

NAME ..... SCHOOL .....

DATE ..... INDEX NO..... ADM NO. ....

CANDIDATE'S SIGNATURE .....

121/2

MATHEMATICS

PAPER 2

AUGUST/ SEPTEMBER 2022

TIME:  $2\frac{1}{2}$  HOURS**SUKELLEMO JOINT EXAMINATION – 2022***Kenya Certificate of Secondary Education (K.C.S.E)***INSTRUCTIONS TO THE CANDIDATES**

- Write your *name, school, date, index number admission number* in the spaces provided above.
- This paper contains *two sections: Section I and Section II.*
- Answer *all the questions in section I and any five questions from Section II.*
- *Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.*
- Marks may be given for correct working even if the answer is wrong.
- *Non-Programmable silent calculators and KNEC Mathematical tables may be used EXCEPT where stated otherwise.*

**FOR EXAMINERS'S USE ONLY****Section I**

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

**Section II**

Question	17	18	19	20	21	22	13	24	Total
Marks									

**GRAND TOTAL**

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This paper consists of **14** printed pages. Candidates should check carefully to ascertain that all the pages are printed as indicated and no questions are missing.



**SECTION I (50 marks)**

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

1. Use logarithms to evaluate  $\frac{0.5249^2 \times 83.58}{\sqrt[3]{0.3563}}$  (4 marks)

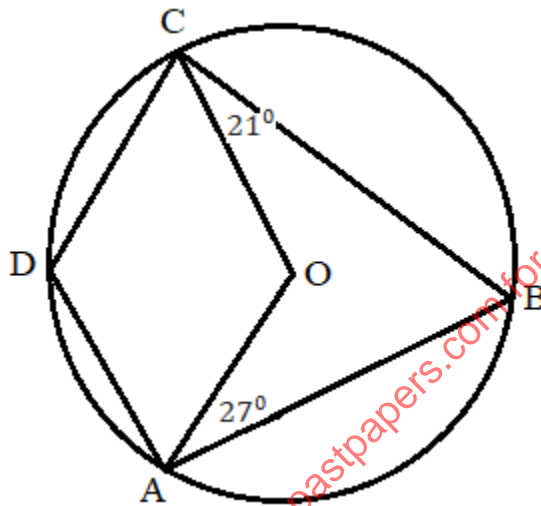
2. Without using a calculator or mathematical table evaluate  $\frac{2 \tan 60^\circ}{\sin 45^\circ - \cos 30^\circ}$  leaving your answer in simplified form. (3 marks)

3. By correcting each number to 2 significant figures, approximate the value of  $927 \times 0.0984$ . Hence, calculate the percentage error arising from this approximation. (3 marks)

4. The equation of a circle is  $x^2 + y^2 + 6x - 14y + 58 = r^2$ . If the circle passes through the point  $(2, 7)$ , determine its radius and the coordinates of its centre. (3 marks)
5. In a shooting practice three soldiers A, B and C aim at a target. The probabilities of A, B and C hitting the target are  $\frac{1}{3}$ ,  $\frac{1}{4}$  and  $\frac{1}{2}$  respectively. The three soldiers shot at the target only once; one after the other. What is the probability that the target was hit only once? (3 marks)
6. The vertices of triangle ABC are  $A(0,0)$ ,  $B(0,5)$  and  $C(4,3)$ . Under a shear represented by the matrix  $\begin{pmatrix} 1 & 0 \\ k & 1 \end{pmatrix}$ , triangle ABC maps onto  $A'B'C'$ .
- (a) Determine the y – coordinate of point  $C'$  in terms of  $k$ . (2 marks)
- (b) If triangle  $ABC'$  is a right – angled triangle in which angle  $AC'B$  is acute and  $AC'$  is the hypotenuse, find  $k$ . (2 marks)

7. A varies partly as the square of R and partly as a constant. When  $A = 23$ ,  $R = 3$ . When  $A = 55$ ,  $R = 5$ . Find A when  $R = 7$ . (3 marks)

8. The figure below shows a circle centre O. ABCD is a cyclic quadrilateral.  $\angle BCO = 21^\circ$  and  $\angle BAO = 27^\circ$ .



Determine the size of;

(a)  $\angle CBA$  (1 mark)

(b)  $\angle CDA$ . (1 mark)

9. An inlet tap can fill an empty tank in 8 hours. It takes 12 hours to fill the tank when the inlet tap and outlet tap are both opened at the same time. Calculate the time the outlet tap takes to empty the full tank when the inlet tap is closed. (2 marks)

10. (a) Expand  $(2 - \frac{1}{5}x)^5$  up to the fourth term. (2 marks)

(b) Hence use the expansion to find the value of  $(1.96)^5$  correct to 3 decimal places. (1 mark)

11. An aeroplane leaves town A( $40^{\circ}\text{N}$ ,  $155^{\circ}\text{W}$ ) for town B( $40^{\circ}\text{N}$ ,  $25^{\circ}\text{E}$ ) using the shortest route at a speed of 300 knots. Calculate the time it takes to travel from A to B. (3 marks)

12. Solve the simultaneous equations (4 marks)

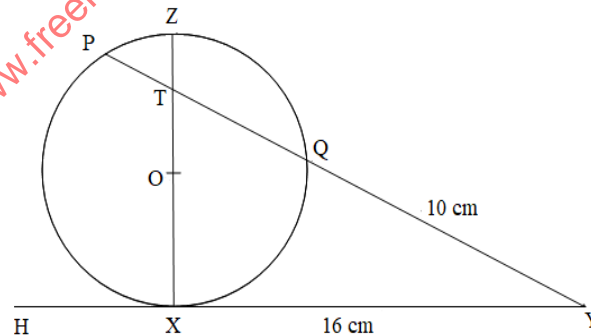
$$\begin{aligned}2x - y &= 3 \\ x^2 - xy &= -4\end{aligned}$$

13. Solve for  $x$  in  $3 \log_3 x + 4 = \log_3 24$ . (3 marks)

14. The cash price of a gas cooker is Ksh 30 000. A customer bought the cooker on hire purchase terms by paying a deposit of Ksh 15 000 followed by 18 monthly instalments of Ksh 1 000 each. Annual interest, compounded quarterly, was charged on the balance for a period of 18 months. Determine, correct to 1 decimal place, the rate of interest per annum. (3 marks)

15. Solve  $2\cos^2 x = 5 \sin x + 1$  for  $0^\circ \leq x \leq 360^\circ$ . (3 marks)

16. In the figure below, the tangent HXY meets chord PQ produced at Y. Chord XZ passes through the centre, O, of the circle and intersects PQ at T. Line XY = 16 cm and QY = 10 cm.



- (a) Calculate the length PQ. (2 marks)

- (b) If  $ZT = 4$  cm and  $PT : TQ = 3 : 5$ , find XT. (2 marks)

**SECTION II (50 marks)**

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

17. The table below shows income tax rates in a certain year.

<b>Monthly income in Kenya shilling</b>	<b>Tax rate % in each shilling</b>
<i>Up to 11 180</i>	10
11 181 – 21 714	15
21 715 – 32 248	20
32 249 – 42 782	25
42 783 and above	30

In the year, Rency earned a basic salary of Ksh 50 000 per month. She also enjoyed the following allowances:

House allowance      Ksh 30 000

Commuter allowance    Ksh 10 000

Medical allowance      Ksh 10 000

She had a life insurance policy for which she paid Ksh 24 000 per month. She contributed Ksh 5 000 towards a pension fund, which is exempted from taxation. She was entitled to a personal relief of Ksh 1 280 per month and an insurance relief of 15% of the premium paid up to a maximum of Ksh 3 000.

Calculate;

(a) Rency's monthly taxable income. (2 marks)

(b) the tax payable by Rency that month. (5 marks)

(c) Rency's net pay that month. (3 marks)

18. A trapezium OPQR is such that  $\mathbf{OP} = \mathbf{p}$ ,  $\mathbf{PQ} = \mathbf{r}$  and  $\mathbf{PQ}$  is parallel to  $\mathbf{OR}$ .  $2\mathbf{PQ} = \mathbf{OR}$ . T is a point on OR produced so that  $\mathbf{OR} : \mathbf{RT} = 2:1$ . PT and QR intersect at X so that  $\mathbf{QX} = h\mathbf{QR}$  and  $\mathbf{PX} = k\mathbf{PT}$ .

(a) Find  $\mathbf{OQ}$  and  $\mathbf{QR}$  in terms of  $\mathbf{p}$  and  $\mathbf{r}$ . (2 marks)

(b) Express  $\mathbf{RX}$  in terms of  $\mathbf{p}$ ,  $\mathbf{r}$  and  $k$ . (2 marks)

(c) Calculate the values of  $h$  and  $k$ . (5 marks)

(d) In what ratio does T divide PX? (1 mark)

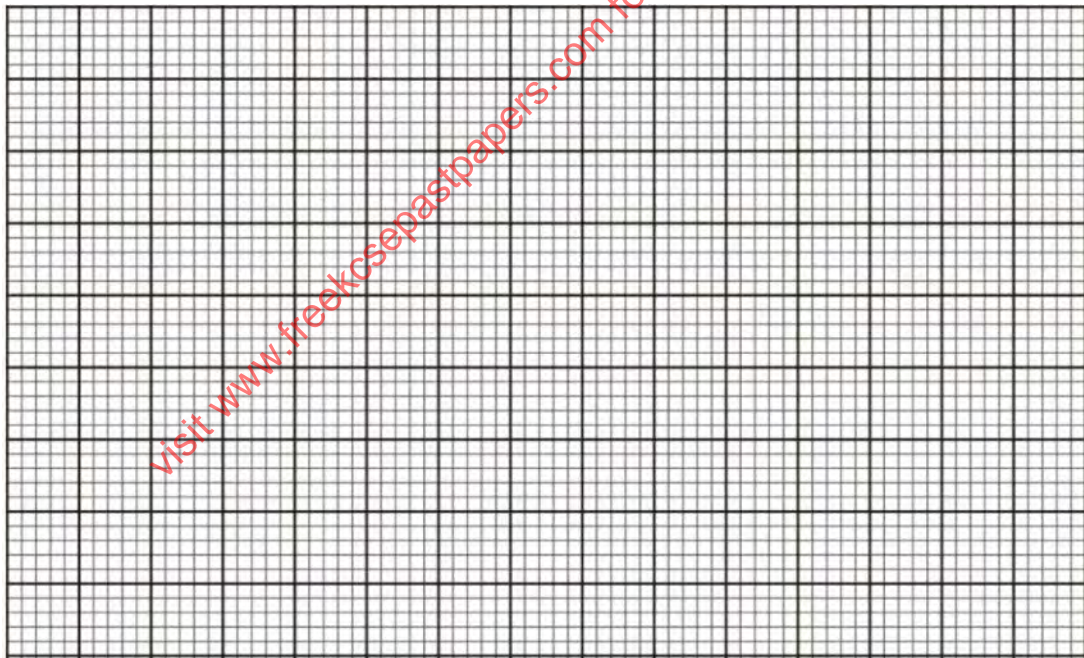


19. The table below shows marks obtained by 80 students in a mathematics exam.

Marks	Number of students
0 - 10	3
10 - 20	8
20 - 30	17
30 - 40	29
40 - 50	15
50 - 60	6
60 - 70	2

(a) Using an assumed mean of 45, calculate the standard deviation for the above data. (4 marks)

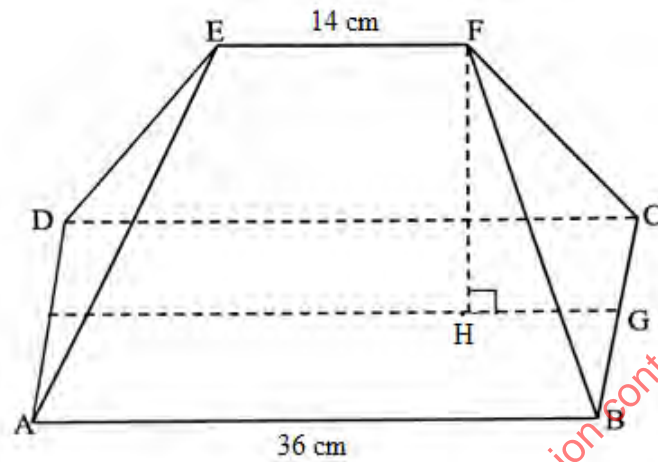
(b) On the grid provided, draw an ogive to represent the data. (3 marks)



(c) Use the graph in (b) above to estimate;  
(i) the quartile deviation. (2 marks)

(ii) the percentage number of students who scored at least 45 marks. (1 mark)

20. The figure below shows a model of a roof with a rectangular base ABCD.  $AB = 36$  cm,  $EF = 14$  cm and  $BC = 16$  cm. The ridge EF is centrally placed. The faces ADE and BCF are equilateral triangles. G is the mid-point of BC.



Calculate, to 2 decimal places;

- (a) the length FG. (2 marks)
- (b) the height FH of the roof above the base ABCD. (2 marks)
- (c) the perpendicular height of the trapezoidal face ABFE. (2 marks)
- (d) the angle between planes FBC and ABCD. (2 marks)
- (e) the angle between the planes ABFE and DCFE. (2 marks)

21. (a) A triangular garden ABC is such that  $AB = 16$  m,  $\angle BAC = 45^\circ$  and  $\angle ABC = 75^\circ$ . Using a scale of 1 cm represents 2 m, draw the garden using a ruler and a pair of compasses only. (3 marks)

- (b) A water tap P is to be mounted in the garden such that it is equal in distance from A, B and C. On the diagram in (a) above, show the position of point P. (3 marks)

- (c) A section of the plot is enclosed such that a region R is formed under the following conditions:

- (i)  $CR \geq 3$  m. (1 mark)
  - (ii) R is more than 4 m from line AB. (1 mark)
  - (iii) R is nearer to CB than CA. (1 mark)
- By shading, show the region R. (1 mark)

22. The gradient function of the curve is given by the expression  $2x + 1$ . If the curve passes through the point  $(-4, 6)$ ;

(a) Find;

(i) the equation of the curve,

(3 marks)

(ii) the values of  $x$  at which the curve cuts the  $x$  – axis.

(3 marks)

(b) Determine the area enclosed by the curve, the  $x$  – axis and the line  $x = 3$ .

(4 marks)

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23. (a) The 18<sup>th</sup> term of an arithmetic progression(AP) is 59. The sum of the 7<sup>th</sup> and 11<sup>th</sup> terms of the AP is 58. Find:

(i) the first term and common difference of the AP. (3 marks)

(ii) the sum of the first 50 terms of the AP. (2 marks)

(b) The basic salary per month of John during the first month of employment is Ksh 32 400. His salary is increased by 4% at the end of each year. If he was employed on 1<sup>st</sup> January, 2002, find;

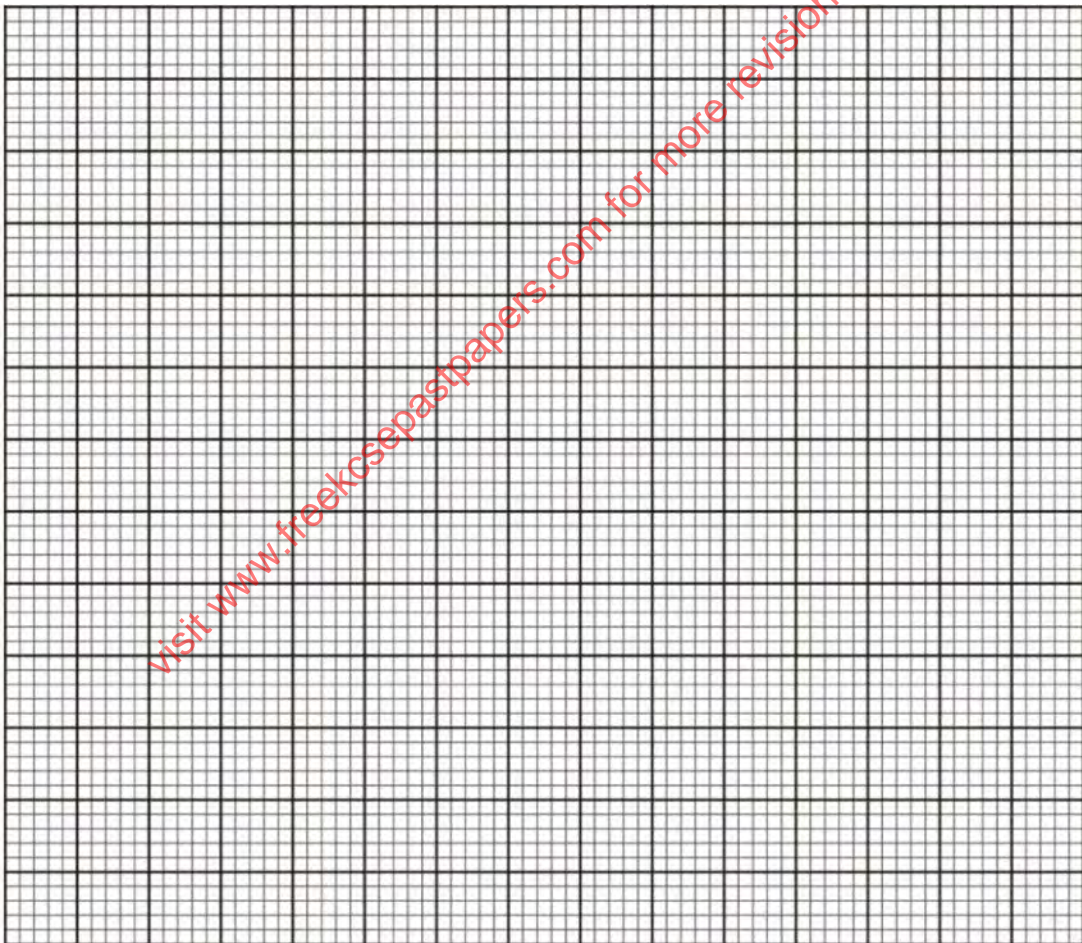
(i) his monthly earnings during the month of January, 2014 if his incremental date is the month of January each year. (2 marks)

(ii) his total earnings by 31<sup>st</sup> December, 2014. (3 marks)

24. Koech, a prominent businessman in Nakuru, has two vehicles; a pick – up and a canter. He uses them to carry as many bags of maize as possible to Kitale. He wishes to limit the number of trips to 13 or less. For each trip in the pick – up, he uses 40 litres of petrol and 1 litre of oil. For each trip in the canter, he uses 20 litres of petrol and 3 litres of oil. He has 480 litres of petrol and 18 litres of oil available for use. If he makes  $x$  trips in the pick – up and  $y$  trips in the canter,

(a) Write down three inequalities (apart from  $x \geq 0$  and  $y \geq 0$ ) to represent the information above. (3 marks)

(b) Represent the inequalities graphically and shade the unwanted regions. (4 marks)



(c) If the pick – up carries 10 bags in each trip and the canter carries 35 bags in each trip, use your graph to determine the number of trips each vehicle should make in order to transport the maximum number of bags. (3 marks)