

23.3 MATHEMATICS (121)



23.3.1 Mathematics Paper 1 (121/1)

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Name Index Number /

121/1
MATHEMATICS
 Paper 1
 Oct./Nov. 2006
 2¼ hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
 Kenya Certificate of Secondary Education
MATHEMATICS
 Paper 1
 2¼ hours

Instructions to candidates.

Write your name and index number in the spaces provided at the top of this page.

The paper contains two sections: Section I and Section II.

Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.

Marks may be given for correct working even if the answer is wrong.

Non-programmable silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.

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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Candidates should check the question paper to ensure that all the pages are printed as indicated and no questions are missing.

6016

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Turn over

SECTION I (50 marks)

Answer all the questions in this section.

- 1 Without using mathematical tables or a calculator evaluate

$$\frac{\sqrt[3]{675 \times 135}}{\sqrt{2025}}$$

(2 marks)

- 2 All prime numbers less than ten are arranged in descending order to form a number.

(a) Write down the number formed.

(1 mark)

b) State the total value of the second digit in the number formed in (a) above.

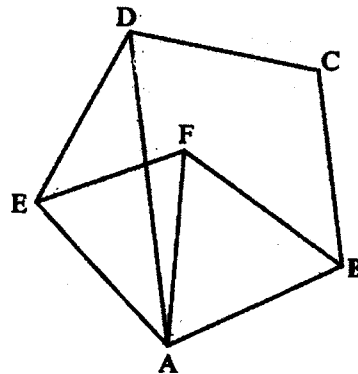
(1 mark)

- 3 Simplify

$$\frac{p^2 + 2pq + q^2}{p^3 - pq^2 + p^2q - q^3}$$

(4 marks)

- 4 In the figure below, ABCDE is a regular pentagon and ABF is an equilateral triangle.



Find the size of

(a) $\angle ADE$

(1 mark)

(b) $\angle AEF$

(1 mark)

(c) $\angle DAF$

(1 mark)

5 Solve the inequality $3 - 2x < x \leq \frac{2x + 5}{3}$ and show the solution on the number line. (4 marks)

6 The length of a rectangle is $(3x + 1)$ cm. Its width is 3 cm shorter than its length. Given that the area of the rectangle is 28 cm^2 , find its length. (3 marks)

7 In this question, mathematical tables should not be used.

A Kenyan bank buys and sells foreign currencies as shown below:

	Buying (in Kenya shillings)	Selling (in Kenya shillings)
1 Hong Kong dollar	9.74	9.77
1 South African rand	12.03	12.11

A tourist arrived in Kenya with 105 000 Hong Kong dollars and changed the whole amount to Kenya shillings. While in Kenya, she spent sh 403 879 and changed the balance to South African rand before leaving for South Africa. Calculate the amount, in South African rand, that she received. (3 marks)

8 In this question use a pair of compasses and a ruler only.

(a) Construct triangle ABC such that $AB = 6 \text{ cm}$, $BC = 8 \text{ cm}$ and $\angle ABC = 135^\circ$. (2 marks)

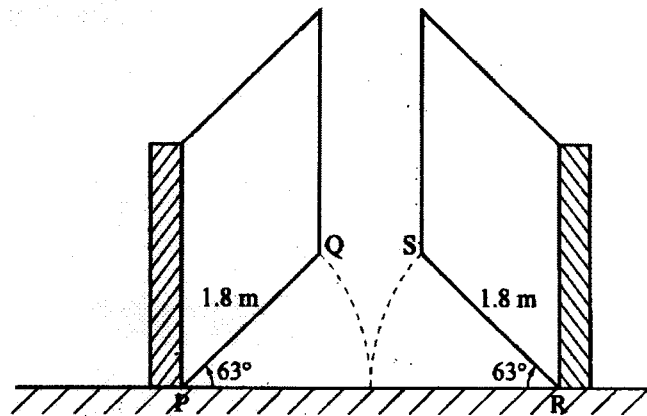
(b) Construct the height of triangle ABC in (a) above, taking BC as the base. (1 mark)

9 A line with gradient of -3 passes through the points $(3, k)$ and $(k, 8)$. Find the value of k and hence express the equation of the line in the form $ax + by = c$, where a , b and c are constants. (3 marks)

10 Without using mathematical tables or a calculator evaluate

$$6 \log_2 \sqrt[3]{64} + 10 \log_3 \sqrt[5]{243} \quad (3 \text{ marks})$$

- 11 The diagram below represents a school gate with double shutters. The shutters are each opened through an angle of 63° .
The edges of the gate, PQ and RS are each 1.8 m.



Calculate the shortest distance QS, correct to 4 significant figures. (3 marks)

- 12 Two points P and Q have coordinates $(-2, 3)$ and $(1, 3)$ respectively. A translation maps point P to $P'(10, 10)$.

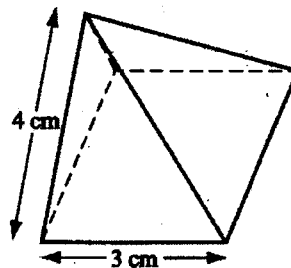
- (a) Find the coordinates of Q' , the image of Q under the translation. (1 mark)
(b) The position vectors of P and Q in (a) above are \mathbf{p} and \mathbf{q} respectively. Given that

$$m\mathbf{p} - n\mathbf{q} = \begin{pmatrix} -12 \\ 9 \end{pmatrix}$$

find the values of m and n .

(3 marks)

- 13 The diagram below represents a right pyramid on a square base of side 3 cm. The slant edge of the pyramid is 4 cm.

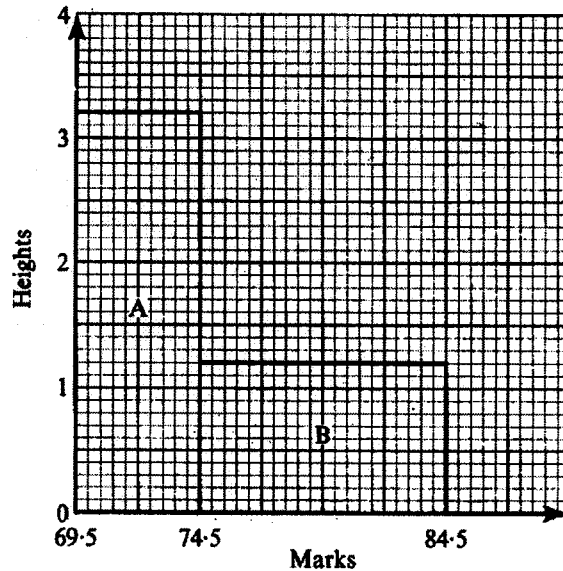


- (a) Draw a net of the pyramid. (2 marks)

- (b) On the net drawn, measure the height of a triangular face from the top of the pyramid. (1 mark)

- 14 Hadija and Kagendo bought the same types of pens and exercise books from the same shop. Hadija bought 2 pens and 3 exercise books for sh 78. Kagendo bought 3 pens and 4 exercise books for sh 108. Calculate the cost of each item. (3 marks)

- 15 The histogram below represents the distribution of marks obtained in a test. The bar marked A has a height of 3.2 units and a width of 5 units. The bar marked B has a height of 1.2 units and a width of 10 units.



If the frequency of the class represented by bar B is 6, determine the frequency of the class represented by bar A. (3 marks)

- 16 A circle centre O, has the equation $x^2 + y^2 = 4$. The area of the circle in the first quadrant is divided into 5 vertical strips each of width 0.4 cm. (a) Use the equation of the circle to complete the table below for values of y correct to 2 decimal places. (1 mark)

x	0	0.4	0.8	1.2	1.6	2.0
y	2.00			1.60		0

- (b) Use the trapezium rule to estimate the area of the circle. (3 marks)

SECTION II (50 marks)

Answer any five questions in this section.

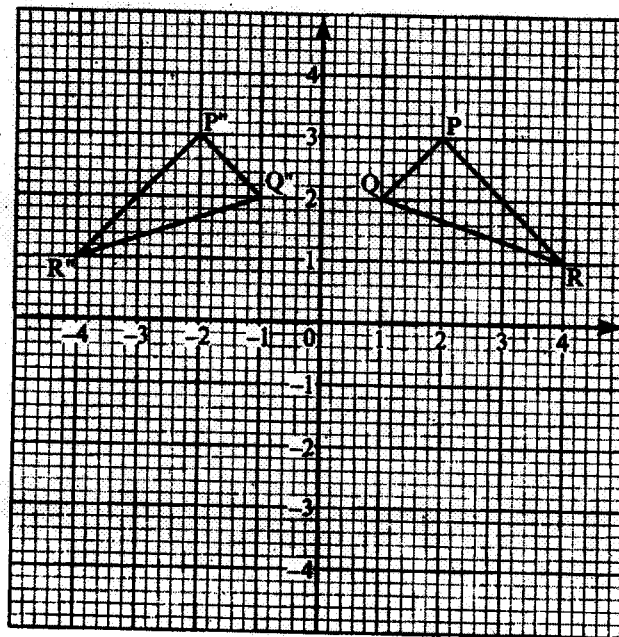
- 17 In the year 2001, the price of a sofa set in a shop was sh 12 000. (a) Calculate the amount of money received from the sales of 240 sofa sets that year. (2 marks)

(b) (i) In the year 2002 the price of each sofa set increased by 25% while the number of sets sold decreased by 10%.
Calculate the percentage increase in the amount received from the sales. (3 marks)

(ii) If at the end of year 2002, the price of each sofa set changed in the ratio 16:15, calculate the price of each sofa set in the year 2003. (1 mark)

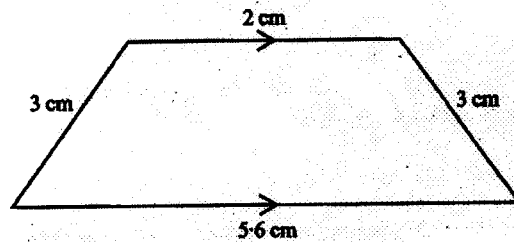
(c) The number of sofa sets sold in the year 2003 was P% less than the number sold in the year 2001.
Calculate the value of P, given that the amounts received from sales in the two years were equal. (4 marks)

18 On the cartesian plane below, triangle PQR has vertices P(2,3), Q(1,2) and R(4,1) while triangle P^{*}Q^{*}R^{*} has vertices P^{*}(-2,3), Q^{*}(-1,2) and R^{*}(-4,1).

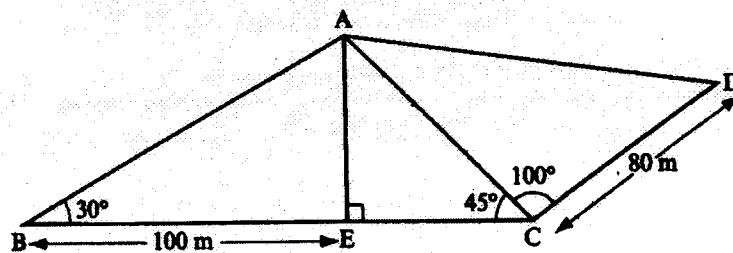


- (a) Describe fully a single transformation which maps triangle PQR onto triangle P^{*}Q^{*}R^{*}. (2 marks)
- (b) On the same plane, draw triangle P^{*}Q^{*}R^{*}, the image of triangle PQR, under reflection in line $y = -x$. (2 marks)
- (c) Describe fully a single transformation which maps triangle P^{*}Q^{*}R^{*} onto triangle P^{**}Q^{**}R^{**}. (2 marks)
- (d) Draw triangle P^{**}Q^{**}R^{**} such that it can be mapped onto triangle PQR by a positive quarter turn about (0,0). (2 marks)
- (e) State all pairs of triangles that are oppositely congruent. (2 marks)

- 19 The diagram below (not drawn to scale) represents the cross-section of a solid prism of height 8.0 cm.



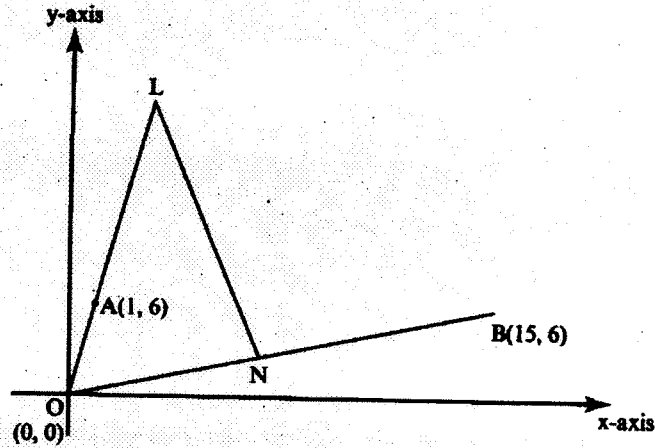
- (a) Calculate the volume of the prism. (3 marks)
- (b) Given that the density of the prism is 5.75 g/cm^3 , calculate its mass in grams. (2 marks)
- (c) A second prism is similar to the first one but is made of a different material. The volume of the second prism is 246.24 cm^3 .
- (i) Calculate the area of the cross-section of the second prism. (3 marks)
- (ii) Given that the ratio of the mass of the first prism to that of the second is 2:5, find the density of the second prism. (2 marks)
- 20 A bus left Mombasa and travelled towards Nairobi at an average speed of 60 km/h. After $2\frac{1}{2}$ hours, a car left Mombasa and travelled along the same road at an average speed of 100 km/h. If the distance between Mombasa and Nairobi is 500 km, determine
- (a) (i) the distance of the bus from Nairobi when the car took off. (2 marks)
- (ii) the distance the car travelled to catch up with the bus. (4 marks)
- (b) Immediately the car caught up with the bus, the car stopped for 25 minutes. Find the new average speed at which the car travelled in order to reach Nairobi at the same time as the bus. (4 marks)
- 21 The figure below represents a quadrilateral piece of land ABCD divided into three triangular plots. The lengths BE and CD are 100 m and 80 m respectively. Angle $\angle ABE = 30^\circ$, $\angle ACE = 45^\circ$ and $\angle ACD = 100^\circ$.



- (a) Find to four significant figures:
- (i) the length of AE (2 marks)
- (ii) the length of AD (3 marks)
- (iii) the perimeter of the piece of land. (3 marks)

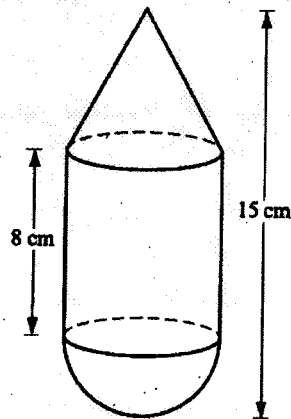
(b) The plots are to be fenced with five strands of barbed wire leaving an entrance of 2.8 m wide to each plot. The type of barbed wire to be used is sold in rolls of length 480 m. Calculate the number of rolls of barbed wire that must be bought to complete the fencing of the plots. (2 marks)

22 In the diagram below, the coordinates of points A and B are (1,6) and (15,6) respectively. Point N is on OB such that $3ON = 2OB$. Line OA is produced to L such that $OL = 3OA$.



- (a) Find vector LN. (3 marks)
- (b) Given that a point M is on LN such that $LM:MN = 3:4$, find the coordinates of M. (2 marks)
- (c) If line OM is produced to T such that $OM:MT = 6:1$
 - (i) Find the position vector of T. (1 mark)
 - (ii) Show that points L, T and B are collinear. (4 marks)

23 The figure below is a model representing a storage container. The model whose total height is 15 cm is made up of a conical top, a hemispherical bottom and the middle part is cylindrical. The radius of the base of the cone and that of the hemisphere are each 3 cm. The height of the cylindrical part is 8 cm.



- (a) Calculate the external surface area of the model. (4 marks)

(b) The actual storage container has a total height of 6 metres. The outside of the actual storage container is to be painted. Calculate the amount of paint required if an area of 20 m^2 requires 0.75 litres of the paint. (6 marks)

24 A particle moves along a straight line such that its displacement S metres from a given point is $S = t^3 - 5t^2 + 3t + 4$ where t is time in seconds.

Find:

(a) the displacement of the particle at $t = 5$ (2 marks)

(b) the velocity of the particle when $t = 5$ (3 marks)

(c) the values of t when the particle is momentarily at rest (3 marks)

(d) the acceleration of the particle when $t = 2$. (2 marks)

23.3.2 Mathematics Paper 2 (121/2)

Name Index Number

121/2
MATHEMATICS
 Paper 2
 Oct./Nov. 2006
 2½ hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL
 Kenya Certificate of Secondary Education
MATHEMATICS
 Paper 2
 2½ hours

Instructions to candidates.

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Section II

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**Grand
Total**

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SECTION I (50 marks)

Answer all the questions in this section.

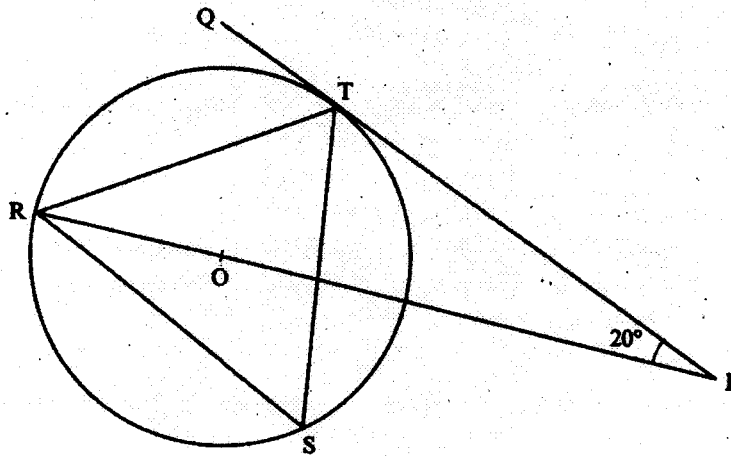
- 1 In this question, show all the steps in your calculations, giving your answer at each stage. Use logarithms, correct to 4 decimal places, to evaluate

$$\sqrt[3]{\frac{36 \cdot 72 \times (0.46)^2}{185 \cdot 4}} \quad (4 \text{ marks})$$

- 2 Make s the subject of the formula

$$\sqrt{p} = r\sqrt{1 - as^2} \quad (3 \text{ marks})$$

- 3 In the figure below R , T and S are points on a circle centre O . PQ is a tangent to the circle at T , POR is a straight line and $\angle QPR = 20^\circ$.



Find the size of $\angle RST$. (2 marks)

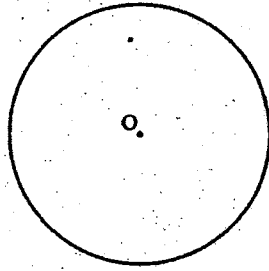
- 4 By correcting each number to one significant figure, approximate the value of 788×0.006 . Hence calculate the percentage error arising from this approximation. (3 marks)

- 5 The data below represents the ages in months at which 6 babies started walking: 9, 11, 12, 13, 11 and 10. Without using a calculator, find the exact value of the variance of the data. (3 marks)

- 6 Without using a calculator or mathematical tables, simplify

$$\frac{3\sqrt{2} - \sqrt{3}}{2\sqrt{3} - \sqrt{2}} \quad (3 \text{ marks})$$

- 7 The figure below shows a circle centre O and a point Q which is outside the circle.



Using a ruler and a pair of compasses only, locate a point P on the circle such that angle OPQ = 90°. (2 marks)

- 8 The table below is a part of tax table for monthly income for the year 2004.

Monthly taxable income in Ksh	Tax rate percentage (%) in each shilling
Under Ksh 9681	10%
From Ksh 9681 but under Ksh 18801	15%
From Ksh 18801 but under Ksh 27921	20%

In the year 2004, the tax on Kerubo's monthly income was Ksh 1916.

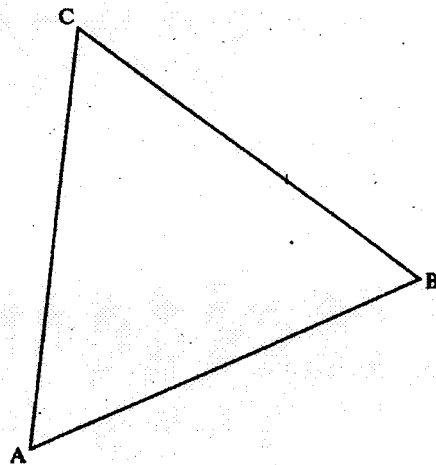
Calculate Kerubo's monthly income. (3 marks)

- 9 Given that $q\mathbf{i} + \frac{1}{2}j + \frac{3}{2}k$ is a unit vector, find q . (2 marks)
- 10 The points with coordinates (5, 5) and (-3, -1) are the ends of a diameter of a circle centre A. Determine:
- (a) the coordinates of A (1 mark)
- (b) the equation of the circle, expressing it in the form $x^2 + y^2 + ax + by + c = 0$ where a , b and c are constants. (3 marks)
- 11 Use binomial expression to evaluate

$$\left(2 + \frac{1}{\sqrt{2}}\right)^5 + \left(2 - \frac{1}{\sqrt{2}}\right)^5 \quad (4 \text{ marks})$$

- 12 Three quantities t , x and y are such that t varies directly as x and inversely as the square root of y . Find the percentage decrease in t if x decreases by 4% when y increases by 44%. (4 marks)

- 13 The figure below is drawn to scale. It represents a field in the shape of an equilateral triangle of side 80 m.



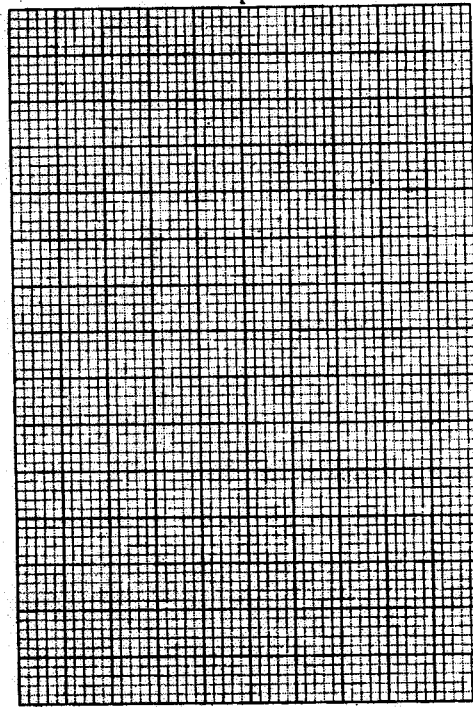
The owner wants to plant some flowers in the field. The flowers must be at most, 60 m from A and nearer to B than to C. If no flower is to be more than 40 m from BC, show by shading, the exact region where the flowers may be planted. (4 marks)

- 14 The table below shows some corresponding values of x and y for the curve represented by

$$y = \frac{1}{4}x^3 - 2.$$

x	-3	-2	-1	0	1	2	3
y	-8.8	-4	-2.3	-2	-1.8	0	4.8

On the grid provided below, draw the graph of $y = \frac{1}{4}x^3 - 2$ for $-3 \leq x \leq 3$. Use the graph to estimate the value of x when $y = 2$. (3 marks)



- 15 A particle moving in a straight line passes through a fixed point O with a velocity of 9 m/s. The acceleration of the particle, t seconds after passing through O is given by $a = (10 - 2t) \text{ m/s}^2$.
Find the velocity of the particle when $t = 3$ seconds. (3 marks)
- 16 Two places P and Q are at $(36^\circ\text{N}, 125^\circ\text{W})$ and $(36^\circ\text{N}, 55^\circ\text{E})$ respectively.
Calculate the distance in nautical miles between P and Q measured along the great circle through the North Pole. (3 marks)

SECTION II (50 marks)

Answer any five questions in this section.

- 17 (a) A certain sum of money is deposited in a bank that pays simple interest at a certain rate. After 3 years the total amount of money in the account is sh 358 400. The interest earned each year is sh 12 800.
Calculate:
(i) the amount of money which was deposited (2 marks)
(ii) the annual rate of interest that the bank paid. (2 marks)
- (b) A computer whose marked price is sh 40 000 is sold at sh 56 000 on hire purchase terms.
(i) Kioko bought the computer on hire purchase terms. He paid a deposit of 25% of the hire purchase price and cleared the balance by equal monthly instalments of sh 2625. Calculate the number of instalments. (3 marks)
(ii) Had Kioko bought the computer on cash price terms he would have been allowed a discount of $12\frac{1}{4}\%$ on marked price.
Calculate the difference between the cash price and hire purchase price and express it as a percentage of the cash price. (3 marks)

18 A garden measures 10 m long and 8 m wide. A path of uniform width is made all round the garden. The total area of the garden and the path is 168m^2 .

(a) Find the width of the path. (4 marks)

(b) The path is to be covered with square concrete slabs. Each corner of the path is covered with a slab whose side is equal to the width of the path.

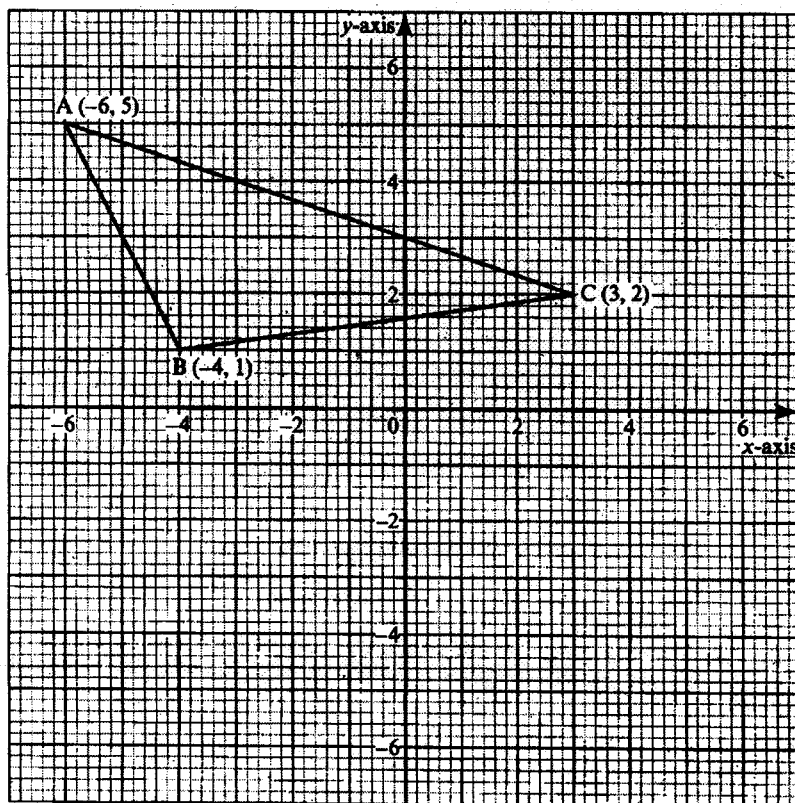
The rest of the path is covered with slabs of side 50 cm. The cost of making each corner slab is sh 600 while the cost of making each smaller slab is sh 50.

Calculate:

(i) the number of the smaller slabs used (3 marks)

(ii) the total cost of the slabs used to cover the whole path. (3 marks)

19 Triangle ABC is shown on the coordinate plane below.



(a) Given that $A(-6, 5)$ is mapped onto $A'(-6, -4)$ by a shear with y-axis invariant,

(i) draw triangle $A'B'C'$, the image of triangle ABC, under the shear. (3 marks)

(ii) determine the matrix representing the shear. (2 marks)

(b) Triangle $A' B' C'$ is mapped onto $A'' B'' C''$ by a transformation defined by the matrix $\begin{pmatrix} -1 & 0 \\ 1\frac{1}{2} & -1 \end{pmatrix}$.

- (i) Draw triangle $A'' B'' C''$ (3 marks)
(ii) Describe fully a single transformation that maps $A' B' C'$ onto $A'' B'' C''$. (2 marks)

20 (a) Two integers, x and y , are selected at random from the integers 1 to 8. If the same integer may be selected twice, find the probability that:

(i) $|x - y| = 2$ (2 marks)

(ii) $|x - y|$ is 5 or more (2 marks)

(iii) $x > y$ (2 marks)

(b) A die is biased so that when tossed, the probability of a number r showing up, is given by $P(r) = Kr$ where K is a constant and $r = 1, 2, 3, 4, 5, 6$ (the numbers on the faces of the die).

(i) Find the value of K . (2 marks)

(ii) If the die is tossed twice, calculate the probability that the total score is 11. (2 marks)

21 A solution whose volume is 80 litres is made up of 40% of water and 60% of alcohol. When x litres of water are added, the percentage of alcohol drops to 40%.

(a) Find the value of x . (4 marks)

(b) Thirty litres of water is added to the new solution. Calculate the percentage of alcohol in the resulting solution. (2 marks)

(c) If 5 litres of the solution in (b) above is added to 2 litres of the original solution, calculate in the simplest form, the ratio of water to that of alcohol in the resulting solution. (4 marks)

22 The product of the first three terms of a geometric progression is 64.

If the first term is a , and the common ratio is r ,

(a) Express r in terms of a . (3 marks)

(b) Given that the sum of the three terms is 14

(i) Find the values of a and r and hence write down two possible sequences each up to the 4th term. (5 marks)

(ii) Find the product of the 50th terms of the two sequences. (2 marks)

- 23 Mwanjoki Flying Company operates a flying service. It has two types of aeroplanes. The smaller one uses 180 litres of fuel per hour while the bigger one uses 300 litres per hour.

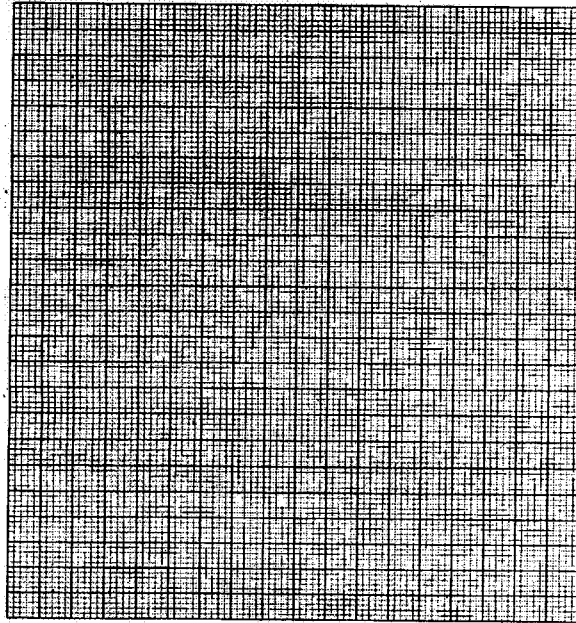
The fuel available per week is 18 000 litres. The company is allowed 80 flying hours per week. To keep the aeroplane in good condition the bigger aeroplane must be flown for x hours per week while the smaller aeroplane must be flown for y hours per week.

(a) Write down all the inequalities representing the above information. (3 marks)

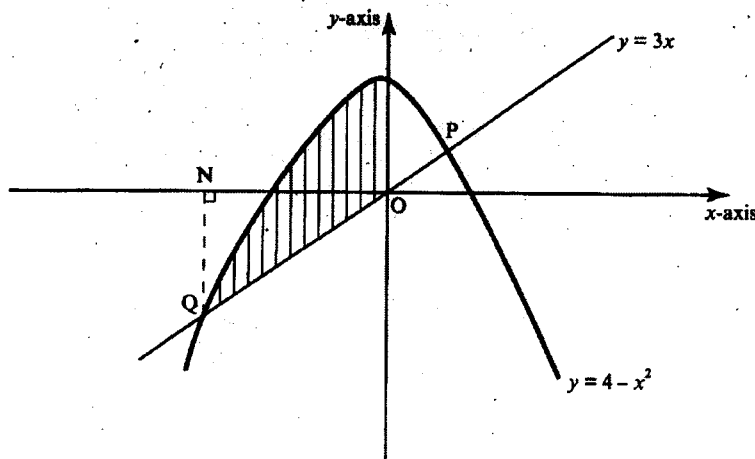
(b) On the grid provided on page 21, draw all the inequalities in (a) above by shading the unwanted regions. (4 marks)

(c) The profit on the smaller aeroplane is sh 4 000 per hour while that on the bigger one is sh 6 000 per hour.

Use the graph drawn in (b) above to determine the maximum profit that the company made per week. (3 marks)



- 24 The diagram below shows a sketch of the line $y = 3x$ and the curve $y = 4 - x^2$ intersecting at points P and Q.



(a) Find the coordinates of P and Q.

(4 marks)

(b) Given that QN is perpendicular to the x -axis at N, calculate

(i) the area bounded by the curve $y = 4 - x^2$, the x -axis and the line QN.

(2 marks)

(ii) the area of the shaded region that lies below the x -axis.

(2 marks)

(iii) the area of the region enclosed by the curve $y = 4 - x^2$, the line $y = 3x$ and the y -axis.

(2 marks)