

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

SECTION I

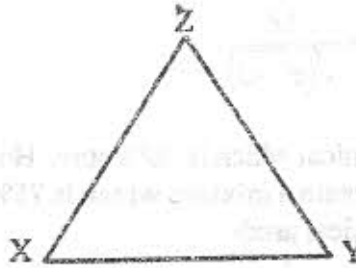
Answer all the questions in this section

- 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:
 $4x + 3y = 18$
 $5x - 2y = 11$ (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 $a\sqrt{b}$
- Given that $\vec{OA} = 3\mathbf{i} - 2\mathbf{j} + \mathbf{k}$ and $\vec{OB} = 4\mathbf{i} + \mathbf{j} - 3\mathbf{k}$. 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° 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.



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. Buyu 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.

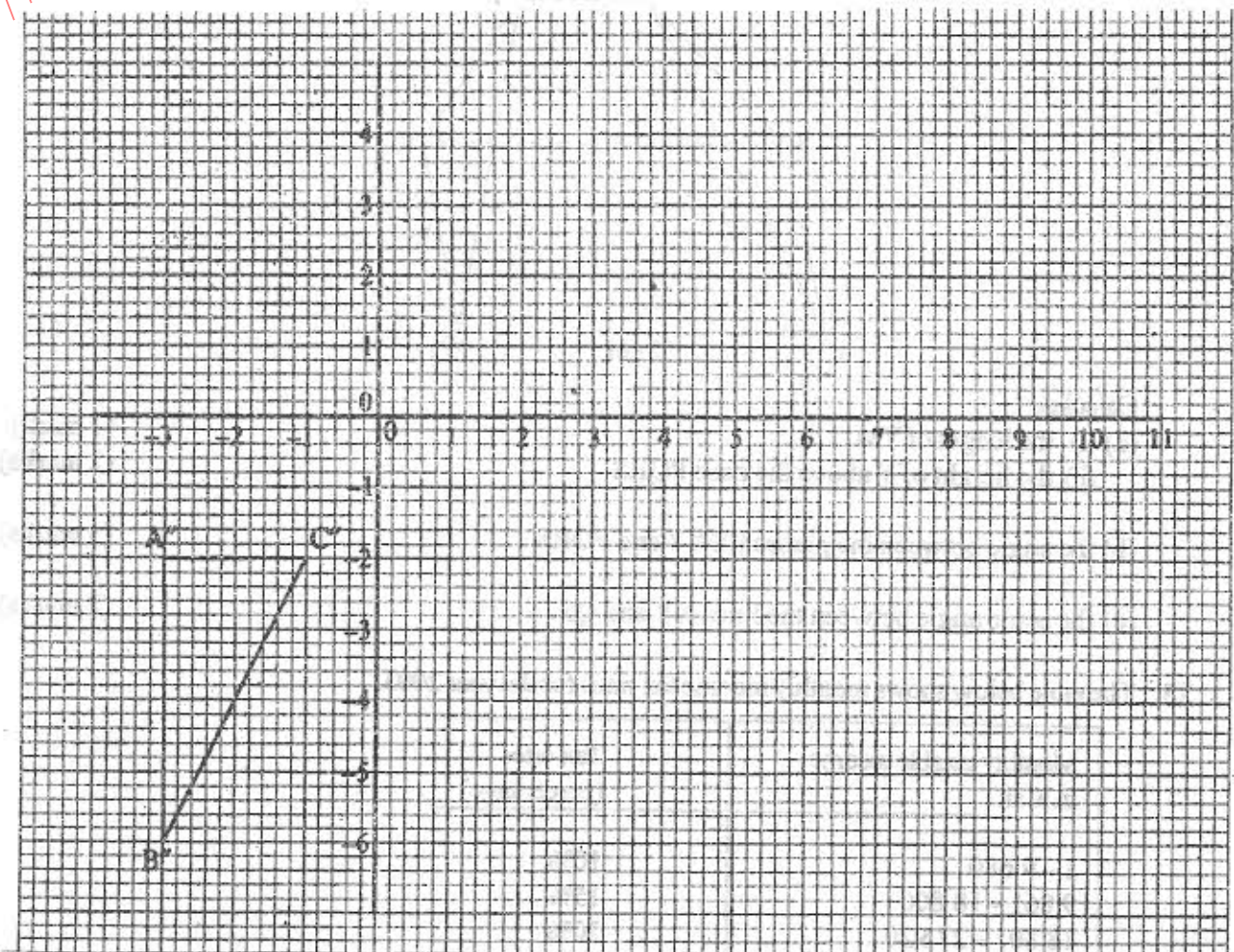
(i) Form two equations to represent the information above. (2 marks)

(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 $a = 6t + 4$.

(a) Express the velocity V of the particle at time t seconds in terms of t . (3 marks)

(b) Calculate:

(i) the velocity of the particle when $t = 3$. (2 marks)

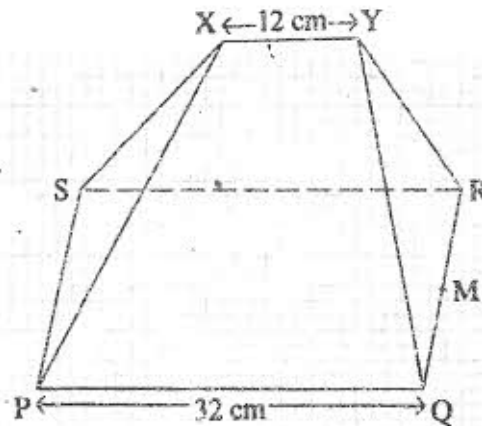
(ii) the distance covered by the particle between $t = 2$ and $t = 4$. (3 marks)

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 .

(a) Given that $P = 20$ when $Q = 5$ and $R = 9$, find P when $Q = 7$ and $R = 25$. (3 marks)

(b) 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 $XY = 12\text{ cm}$ and is centrally placed. The faces PSX and QRY are equilateral triangles. M is the midpoint of QR .



Calculate:

(a) (i) the length of YM (1 mark)
 (ii) the height of Y above the base $PQRS$ (2 marks)

(b) the angle between the planes $RSXY$ and $PQRS$ (3 marks)

(c) 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 $y = x^3 + 4x^2 - 2$.

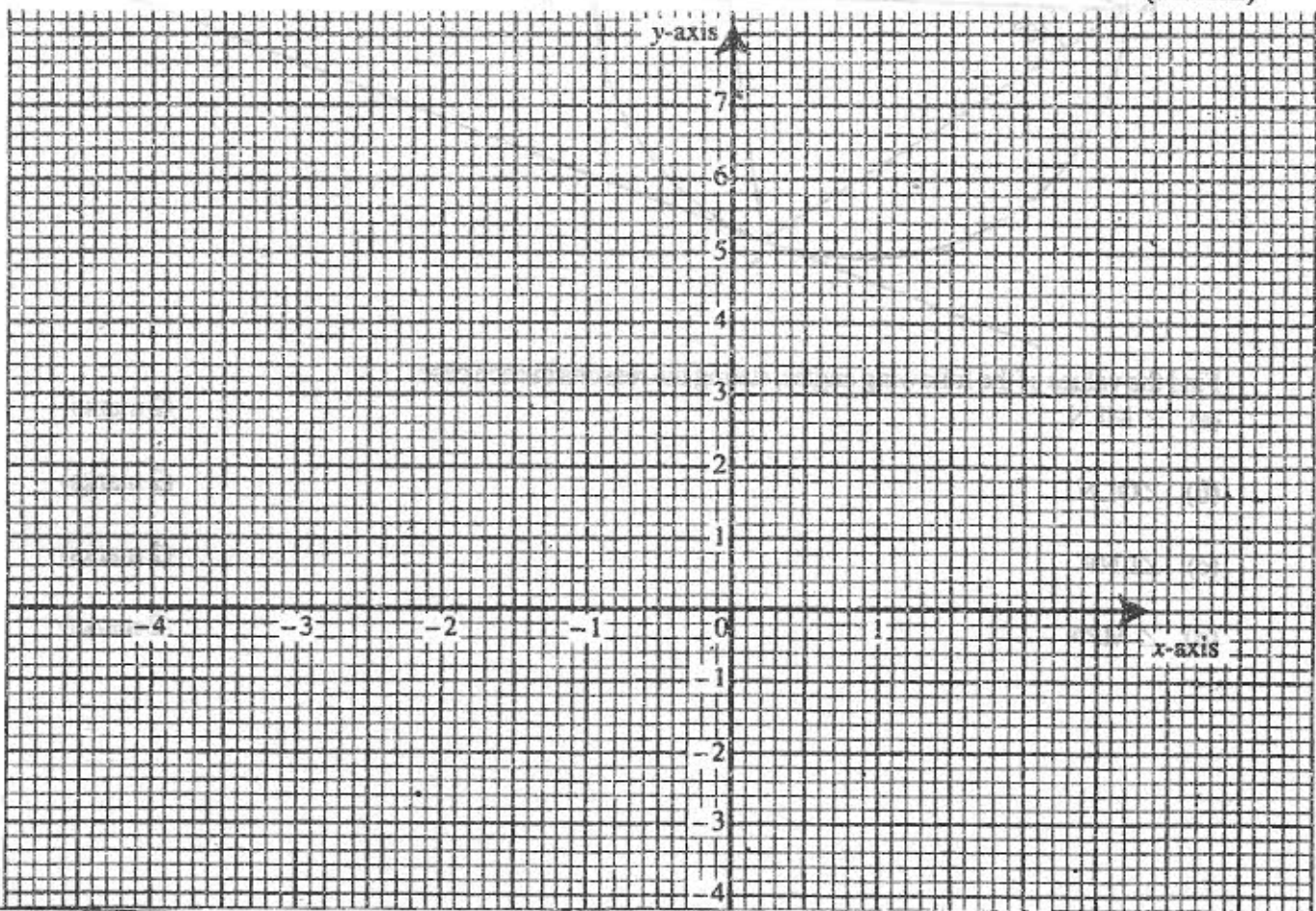
(a) Determine the coordinates of the turning points of the curve, correct to 1 decimal place. (3 mark)

(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)



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

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

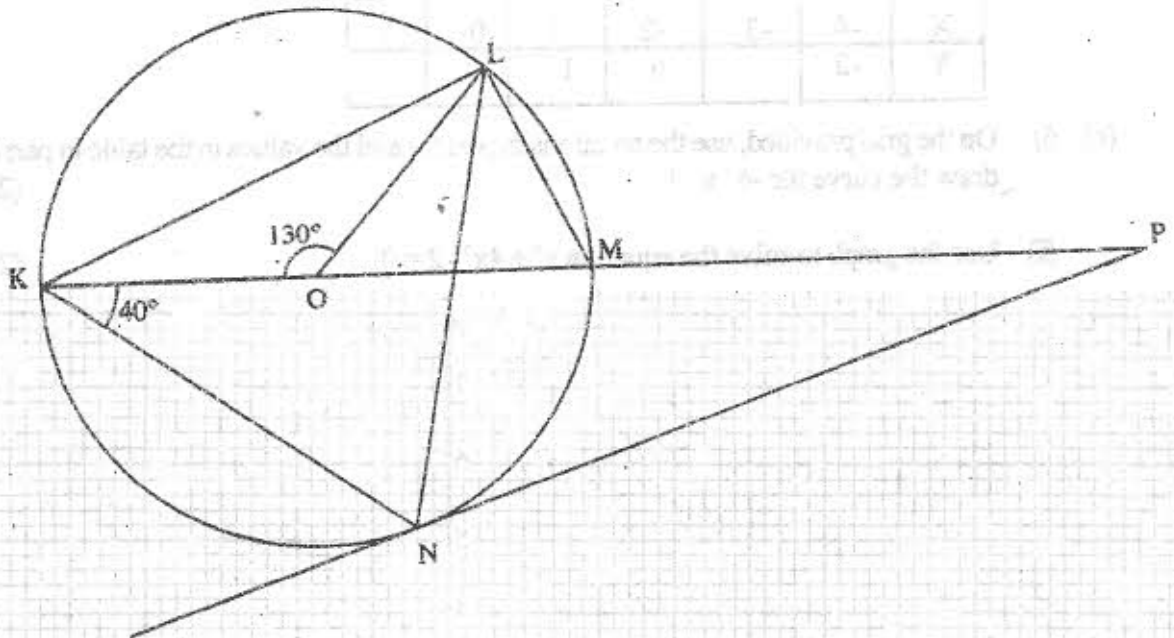
(i) \overrightarrow{PR} (1 mark)

(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° and angle MKN = 40° .



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)