THE SPARK (HOTBED OF MATHEMATICS)
Kenya Certificate of Secondary Education

121/2 Paper 2

MATHEMATICS

ALT. A

June. 2022 – 2½ hours

Name: .... **Index Number:** ....

Student's Signature: .... **Date:** .... **Class:**.............

Instructions to candidates

(i) Write your name, adm number and class in the spaces provided above.
(ii) Sign and write the date of examination in the spaces provided above.
(iii) This paper consists of **two** sections: **Section I** and **Section II**.
(iv) Answer **all** the questions in **Section I** and only **five** questions from **Section II.**
(v) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
(vi) Marks may be given for correct working even if the answer is wrong.
(vii) **Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.
(viii) This paper consists of 16 printed pages. **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(ix) **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

SECTION I (50 Marks)

*Answer **all** the questions in this section in the spaces provided.*

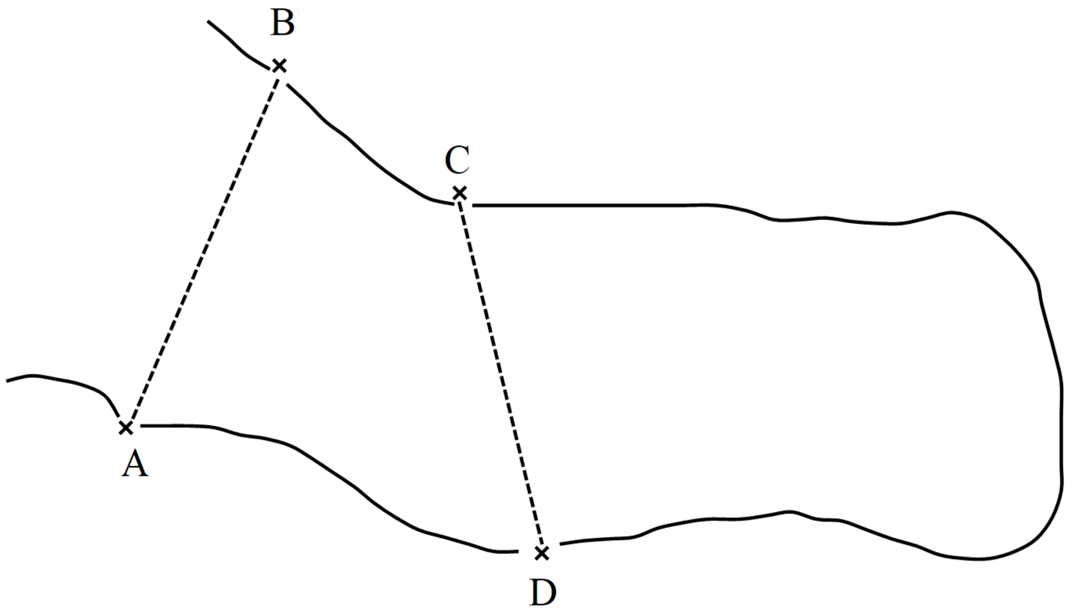
1. Rationalize the denominator $\frac{y}{\sqrt{y}}$. (2 marks)

2. Construct a circle of radius 6 cm. Using a pair of compasses only, mark point T on the circle at angle 120° above the radius. Hence, construct the tangent to the circle at T. (3 marks)

3. Find the term which is independent of *x*, in the binomial expansion of

$\left(4x^3 - \frac{1}{2x}\right)^8, x \neq 0$ (4 marks)

4. The map shows part of a lake. In a competition for radio – controlled boats, a competitor has to steer a boat so that its path between AB and CD is a straight line. This path is always the same distance from A as from B. On the map, draw the path the boat should take. (3 marks)



5. Solve the following logarithmic equation. (4marks)

$$\log_2\left(w^2+4w+3\right)=4+\log_2\left(w^2+w\right), w\neq -1$$

6. Express $3x^2+2x+1$ in the form $a\left(x+p\right)^2+q$ where a, p and q are integers.

(3 marks)

7. Find the equation of the circle with centre at $(5,-1)$ and passes through the point $(-3,5)$. (3 marks)

8. Given that α is measured in degrees, solve the following trigonometric equation

$\frac{4}{\tan^2 3\alpha}+2=\frac{7}{\sin 3\alpha}$ for $0^\circ \le \alpha \le 180^\circ$ (4 marks)

9. Make t the subject of the formula: $s = ut + \frac{1}{2}at^2$ (3 marks)

10. A car which costs Kshs.200 000 depreciates in value at the rate of 5% every 6 months. Find its value after 4 years to the nearest whole number. (3 marks)

11. A 2×2 matrix **A**, is defined as $\mathbf{A} = \begin{pmatrix} 2 & a \\ b & -2 \end{pmatrix}$ where *a* and *b* are constants. The matrix **A**, maps the point $\mathrm{P}(2,5)$ onto the point $\mathrm{Q}(-1,2)$. Find the value of *a* and *b*.(3 marks)

12. Given that $\mathbf{r} = \mathbf{i} + 2\mathbf{j} - \mathbf{k}$, $\mathbf{s} = 4\mathbf{i} - \mathbf{j} + 2\mathbf{k}$, $\mathbf{t} = 2\mathbf{i} + 3\mathbf{k}$ and **0** is origin, determine the co-ordinate of P if $\mathbf{OP} = \mathbf{r} - 3\mathbf{s} + \mathbf{t}$. (3 marks)

13. Given $\left(1+\sqrt{2}\right)^5 \equiv p+q\sqrt{2}$. Determine the value of each of the constants p and q.

(3 marks)

14. Two types of juice M and N contains 30% and 48% of water respectively. In what ratio should the two be mixed so that the mixture contains 42% of water. (3 marks)

15. A student was asked to write $2.\dot{3}$ but truncated it to 1 decimal place. Calculate the percentage error committed. (3 marks)

16. The number of phones text messages sent by 11 different students is given below..
14, 52, 55, 79, 112, 25, 31, 36, 37, 41, 51. Calculate the semi-interquartile range.

(3 marks)

SECTION II (50 Marks)

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

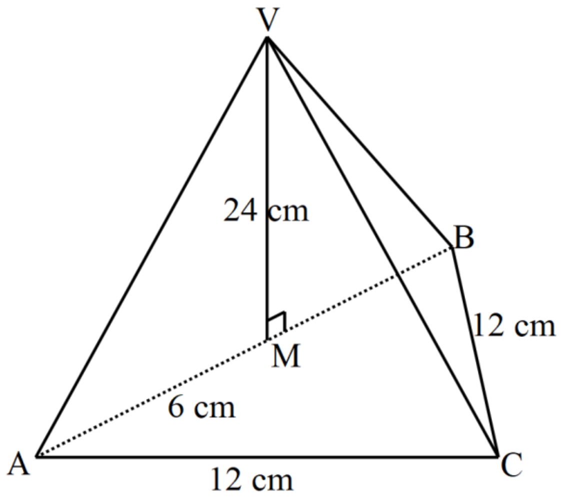
17. A trapezium with vertices $A(1,4)$, $B(3,1)$, $C(5,1)$ and $D(7,4)$ is mapped onto a trapezium whose vertices $A'(-4,1)$, $B'(-1,3)$, $C'(-1,5)$ and $D'(-4,7)$

(a) Using a scale of 1 cm for one unit on both axes, draw the trapezium ABCD and its image $A'B'C'D'$. Describe this transformation. (4 marks)

(b) the trapezium $A'B'C'D'$ is mapped by matrix $\mathbf{T} = \begin{pmatrix} 1 & 2 \\ 0 & 1 \end{pmatrix}$ have the image $A''B''C''D''$. Determine its coordinates and draw it. (3 marks)

(c) Calculate the area of the figure $A''B''C''D''$ hence find a single transformation that would map ABCD onto $A''B''C''D''$. (3 marks)

18. The figure below shows a pyramid VABC, standing on a horizontal ground. The base of the pyramid ABC is an equilateral triangle of length 12 cm. the point M is the midpoint of AB. The vertex of the pyramid V lies vertically above M so that the length of VM is 24 cm.



Find to 2 decimal places:

(a) The length of VA; (2 marks)

(b) The length of VC; (3 marks)

(c) The angle VA makes with VB; (2 marks)

(d) The angle VC makes with the horizontal; (3 marks)

19. The mean and standard deviation of the test marks of 40 students in a Mathematics class $x_1, x_2, x_3 ... x_{40}$ are 65 and 18 respectively. The mean and standard deviation of the test marks of the 24 girls of the Mathematics class $y_1, y_2, y_3 ... y_{24}$ are 72 and 20 respectively. Find :

(a) $\sum x^2$ (3 marks)

(b) $\sum y^2$ (3 marks)

(c) The mean of the test scored by boys. (2 marks)

(d) The standard deviation of the test scored by boys. (2 marks)

20. A cubic graph is defined in terms of a constant k as $y = x^3 - 19x + k$. Find the value of k, if the graph:

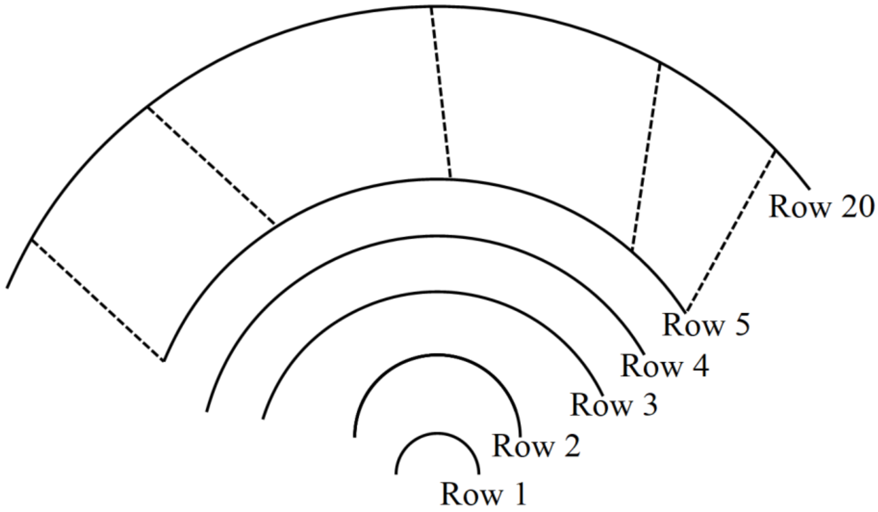
(a) Passes through the origin; (2 marks)

(b) Meets the y – axis at $y = 5$. (2 marks)

(c) Meets x – axis at $x = 2$. (3 marks)

(d) Passes through the point $(-1, -7)$. (3 marks)

21. Seats in the theatre are arranged in rows. The number of seats in this theatre form the terms of an arithmetic series.



The sixth row has 23 seats and the fifteenth row has 50 seats. The theatre has 20 rows of seats in total. Find :

(a) The number of seats in the first row; (4 marks)

(b) The number of seats in the 11^{th} row. (2 marks)

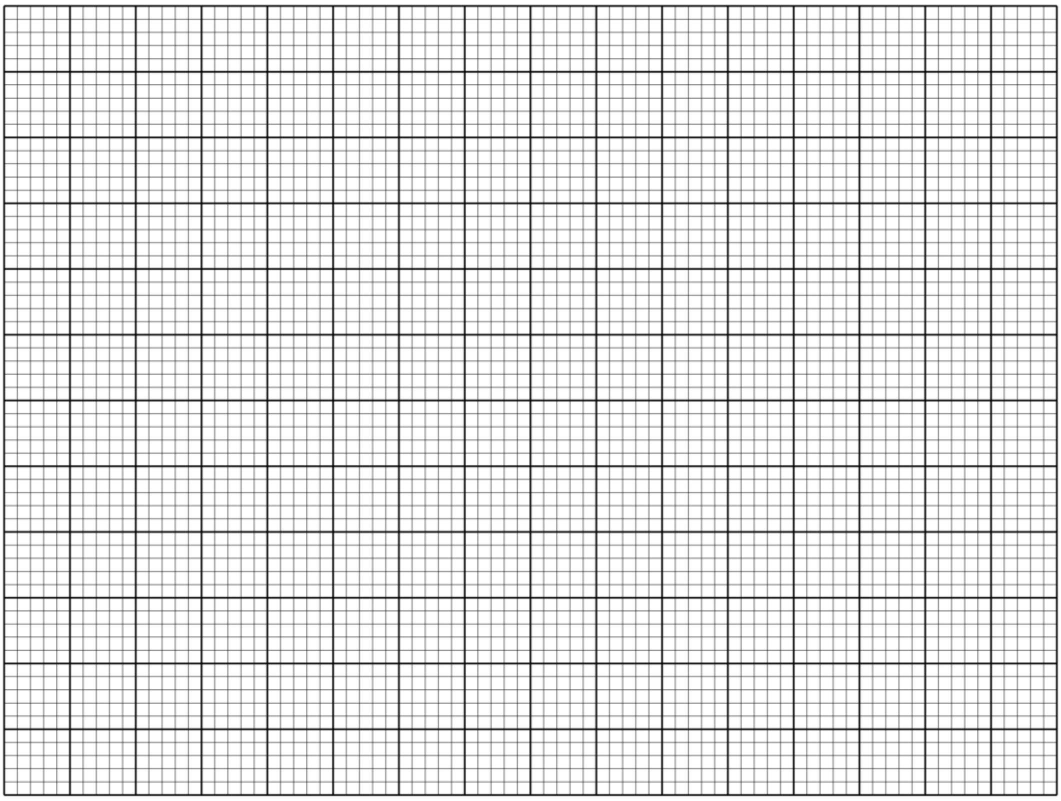
(c) Find the number of seats in this theatre. (4marks)

22. (a) Complete the table below for the functions $y = \sin\beta^\circ$ and $y = -1 + \sin 2\beta^\circ$.

(2 marks)

β°	0	30	60	90	120	150	180	210	240	270	300	330	360
$\sin\beta^\circ$	0.00			1.00		0.50		0.50			–0.87		
$-1+\sin 2\beta^\circ$			–0.13		–1.87			–0.13		–1.00			–1.00

(b) On the same axes, draw the graphs of $y = \sin\beta^\circ$ and $y = -1 + \sin 2\beta^\circ$ for $0^\circ \le \beta \le 360^\circ$. Use a scale of 1cm for 30^0 on x-axis and 2cm for 1 unit on y-axis. (4 marks)



(c) Use the graph to solve $-\sin\beta^\circ + \sin 2\beta^\circ = 1$. (2 marks)

(d) Describe the transformation that map the graph of $y = \sin\beta^\circ$ onto the graph $y = -1 + \sin 2\beta^\circ$. (2 marks)

23. A plane leaves an airport $P(10^{\circ}S, 62^{\circ}E)$ and flies due north at 800 km/hr. Take $\pi = \frac{22}{7}$ and radius of the earth to be 6370 km.

(a) Find its position after 2 hours. (3 marks)

(b) The plane turns and flies at the same speed due west. It reaches Q, at longitude $12^{o}W$.

(i) Find the distance it has travelled in nautical mile; (3 marks)

(ii) If the local time at P was 1300 hours when it reached Q, find the local time at Q when it landed at Q. (4 marks)

24. Machine ***K*** makes 45% of the biscuits. Machine ***J*** makes 30% of the biscuits. The rest of the biscuits are made by machine ***L***. It is known that 2% of the biscuits made by machine ***J*** are broken, 3% of the biscuits made by machine ***K*** are broken and 5% of the biscuits made by machine ***L*** are broken. A biscuits selected at random

(a) Draw a tree diagram to illustrate all the possible outcomes and associated probabilities; (2 marks)

(b) Using the tree diagram, calculate the probability that the biscuit is:

(i) made by machine J and is not broken; (3 marks)

(ii) broken; (3 marks)

(iii) broken but not made by machine K. (2 marks)

THIS IS THE LAST PRINTED PAGE.

BLANK PAGE