121/ 1 MATHEMATICS 2005
PAPER 1
SECTION 1 (52 Marks)

Answer all the question in this section

1. Evaluate

$$\frac{¾ + 1\,^5/_7 \div \text{ of } 2\,^1/_3}{(1\,^3/_7 - ^5/_8 \times ^2/_3)}$$ (3 marks)

2. Express the numbers 1470 and 7056, each as a product of its prime factors
   Hence evaluate

   $\sqrt{\dfrac{1470^2}{7056}}$ Leaving the answer in prime form   (3 marks)

3. The area of a rhombus is 60cm². Given that one of its diagonals is 15 cm long, calculate the perimeter of the rhombus   (3 marks)

4. Simplify the expression $\dfrac{9t^2 - 25a^2}{6t^2 + 19\,at + 15a^2}$ (3 marks)

5. The size of each interior angle of a regular polygon is five times the size of the exterior angle. Find the number of sides of the polygon.   (3 marks)

6.   A point R divides a line PQ internally in the ration 3:4. Another point S, divides the line PR externally in the ration 5:2. Given that PQ = 8cm, calculate the length of RS, correct to 2 decimal places.   (3 marks)

7. Given that sin (90 – x)⁰ = 0.8, where x is an acute angle, find without using mathematical tables the value of tan x⁰.

8. Two teachers are chosen randomly from a staff consisting 3 women and 2 men to attend a HIV/AIDs seminar. Calculate the probability that the two teachers chosen are:

   (a) Of the same sex
   (b) Of opposite sex

9. In this question Mathematical Tables should not be used
   The base and perpendicular height of a triangle measured to the nearest centimeter
   are 6 cm and 4 cm respectively.
   Find
   (a) The absolute error in calculating the area of the triangle   (2marks)
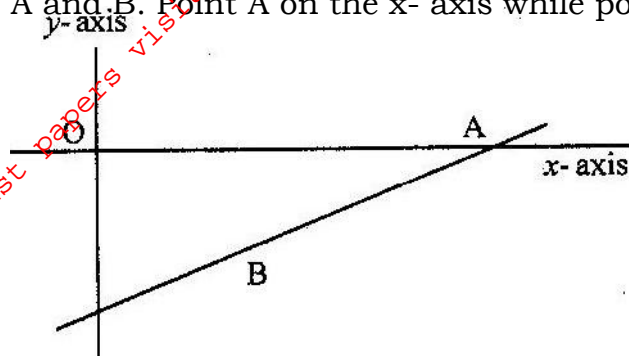   (b) The percentage error in the area, giving the answer to 1 decimal place (2mks)

10. Make P the subject of the formula
$$P^2 = (P – q) (P-r)$$ (3 marks)

11. On the diagram below, the line whose equation is $7y – 3x + 30 = 0$ passes though the
    points A and B. Point A on the x- axis while point B is equidistant from x- and y –
    axes.

        Calculate the co-ordinates of the points A and B   (3mks)

12. A cylindrical piece of wood of radius 4.2 cm and length 150 cm is cut length into
    two equal pieces.
    Calculate the surface area of one piece
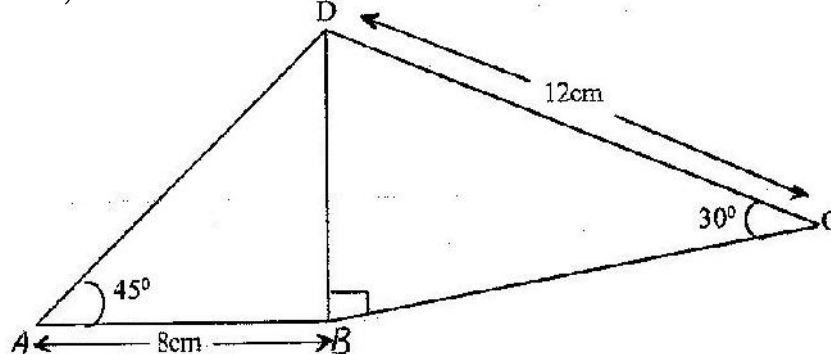   (Take ∏ as 22/7   (4mks)

13. Point T is the midpoint of a straight line AB. Given the position vectors of A and T
    are i-j + k and 2i+ 1 ½ k respectively, find the position vector of B in terms of i, j \
    and k.
                                      (3 marks)

14. The figure below shows a quadrilateral ABCD in which AB = 8 cm, DC = 12 cm, <
    BAD = 45⁰, < CBD = 90⁰ and BCD = 30⁰.

Find:
    (a) the length of BD   (1 mark)
    (b) The size of the angle ADB   (2 marks)

15.   A bank either pays simple interest as 5% p.a or compound interest 5% p.a
       on deposits. Nekesa deposited Kshs P in the bank for two years on simple

interest terms. If she had deposited the same amount for two years on compound interest terms, she would have earned Kshs 210 more.

Calculate without using Mathematics Tables, the values of P (4 marks)

16.   The acceleration, a ms^{-2}, of a particle is given by a =25 – 9t^2, where t in seconds after the particle passes fixed point O.
       If the particle passes O, with velocity of 4 ms^{-1}, find
            (a) An expression of velocity V, in terms of t   (2 marks)
            (b) The velocity of the particle when t = 2 seconds   (2 marks)

SECTION II (48 marks)
Answer any six questions in this section

17.   The distance between towns M and N is 280 km. A car and a lorry travel from M to N. The average speed of the lorry is 20 km/h less than that of the car. The lorry takes 1 h 10 min more than the car to travel from M and N.

   (a)   If the speed of the lorry is x km/h, find x   (5 marks)
   (b)   The lorry left town M at 8: 15 a.m. The car left town M and overtook the lorry at 12.15 p.m calculate the time the car left town M.

18.   The points P, Q, R and S have position vectors 2p, 3p, r and 3r respectively, relative to an origin O. A point T divides PS internally in the ratio 1:6
       (a) Find, in the simplest form, the vectors OT and QT in terms P and r (4 marks)

       (b) (i) Show that the points Q, T, and R lie on a straight line (3 marks)

          (ii) Determine the ratio in which T divides QR   (1 mark)

19.   The diagram below represents a rectangular swimming pool 25m long and 10m wide. The sides of the pool are vertical.
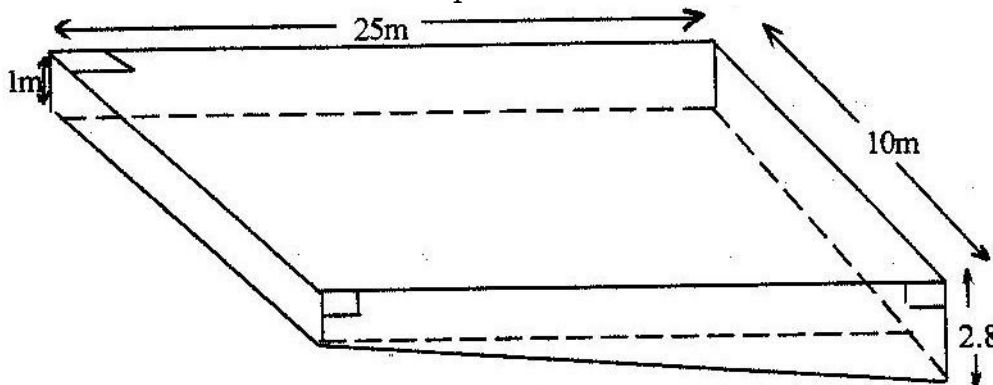
The floor of the pool slants uniformly such that the depth at the shallow end is 1m at the deep end is 2.8 m.

(a) Calculate the volume of water required to completely fill the pool.
(b) Water is allowed into the empty pool at a constant rate through an inlet pipe. It takes 9 hours for the water to just cover the entire floor of the pool.

Calculate:
(i)   The volume of the water that just covers the floor of the pool   (2 marks)
(ii)   The time needed to completely fill the remaining of the pool   (3 marks)

20.   The table below gives some of the values of x for the function y=½ x 2 + 2x + 1 in the interval 0≤ x ≤ 6.

x	0	1	2	3	4	5	6
y	1	3.5	7	11.5	17	23.5	31

(a) Use the values in the table to draw the graph of the function   (2 marks)

(b)   (i)   Using the graph and the mid – ordinate rule with six (6) strips, estimate the area bounded by the curve, the x- axis, the y- axis and the line = 6
       (ii)   If the exact area of the region described in (b) (i) above is 78cm^2, calculate the percentage error made when the mid – ordinate rule is used.

       Give the answer correct to two decimal places   (2 marks)

21.   The gradient of a curve at point (x,y) is 4x – 3. the curve has a minimum value of – $^1/_8$
(a)   Find
       (i) The value of x at the minimum point   (1 mark)
       (ii) The equation of the curve   (4 marks)

(b)   P is a point on the curve in part (a) (ii) above. If the gradient of the curve at P is -7, find the coordinates of P   (3 marks)

22.   The data below shows the masses in grams of 50 potatoes

Mass (g)	25- 34	35-44	45 -54	55-64	65 -74	75-84	85-94
No of potatoes	3	6	16	12	8	4	1

(a) On the grid provide, draw a cumulative frequency curve for the data (4mks)

(b) Use the graph in (a) above to determine
(i) The 60th percentile mass

(ii) The percentage of potatoes whose masses lie in the range 53 g to 68g
     (3mks)

23.   A boat which travels at 5 km/h in still water is set to cross a river which flows from the north at 6km/h. The boat is set on a course of x^0 with the north.
    (a) Given that $\cos x^0 = {}^3/_5$, calculate
        (i) The resultant speed of the boat   (2 marks)
        (ii) The angle which the track makes with the north   (2 marks)
    (b) If the boat is to sail on a bearing of 135^0, calculate the bearing of possible course on which it can be set   (4 marks)

24. (a) (i) Complete the table below for the function $y = x^3 + x^2 - 2x$ (2 marks

x	-3	-2	-1	0	1	2	2.5
-2x	6	4	2	0	-2	-4	-5
x^2	9	4	1	0	1	4	6.25
x^3	-27	-8	-1	0	1	8	15.625
Y = x3 + x2 – 2x							

    (ii On the grid provided, draw the graph of $y = x^3 + x^2 - 2x$ for the values of x
in

      the interval $-3 \leq x \leq 2.5$ (2 marks)

    (iii) State the range of negative values of x for which y is also negative   (1
mk)

    (b) Find the coordinates of two points on the curve other than (0,0) at which x-coordinate and y- coordinate are equal   (3 marks)

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SECTION I (52 Marks).

Answer all questions in this section

1. Find the value of y in the equation

$$\frac{243 \times 3^{2y} = 81}{729 \times 3^y \text{ divide } 3^{(2y-1)}}$$
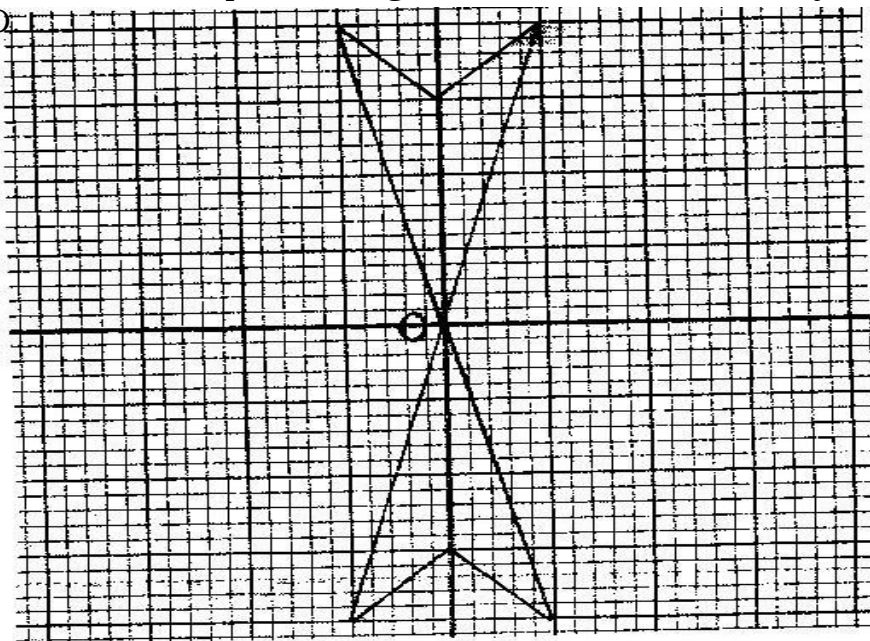
(3 marks)

2. Without using mathematical Tables, simplify

$$\frac{\sqrt{63} + \sqrt{72}}{\sqrt{32} + \sqrt{28}}$$

(3 marks)

3. In a fund- raising committee of 45 people, the ratio of men to women is 7: 2. Find the number of women required to join the existing committee so that the ratio of men to women is changed to 5: 4 (3 marks)

4. The diagram below is a part of a figure which has rotational symmetry of order 4 about O.

(a) Complete the figure (1 mark)
(b) Draw all the lines of symmetry of the completed figure (2 marks)

5. The first three consecutive terms of a geometrical progression are 3, x and 5 $^1/_3$. Find the value of x. (2 marks)

6. Pipe a can fill an empty water tank in 3 hours while, pipe B can fill the same tank in 6 hours, when the tank is full it can be emptied by pipe C in 8 hours. Pipes A and B are opened at the same time when the tank is empty.

If one hour later, pipe C is also opened, find the total time taken to fill the tank

(4 marks)

7. Find, without using Mathematical Tables the values of x which satisfy the equation

$\log_2 (x^2 - 9) = 3 \log_2 2 + 1$ (4 marks)

8. The volumes of two similar solid cylinders are 4752 cm^3 and 1408 cm^3. If the area of the curved surface of the smaller cylinder is 352 cm^2, find the area of the curved surface of the larger cylinder. (4 marks)

9. Given that $\cos 2x^0 = 0.8070$, find x when $0^0 < x < 360^0$ (4 marks)

10. A salesman earns a basic salary of Kshs. 9000 per month
In addition he is also paid a commission of 5% for sales above Kshs 15000
In a certain month he sold goods worth Kshs. 120, 000 at a discount of 2 ½ %
Calculate his total earnings that month (3 marks)

11. Successive moving averages of order 5 for the numbers 9,8.2, 6.7,5.4, 4.7 and k are A and B. Given that A – B = 0.6 find the value of k.

12. Two lines L_1 and L_2 intersect at a point P. L_1 passes through the points (-4,0) and (0,6). Given that L_2 has the equation: y = 2x – 2, find, by calculation, the coordinates of P. (3 marks)

13. Expand and simplify $(3x - y)^4$
Hence use the first three terms of the expansion to approximate the value of $(6-0.2)^4$ (4 marks)

14. The density of a solid spherical ball varies directly as its mass and inversely as the cube of its radius
When the mass of the ball is 500g and the radius is 5 cm, its density is 2 g per cm^3
Calculate the radius of a solid spherical ball of mass 540 density of 10g per cm^3

15. The figure below represents below represents a prism of length 7 cm
AB = AE = CD = 2 cm and BC – ED = 1 cm
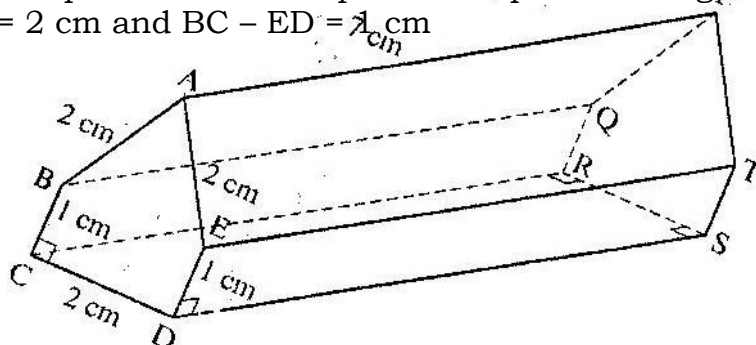
Draw the net of the prism (3 marks)

16. A stone is thrown vertically upwards from a point O
    After t seconds, the stone is S metres from O
    Given that S= $29.4t - 4.9t^2$, find the maximum height reached by the stone
    (3 marks)

SECTION II (48 marks)
Answer any six questions in this section

17. A curve is represented by the function y = $^1/_3 x^3 + x^2 - 3x + 2$
    (a) Find dy/dx (1 mark)

    (b) Determine the values of y at the turning points of the curve
    y = $^1/_3 x 3 + x^2 - 3x + 2$ (4 marks)

18. Triangles ABC and A"B"C" are drawn on the Cartesian plane provided.
    Triangle ABC is mapped onto A"B"C" by two successive transformations
    R = $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ Followed by $\begin{pmatrix} P = & 0 \\ -1 & 0 \end{pmatrix}$ -1
    (a) Find R (4 marks)
    (b) Using the same scale and axes, draw triangles A'B'C', the image of
    triangle ABC under transformation R (2 marks)

    (c) Describe fully, the transformation represented by matrix R (2 marks)

19. Abdi and Amoit were employed at the beginning of the same year. Their
    annual salaries in shillings progressed as follows:

           Abdi: 60,000, 64 800, 69, 600
           Amoit 60,000, 64 800, 69 984
    (a) Calculate Abdi's annual salary increment and hence write down an
    expression for his annual salary in his n^{th} year of employment(2 marks)

    (b) Calculate Amoit's annual percentage rate of salary increment and
    hence write down an expression for her salary in her n^{th} year of
    employment. (2
    marks)

    (c) Calculate the differences in the annual salaries for Abdi and Amoit in
    their 7th year of employment (4 marks)

20. (a) BCD is a rectangle in which AB = 7.6 cm and AD = 5.2 cm. draw the
    rectangle and construct the lucus of a point P within the rectangle such
    that P is equidistant from CB and CD
         (3 marks)

(b)   Q is a variable point within the rectangle ABCD drawn in (a) above such
      that $60° ≤ < AQB ≤ 90°$

On the same diagram, construct and show the locus of point Q, by leaving
unshaded, the region in which point Q lies

21. (a) complete the table below, giving your values correct to 2 decimal places

                                                                    (2 marks)

X⁰	0	30	60	90	120	150	180
2 sin x⁰	0	1		2		1	
1 – cos x⁰			0.5	1			

   (b)   On the grid provided, using the same scale and axes, draw the graphs of
         $y = \sin x°$ and $y = 1 – \cos x° ≤ x ≤ 180°$

         Take the scale: 2 cm for 30⁰ on the x- axis
         2 cm for I unit on the y- axis

   (c)   Use the graph in (b) above to
         (i)   Solve equation
                $2 \sin x° + \cos x° = 1$ (1 mark)
         (ii)   Determine the range of values x for which $2 \sin x° > 1 – \cos x°$
                                                                       (1 mark)

22. A boat at point x is 200 m to the south of point Y. The boat sails X to another
     point Z. Point Z is 200m on a bearing of 310⁰ from X, Y and Z are on the
     same horizontal plane.

     (a) calculate the bearing and the distance of Z from Y   (3 marks)
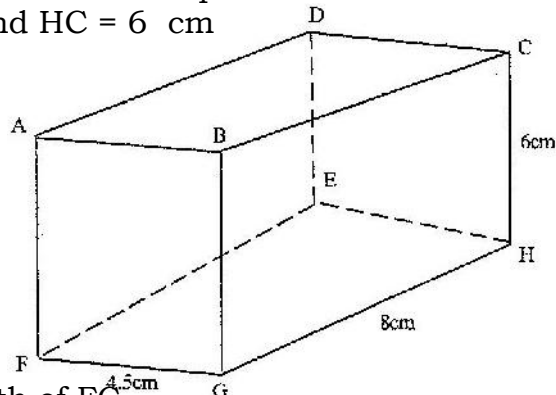   (b) W is the point on the path of the boat nearest to Y.
         Calculate the distance WY   (2 marks)
     (c) A vertical tower stands at point Y. The angle of point X from the top of the
         tower is 6⁰ calculate the angle of elevation of the top of the tower from W (3
         marks)

23. The diagram below represents a cuboid ABCDEFGH in which FG= 4.5 cm, GH
     = 8cm and HC = 6 cm

Calculate:
(a) The length of FC   (2 marks)

(b) (i) the size of the angle between the lines FC and FH   (2 marks)
    (ii) The size of the angle between the lines AB and FH   (2 marks)
(c) The size of the angle between the planes ABHE and the plane FGHE
       (2mks)

24.   diet expert makes up a food production for sale by mixing two ingredients N and S. One kilogram of N contains 25 units of protein and 30 units of vitamins. One kilogram of S contains 50 units of protein and 45 units of vitamins.
If one bag of the mixture contains x kg of N and y kg of S
    (a) Write down all the inequalities, in terms of x and representing the information above   (2 marks)
    (b) On the grid provided draw the inequalities by shading the unwanted regions   (2 marks)

    (c) If one kilogram of N costs Kshs 20 and one kilogram of S costs Kshs 50, use the graph to determine the lowest cost of one bag of the mixture   (3 marks)