NAIROBI SCHOOL

Opener Term 3 Exam

121-Hybrid

Form 4

MATHEMATICS

Question Paper

October. 2022— 150 minutes

FILL IN YOUR PERSONAL DETAILS HERE

Student Name:

Admission Number: | | | | | |

Class: | 4 | |

Instructions to candidates

(a) Write your name, admission number and class in the spaces provided above.
(b) This paper consists of two sections; **Section I** and **Section II**.
(c) Answer **all** the questions in **Section I** and **any five** questions from **Section II.**
(d) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
(e) **KNEC Mathematical tables** may be used, except where stated otherwise.
(f) **Non-programmable** silent electronic calculators **must not** be used, except where stated otherwise.
(g) This paper consists of **16** printed pages.
(h) Remember to tick the questions you have attempted in **Section II**

For Examiner's Use Only

SECTION I

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL

SECTION II(*Please tick the questions you have attempted*)

17	18	19	20	21	22	23	24	TOTAL
								✓

GRAND TOTAL

121-Hybrid

TURN OVER

SECTION ONE - 50 MARKS

Answer all questions from this section in the spaces provided.

1). The coordinates of two airports **M** and **N** are $(\mathbf{60^\circ N, 35^\circ W})$ and $(\mathbf{60^\circ N, 15^\circ E})$ respectively. Calculate;

(a) the longitude difference. **[1 mark]**

(b) the shortest time an aeroplane whose speed is **250** knots will take to fly from **M** to **N** along a circle of latitude. **[2 marks]**

2). Kasyoka and Kyalo working together can do a piece of work in **6** days. Kasyoka, working alone takes **5** days longer than Kyalo. How many days does it take Kyalo to do the work alone? **[4 marks]**

3). Find the radius and the centre of the circle whose equation is: [4 marks]

$$3x^2 + 3y^2 - 6x + 12y + 3 = 0$$

4). A particle moves along a straight line **AB**. Its velocity **v** metres per second after **t** seconds is given by $\mathbf{v = t^2 - 3t + 5}$. Determine distance covered within the third second. [3 marks]

5). Ali deposited **KES 100, 000** in a financial institution that paid simple interest at the rate of **12.5%** p.a. Mohamed deposited the same amount of money as Ali in another financial institution that paid compound interest. After **4** years, they had equal amounts of money. Determine the compound interest rate per annum to one decimal place. [4 marks]

6). Make $\mathbf{x}$ the subject of the formula. **[3 marks]**

$$\frac{x^4 - 4}{x^2 - 2} = k$$

7). Solve for $\mathbf{x}$ in the equation. **[3 marks]**

$$2\sin^2 x - 1 = \cos^2 x - \sin^2 x, \quad \text{where } 0^\circ \leq x \leq 360^\circ.$$

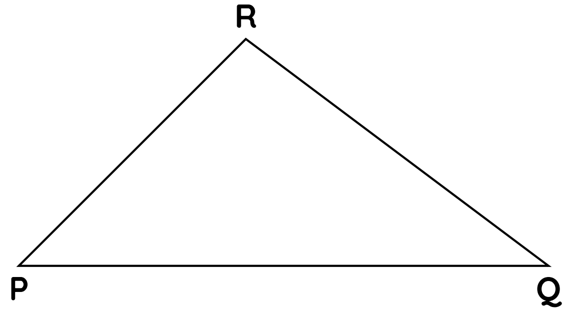
8). Find $\mathbf{C}$ that divide $\mathbf{AB}$ externally in the ratio $5 : 2$, given that $A(3, -6, 9)$ and $B(-15, 3, 12)$. **[3 marks]**

9). If $\sin \mathbf{x} = \mathbf{2b}$ and $\cos \mathbf{x} = \mathbf{2b\sqrt{3}}$, find the value of $\tan \mathbf{x}$. **[2 marks]**

10). Solve for $\mathbf{y}$ in the equation: **[3 marks]**

$$(\log_2 \mathbf{y})^2 + \log_2 \mathbf{8} = \log_2 \mathbf{y}^4$$

11). On the triangle **PQR**, draw a circle touching **PR**, **QP** produced and **QR** produced. **[3 marks]**



12). The gradient of a curve at any point given by $2x - 1$. Given that the curve passes through point $(1, 5)$. Find the equation of the curve. [3 marks]

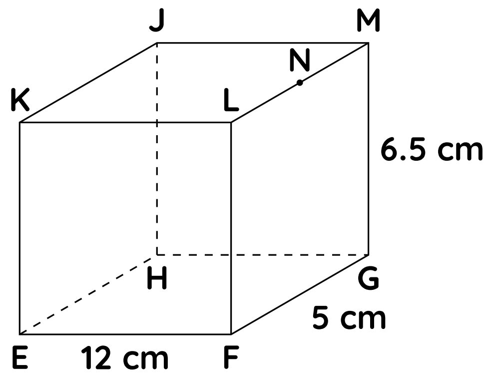
13). w varies directly as the cube of x and inversely as y. Find w in terms of x and y given that $w = 80$ when $x = 2$ and $y = 5$. [3 marks]

14). Given that $2 \leq A \leq 4$ and $0.1 \leq B \leq 0.2$. Find the minimum value of $\frac{AB}{A - B}$ as a fraction. [2 marks]

15). Use matrix method to solve the given simultaneous equation: **[3 marks]**

$$3x + y = 7$$
$$5x + 2y = 12$$

16). The figure below is a cuboid **EFGHJKLM**. $\mathbf{EF = 12\ cm}$, $\mathbf{FG = 5\ cm}$ and $\mathbf{GM = 6.5\ cm}$.



(a) State the projection of **EM** on the plane **EFGH**. **[1 mark]**

(b) Calculate the angle between **EM** and the plane **EFGH** correct to 2 decimal planes. **[3 marks]**

SECTION TWO - 50 Marks

*Answer any **five** questions from this section in the spaces provided.*

17). Use Trapezoidal rule to find the area between the curve $y = x^2 + 4x + 4$, the x-axis and the ordinates $x = -2$ and $x = 1$. *(Use 6 strips)*

(a) Complete the table below. **[2 marks]**

x	-2	-1.5	-1	-0.5	0	0.5	1
y							

(b) Find the area enclosed by the curve, the x-axis, lines $x = -2$ and $x = 1$. **[3 marks]**

(c) Use integration to find the exact area. **[3 marks]**

(d) Hence or otherwise find the percentage error in your approximation correct to 2 significant figures. **[2 marks]**

Total: 10 marks

18). (a) Complete the table below for the functions $y = 3\sin 3\theta$ and $y = 2\cos(\theta + 40^\circ)$ **[2 marks]**

θ	0°	10°	20°	30°	40°	50°	60°	70°	80°	90
$3\sin 3\theta$	0.00		2.60	3.00		1.50		-1.50		-3.00
$2\cos(\theta + 40^\circ)$		1.29	1.00		0.35		-0.35	-0.68	-1.00	

(b) On the grid provided, draw the graphs of $y = 3\sin 3\theta$ and $y = 2\cos(\theta + 40^\circ)$ on the same axis. **[5 marks]**

Take **1 cm** to represent 10° on the **x**-axis and **4 cm** to represent **2** unit on the **y** - axis.

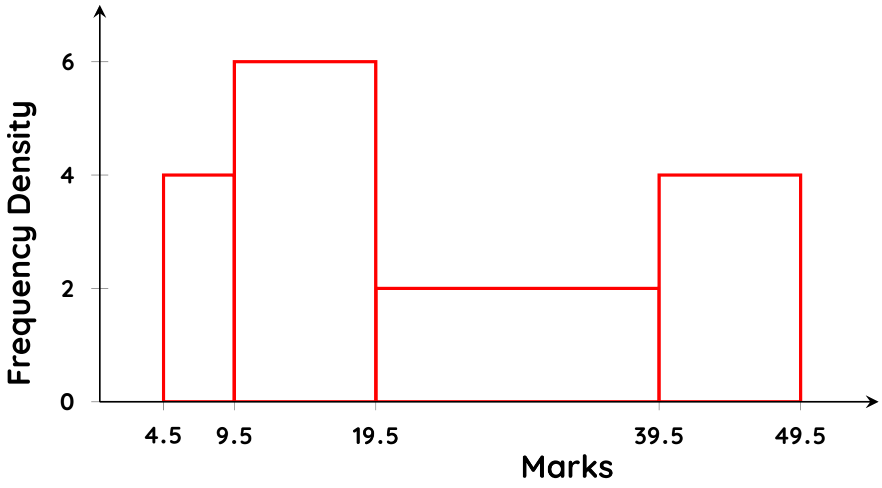
(c) From the graph find the roots of the equation:

(i) $\frac{3}{4}\sin 3\theta = \frac{1}{2}\cos(\theta + 40^\circ)$. **[2 marks]**

(ii) $2\cos(\theta + 40^\circ) = 0$ in the range $0 \le \theta \le 90^\circ$. **[1 mark]**

Total: 10 marks

19). The diagram below shows a histogram marks obtained in a certain test.



(a) Develop a frequency distribution table for the data if the first class **5 − 9** has a frequency of **8**. **[3 marks]**

Class	5 − 9			
Frequency Density				
Frequency	8			

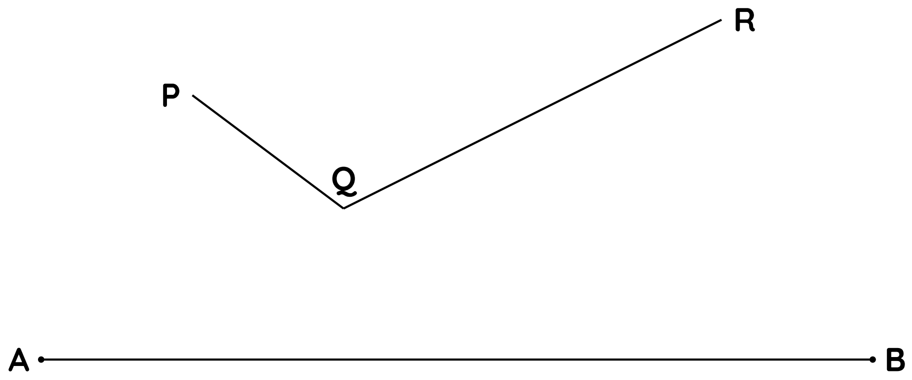
(b) Fill in the table below, hence or otherwise calculate the mean using an assumed mean of **19.5**. **[3 marks]**

Class	Midpoint(x)	$d = x - 19.5$	$t = \frac{d}{5}$	Frequency(f)	ft	cf
5 − 9				8		

(c) Calculate interquatile range. **[4 marks]**

Total: 10 marks

20). In the figure below **AB**, **PQ** and **QR** are straight lines



(a) Use the figure to:

(i) find a point **S** on **AB** such that **S** is equidistant from **P** and **R**. [1 mark]

(ii) complete a heptagon **PQRSTVW** with **AB** as its line of symmetry and hence measure **Q** from **S**. [5 marks]

(b) shade the region within the heptagon in which a variable point **X** must lie given that **X** satisfies the following conditions:

(i) **X** is nearer to **TV** than to **TS**. [1 mark]

(ii) **SX** is less than **3 cm**. [1 mark]

(iii) $\angle \mathbf{PXW} \geq \mathbf{90^\circ}$. [2 marks]

Total: 10 marks

21). The table below shows the income tax rates for a certain year.

Monthly taxable income sh	Tax rates(Percentage)
1 – 9680	10%
9681 – 18800	15%
18801 – 27920	20%
27921 – 37040	25%
37041 – 46160	30%
above 46161	35%

Naliaka earned a basis salary of **KES 30840** and a house allowance of **KES 15000** per month also a commuter allowance amounting to **KES 10480** in a particular month.

(a) Calculate the tax she paid in that month if she is entitled a personal tax relief of **KES 1056** per month. [7 marks]

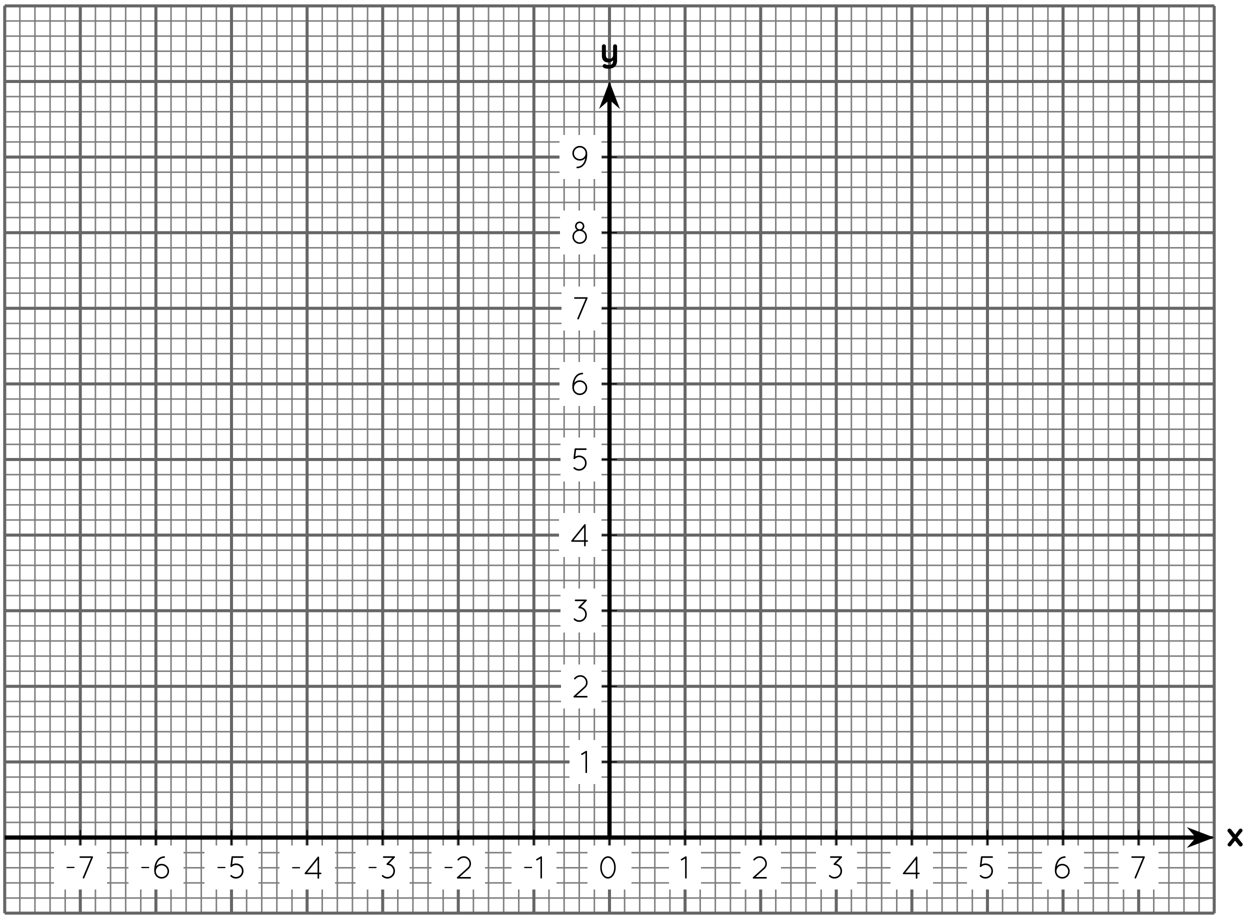
(b) The following deduction are also made on Naliaka's income:

- NHIF = **KES 1800**
- NSSF = **KES 920**

Calculate the net income in that month. [3 marks]

Total: 10 marks

22). The points $\mathbf{P(2,1)}$, $\mathbf{Q(4,1)}$, $\mathbf{R(4,3)}$ and $\mathbf{S(3,3)}$ are coordinates of a quadrilateral.



(a) Plot the quadrilateral **PQRS** on the grid provided. **[1 mark]**

(b) Find the coordinates of $\mathbf{P'Q'R'S'}$ the image of **PQRS** under the transformation represented by the matrix $\mathbf{M} = \begin{pmatrix} \mathbf{1} & \mathbf{1} \\ \mathbf{2} & \mathbf{0} \end{pmatrix}$ **[2 marks]**

#22 continues on the next page...

(c) Draw and label $\mathbf{P'Q'R'S'}$ on the same grid. [1 mark]

(d) Find the coordinates of $\mathbf{P''Q''R''S''}$ on the image of $\mathbf{P'Q'R'S'}$ under the transformation represented by the matrix $\mathbf{M} = \begin{pmatrix} -2 & 1 \\ 0 & 1 \end{pmatrix}$ [2 marks]

(e) Draw and label $\mathbf{P''Q''R''S''}$ on the same grid. [1 mark]

(f) Determine the matrix that maps **PQRS** directly onto $\mathbf{P''Q''R''S''}$. [3 marks]

Total: 10 marks

23). A supermarket is stocked with plates which come from two suppliers **A** and **B**. They are bought in the ratio **3 : 5** respectively, **10%** of plates from **A** are defective and **6%** of the plates from B are defective.

(a) A plate is chosen by a buyer at randon. Find the probability that:

(i) it is from **A**. [1 mark]

(ii) it is from **B** and it is defective. [2 marks]

(iii) it is defective. [2 marks]

(b) Two plates are chosen at random. Find the probability that:

(i) both are defective. [2 marks]

(ii) at least one is defective. [3 marks]

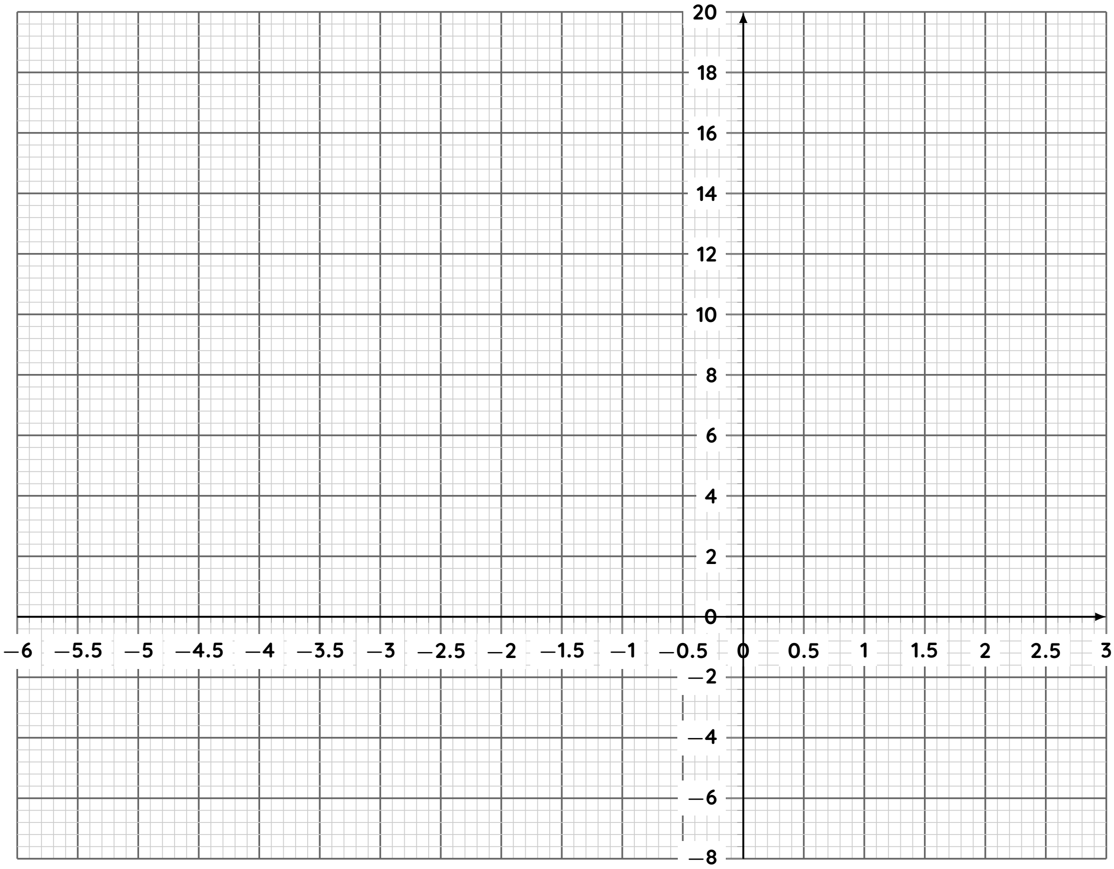
Total: 10 marks

24). (a) Complete the table below for $\mathbf{y = x^3 + 4x^2 - 5x - 5}$. **[2 marks]**

x	-5	-4	-3	-2	-1	0	1	2
y								

(b) On the grid provided, draw the graph of: **[3 marks]**

$$y = x^3 + 4x^2 - 5x - 5 \quad \text{for} \quad -5 \leq x \leq 2.$$



(c) **(i)** Use the graph to solve the equation: **[2 marks]**

$$x^3 + 4x^2 - 5x - 5 = 0$$

(ii) By drawing a suitable straight line on the graph, solve the equation: **[3 marks]**

$$x^3 + 4x^2 - 5x - 5 = -4x - 1$$

Total: 10 marks