

K.C.S.E 2006 MATHEMATICAL PAPER 121/1

SECTION 1 (50 MARKS)

Answer all the questions in this section

1. Without using mathematical tables or a calculator evaluate (4 marks)

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

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)

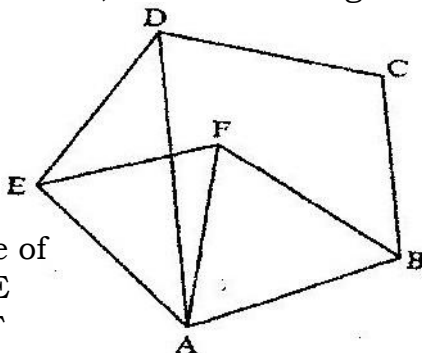
3. Simplify

$$P^2 + 2pq + q^2$$

$$P^3 - pq^2 + p^2q - q^3$$

(4 marks)

4. In the figure below, ABCDE is a regular pentagon and ABF is an equilateral triangle (1mark)



Find the size of

a) $\angle ADE$

b) $\angle AEF$

c) $\angle DAF$

(1 mark)

(1 mark)

(1 mark)

5. Solve the inequality $3 - 2x < x \leq 2x + 5$ and show the solution on the number line

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 28cm^2 , find its length.

7. In this question, mathematical table 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 tourists arrived in Kenya with 105 000 Hong Kong dollars and changed the whole amount to Kenyan shillings. While in Kenya, she pent Kshs 403 897 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

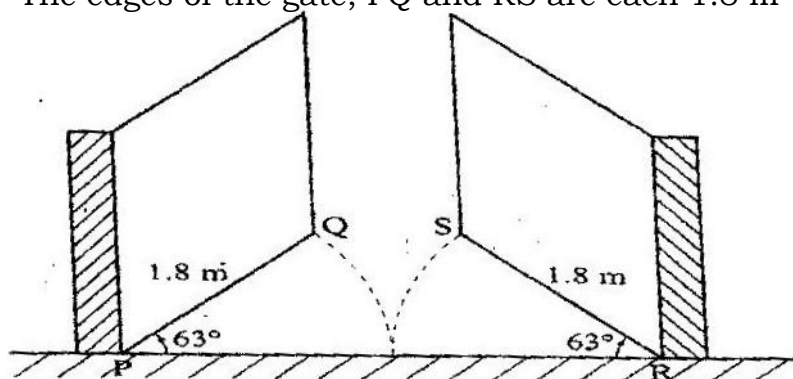
(a) construct triangle ABC such that $AB = 6 \text{ cm}$, $BC = 8 \text{ cm}$ and $\angle ABC = 135^\circ$
(2 marks)

(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.

10. Without using mathematical tables or a calculator evaluate
 $6 \log_2 3 + \sqrt{64} + 10 \log_3 5 + \sqrt{243}$
(3 marks)

11. The diagram below represents a school gate with double shutters. The shutters are such 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)

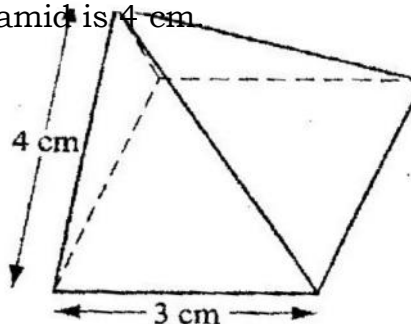
12. Two points P and Q have coordinates $(-2, 3)$ and $(1, 3)$ respectively. A translation map point P to $P' (10, 10)$

(a) Find the coordinates of Q' the image of Q under the translation (1 mark)

(b) The position vector of P and Q in (a) above are p and q respectively given that $m\begin{pmatrix} p \\ 9 \end{pmatrix} - nq = -12$
(3 marks)

Find the value of m and n

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

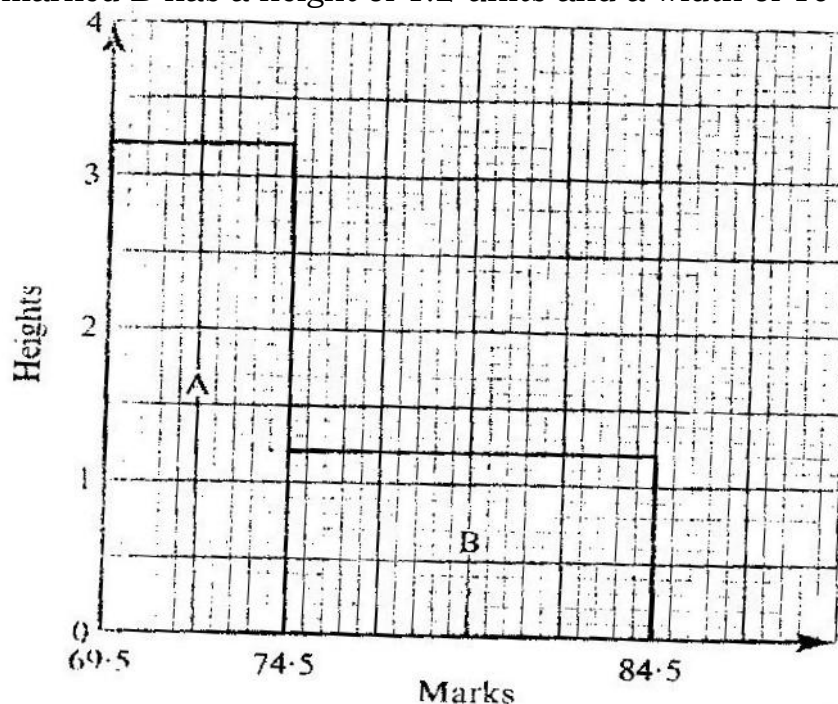


(a) Draw a net of the pyramid (2 marks)

- (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 Kshs 78. Kagendo bought pens and 4 exercise books for Kshs 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.

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 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

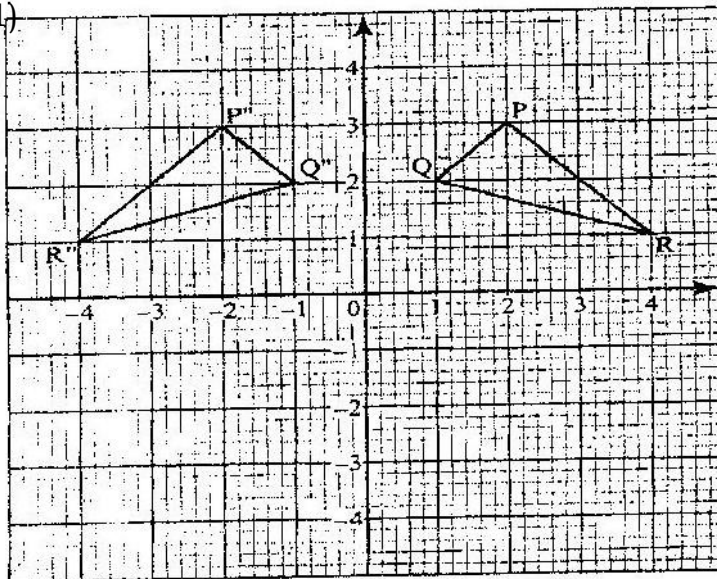
- (b) Use the trapezium rule to estimate the area of the circle (3 marks)

SECTION II (50 MARKS)

Answer any five questions in this section)

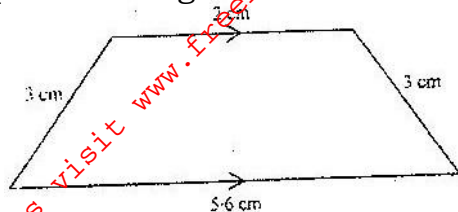
17. In the year 2001, the price of a sofa set in a shop was Kshs 12,000
- (a) Calculate the amount of money received from the sales of 240 sofa sets that year (2 marks)
- (b) (i) In the year 2002 the price of each sofa set increased by 25% while the number of sets sold decreased by 10%
Calculate the 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 triangle 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 (3 marks)



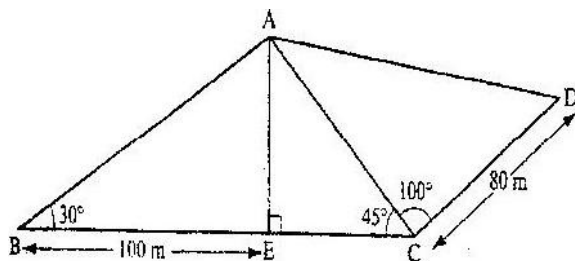
- (a) Calculate the volume of the prism (3 marks)
 (b) Given that the density of the prism is 5.75g/cm^3 , calculate its mass in grams (2 marks)
 (c) A second prism is similar to first one but is made of a different materials. The volume of the second is 246.24cm^3
 (i) calculate the area of the cross section of the second prism (3 marks)
 (ii) Given that the ratio of the mass of the first to that of the second is 2: 5 and the density of the second prism (2 marks)

20. A bus left Mombasa and traveled towards Nairobi at an average speed of 60km/hr . after $2\frac{1}{2}$ hours; a car left Mombasa and traveled along the same road at an average speed of 100km/hr . If the distance between Mombasa and Nairobi is 500km , Determine

- (a) (i) The distance of the bus from Nairobi when the car took off (2 marks)
 (ii) The distance the car traveled to catch up with the bus

- (b) Immediately the car caught up with the bus, the car stopped for 25 minutes. Find the new average speed at which the car traveled 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 100m and 80m respectively. Angle ABE = 30° $\angle ACE = 45^\circ$ and $\angle ACD = 100^\circ$

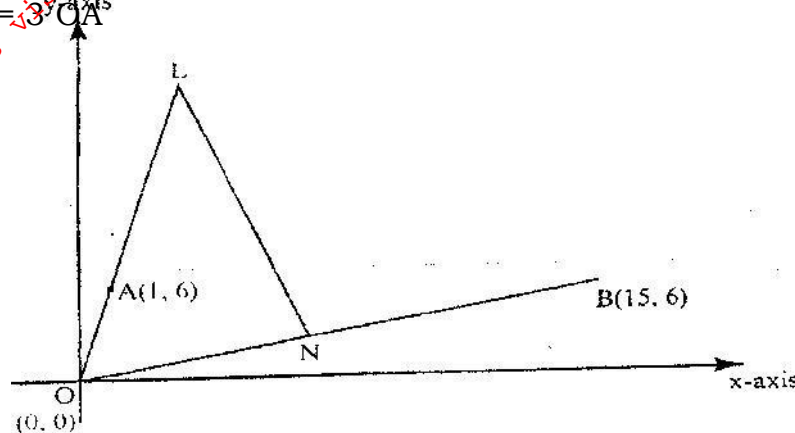


Find to four significant figures:

- (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 2.8m wide to each plot. The type of barbed wire to be used is sold in rolls of lengths 480m .

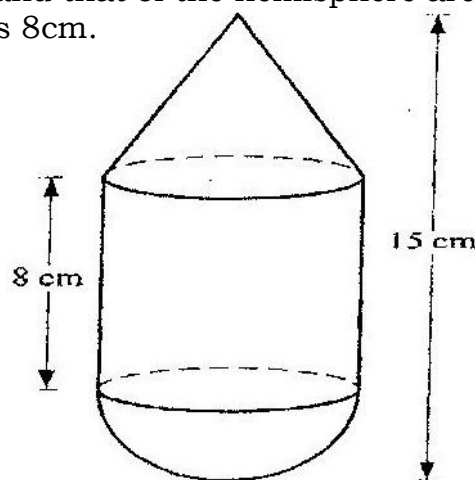
Calculate the number of rolls of barbed wire that must be bought to complete the fencing of the plots (2 marks)

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 $3 ON = 2OB$. Line OA is produced to L such that $OL = 3OA$



- Find vector LN (3 marks)
- Given that a point M is on LN such that $LM: MN = 3: 4$, find the coordinates of M (2 marks)
- If line OM is produced to T such that $OM: MT = 6:1$
 - Find the position vector of T (1 mark)
 - 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 15cm 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 3cm. The height of the cylindrical part is 8cm.



- Calculate the external surface area of the model (4 marks)
- 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 $20m^2$ 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 $S = t^3 - 5t^2 + 4$ where t is time in seconds

Find

- (a) the displacement of 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)

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K.C.S.E 2006 MATHEMATICS PAPER 121/2
SECTION 1 (50 Marks)

1. In this question, show all the steps in your calculations, giving your answers at each stage

Use logarithms, correct to 4 decimal places, to evaluate (4 marks)

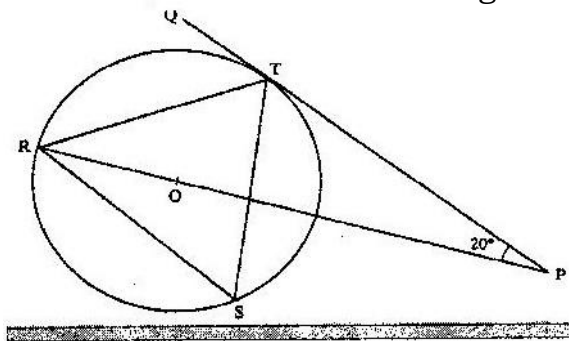
$$\sqrt[3]{\frac{36.72 \times (0.46)^2}{185.4}}$$

2. Make s the subject of the formula

(4 marks)

$$\sqrt{P} = r \sqrt{1 - as^2}$$

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 $\angle RST$

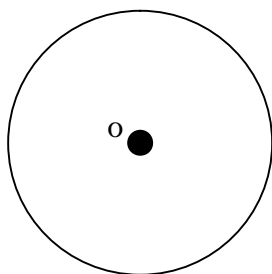
(2 marks)

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 (3 marks)

6. Without using a calculator or mathematical tables, simplify $3\sqrt{2} - \sqrt{3}$ (3 marks)

$$2\sqrt{3} - \sqrt{2}$$

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 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 rate percentage In (kshs) each shillings	Tax (%) in
Under Kshs 9681	10%
From Kshs 9681 but under 18801	15%
From Kshs 18801 but 27921	20%

In the tax year 2004, the tax of Kerubo's monthly income was Kshs 1916
Calculate Kerubos monthly income (3 marks)

9. Given that $q \mathbf{i} + \frac{1}{3} \mathbf{j} + \frac{2}{3} \mathbf{k}$ is a unit vector, find q (2 marks)

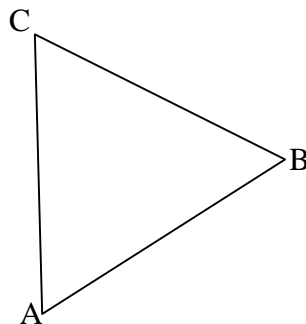
10. The points which coordinates (5,5) and (-3,-1) are the ends of a diameter of a circle centre A
Determine:
(a) the coordinates of A (1 mark)
(b) The equation of the circle, expressing it in form $x^2 + y^2 + ax + by + c = 0$ where a, b, and c are constants (3 marks)

11. Use binomial expression to evaluate (4 marks)

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

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 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 80m



The owner wants to plant some flowers in the field. The flowers must be at most, 60m from A and nearer to B than to C. If no flower is to be more than

40m from BC, show by shading, the exact region where the flowers may be planted (4 marks)

14. The table 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 9m/s. The acceleration of the particle, t seconds after passing through O is given by $a = (10 - 2t)$ m/s². Find the velocity of the particle when $t = 3$ seconds (3 marks)
16. Two places P and Q are at (36°N, 125°W) and 36°N, 125°W) and 36° N, 125°W) and 36° N, 55°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)

17. A certain sum of money is deposited in a bank that pays simple interest at a certain rate. After 5 years the total amount of money in an account is Kshs 358 400. The interest earned each year is 12 800 Calculate
- the amount of money which was deposited (2 marks)
 - the annual rate of interest that the bank paid (2 marks)
- (b) A computer whose marked price is Kshs 40,000 is sold at Kshs 56,000 on hire purchase terms.
- Kioko bought the computer on hire purchase term. He paid a deposit of 25% of the hire purchase price and cleared the balance by equal monthly installments of Kshs 2625 Calculate the number of installments (3 marks)
 - Had Kioko bought the computer on cash terms he would have been allowed a discount of 12 ½ % on marked price. Calculate the difference between the cash price and the hire purchase price and express as a percentage of the cash price.
18. A garden measures 10m long and 8 m wide. A path of uniform width is made all round the garden. The total area of the garden and the paths is 168 m².

(a) Find the width of the path

(4 marks)

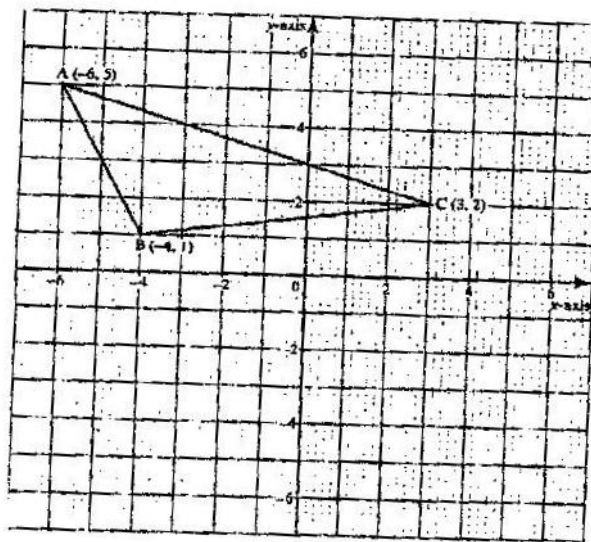
(b) The path is to be covered with square concrete slabs. Each corner of the path is covered with a slab whose side is equal to the width of the path. The rest of the path is covered with slabs of side 50 cm. The cost of making each corner slab is Kshs 600 while the cost of making each smaller slab is Kshs 50.

Calculate

(i) The number of smaller slabs used

(3 marks)

19. Triangle ABC is shown on the coordinates 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 this shear (2 marks)

(b) Triangle A B C is mapped on to A'' B'' C'' by a transformation defined by the matrix $\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$

(i) Draw triangle A'' B'' C''

(ii) Describe fully a single transformation that maps ABC onto A''B'' C''

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 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 $r = 1, 2, 3, 4, 5$ and 6 (the number 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 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

(c) If 5 litres of the solution in (b) 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 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 value of a and r and hence write down two possible sequence each up to the 4th term.

(ii) Find the product of the 50th terms of 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 while the smaller aeroplane must be flown for y hours per week.

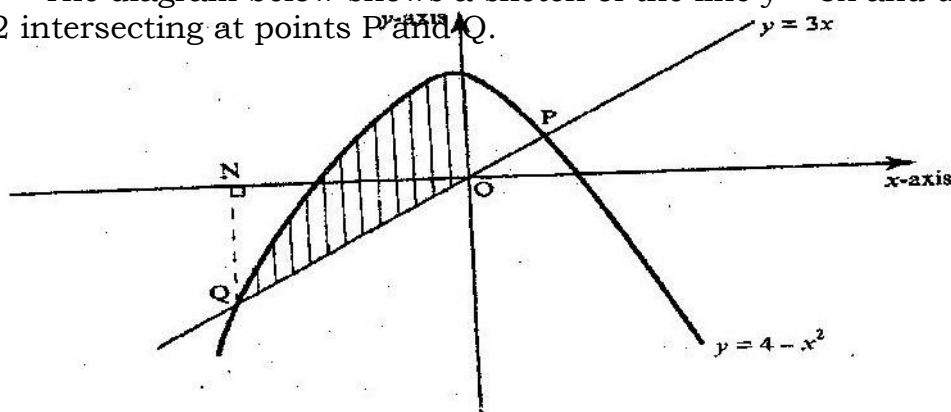
(a) Write down all the inequalities representing the above information (3 marks)

(b) On the grid provided on page 21, draw all the inequalities in a) above by shading the unwanted regions (3 marks)

(c) The profits on the smaller aeroplane is Kshs 4000 per hour while that on the bigger one is Kshs 6000 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