

# K.C.S.E. MATHEMATICS PAPER 121/2 2004

## SECTION I

Answer all the questions in this section

- Find the number of terms of the series  $2 + 6 + 10 + 14 + 18 + \dots$  that will give a sum of 800. (2 marks)
- Evaluate, without using mathematical tables, the expression  $2 \log_{10} 5 - \log_{10} 16 + 2 \log_{10} 40$  (3 marks)
- A student obtained the following marks in four tests during a school term: 60%, 75%, 48% and 66%. The tests were weighted as follows: 2, 1, 4, and 3 respectively. Calculate the students weighted mean mark of the tests (3 marks)
- Use matrices to solve the simultaneous equations:  
$$\begin{aligned} 4x + 3y &= 18 \\ 5x - 2y &= 11 \end{aligned}$$
(3 marks)
- (a) Expand  $(1+x)^5$  (2 marks)  
(b) Use the first three terms of the expansion in (a) to find the approximate value of  $(0.98)^5$  (2 marks)
- Make  $b$  the subject of the formula  $a = \frac{bd}{\sqrt{(b^2 - d)}}$  (3 marks)
- An industrialist has 450 litres of a chemical which is 70% pure. He mixes it with a chemical of the same type but 90% pure so as to obtain a mixture which is 75% pure. Find the amount of the 90% pure chemical used. (4 marks)
- The gradient function of a curve is given by  $\frac{dy}{dx} = 3x^2 - 8x + 2$ . If the curve passes through the point (0, 2), find its equation. (3 marks)
- Without using mathematical tables, simplify  $\frac{2}{3 - \sqrt{7}} - \frac{2}{3 + \sqrt{7}}$ , in the form  $a\sqrt{b}$  (3 marks)
- Given that  $\mathbf{OA} = 3\mathbf{i} - 2\mathbf{j} + \mathbf{k}$  and  $\mathbf{OB} = 4\mathbf{i} + \mathbf{j} - 3\mathbf{k}$ . Find the distance between points A and B to 2 decimal places (3 marks)
- The velocity,  $V \text{ ms}^{-1}$ , of a moving body at time  $t$  seconds is given by  
$$V = 5t^2 - 12t + 7$$
 Calculate the acceleration when  $t = 2$  seconds (3 marks)
- In the year 2003, the population of a certain district was 1.8 million. Thirty per cent of the population was in the age group 15 - 40 years. In the same year, 120,000 people in the district visited the Voluntary Counselling and Testing (VCT) centre for an HIV test.  
If a person was selected at random from the district in that year, find the probability that the person visited a VCT centre and was in the age group 15 - 40 years. (3 marks)

13. Given that  $x^\circ$  is an angle in the first quadrant such that  $3 \sin^2 x + 2 \cos x - 5 = 0$ ,  
 find  
 (a)  $\cos x$  (3 marks)  
 (b)  $\tan x$  (1 mark)

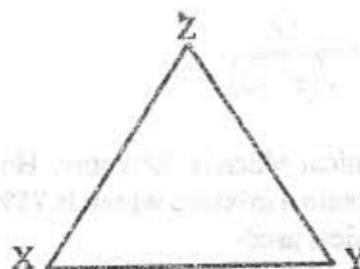
14. Omolo bought a new car for Ksh.800 000. After 5 years, he sold it through a second-hand car dealer. The dealer charged a commission of 4% for the sale of the car. If Omolo received Ksh.480 000, calculate the annual rate of depreciation of the car as a percentage. (4 marks)

15. The table below shows some values of the function  $y = x^2 + 3$

x	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$	4	$4\frac{1}{2}$	5	$5\frac{1}{2}$	6
y	3		4	$5\frac{1}{4}$	7		12	$15\frac{1}{4}$	19		28		39

- (a) Complete the table (1 mark)
- (b) Use the mid-ordinate rule with six ordinates to estimate the area bounded by  $y = x^2 + 3$ , the y axis, the x axis and the line  $x = 6$  (3 marks)

16. The figure below is a triangle XYZ. Using a pair of compasses and a ruler only, construct an inscribed circle such that the centre of the circle and the point X are on the opposite side of line YZ.



(3 marks)

## SECTION II

Answer any six questions from this section

17. The table below shows the ages in years of 60 people who attended a conference.

Age in years	30 - 39	40 - 49	50 - 59	60 - 69	70 - 79
Number of people	10	12	18	17	3

Calculate:

- (a) the interquartile range of the data (5 marks)

- (b) the percentage of the people in the conference whose ages were 54.5 years and below. (3 marks)

18. (a) Given that the matrix  $A = \begin{pmatrix} 2 & 3 \\ 3 & 4 \end{pmatrix}$ , find  $A^{-1}$ . The inverse of A. (1 mark)

(b) Kantai bought 200 bags of sugar and 300 bags of rice for a total of sh. 850 000. Buya bought 90 bags of sugar and 120 bags of rice for a total of sh. 360 000. If the price of a bag of sugar is sh  $x$  and that of rice is sh.  $y$ ,

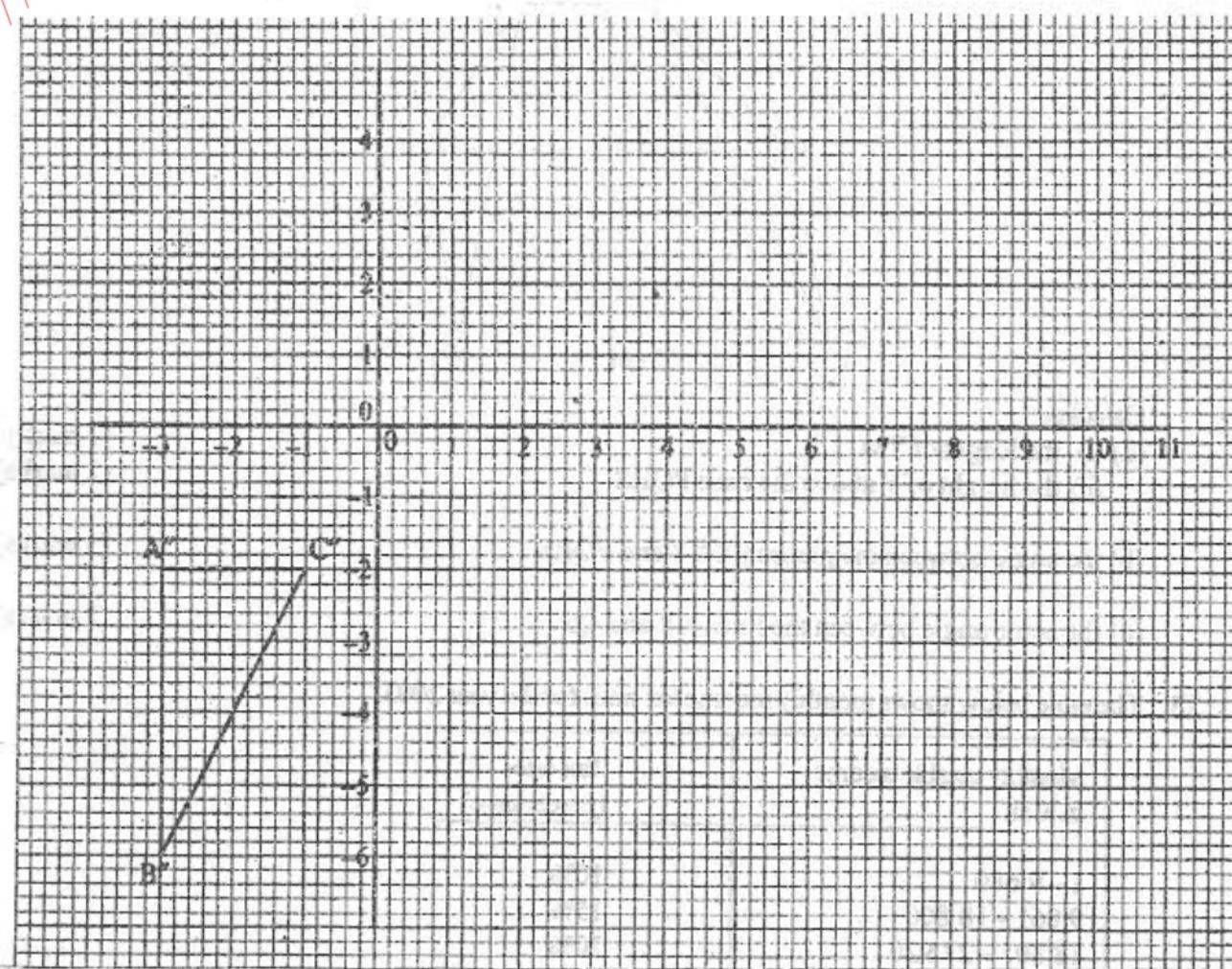
(i) Form two equations to represent the information above. (2 marks)

(ii) Use the matrix  $A^{-1}$ , to find the prices of one bag of each item. (2 marks)

(c) Kali bought 225 bags of sugar and 360 bags of rice. He was given a total discount of sh. 33 300. If the discount on the price of a bag of rice was 2%, calculate the percentage discount on the price of a bag of sugar. (3 marks)

19. Triangle ABC is the image of triangle PQR under the transformation  $M = \begin{pmatrix} 2 & 4 \\ 0 & 2 \end{pmatrix}$  where P, Q and R map onto A, B and C respectively.

(a) Given the points P(5, -1) Q(6, -1) and R(4, -0.5), draw the triangle ABC on the grid provided below. (3 marks)

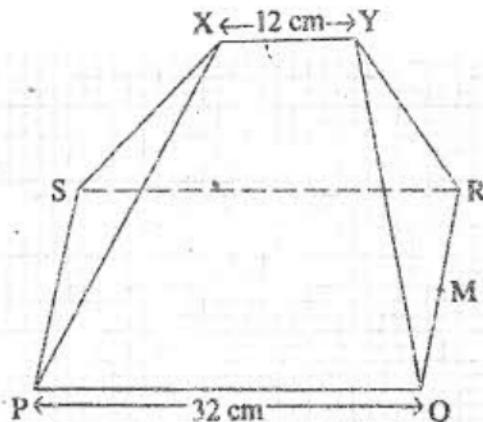


(b) Triangle ABC in part (a) above is to be enlarged by scale factor 2 with centre at (11, -6) to map onto A'B'C'.

Construct and label triangle A'B'C' on the grid above. (2 marks)

- (c) By construction, find the coordinates of the centre and the angle of rotation which can be used to rotate triangle A'B'C' onto triangle A''B''C'', shown on the grid above. (3 marks)
20. A particle moves in a straight line. It passes through point O at  $t = 0$  with velocity  $v = 5 \text{ m/s}$ . The acceleration  $a \text{ m/s}^2$  of the particle at time  $t$  seconds after passing through O is given by  $a = 6t + 4$ .
- Express the velocity  $V$  of the particle at time  $t$  seconds in terms of  $t$ . (3 marks)
  - Calculate:
    - the velocity of the particle when  $t = 3$ . (2 marks)
    - the distance covered by the particle between  $t = 2$  and  $t = 4$ . (3 marks)
21. Three quantities P, Q and R are such that P varies directly as the square of Q and inversely as the square root of R.
- Given that  $P=20$  when  $Q=5$  and  $R=9$ , find P when  $Q=7$  and  $R=25$ . (3 marks)
  - If Q increases by 20% and R decreases by 36%, find the percentage increase in P. (5 marks)

22. The figure below shows a model of a roof with a rectangular base PQRS.  $PQ=32 \text{ cm}$  and  $QR=14 \text{ cm}$ . The ridge XY=12 cm and is centrally placed. The faces PSX and QRY are equilateral triangles. M is the midpoint of QR.



- Calculate:
- (i) the length of YM (1 mark)  
(ii) the height of Y above the base PQRS (2 marks)
  - the angle between the planes RSXY and PQRS (3 marks)
  - the acute angle between the lines XY and QS. (2 marks)

23. The table below shows monthly income tax rates for the year 2003.

Monthly taxable income in K sh	Tax rates (percentage)
1 - 9 680	10%
9 861 - 18 800	15%
18 801 - 27 920	20%
27 921 - 37 040	25%
37 041 and above	30%

In the year 2003, Ole Sanguya's monthly earnings were as follows:

Basic salary	K sh 20 600
House allowance	K sh 12 000
Medical allowance	K sh 2 880
Transport allowance	K sh 340

Ole Sanguya was entitled to a monthly tax relief of K sh 1 056.

Calculate:

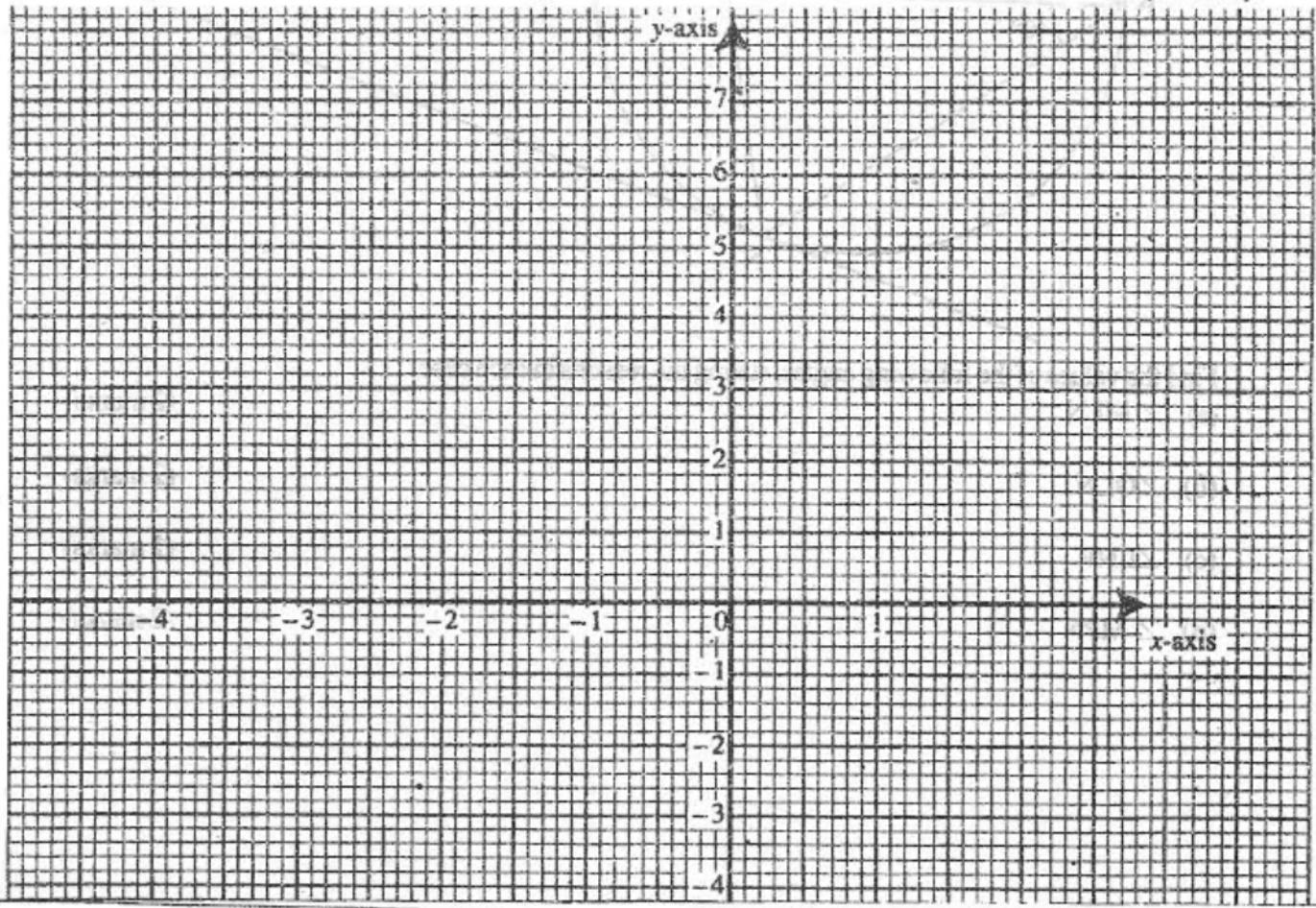
- (a) his monthly taxable income (2 marks)
- (b) the monthly tax paid by Ole Sanguya. (6 marks)

24. The equation of a curve is given by  $y = x^3 + 4x^2 - 2$ .

- (a) Determine the coordinates of the turning points of the curve, correct to 1 decimal place. (3 marks)
- (b) Use the equation of the curve to complete the table below. (1 mark)

X	-4	-3	-2	-1	0	1
Y	-2		6	1		

- (c) (i) On the grid provided, use the solutions in part (a) and the values in the table in part (b) to draw the curve for  $-4 \leq x \leq 1$ . (2 marks)
- (ii) Use the graph to solve the equation  $x^3 + 4x^2 - 2 = 0$ . (2 marks)



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25. (a) If A, B and C are the points (2, -4), (4, 0) and (1, 6) respectively, use the vector method to find the coordinates to point D given that ABCD is a parallelogram. (3 marks)

- (b) The position vector of points P and Q are  $\mathbf{p}$  and  $\mathbf{q}$  respectively. R is another point with position

$$\mathbf{r} = \frac{3}{2}\mathbf{q} - \frac{1}{2}\mathbf{p}$$

Express the terms of  $\mathbf{p}$  and  $\mathbf{q}$

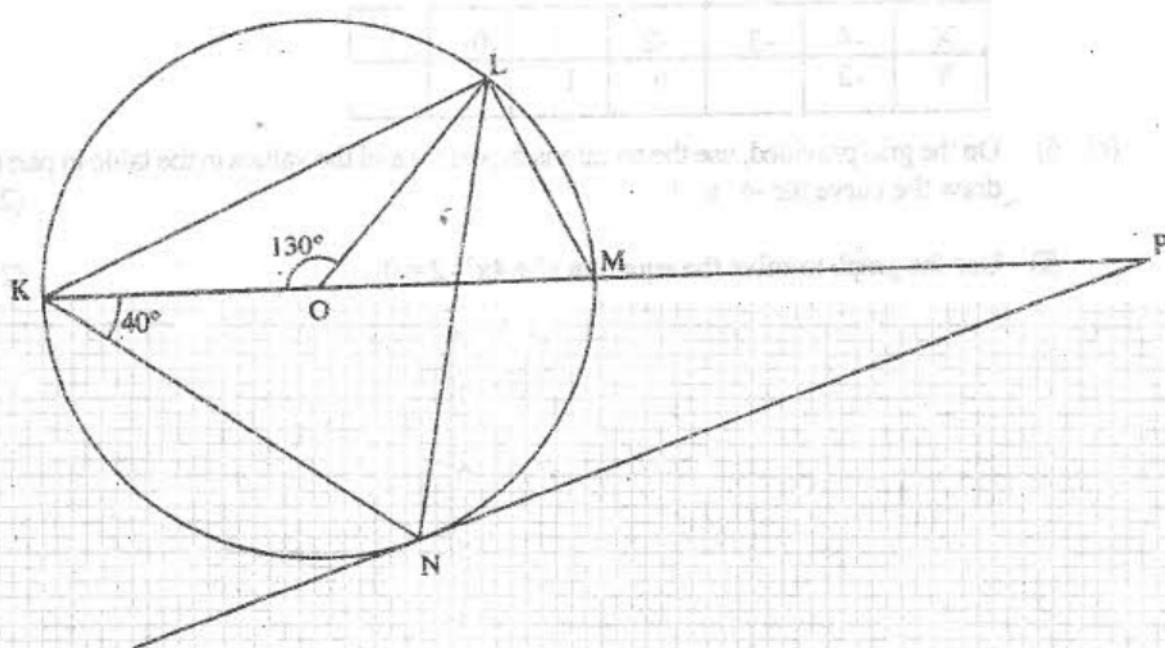
- (i)  $\overrightarrow{PR}$  (1 mark)

- (ii)  $\overrightarrow{RQ}$ , hence show that P, Q and R are collinear (3 marks)

- (iii) Determine the ratio  $PQ : QR$  (1 mark)

26. In the figure below, K, L, M and N are points on the circumference of a circle centre O. The points K, O, M and P are on a straight line.

PN is a tangent to the circle at N. Angle  $KOL = 130^\circ$  and angle  $MKN = 40^\circ$ .



Find the values of the following angles, stating the reasons in each case:

- (a)  $\angle MLN$  (2 marks)
- (b)  $\angle OLN$  (2 marks)
- (c)  $\angle LNP$  (2 marks)
- (d)  $\angle MPN$  (2 marks)