Name _____ Index No. _____

Candidate's signature _____

Date _____

121/1
MATHEMATICS
PAPER 1
JULY 2011
2 ½ HOURS

MAKUENI / KATHIONZWENI JOINT EXAMINATION
Kenya Certificate of Secondary Education
MATHEMATICS
PAPER 1

INSTRUCTIONS TO DANDIDATES
1. Write your name, index number and class.
2. The paper contains two sections: Section I and II
3. Answer ALL questions in section I and ONLY FIVE questions from section II.
4. All working and answers must be written on the question paper in the spaces provided below each question.
5. Marks may be awarded for correct working even if the answer is wrong.
6. Negligence and slovenly work will be penalized.
7. Non-programmable silent electronic calculators and mathematical tables are allowed for use.

FOR EXAMINER'S USE ONLY

SECTION 1

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL

GRAND TOTAL

SECTION II

17	18	19	20	21	22	23	24	TOTAL

This paper consists of 16 printed pages

Turn Over

SECTION I (50 marks)

Answer all the questions in this section.

1. Work out the following giving the answer as a mixed number in its simplest form. (3 marks)

$$\frac{{}^{2}/_{5} \div \frac{1}{2} \text{ of } {}^{4}/_{9} - 1{}^{1}/_{10}}{{}^{1}/_{8} - {}^{1}/_{6} \times {}^{3}/_{8}}$$

2. Simplify : (3 marks)

$$\frac{2a^2 - 3ab - 2b^2}{4a^2 - b^2}$$

3. A sales man earns a basic salary of sh. 9,000 p.m. In addition he is also paid a commission of 5% for sales above sh. 15,000. In a certain month he sold goods worthy sh. 120,000 at a discount of 2 ½ %. Calculate his total earning that month. (3 marks)

4. In the figure, O is the centre of the circle and $O\hat{A}B = 20^0$.

Calculate

(a) $\angle AOB$ (1 mark)

(b) $\angle ACB$ (2 marks)

5. Solve for x

$^1/_5 (x + 2) - ¼ (2 – x) \geq {}^1/_3 (x + 4) – ½ (5 – x)$ (3 marks)

6. Each interior angle of a regular polygon is 120^0 larger than the exterior angle. How many sides has the polygon. (3 marks)

7. 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)

8. Express in surd form and simplify by rationalizing the denominator. (3 marks)

$$\frac{\sqrt{7} + \tan 60^0}{2\cos 30^0 - 2\sin 45^0}$$

9. Find in hectares the area of the following plot from the given field book entries. (4 marks)

	To E 900m	
	640m	440m
	320m	160m
500m	0	600m
	A From	

10. Given that P(-2, 4) and Q (3, 7) are points on a cartesian plane and R divides PQ in the ratio 7 : -2, find the co-ordinates of R. (3 marks)

11. Solve

$2x - 5y = 1$

$4x^2 + 25y^2 = 41$ (3 marks)

12. Machine A can do a piece of work in 6 hours while machine B can do the same work in 9 hours. Machine A was set to do the piece of work but after 3 ½ hrs it broke down and machine B did the rest of the work. Find how long machine B took to do the rest of the work (3 marks)

13. A pyramid with triangular base has slant edge 5cm long. The base itself is a 6cm equilateral triangle. Find; (4 marks)
(a) The height

(b) Volume of the pyramid

14. The table below shows the distribution of marks scored in a test by form 4 students in one school.

Marks	No. of students
30 – 34	12
35 – 39	5
40 – 44	3
45 – 49	12
50 – 54	18

Calculate the median mark . (3 marks)

15. Three points O, A and B are on the same horizontal ground. Point A is 80m to the North of O. B is located 70m on a bearing of 060^0 from A. A vertical mast stands at B. The angle of elevation of the top of the mast from O is 20^0.
Calculate:
(a) The distance of B from O. (2 marks)

(b) The height of the mast in metres. (2 marks)

16. Find the value of x for which $\begin{pmatrix} 3 & x-1 \\ -4 & x \end{pmatrix}$ is a singular matrix. (2 marks)

SECTION II (50 marks)

Answer any FIVE questions in this section.

17. Tickets for a football match cost 100 shillings and 50 shillings and tickets to the value of Kenya pounds K£ 100,000 were sold. If 30% more sh. 50 tickets and 40% fewer sh. 100 tickets had been sold, the income would have increased to K£ 112,500. How many tickets of each category were sold ? (10marks)

18. Triangle ABC has coordinates A(0, -1) B (4, 3) and C (2, 2).

(a) Find the image $A^1B^1C^1$ of triangle ABC under translation $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$ (2 marks)

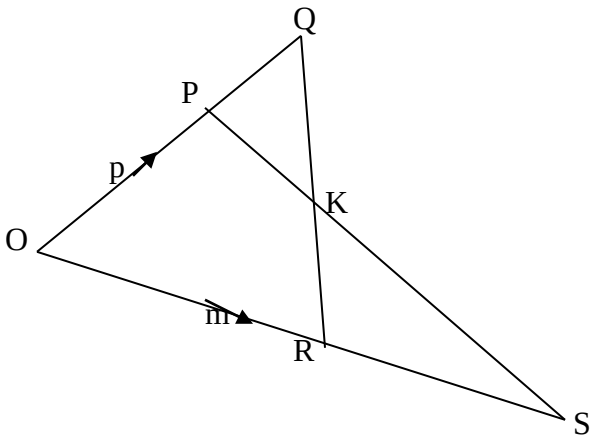
(b) Given that triangle$A^{11}B^{11}C^{11}$ is the image of $A^1B^1C^1$ under an enlargement scale factor 3, centre (0, 0), find the coordinates of $A^{11}B^{11}C^{11}$. (3 marks)

(c) Given that the area of triangle ABC is 6 square units, state the area of $A^{11}B^{11}C^{11}$. (2 marks)

(d) State the coordinates of the image of triangle $A^{11}B^{11}C^{11}$ under the reflection in the x – axis. (3 marks)

GRAPH PAPER

19. In the figure, OP = P and OP = r. OS = 2r and OQ = $^3/_2$ p



(a) Express in terms of p and r

(i) QR (2 marks)

(ii) PS (2 marks)

(b) The lines QR and PS intersect at K such that QK = mQR and PK = nPS , where

m and n are scolars. Find two distinct expressions for OK in terms of p, r, m and n.
Hence find the values of m and n. (5 marks)

(c) State the ratio PK : KS. (1 mark)

20. A model of a tank is made of a hemisphere and a cone. The diameter of the cone is 35cm and its height is 62cm as shown in the figure below.

Calculate:

(a) The total surface area of the tank. (7 marks)

(b) The capacity of the container in litres. (3 marks)

21. The table below shows monthly income tax rates for the year 2010.

Monthly taxable income (Ksh)	Tax rates
1 – 9,680	10%
9,681 – 18800	15%
18801 – 27,920	20%
27921 – 37040	25%
37041 and above	30%

In the year 2010, Sally's monthly income was as follows

Basic salary	Ksh. 20,600
House allowance	Ksh 12,000
Medical Allowance	Ksh 2,880
Transport Allowance	Ksh. 340

Sally was entitled to a monthly tax relief of Ksh. 1056
Calculate:

(a) His monthly taxable income. (2 marks)

(b) The monthly tax paid by Sally (6 marks)

(c) Other monthly deduction from her earning are as follows.

- Heath insurance Ksh. 300
- Cooperate contribution Ksh 2000
- Loan repayment Ksh. 1500

Calculate her net income. (2 marks)

22. (a) Complete the table below, for the function $y = 2x^2 + 4x – 3$. (2 marks)

x	-4	-3	-2	-1	0	1	2
$2x^2$	32		8	2	0	2	
$4x – 3$			-11		-3		5
y			-3			3	13

(b) On the grid provided, draw the graph of $y = 2x^2 + 4x - 3$ for $-4 \leq x \leq 2$ and use the graph to estimate the roots of the equation $2x^2 + 4x – 3 = 0$ to 1 decimal place. (4 marks)

GRAPH PPAER

(c) In order to solve graphically $2x^2 + x – 5 = 0$, a straight line must be drawn to intersect the curve $y = 2x^2 + 4x – 3$

Determine the equation of this straight line, draw the straight line and hence obtain the roots of the equation.

$2x^2 + x – 5 = 0$ to 1 decimal place. (4 marks)

23. The figure below shows a triangle ABC circumscribed by a circle centre O. Chords AB and AC measures 8cm and 5cm respectively. Angle BAC = 52^0. A point X is outside the circle.

A B Q O C P X R

Calculate:

(i) Length of chord BC. (2 marks)

(ii) The radius of the circle. (2 marks)

(iii) The area of the shaded region. (3 marks)

(iv) PX and QX are tangents to the circle. If QX is produced to R and angle POX = Y, show that angle PXR = 2y. (3 marks)

24. The velocity V metres per second of a particle projected into space is given by the formula $V = 5t^2 - 2t + 9$ where t is time in seconds elapsed since projection.

(a) Determine the acceleration of the particle when t = 4 seconds. (3 marks)

(b) The value of t which minimizes the acceleration.

(c) The total distance moved by the particle

(i) Between time t = 1 to t = 4 seconds

(ii) During the 3rd second

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1.	$\frac{(\frac{2}{5} \times \frac{9}{2}) - \frac{11}{10}}{\frac{1}{8} - \frac{1}{16}}$		
	$= \frac{\frac{7}{10}}{\frac{1}{16}}$	M1	simplification of numerator
		M1	simplification of denominator
	$= 11\frac{1}{5}$ √	A1	
		3	
2.	$\frac{(2a + b)(a - 2b)}{(2a + b)(2a - b)}$	M1	√ factorization numerator
		M1	√ factorization denominator
	$= \frac{a - 2b}{2a - b}$	A1	
		3	
3.	$\frac{97.5}{100} \times 120{,}000 = 117{,}000$	M1	
	$\frac{5}{100} \times 117{,}000 = 5{,}850$	M1	
	9,000 + 5,850		
	= sh. 14,850	A1	
		3	
4.	(a) $A\hat{O}B = 180 - (20 + 20)$		
	$= 140^0$	B1	
	(b) $A\hat{C}B = ½$ reflex $A\hat{O}B$		
	$= ½ (360 - 140)$	M1	
	$= 110^0$	A1	
		3	
5.	$\frac{1}{5}x + \frac{2}{5} - ½ + \frac{x}{4} \geq \frac{1}{3}x + \frac{4}{3} - \frac{5}{2} + ½ x$		
	$\frac{1}{5} + \frac{x}{4} - \frac{1}{3}x - ½ x \geq \frac{4}{3} - \frac{5}{2} - \frac{2}{5} + ½$	M1	
	$\frac{-23}{60} x \geq \frac{-7}{30}$	M1	

This paper consists of 9 printed pages

$x \leq {}^{14}/_{23}$	A1	
	3	
6. Exterior x Interior $120^0 + x$ $120^0 + x + x = 180^0$ $2x = 60^0$ $x = 30^0$ $n = \frac{360^0}{30^0}$ n = 12 sides	M1 A1 B1	
	3	
7. $\frac{8-k}{k-3} = -3$ $k = ½$ $\frac{y-½}{x-3} = -3$ $y + 3x = 9\ ½$	B1 M1 A1	
	3	
8. $\frac{\sqrt{7} + \sqrt{3}}{2 \times \frac{\sqrt{3}}{2} - 2\frac{1}{\sqrt{2}}}$ $= \frac{\sqrt{7} + \sqrt{3}}{\sqrt{3} - \frac{2}{\sqrt{2}}} \times \left(\sqrt{3} + \frac{2}{\sqrt{2}}\right)$ $= 3 + \sqrt{21} + \sqrt{14} + \sqrt{16}$ √	M1 M1 A1	√ ratios
	3	
9.		

	½ x 500 x 900 = 225000 ½ (160 + 600) x 320 = 121600	B1	
	½ (160 + 440) x 320 = 96000 ½ x 440 x 260 = 57200	B1	
	Total = 499,800	B1	
	$\frac{499800}{10000}$ = 49.98Ha √	B1	
		4	
10.	P 5 Q 2 R PR : RQ 7 : -2		
	OR = 7 q – 2 p √ □ 5 □ 5 □	M1	
	= $\frac{7}{5}\begin{pmatrix}3\\7\end{pmatrix} - \frac{2}{5}\begin{pmatrix}-2\\4\end{pmatrix}$ √	M1	
	= $\left((^{21}/_5 + {}^{4}/_5)\ (^{49}/_5 - {}^{8}/_5) \right)$ = R (5, 8.2) √	A1	
		5	
11.	$x = \frac{1 + 5y}{2}$	M1	
	$4 [½ (1 + 5y)]^2 + 25y^2 = 41$ $y = {}^{4}/_5$ or – 1	M1	
	∴ x = 2 ½ or -2 (2 ½ , $^{4}/_5$) and (-2, -1)	A1	
		3	
12.	Work done by A $^{1}/_6$ x $^{7}/_2$ = $^{7}/_{12}$ √	M1	
	Remaining work 1 – $^{7}/_{12}$ = $^{5}/_{12}$		
	Time taken by B $^{5}/_{12} \div {}^{1}/_9$ √	M1	
	$^{5}/_{12}$ x $^{9}/_1$ = $3^{3}/_4$ hrs √	A1	
		3	
13.			

(a) Base $\sqrt{6^2 + 3^2} = \sqrt{45}$ $\sqrt{5^2 (\ ^2/_3 \sqrt{45})^2}$ √ $\sqrt{25 - 20} = \sqrt{5}$ Height = 2.236cm √	M1 A1	
(b) Volume of the pyramid $= \ ^1/_3$ x (½ x 6 x $\sqrt{45}$) x $\sqrt{5}$ √ $= 15cm^3$ √	M1 A1	
	4	

14. mdn = Lm + $\left(\frac{^n/_2 \text{ cf} - \text{cfb}}{\text{fw}} \right)$ x i

x	f
30 – 34	12
35 – 39	17
40 – 44	20
45 – 49	32
50 – 54	50

$= 44.5 + \left(\frac{^{50}/_2 - 20}{12} \right)$ x 5 √ $= 44.5 + \ ^5/_{12}$ x 5 = 44.5 + 2.083 = 46.58 marks √	M1 M1 A1	
	3	

15. 30

(a) $a^2 = 80^2 + 60^2 - 2$ x 80 x 60 cos 30 a = 41.06	M1	
(b) tan 20 = $\frac{h}{41.06}$ h = 14.95	M1 A1	
	4	

16. $3x - (-4x + 5) = 0$ $x = \ ^5/_7$	M1 A1	
	2	

17.	Let the number of sh. 100 tickets be x Let the number of sh. 50 tickets be y Total amount collected = 100x + 50y = 100,000 If 30% more of y were sold, the amount = ($^{130}/_{100}$ x 50y) If 40% less of x were sold, the amount = ($^{60}/_{100}$ x 100x) (65y + 60x) = 112500) x 10 (50y + 100x =100,000) x 13 650y + 600x = 1125000 - 650y + 1300x = 1300000 700x = 175000 x 20 (change to £) x = 5000 ∴ 5oy + 100 x 5000 = 1000000 x 20 = 2000000 50y = 1500000 y = 30000 Number of tickets costing sh. 50 = 30,000 Number of tickets costing sh. 100 = 5000	 M1 M1 M1 M1 A1 M1 M1 A1 B1 B1	
		10	
18.	(a) $A^1B^1C^1$ under translation $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$ $A^1 = \begin{pmatrix} 0 \\ -1 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \end{pmatrix} = \begin{pmatrix} 1 \\ -3 \end{pmatrix}$ (1, -3) $B^1 = \begin{pmatrix} 4 \\ 3 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \end{pmatrix} = \begin{pmatrix} 5 \\ 1 \end{pmatrix}$ (5, 1) $C^1 = \begin{pmatrix} 2 \\ 2 \end{pmatrix} + \begin{pmatrix} 1 \\ -2 \end{pmatrix} = \begin{pmatrix} 3 \\ 0 \end{pmatrix}$ (3, 0) (b) $A^{11}B^{11}C^{11}$ scale factor 3 enlargement = $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix} \begin{pmatrix} 1 & 5 & 3 \\ -3 & 1 & 0 \end{pmatrix}$ = $\begin{pmatrix} 3 & 15 & 9 \\ -9 & 3 & 0 \end{pmatrix}$ A^{11}(3, -9) B^{11} (15, 3) C^{11} (9, 0) (c) Area of $A^{11}B^{11}C^{11}$ $\begin{pmatrix} 3 & 0 \\ 0 & 3 \end{pmatrix}$ det 9 – 0 = 9 A.S.F 6 x 9 = 54 sq. units (d) $\begin{pmatrix} 1 & 0 \\ - & -1 \end{pmatrix} \begin{pmatrix} 3 & 15 & 9 \\ -9 & 3 & 0 \end{pmatrix}$	 B1 B1 M1 M1 A1 M1 A1 M1	

		$= \begin{pmatrix} 3 & 15 & 9 \\ 9 & -3 & 0 \end{pmatrix}$	M1	√ multiplication
		A^{111} (3, 9) B^{111} (15, -3) C^{111} (9, 0)	A1	√ coordinates
			10	
19.	(a)	(i) QR = QO + OR $= {}^{-3}/_{2}$ p + r	M1 A1	
		(ii) PS = PO + OS = -p + 2r	M1 A1	
	(b)	(i) OK = OQ + QK $= {}^{3}/_{2}$ p + m ($^{-3}/_{2}$ p + r)	M1	
		(ii) OK = OP + PK = P + n (-P + 2r)	M1	
		$^{3}/_{2} - {}^{3}/_{2}$m = 1 – n m = 2n	M1	
		3m – 2n = 1 m = 2n m = ½ n = ¼	M1 A1	√ elimination of n or m
	(c)	PK : KS 1 : 3	B1	
			10	
20.	(a)	Surface area of the conical part $L^2 = 62^2 + 17.5^2$ = 3844 + 306.25 = 4150.25 L = 64.42 cm	M1 A1	
		SA = πrl = 3.142 x 17.5 x 64.42 = 3542.1cm^2	 M1 A1	
		The surface area of the hemispherical part = ½ (4) πr^2 = 2πr^2 = 2 x 3.142 x 17.5^2 = 1924.5cm^2	 M1 A1	
		Total SA = 1924.5 + 3542.1 = 5466.6cm^2	 B1	
	(b)	Volume of the container Conical part : $^{1}/_{3}$ πr^{2}h = $^{1}/_{3}$ x 3.142 x 17.5^2 x 62 = 19886.2	 M1	

		Sphere : $^4/_3$ x $\frac{3.142}{2}$ x 17.5^3 = 11226.1		
		Total volume = 31112.3cm^3 = 31.1123 litres √	A1	
21.	(a)	20600 + 12000 + 2880 + 340	M1	
		= 35820	A1	
	(b)	9680 x $^{10}/_{100}$ = 968		
		9120 x $^{15}/_{100}$ = 1368	M1	for 9120
		9120 x $^{20}/_{100}$ = 1824	M1	for 7900
		7900 x $^{25}/_{100}$ = 1975	M1	√ slabs
		6135	M1	√ addition
		Relief 1056 -	M1	
		Monthly tax 5079	A1	
	(c)	Total deductions 5079 + 300 + 2000 + 1500 = 8879	M1	
		Net income = 35820 – 8879 = 26,941	A1	
			10	

22. (a)

x	-4	-3	-2	-1	0	1	2
$2x^2$		18					8
4x – 3	-19	-15		-7			
y	13	3		-5	-3		

B2 for √ table

√ B1

(b) 16 12 8 4 0 -4 -4 -2 2 -2.5, 0.6 L1 √
S1
P1
C1

(c) $y = 2x^2 + 4x - 3$
$= 2x^2 + x - 5$
$y = 3x + 2$ B1
B1 (B1 for each √ value of x)
-1.8, 1.6 B1

23. (a)	Length of chord BC BC $= \sqrt{5^2 + 8^2 - 2(5)(8)\cos 52^0}$ $= 6.304$cm	 M1 A1	
	(b) The radius of the circle $\frac{\text{Sin } 52^0}{6.304} = \frac{1}{2r}$ $r = 4$cm	 M1 A1	
	(c) The area of the shaded region. $= 3.142 \times 4^2 - \frac{1}{2} \times 8 \times 5 \sin 52^0$ $= 50.272 - 15.76$ $= 34.51\text{cm}^2$	 M1 M1 A1	
	(d) If QX is produced to R and $\angle$ POX = y, show that angle PXR = 2y $\angle$POX = y and $\angle$OPX = 90^0 (radius is perpend. To tangent) $\angle$ PXO = $90^0 - y$ (complementary angles) $\angle$PXQ = 2 ($90^0 - y$) (OX bisects PXO) $\therefore \angle$PXR = $180^0 - 2(90^0 - y)$ Adjacent angles $\angle$PXR = 2y	 B1 B1 B1	
		10	
24. (a)	$V = St^2 - 2t + 9$ Acceleration $= \frac{dv}{dt} = 10t - 2$ $t = 4$ $a = 10 \times 4 - 2$ $a = 40 - 2$ $= 38\text{m/s}^2$	 M1 M1 A1	
(b)	$\frac{da}{dt} = t = 0$	A1	
(c) (i)	Distance $= \int 5t^2 - 2t + 9dt$ $= \frac{5t^3}{3} - \frac{2t^2}{2} + 9t + c$ $= \left[\frac{5t^3}{3} - t^2 + 9t + C \right]_1^4$ $(^{320}/_3 - 16 + 36 + C) - (\,^5/_3 - 1 + 9 + C)$ $(126.667 - 9.667)$ $= 117$m	 M1 M1 A1	C need not be there
(ii)	During the third second $t = 2$ and $t = 3$ $\left[\frac{5}{3} t^3 - t^2 + 9t + C \right]_2^3$ $(45 - 9 + 27 + C) - (13.33 - 4 + 18 + C)$ $(63 + C) - (27.33 + C)$ 35.67m	 M1 M1 A1	
		10	

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121/2
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SECTION I (50 marks)

1. Without using logarithm tables or calculators evaluate giving your answer in decimal form : (2 marks)

$$\frac{0.015 + 0.45 \div 1.5}{49 \times 0.2 + 0.07}$$

2. A quantity y varies partly as x^2 and partly as x. When y = 6, x =1 and when y = 30, x = 3. Find the equation relating y to x. (3 marks)

3. Use logarithms to evaluate:

$$\sqrt[3]{\frac{1.42 \times 0.004623}{\text{Log } 4}}$$

(4 marks)

4. The equation $3x^2 + mx = 6$ has $x = 2$ as one of the roots. Find the other root. (3 marks)

5. Find the gradient function of the following
$y = (2x – 1) (2x + 1) (7x – 4)$ (3 marks)

6. A rectangle measures 10cm by 15cm. If there was an error margin of 1% in each of these measurements, find the percentage error in its area. (3 marks)

7. Make P the subject of the equation;

$$\frac{m^4 - p^2}{m^2 + p} = px$$

(3 marks)

8. (a) Given that $y = 2 \cos (2x - 30^0)$ is the equation of a curve. State the amplitude and period of the curve. (2 marks)

(b) Given that $y = -1^1/_5$ in the above function, find x where $180^0 \leq x \leq 36^0$. (2 marks)

9. D E A F B

The figure above shows the roof of a building, ABCD being a rectangular in which AB = 25m and BC = 12m. The faces ADE and FBC are equilateral and each is inclined at 50^0 to the horizontal plane ABCD. Calculate the length of ridge EF. (3 marks)

10. Use the trapezium rule to estimate the area bounded by the curve $y (x + 1) = 1$, $x = 0$ and $x = 5$. Use strips of unit width. (3 marks)

11. Given that matrix R is $\begin{pmatrix} 2 & 2 \\ 1 & 0 \end{pmatrix}$ and T is a negative quarter turn about the origin, find the image of (3, -2) under TR. (3 marks)

12. The following line and curve intersect at a a point m. $x + y = 0$ and $x^2 + y^2 - xy = 12$. A circle centre m has a radius of 4cm. Find the possible values of M and the equations of the two circles. (4 marks)

13. Expand $(2 - x)^5$ and use the expansion to find the value of $(1.99)^5$ to 4 d.p. (3 marks)

14. A trader mixes millet costing sh. 40 per kg with wheat flour costing sh. 60 per kg. Find the ratio in which the two should be mixed so that by selling the mixture at sh. 55, a profit of 10% is realised. (3 marks)

15. A processing company makes two types of juices using machines A and B respectively. Every hour machine A produces 30 litres while machine B 40 litres. All machines must make at least 3600 litres per hour. Machine A consumes 30 litres of diesel per hour while machine B consumes 20 litres of diesel per hour. The total fuel allocated for the machines costs sh. 4800 per hour. For every hour,the number of machine A producing the juice must be three times the number of machine B. If there are x machine A type and y machine B type, write all the inequalities representing this information. (3 marks)

16. Evaluate: $\int_{1}^{2} (x^2 + \frac{1}{x^2} + 2\ )\, dx$ (3 marks)

SECTION II 50 marks

Answer any five questions in this section.

17. The second, fourth and seventh terms of an arithmetic progression (A.P) are the first three Consecutive terms of a geometric progression (G.P). If the common difference of the A.P is 2, find

(a) The common ratio of the G.P. (5 marks)

(b) The last term of the A.P given that there are eighteen terms. (2 marks)

(c) The sum of the first 14 terms of the G.P. (3 marks)

18. The following table shows the masses to the nearest kg of a number of people.

Mass	50 – 54	55 – 59	60 – 64	65 – 69	70 – 74	75 – 79	80 – 84
Frequency	19	23	40	28	17	9	4

(a) Determine the modal class. (1 mark)

(b) Taking 67.0 as an assumed mean, calculate the mean mass to one decimal place. (5 marks)

(c) Calculate to one decimal place the standard deviation of the distribution. (3 marks)

(d) If each value increases by 2 what is the new standard deviation? (1 mark)

19. In a driving to work a teacher has to pass through three sets of traffic lights. The probability that she will have to stop at the first set of light is $^3/_5$. Each time she stops the probability of stopping in the next set of light is decreased by 20% and if she had not stopped the probability of stopping increases by 15%.

(a) Draw a tree diagram to represent this information. (2 marks)

(b) Using the tree diagram determine on any one journey the probability that she stops at

(i) All three sets of data. (2 marks)

(ii) Only one of the sets. (2 marks)

(iii) Only two of the sets. (2 marks)

(iv) None of the sets. (2 marks)

20. In a rectangle ABCD, AB = 7cm and CD = 4cm.

(a) (i) Construct ABCD and show the locus of P such that AP > 3cm. (3 marks)

(ii) Construct also the locus of P such that DP ≤ PC. (2 marks)

(iii) Show the position of P inside the rectangle that satisfies the above conditions. (1 marks)

11.

(b)Show on a graph paper the locus satisfied by the inequality $x^2 + y^2 – 4x + 6y \leq 12$. (4 marks)

Graph paper

21. An aeroplane flies from a town P ($1^0$15'S, 37^0E) to another town Q directly North of town P along the same longitude. The arc PQ subtends an angle of 48^0 at the centre of the earth. From Q the plane flies due West to another town R on longitude 23^0W taking the radius of the earth as 6400km.

(a) (i) State the location of town Q. (1 mark)

(ii) Find the distance travelled by the aerocraft in km from town Q to Rcorrect to 4. S.F. (Take $\pi = {}^{22}/_{7}$) (3 marks)

(b) The plane left town Q at 1.00 am local time. What was the local time at town R. (2 marks)

(c) The aeroplane took a total of 12 hours, determine its average speed in knots from P to R. (4 marks)

22. In the figure below EFGHI is a circle. GI is a diameter and angle FHI = 70^0, angle JHG = 52^0, JK is a tangent to the circle at H.

Find stating reasons

(a) Angle IGF

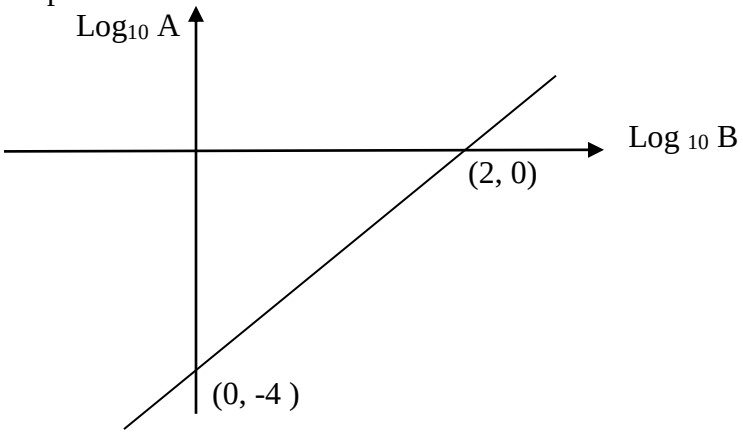
(b) Angle FHG

(c) Angle HIG

(d) Angle HKI

(e) Angle FEI

23. In the diagram the straight line graph is obtained by plotting $\text{Log}_{10} A$ against $\text{Log}_{10} B$ for position values of the variables A and B.



Obtain

(i) $\text{Log}_{10} A$ in terms of $\log_{10} B$ (3 marks)

(ii) A in terms of B. (2 marks)

(iii) The value of A when $\log_{10} B = 3$ (2 marks)

24. Draw the graphs of $y = \frac{1}{2} \sin 2x$ and $y = \sin x$ for $0 \leq x \leq 360$ on the same set of axes

GRAPH PAPER

(b) Use your graph to solve the equation
Sin 2x = 2 sin x.

(c) Determine the transformation that maps y = ½ sin x onto y = sin x. (10 marks)

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MATHEMATICS
PAPER 2
JULY 2011

MAKA JOINT EXAMINATION
Kenya Certificate of Secondary Education
MATHEMATICS

MARKING SCHEME

SECTION 1 (50 marks)

1.	$= \frac{0.315}{1.05}$ $=0.3$	M1 A1	
		2	
2	$y = mx^2 + nx$ $6 = m + n$ $30 = 9m + 3n$ √ $30 = 9m + 3n$ $18 = 3m + 3n$ $12 = 6m$ $4 = n \quad m = 2$ $y = 2x^2 + 4x$	 B1 M1 A1	 either one correct attempt to solve
		3	
3.	No: 1.42; 0.004623; 0.6021; 2.217×10^{-1} Log: $\bar{0}.1523$; $\bar{3}.6649$; $\bar{3}.8172$; $\bar{1}.7792$; $\bar{2}.0375$; $\frac{3}{3}$; $\frac{\bar{3} + 1.0375}{3}$; $\bar{1}.3458$; 0.2217	M1 M1 M1 A1	correct logs correct add. At log correct div. by 3
		4	
4.	$3x^2 + mx = 6 \quad x = 2$ $3 \times 4 + 2m = 6$ $2m = 6 - 12$ $2m = -6$ $m = -3$	 B1	

$3x^2 - 3x - 6 = 0$ $x^2 - x - 2 = 0$ $(x - 2)(x + 1) = 0$ other root is -1 $x = 2$ $x = -1$	M1 A1	
	3	
5. $y = (2x - 1)(2x + 1)(7x - 4)$ $y = (4x^2 - 1)(7x - 4)$ $y = 28x^3 - 16x^2 - 7x + 4$ $\frac{dy}{dx} = 84x^2 - 32x - 7$	M1 M1 A1	
	3	
6. $10 \times {}^1/_{100} = 0.1 \pm 10$ $15 \times {}^1/_{100} = 0.15 \pm 16$ $9.9 \leq 10 \leq 10.1$ $14.85 \leq 15 \leq 15.15$ Actual area $= 15 \times 10 = 150cm^2$ Max area $= 15.15 \times 10.1 = 153.015$ Min area $= 14.85 \times 9.9 = 147.015$ A.E $= \frac{1}{2}(153.015 - 147.015)$ $\frac{1}{2} \times 6 = 3$ P.E $= {}^3/_{150} \times 100$ $= 2\%$	M1 M1 A1	both max and min correct calculation
	3	
7. $\frac{m^4 - p^2}{m^2 + p} = px$ $\frac{(m^2 - p)\cancel{(m^2 + p)}}{\cancel{m^2 + p}} = px$ $m^2 - p = px$ $m^2 = p + px$ $m^2 = p(1 + x)$ $\frac{m^2}{1 + x} = p$	M1 M1 A1	
	3	
8. (a) $y = 2\cos(2x - 30^0)$ Amplitude $= 2$ Period $= \frac{360}{2} = 180^0$ (b) $-1{}^1/_5 = 2\cos(2x - 30)$ $-1.2 = 2\cos(2x - 30)$ $-0.6 = \cos(2x - 30)$	B1 B1 M1	

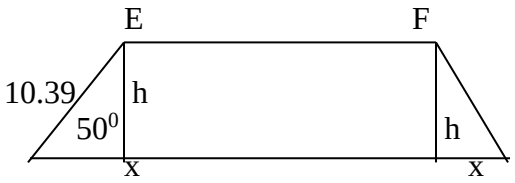
$2x - 30 = 233.13^0, 126.87^0$
$486.87^0, 593.13^0$
$x = 258.435^0, 311.565^0$ A1

4

9.

$\tan 60^0 = \frac{EM}{6}$

$EM = 10.39$ B1



$\cos 50 = \frac{x}{10.39}$

$6.68 = x$ M1

$E.F = 25 - (2 \times 6.68)$ A1

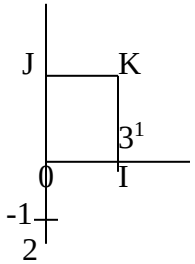
3

10. $y(x + 1) = 1$

$y = \frac{1}{x + 1}$

x	0	1	2	3	4	5
y	1	0.5	0.33	0.25	0.2	0.167

M1

	Area = ½ x 1 [(y1 + y6) + 2 (y2 + y3 + y4 + y5) = ½ x 1 [1 + 0.167) + 2[0.5 + 0.33 + 0.25 + 0.2) 0.5 [3.727] 1.8635 square units	M1 A1	
		3	
11.	$R = \begin{pmatrix} 2 & 2 \\ 1 & 0 \end{pmatrix}$ $T = \begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ √ TR R $\begin{pmatrix} 2 & 2 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 3 \\ -2 \end{pmatrix} = \begin{pmatrix} 2 \\ 3 \end{pmatrix}$ T $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\begin{pmatrix} 2 \\ 3 \end{pmatrix} = \begin{pmatrix} 3 \\ -2 \end{pmatrix}$	 M1 M1 A1	
		3	
12.	$x + y = 0$ $x^2 + y^2 – xy = 12$ $x = -y$ Subt. $(-y)^2 + y^2 – (-y.y) = 12$ $y^2 + y^2 + y^2 = 12$ $3y^2 = 12$ $y^2 = 4$ $y = \pm 2$ When y = 2, x = -2 m (-2, 2) y = -2, x = 2 m (2, -2) $(x + 2)^2 + (y – 2)^2 = 16$ $(x – 2)^2 + (y + 2)^2 = 16$	 M1 A1 B1 B1	 for both for both
		4	
13.	$(2 – x)^5$ $2^5 \ 2^4 \ 2^3 \ 2^2 \ 2^1 \ 2^0$ 1 5 10 10 5 1 $(-x)^0 (-x)^1 (-x)^2 (-x)^3 (-x)^4 (-x)^5$ $32 – 80x + 80x^2 – 40x^3 + 10x^4 – x^5$ $(1.99)^5 = (2 – 0.01)^5$ $x = 0.01$ $32 – 80 (0.01) + 80 (0.01)^2 – 40(0.01)^3 + 10(0.01)^4 – (0.01)^5$ $32 – 0.8 + 0.008 – 0.00004$ 31.20796 = 31.2080 4d.p	 B1 M1 A1	 subst.
		3	

14.	Let xkg of millet be mixed with ykg of wheat Cost of mixture = $\frac{40x + 60y}{x + y}$	M1	
	Profit is 10% 110% = 55/= 100% = $\frac{55 \times 100}{110}$ = 50/=		Allow for an alternative method
	Cost of 1kg = 50/= $\frac{40x + 60y}{x + y} = 50$	M1	
	$40x + 60y = 50x + 50y$ $10y = 10x$ $\frac{10}{10} = \frac{x}{y}$ $x : y = 1 : 1$	A1	
		3	
15.	$30x + 40y \geq 3600$ $30x + 20y \leq 4800$ $x < 3y$	B1 B1 B1	
		3	
16.	$\left(\frac{x^3}{3} + \frac{x^{-1}}{-1} + 2x + C \right)^{2}_{-1}$ $\left(\frac{x^3}{3} - \frac{1}{x} + 2x + C \right)^{2}_{-1}$	B1	C need not be there
	$({}^{8}/_{3} - ½ + 4 + C) - ({}^{-1}/_{3} + 1 - 2 + C)$ $= 7 ½$	M1 A1	
		3	
17.	(a) $a + d, a + 3d, a + 6d$ $a + 2, a + 6, a + 12$	M1	
	$R = \frac{a + 6}{a + 2} = \frac{a + 12}{9 + 6}$	M1	
	$(a + 6)(a + 6) = (a + 2)(a + 12)$ $a^2 + 12a + 36 = a^2 + 14a + 24$	M1	
	$36 - 24 = 14a - 12a$ $12 = 2a$ $6 = a$	A1	
	$R = \frac{a + 6}{a + 2} = \frac{12}{8} = \frac{3}{2}$ or 1.5	B1	

(b) Last term = n^{th} term

$a + (n - 1)\,d$ M1

$h = 18$ $\quad 6 + (18 - 1)^2$

$a = 6$ $\quad 6 + 34$

$d = 2$ $\quad = 40$ A1

(c) Term of the GP are

$8, + 12, + 18, + \ldots\ldots$

$A = 8$

$r = {}^3/_2$ B1

$h = 14$

$$Sn = a\,\frac{(r^n - 1)}{r - 1}$$

$$= \frac{8\,(1.5^{14} - 1)}{1.5 - 1}^{10}$$ M1

$= 4655$ A1

10

18. $A = 67.0$

Mass	Frequency	x	M1 X – A (d)	M1 fd	d^2	M1 fd^2
50 – 54	19	52	-15	-285	225	4275
55- 59	23	57	-10	-230	100	2300
60 – 64	40	62	-5	-200	25	1000
65 – 69	28	67	0	0	0	0
70 – 74	17	72	5	85	25	425
75 – 79	9	77	10	90	100	900
80 - 84	4	82	15	60	225	900
	$\sum f = 140$			$\sum fd$ - 480 A1 √		$\sum fd^2$ 9800

(a) Modal class 60 – 64 B1

(b) Mean $67.0 + \frac{-480}{140}$ M1

$67.0 + -3.4286$

$= 63.5714 = 63.6$ 1 d.p A1

(c) Standard deviation

$$S = \sqrt{\frac{\sum fd^2}{\sum f} - \left(\frac{\sum fd}{\sum f}\right)^2}$$

$$= \sqrt{\frac{9800}{140} - \left(\frac{-480}{140}\right)^2}$$ M1

$= \sqrt{70 - 11.7551}$

$= \sqrt{70 - 11.7551}$

	= $\sqrt{58.2449}$		
	= 7.63		
	= 7.6 1 d.p	A1	
(d)	New standard deviation (unaffected) 7.6	B1	
		10	

19. Let S represent stepping at each set of light

$^{2}/_{5}$ $^{3}/_{5}$ $^{12}/_{25}$ $^{13}/_{25}$ $^{23}/_{150}$ $^{27}/_{50}$ $^{379}/_{1000}$ $^{621}/_{1000}$ $^{79}/_{125}$ $^{46}/_{125}$ $^{201}/_{500}$ $^{299}/_{500}$ $^{77}/_{125}$ $^{48}/_{125}$ SSS SSS^1 SS^1S SS^1S^1 S^1SS S^1SS^1 $S^1S^1S^1$ $S^1S^1S^1$ $S^1SS^1SS^1SS^1$

B1 √ probabilities for the first and second sets

B1 √ probabilities for the last set

(a) P(S) and P (S) and P(S)

= $^{3}/5$ x $^{13}/_{25}$ x $^{48}/_{128}$ M1

= 0.1198 A1

(b) $P(SS^1S^1)$ or $P(S^1SS^1)$ or $P(S^1S^1S)$

($^{3}/_{5}$ x $^{13}/_{25}$ x $^{201}/_{500}$) + ($^{2}/_{5}$ x $^{23}/_{50}$ x $^{79}/_{129}$) + ($^{2}/_{5}$ x $^{27}/_{50}$ x $^{62}/_{100}$) M1

0.125 + 0.116 + 0.134

= 0.375

(c) $P(SSS^1)$or $P(SS^1S)$or $P(S^1SS)$

($^{5}/_{5}$ x $^{12}/_{25}$ x $^{77}/_{125}$) + ($^{3}/_{15}$ x $^{13}/_{25}$ x $^{299}/_{500}$) + ($^{2}/_{5}$ x $^{23}/_{50}$ x $^{46}/_{125}$) M1

0.177 + 0.187 + 0.068

= 0.432 A1

(d) $P(S^1S^1S^1)$

= $^{2}/_{5}$ x $^{27}/_{50}$ x $^{379}/_{1000}$ M1

= 0.082 A1

10

20.		B1	√rectangle
		B1	√ dotted a rich
		B1	√ region shaded
		B1	√ Bisection AB
		B1	√ region
		B1	√locus at P
(b)	$x^2 + y^2 – 4x + 6y \leq 12$	B1	√
	$x^2 – 4x + 4 + y^2 + 6x + 9 \leq 12 + 13$	M1	√ centre radius
	$(x – 2)^2 + (y + 3)^2 \leq 12 + 13$	A1	centre
	Centre (2, -3)	B1	radius
	Radius 5 units	B1	region shaded outside (on graph)
		10	

21.	(a)	(i) $48^0 - 1^0\ 15' = 46^0\ 45'$ N. (46^0 45' N, 37^0E)	B1	
		(ii) Dist in longitude = 37 + 23 = 600 $d = {}^{60}/_{360} \times 2 \times {}^{22}/_{7} \times 6400 \cos 46.75^0$ = 4593.99 = 4594km	B1 M1 A1	
	(b)	(i) Diff. in mins = $\frac{60 \times 4 \text{ hrs}}{60}$ = 4 hrs Time 1.00 a.m – 4 hrs 9.00 p.m	M1 A1	
	(c)	P to Q = 48^0 x 60 nm = 2880 nm	M1	
		Q to R = 60^0 x 60 cos 46.75^0 = 2466.66nm	M1	
		Speed = $\frac{2466.66 + 2880}{12}$ = 445.56 knots	A1	
			10	
22.	(a)	Angle IGF = 70^0 angle subtended the same chord IF in the same segment as angle IHF. (2 marks)	B1	(B1 for answer B1 for reason)
	(b)	Angle FHG $\angle$ FHG = 20^0 Angle subtended by IG the diameter is 90^0 ($90^0 - 70^0$) = 20^0	B1B1	
	(c)	$\angle$HIG = 52^0 Angle subtended the chord HG in the alternate segment. (2 marks)	B1B1	
	(d)	$\angle$HKI Angle IHJ = (70 + 20 + 52) = 142^0 Angle KHI =38^0 Angle HIK = 108^0 $\therefore \angle$ HKI = 180 – (108 + 38) = 34^0 (2 marks)	B1	
	(e)	Angle FEI = 110^0 Opposite angles of a cyclic quadrilateral (2 marks)	B1B1	
			10	

23. (i)	$\text{Log}_{10} A = m\log_{10} B + C$	M1	
	$C = -4$	A1	
	$m = \frac{0 - {}^{-}4}{2 - 0} = \frac{4}{2} = 2$	M1A1	
	$\text{Log}_{10} A = 2 \log_{10} B - 4$	A1	
(ii)	$\text{Log}_{10} A = \log_{10} B^2 - 4$		
	$4 = \log_{10} B^2 - \log_{10} A$		
	$\text{Log } 10{,}000 = \log \frac{B^2}{A}$	M1	
	$\frac{B^2}{A} = 10{,}000$		
	$A = \frac{B^2}{10{,}000}$	A1	
(iii)	$\text{Log}_{10} A = 2 \log_{10} B - 2$	M1	
	$\text{Log } A = (2 \times 3) - 2$	M1	
	$10^4 = A$	A1	
		10	

24.

x	0	30	90	150	180	210	270	330	360
Sin x	0	0.5	0	0.5	0	-0.5	-1	-0.5	0
½ sin 2x	0	0.4	0	-0.4	0	0.4	0	-0.4	0

B2 table

S1 √ Scale
P1 √ Plotting sin x
C1 √ Curve sin X
P1 √ plotting ½ sin x
C1 √ Curve
B2 all 3 correct
1 for 2 correct)

(b) Points of intersection 0^0, 180^0, 360^0

(c) Stretch scale factor ½ x axis inverse followed by sketch scale factor ½ followed by y axis invariant.

10

30^0 60^0 90^0 120^0 150^0 180^0 210^0 240^0 270^0 300^0 330^0 360^0 y = sin c

12.