The line through the point C and is perpendicular to the line AB. **(5 marks)**

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MARKING GUIDE

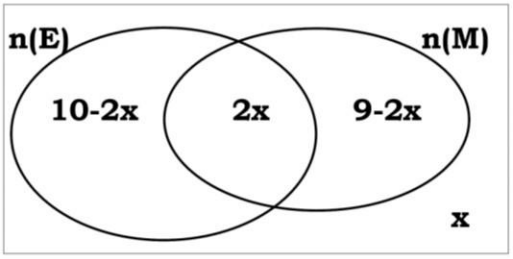
COMBINATION/ OPTION/TRADE:	.....

May 2025

Answers

Question No	Answer	Marks allocation
1	a) $3 \in E$ b) $4 \notin E$ c) $\{1, 3, 7\} \subset E$ d) $E \subset$ {prime numbers}	/**4** Marks
2	a) True b) True c) False d) True	/**4** Marks
3	a) False b) False c) True d) True	/**4** Marks
4	**b)** 17.97	/**3** Marks
5	**d)** $x \notin \{-1, 0, 1\}$ and $E = \frac{1}{3}$	/**4** Marks
6	**a)** $514_8 = 101001100_2$	/**4** Marks
7	**a)** $1+\sqrt{2}$	/**4** Marks
8	**c)** $V = 88\ m^3$	/**3** Marks
9	**d)** $x = 12$ cm	/**3** Marks
10	**c)** $P = \frac{19}{20}$	/**4** Marks
11	**b)** $S = \{(5, 2)\}$	/**4** Marks
12	**d)** $L = 25$ cm and $W = 15$ cm	/**3** Marks
13	**a)** $\left\{-\frac{3}{2}, 3\right\}$	/**3** Marks
14	**a)** 3,100,000 Frw	/**3** Marks
15a	The length of the third side $= \sqrt{(17\text{ cm})^2 - (8\text{ cm})^2}$ ...../**1** $= \sqrt{289\text{ cm}^2 - 64\text{ cm}^2}$ ..... /**1** $= \sqrt{225\text{ cm}^2} = 15$ cm ...../**1**	/**3** Marks
15b	The area of the triangle $= \frac{15\text{ cm} \times 8\text{ cm}}{2}$ ..... /**1** $= 60\text{ cm}^2$ ..... /**1**	/**2** Marks

16a	$Q(x) = 2x^3 - 5x^2 - 9x + 18$ $Q(-2) = 2(-2)^3 - 5(-2)^2 - 9(-2) + 18$ ..... /1 $Q(-2) = -16 - 20 + 18 + 18$ ..... /1 $Q(-2) = -36 + 36$ ..... /1 $Q(-2) = 0$ ..... /1	/**4** Marks
16b	**Factorization of** $Q(x) = 2x^3 - 5x^2 - 9x + 18$ $Q(-2) = 0 \Rightarrow x+2$ is a factor of $Q(x)$ ..... /1 $\frac{Q(x)}{x+2} = \frac{2x^3-5x^2-9x+18}{x+2} = 2x^2-9x+9$ ..... /1 $Q(x) = (x+2)(2x^2-9x+9)$ Factorization of $q(x) = 2x^2 - 9x + 9$ $q(3) = 2(3)^2 - 9(3) + 9 = 18 - 27 + 9 = 27 - 27 = 0$ ..... /1 $q(3) = 0 \Rightarrow (x-3)$ is a factor of q(x) ..... /1 $\frac{q(x)}{x-3} = \frac{2x^2-9x+9}{x-3} = 2x-3$ ..... /1 **So,** $Q(x) = 2x^3 - 5x^2 - 9x + 18 = (x+2)(x-3)(2x-3)$. /1	/**6** Marks
16c	$Q(x) = 2x^3 - 5x^2 - 9x + 18 = 0 \Leftrightarrow (x+2)(x-3)(2x-3) = 0$ ..... /1 $x+2=0$ or $x-3=0$ or $2x-3=0$ $x=-2$ or $x=3$ or $x=\frac{3}{2}$ .... /3 **The solutions set is** $\left\{-2, \frac{3}{2}, 3\right\}$ ..... /1	/**5** Marks
17a	Number of all teachers= $n(T) = 17$ Number of teachers who teach Economics= $n(E) = 10$ Number of teachers who teach Mathematics= $n(M)=9$. Let x be the number of teachers who teach none of the two subjects. $\Rightarrow$ the number of teachers who teach both subjects is 2x	/**9** Marks

<table>
<tr><td></td><td> 

..... /5
10- 2x + 2x + 9-2x + x = 17 ..... /2
19 – x = 17 ..... /1
x = 19-17=2 ..... /1
The number of teachers who teach none of the subjects is 2.</td><td></td></tr>
<tr><td>17b</td><td>The number of teachers who teach both subjects= 2×2=4</td><td>/3 Marks</td></tr>
<tr><td>17c</td><td>The number of teachers who teach only one subject
=10-4+9-4=11</td><td>/3 Marks</td></tr>
<tr><td>18a</td><td><table>
<tr><td>Age (x)</td><td>Frequency (f)</td><td>fx</td></tr>
<tr><td>14</td><td>12</td><td>168</td></tr>
<tr><td>15</td><td>8</td><td>120</td></tr>
<tr><td>16</td><td>10</td><td>160</td></tr>
<tr><td>17</td><td>20</td><td>340</td></tr>
<tr><td>18</td><td>10</td><td>180</td></tr>
<tr><td>19</td><td>11</td><td>209</td></tr>
<tr><td>20</td><td>10</td><td>200</td></tr>
<tr><td></td><td>$\Sigma f = \mathbf{81}$</td><td>$\Sigma fx =$ 1,377</td></tr>
</table></td><td>/8 Marks</td></tr>
<tr><td>18b</td><td>The mode age is 17 years.</td><td>/2 Marks</td></tr>
<tr><td>18c</td><td>The median age is the 41st term; it is 17 years.</td><td>/3 Marks</td></tr>
<tr><td>18d</td><td>The mean age $= \frac{\Sigma fx}{\Sigma f} = \frac{1377}{81} =$ 17 years.</td><td>/2 Marks</td></tr>
<tr><td>19a</td><td>Principal P=10,000Frw
Rate r=10%
The interest for the 1st year$= \frac{10 \times 10{,}000 \text{ Frw}}{100} = 1{,}000$ Frw</td><td>/3 Marks</td></tr>
<tr><td>19b</td><td>Amount of money accumulated at the end of the 1st year=
10,000 Frw + 1,000 Frw = 11,000 Frw ..... /3</td><td>/8 Marks</td></tr>
</table>

	The interest for the 2nd year= $\frac{10\times 11{,}000\ \text{Frw}}{100}$ =1,100 Frw .... /2 The amount after the 2nd year= 11,000 Frw + 1,100 Frw = 12,100 Frw .....**/3** **Alternative method** Apply the formula $A = P(1+r)^n$ The amount after 2 years= $10{,}000\left(1+\frac{10}{100}\right)^2 = 10{,}000(1+0.1)^2 = 10{,}000(1.1)^2 = 10{,}000\times 1.21$ **=12,100 Frw**	
19c	The investment for the 3rd year is 12,100 Frw The interest for the 3rd year= $\frac{10\times 12{,}100}{100}$ =1,210 Frw ..... **/2** The amount accumulated after 3 years= 12,100 Frw+1,210 Frw = 13,310 Frw .....**/2** **Alternative method** Apply the formula $A = P(1+r)^n$ The amount accumulated after 3 years= $10{,}000(1+0.1)^3 = 10{,}000(1.1)^3 = 10{,}0000(1.331) = 13{,}310\text{Frw}$	/**4** Marks
20a	The equation of the line AB $\equiv y-(5) = \frac{-3-5}{4-(-2)}(x-(-2))$ **/1** $\equiv y-5 = \frac{-8}{6}(x+2)$ ..... **/1** $\equiv y-5 = \frac{-4}{3}(x+2) \Leftrightarrow y-5 = -\frac{4}{3}x-\frac{8}{3}$ **/1** $y = -\frac{4}{3}x-\frac{8}{3}+5$ ..... **/1** The equation of the line AB is $y = -\frac{4}{3}x+\frac{7}{3}$ ..... **/1**	/ ... Marks
20b	Two parallel lines have the same gradient. Thus the gradient of the two lines is $m = -\frac{4}{3}$ ..... **/1** The equation of the line: $y = -\frac{4}{3}x + c$ ..... **/1** The line passes through $C(-3,3)$ implies $3 = -\frac{4}{3}(-3)+c$ ... **/1**	/**5** Marks

	$c = 3 - 4 = -1$ ..... /1 Therefore the equation of the line is $y = -\frac{4x}{3} - 1$ ..... /1	
20c	The equation of the line $y = mx + c$ The line is perpendicular to the line AB $\Leftrightarrow -\frac{4}{3}m = -1$ ..... /1 $\Leftrightarrow m = \frac{3}{4}$ ..... /1 The equation of the line is $y = \frac{3}{4}x + c$ ..... /1 $\Rightarrow 3 = -\frac{9}{4} + c$ The line passes through $C(-3,3)$ ..... /1 $\Rightarrow c = 3 + \frac{9}{4} = \frac{21}{9}$ The equation of the line is $y = \frac{3}{4}x + \frac{21}{4}$ ..... /1	/5 Marks

END