THE OCTAGON MATHEMATICS JOINT

Kenya Certificate of Secondary Education

121/2   **MATHEMATICS ALT. A**   **Paper 2**
MAY, 2023 – TIME : 2½ HOURS

Name: ……………………………………………………... Adm No: ……….……

Index Number: ……..…………... 　　　　Candidate's Signature: ……..……….....

School……………………………………………….Stream …………………………...

Instructions to Candidates

    (a) Write your name, Adm. Number and stream in the spaces provided at the top of this page.
    *(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 calculation, giving your answer at each stage in the
spaces provided below each question.
    (e) Marks may be given for correct working even if the answer is wrong.
    *(f) **Non-programmable** silent electronic calculators and **KNEC** Mathematical tables*
may be used, except where stated otherwise.
    *(g) **This paper consists of 16 printed pages.***
    (h) Candidates should check the question paper to ascertain that all the pages are
printed as indicated and that no questions are missing.
    *(i) **Candidates should answer the questions in English**.*

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

17	18	19	20	21	22	23	24	**Total**

Grand Total

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Section 1(50 marks)

Answer all the questions in this section.

1. Kanini and Mutanu working individually take 3 days and 4 days to complete a task. Kanini and Auma working together take 2 days to complete the same task. How long will it take Auma and Mutanu working together to do the same task. (3 marks)

2. The average of the first and third terms of an increasing geometric progression is $8\frac{1}{2}$ times the value of the common ratio of the same progression. If the first term of the progression is 4, find the common ratio. (3 marks)

3. The expression $9 - 30x + ax^2$ is a perfect square, where a is a constant. Find the value of a. (2 marks)

4. Without using a calculator or mathematical tables simplify $\dfrac{96}{\left(4+2\sqrt{3}\right)^2-\left(4-2\sqrt{3}\right)^2}$ (3marks)

5. Solve for x in the equation $-8\cos x + 10 = 8\sin^2 x$ for $0^c \leq x \leq 2\pi^c$
leaving your answer in terms of π^c (4 marks)

6. Using a ruler and a pair of compass only;
(a) Construct a circle centre O with a radius of 3 cm and mark a point T, 8cm from point O
(1 mark)

(b) On the same diagram in (a) above locate a point P on the circumference of the circle such that angle OPT= 90^0 (2 marks)

7. At the beginning of the year 1996, a forest had 1246326 trees. If the rate of deforestation is 10% for every 5 years. Calculate to the nearest 100 the number of trees in that forest at the end of year 2020

(3 marks)

8. The diagram below represents a cuboid ABCDEFGH with square base ABCD.
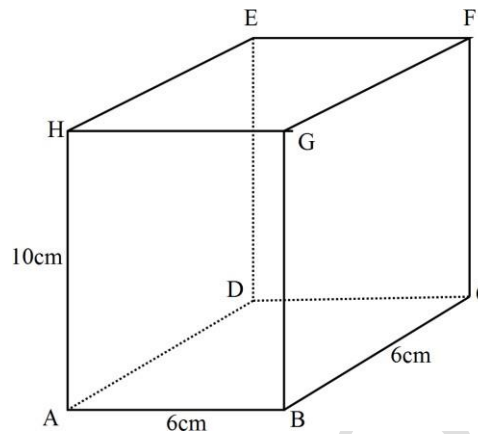
Given that AB = 6 cm and AH = 10 cm, calculate the angle between the planes ABCD and EAC.

(3 marks)

9 Find the area of triangle $A'B'C'$, the image of triangle ABC with coordinates A(1,1), B(4,1) and C(4,5) under transformation matrix $\begin{pmatrix} 1 & 4 \\ 3 & 6 \end{pmatrix}$ {3Marks}

10 A circle cuts the x – axis at $(-2, 0)$ and $(4, 0)$. It also cuts the y – axis at $(0, 2)$ and $(0, -4)$. Find the equation of the circle in the form $x^2 + y^2 + ax + by = c$ where a, b and c are integers. (3 marks)

11. The table below shows the cooling rate for a substance X at intervals of 1 hour.

t(h)	0	1	2	3	4	5	6
Temperature $(c)^\circ$	50	21	12	7	4	3	2

a) On the grid provided, draw a graph of temperature against time. (2 marks)
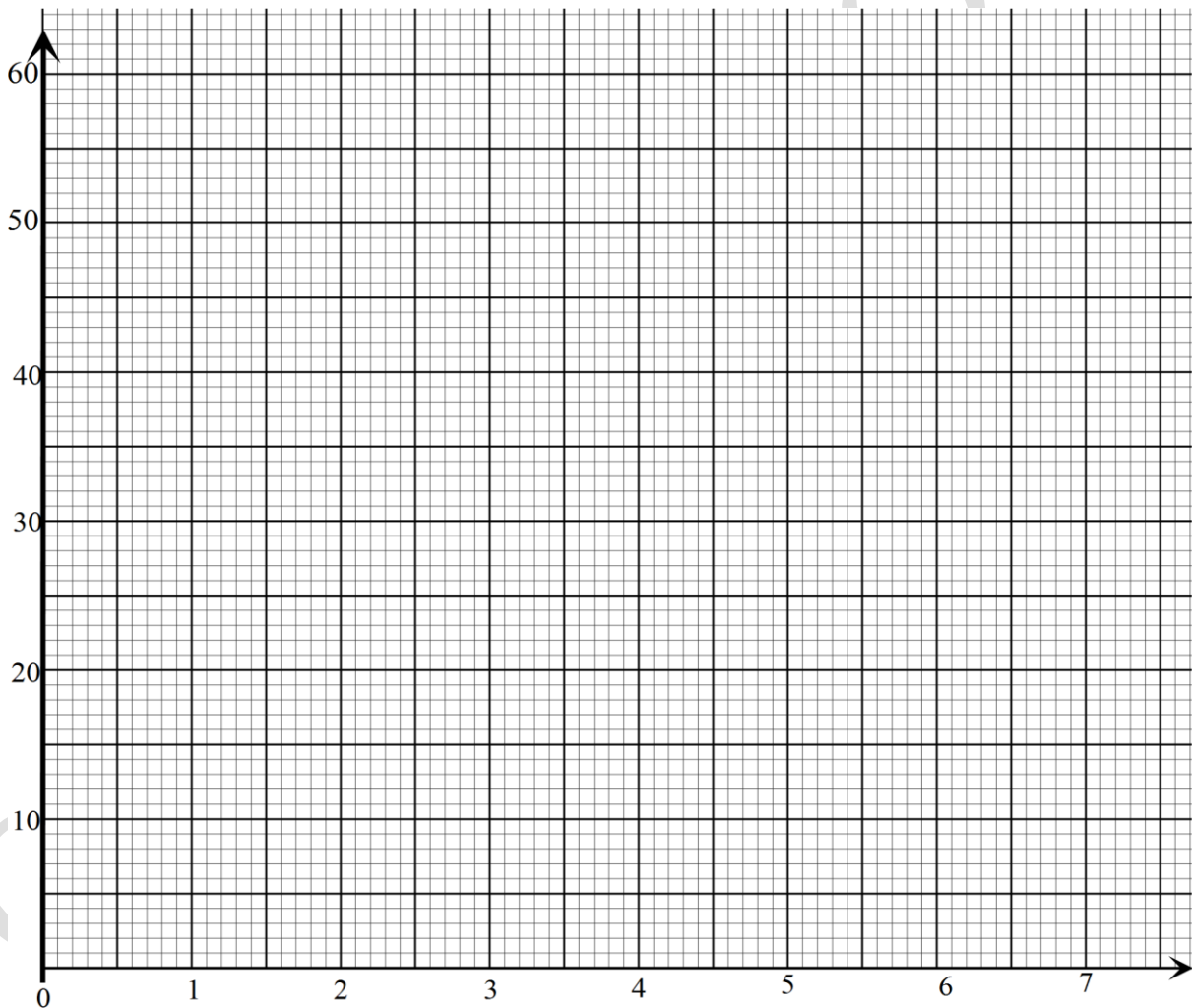
b) Use the graph to determine the rate of cooling between t = 1 hours and t = 4 hours. (2 marks)

12. The length and the width of a cuboid are recorded as 7.25cm and 3.0cm respectively. The height of thecuboid is exactly 12cm. Calculate the percentage error in calculating the volume of the cuboid correct to 4 decimal places. (3 marks)

13. a) Expand $(3 - \frac{1}{2}x)^5$ in ascending powers of x leaving the coefficients as fraction in their simplest form. (2 marks)

b) Hence, use the first three terms of the expansion in (a) above to evaluate 3.05^5 (2 marks)

14. The figure below shows a ranch ABCD drawn to a scale of 1: 100,000. A security light tower is tobe installed in the ranch such that it meets the following conditions:
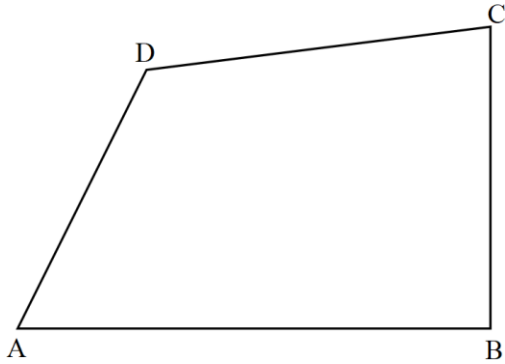
- It is nearer to A than it is to B
- It is at least 200 metres from the point C
- It is further from the line CD than it is to A

Shade the possible region in the ranch where the tower would be installed to meet the above conditions   (4marks)

15. The position vectors of points **P,Q** and **R** are given as $OP = 7i - 10j, \ OQ = i + 2j \ and \ OR = -3i + 10j$
   Show that **P,Q** and **R** are collinear   (3 marks)

16. Solve for x in the equation $\log(5x + 75) - 2\log 3 = \log(2x - 9)$ (3marks)

Section II (50 marks)

*Answer only **five** questions in this section in the spaces provided*

17. The table below illustrate number of Form 4 students per stream in a certain school.

STREAM	NUMBER OF STUDENTS	PERCENTAGE NUMBER OF STUDENTS WHO ARE LEFT-HANDED (%)
A	20	20
B	36	25
C	24	12.5
D	30	40

    a. A form 4 student is chosen at random. Calculate:

(i)   the probability that the student chosen is from stream B or C   (2 marks)

(ii)   the probability that the student is right-handed.   (3 marks)

b) Water supply in a school depends entirely on three pumps; P, Q and R. The probabilities that three pumps are working at any given time are $\frac{3}{4}$, $\frac{5}{7}$ and $\frac{4}{5}$ respectively. Calculate the probability that:

(i) all the pumps are working   (1 mark)

(ii) there is no water in the school.   (2 marks)

(iii)   there is some water in the school   (2 mark

18   James' earning are as follows:-

Basic salary Sh. 38,000 p.m

House allowance Sh. 14,000 p.m

Travelling allowance Sh. 8,500 p.m

Medical allowance Sh. 3,300

The table for the taxable income is as shown below.

Income tax in K£ p.a	Tax in Sh. per pound
1————600	2
6001———12000	3
12001———18000	4
1001———24000	5
24001———30000	6
30001———36000	7
36001———42000	8
42001———48000	9
Over 48000	10

(a) Calculate James' taxable income in K£ p.a.   (2 Marks)

(b) Calculate James's P.A.YE if he is entitled to a tax relief of Sh. 18000 p.a.   (4 Marks)

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(c) James is also deducted the following per month:-

NHIF   Sh. 320

Pension scheme   Sh. 1000

Co-operative shares   Sh. 2000

Loan repayment   Sh. 5000

Interest on loan   Sh. 500

(i) Calculate James' total deduction per month in KSh.   (2 Marks)

(ii) Calculate his net salary per month   (2 Marks)

19 (a) Complete the table below, giving the values correct to 2 decimal places.   (2 marks)

x^0	0	30	60	90	120	150	180	210	240	270	300	330	360
Sin 2x	0		0.87		-0.87		0	0.87	0.87				0
3cos x - 2	1	0.60		- 2	- 3.5			- 4.60			-0.5		1

(b) On the grid provided draw the graph of y = sin 2x and y = 3cos x – 2 for $0° \leq x \leq 360°$

on the same axes.

Use the scale of 1cm to represent 30^0 on the x-axis and 2cm to represent 1 unit on the y -axis.

(5marks)
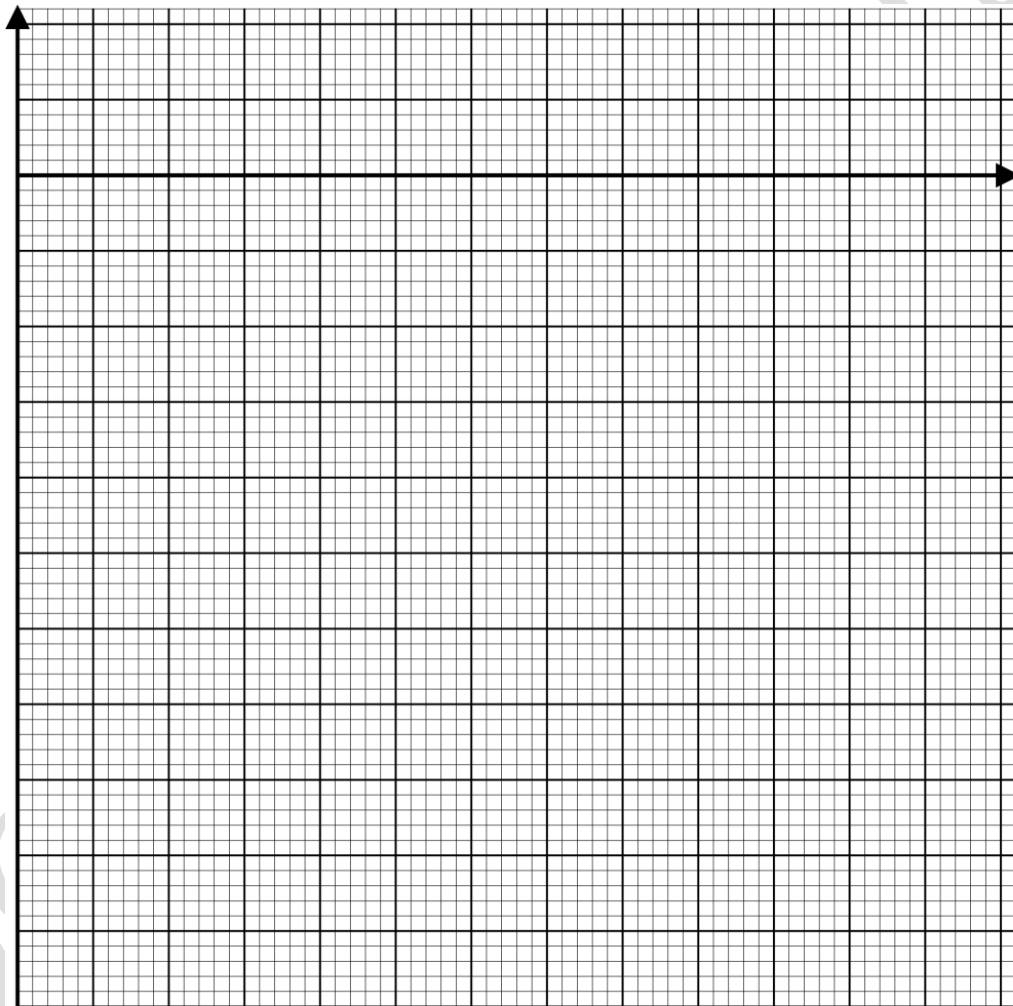
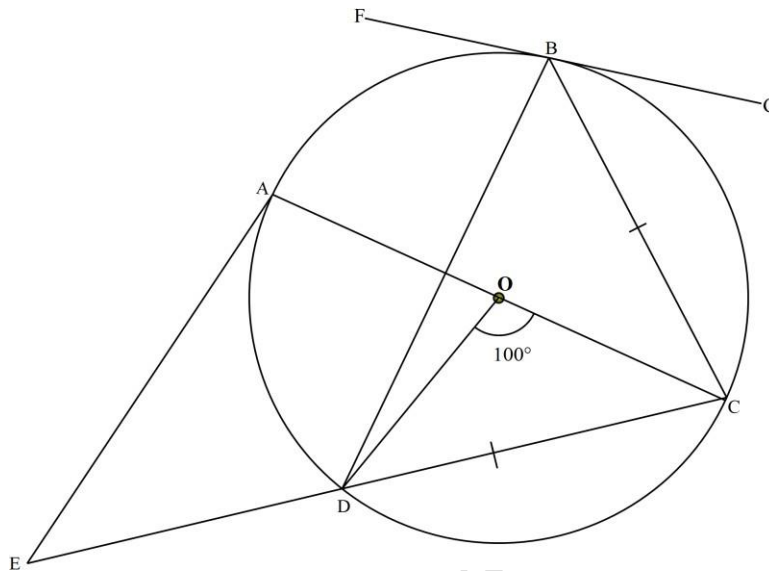
(a) Use the graph in (b) above to solve the equation 3cos x – sin 2x = 2.   (2marks)

(b) State the amplitude of y = 3cosx – 2   (1mark)

20 In the figure below A, B, C and D are points on the circumference of a circle centre O. $\angle COD = 100°$ and $BC = CD$. AE and FG are tangents to the circle at Points A and B respectively.

Find the following angles stating the reason in each case.

(a) $\angle CBD$ (2 marks)

(b) $\angle ODC$ (2 marks)

(c) $\angle ADB$ (2 marks)

(d) $\angle DAE$ (2 marks)

(e) $\angle ABF$ (2 marks)

21 A passenger plane takes off from airport A(60°S,20°W) and flies directly to airport B(60°S,25°E). After refueling for 1hour 35 minutes, it then flies due North for 5400 nautical miles to another airport C

(a) Find the position of airport C   (2 marks)

(b)Find the distance travelled by the plane between airport A and C through B in kilometres.
 (Use $\pi = \dfrac{22}{7}$ and Radius of the Earth R = 6370 km)   (3 marks)

(c) If the plane flew at an average speed of 600 knots, find the total time when the plane was airborne
(3 marks)

(d) Given that the plane arrival time at airport C was Tuesday 0030h. Find the local time and day it departed from airport A.   (2 marks)

22 A School intends to build Ultra-Modern Science Complex. The build is approximated to use at most 144 tonnes of cement. The constructor intends to use two trucks; truck A and truck B to transport these cement. Truck A can carry 8000 kg of cement while truck B can carry 12000 kg of cement per trip. Truck A should make less than 9 trips and truck B should make at most twice the number of trips made by truck A. The total number of trips should be more than 10 trips.

(a) By putting x to represent the number of trips made by truck A and y to represent the number of trips made by truck B. Write down all the inequalities to represent the above information.   (4 marks)

(b) Represent the inequalities in (a) on the grid provided.   (4 marks)
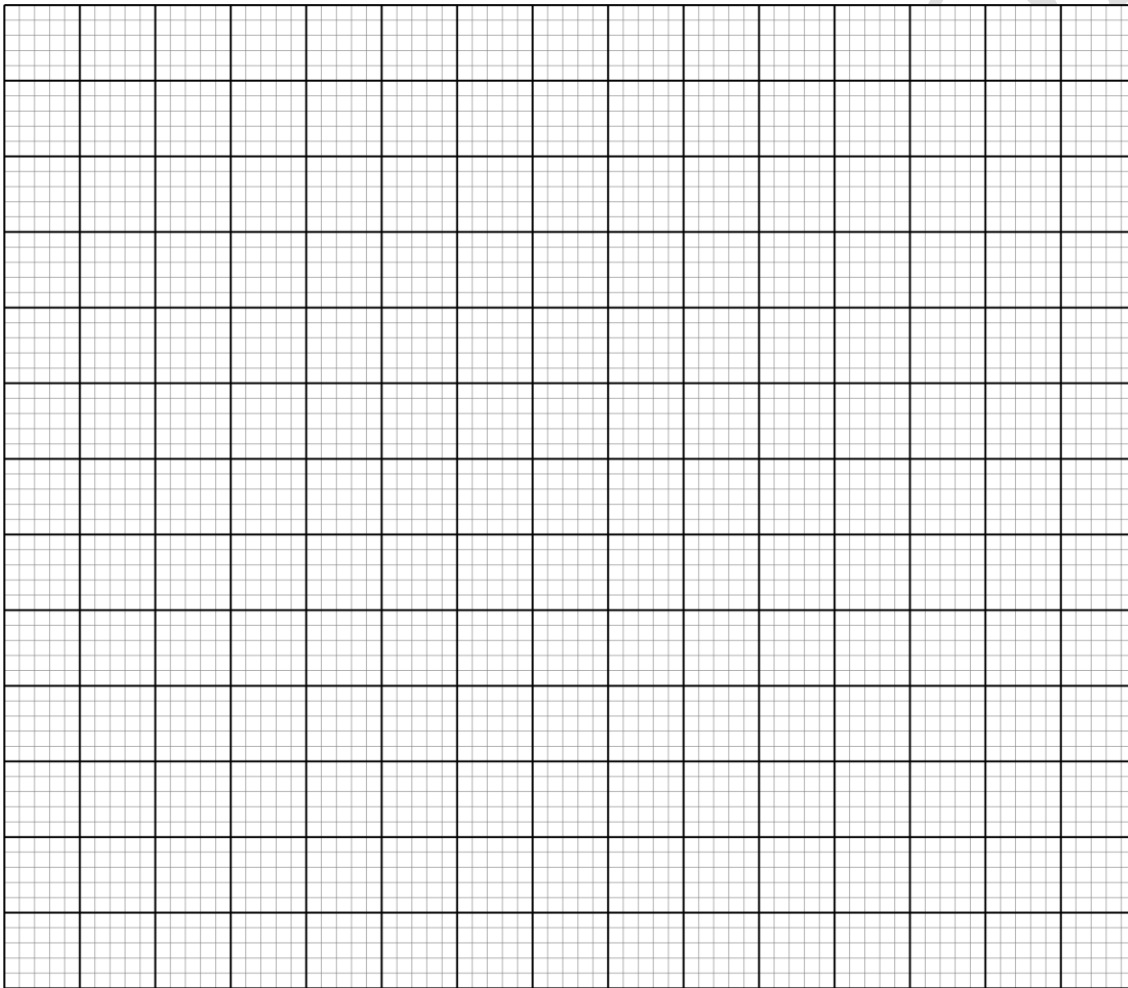
(c) If cost of transport by truck A is Ksh. 8000 per trip and Ksh 12000 for truck B. Using a search line or otherwise determine the minimum cost of transportation.   (2 marks)

23 (a) Using the trapezoidal rule, estimate the area under the curve $y = \frac{1}{2}x^2 - 2$
between the lines $x = 0$ and $x = 6$ using 6 strips. (4 marks)

(b) Use the integration to evaluate the exact area under the curve. (4 marks)

(c) Hence calculate the percentage error in calculating the area using trapezoidal
rule. (2 marks)

24 Pipes A and B can fill a tank in 20 hours and $7\frac{1}{2}$ hours respectively. A third pipe C empties the tank in 10 hours. The tank is initially empty. Pipes A and B are both opened at 8.00 a.m for $2\frac{1}{2}$ hours.

(a) The fraction of the water in the tank after $2\frac{1}{2}$ hours   (3 marks)

(b) After the $2\frac{1}{2}$ hrs, pipe C is opened and the three pipes run for 6 hours. What fraction of the tank is empty at the end of the 6 hours?   (3 marks)

(c) Pipe A is closed after the 6 hours and Pipe B and C continue to run. Find the time the tank would be fully filled up.   (4 marks)

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