Name _____ Index No. _____

Candidate's signature _____

Date _____

121/1
MATHEMATICS
PAPER 1
JULY / AUGUST 2011
2 ½ HOURS

KANGUNDO DISTRICT FORM FOUR MULTILATERAL EXAM.
Kenya Certificate of Secondary Education
MATHEMATICS
PAPER 1
2 ½ HOURS.

INSTRUCTIONS TO CANDIDATES

1. Write your name and index number in the spaces provided above.
2. The paper contains two sections" Section I and section II.
3. Answer all the questions in section I and any five questions from section II.
4. All answers and working must be written on the question paper in the spaces provided below each question.
5. Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.
6. Non-programmable silent electronic calculators and KNEC mathematical tables may be used, except where stated otherwise.

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

This paper consists of 16 printed pages

Turn Over

SECTION A (50 MARKS)

Answer all questions

1. Simplify (3 marks)

$$\frac{{}^{3}/_{6} \div \frac{1}{2} - {}^{4}/_{7} \times {}^{1}/_{5} \text{ of } (\frac{1}{4} + {}^{2}/_{3})}{4^{1}/_{3} - 3^{2}/_{5}}$$

2. The sum of the angles of a triangle is given by the expression $(2a + b)^0$ while that of a quadrilateral is given by $(13a – b)^0$. Find the values of a and b. (3 marks)

3. Without using mathematical tables, solve for x in the equation. (3 marks)

$$9^{(2x - \frac{1}{4})} \times 27^{(x - \frac{1}{2})} = 729^{(x + 1/3)}$$

4. The surface area of two similar bottles are $12cm^2$ and $108cm^2$ respectively. If the larger one has a volume of $820cm^3$, find the volume of the smaller one, correct to 1 decimal place. (4 marks)

5. Train A leaves a station 48 minutes before train B. How long will train B take to catch up with train A if their speeds are 50km/h and 66km/h respectively. (3 marks)

6. Given that $\cos (90 - x) = \frac{\sqrt{3}}{2,}$

determine without using trigonometric tables the value of cos x. (3 marks)

7. The diagram below represents a cube with faces marked as shown. Each opposite face to that shown in the diagram is marked with the same sign but in the reverse direction to that shown on the diagram of the cube.

On the net below, only one face has been identified with its sign. Identify each of the remaining five faces with the correct signs . (3 marks)

8. The sum of digits of a two digit number is 13. When the number is subtracted from the number formed by reversing the digits, the difference is 27. Find the number. (3 marks)

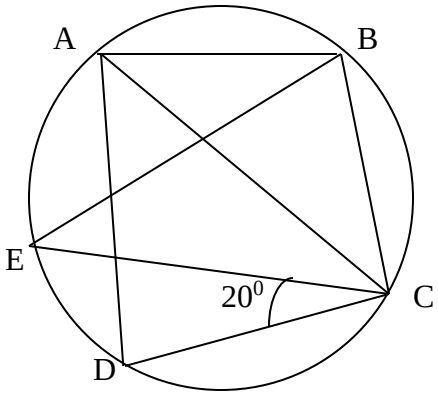
9. The line $y = 2x + 3$ is reflected in the line $y = -3$. Find the equation of the image line, leaving your answer in the double intercept form. (4 marks)

10. The cost of a pipeline 1920km long is estimated at two hundred and eighteen million US dollars. What is the cost of a pipeline 480km long. Give your answer in shillings, taking 1US dollar = shs. 87.04. (3 marks)

11. A form IV Maths teacher originally worked out the mean mark of her 30 students to be 41. After the correction of the test, she added some marks to Amina, Nduku and Karimi in the ratio 2 : 3 : 4. If the new mean mark for the class is 42.5, determine how many more marks Karimi was added than Nduku. (3 marks)

12. A solid metal cuboid 1.5m, 0.4m wide and 0.25m high is made of material of density $7.5g/cm^3$. Calculate its mass in kilograms. (4 marks)

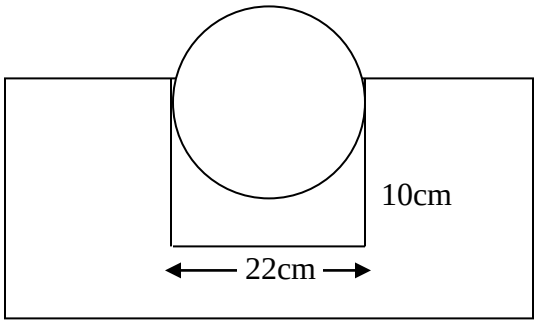
13. The figure below ACD is an equilateral triangle and ABCD is a cyclic quadrilateral. Angle ECD = 20^0.



(a) Calculate $\angle$ ABE. (1 mark)

(b) Calculate $\angle$EBC (2 marks)

14. The figure below shows a circular wire of radius 27cm resting in a rectangular groove in a bench. The groove is 10cm deep and 22cm wide. Calculate the distance between the bottom of the wire and the bottom of the groove. (3 marks)



15. Given that $5x^2 - 7xy + 2y^2 = 0$ express x in terms of y. (3 marks)

16. Four bells ring at intervals of 10 minutes, 15 minutes, 30 minutes and 40 minutes. If the bells start ringing together, find the time that elapses before they again ring together. (2 marks)

SECTION B – 50 MARKS

Answer any five questions

17. The model of an air craft is designed such that the volume of its interior airspace is $125cm^3$. The volume of the airspace of the actual aircraft is 3375 litres.

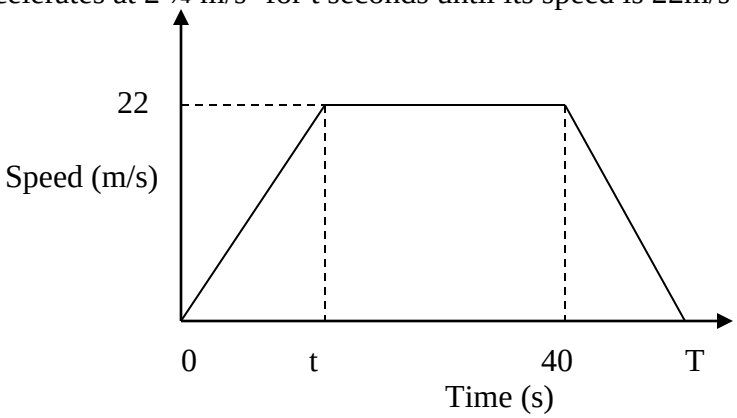
(a) Given that the wing-span of the actual aircraft is 7.44 metres, find the wing-span of the model in centimeters. (3 marks)

(b) If the total surface area of the model is $2420cm^2$, find the total surface area of the actual aircraft in square metres. (3 marks)

(c) Calculate the cost of the materials used to build the actual aircraft if the material costs US$ 2.5 per square centimeter. (2 marks)

(d) If the model was designed when 1US dollar = 78sh but the materials bought when the 1 US dollar = 80Ksh calculate the percentage increase in cost of materials in shillings. (2 marks)

18. The figure below shows a speed-time graph of a journey by a car. The car starts from rest and accelerates at 2 ¾ m/s^2 for t seconds until its speed is 22m/s .



It then travels at this speed for 40 seconds since the start of the journey at which point it brakes, bringing it uniformly to rest. The total journey is 847m long and takes T seconds. Calculate;

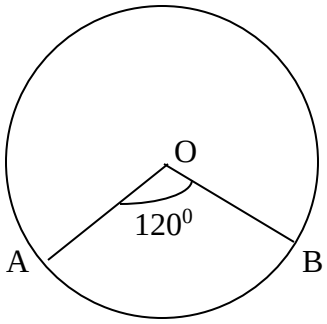
(a) The value of t. (3 marks)

(b) The distance travelled during the first t seconds. (2 marks)

(c) The value of T. (3 marks)

(d) The final deceleration. (2 marks)

19. The figure below shows a circle centre O and radius 18cm. The minor sector AOB subtends an angle of 120^0 at the centre of the circle. The sector is cut off and folded into cone.
Take $\pi = {}^{22}/_{7}$



Calculate

(a) The area of the minor sector AOB. (2 marks)

(b) The radius of the cone formed. (3 marks)

(c) The height of the cone. (3 marks)

(d) The volume of the cone in cm^3. (2 marks)

20. The table below gives field book showing the results of a survey of a section of a piece of land between X and Y. All measurements are in metres and XY is the base line, where XY = 100m.

	Y	
To C 33	95	
	90	To D 36
To B 21	70	
To A 42	30	To E 25
	25	To F 40
	X	

(a) Draw the sketch of the land. (2 marks)

(b) Hence calculate the area of this piece of land in hectares. (8 marks)

21. A bus left Mombasa and travelled towards Nairobi at an average speed of 60km/h. After 2 ½ hrs, a car left Mombasa and travelled along the same road at an average speed of 100km/h. 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 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 the same time as the bus. (4 marks)

22. A certain number of people agreed to contribute to buy Novels worth 2,000,000/=. Forty of them pulled out and the others agreed to contribute an extra Kshs. 2,500 each. Their contributions bought novels worth Kshs. 2,000,000 as they originally expected.

(i) If the original number of people was x, write an expression of how much each was to contribute. (1 mark)

(ii) Write an expression of how much each was to contribute after forty of them pulled out. (1 mark)

(iii) Find the value of x. (6 marks)

(iv) Calculate the percentage increase in the amount each contributed when forty people pulled out. (2 marks)

23. Three hundred and sixty litres of a homogeneous paint is made by mixing three paints, paints A, B and C. The ratio by volume of paint A to paint B is 3 : 2 and paint B to paint C is 1 : 2. Paint A cost Ksh. 180 per litre, paint B Kshs. 240 per litre and paint C Kshs. 127.50 per litre.

Determine;

(a) The volume of each of type of paints in the mixture. (4 marks)

(b) The amount of money spent in making one litre of the mixture. (3 marks)

(c) The percentage profit made by selling the mixture at Kshs. 221 per litre, correct to 2 decimal places. (3 marks)

24. (a) Complete the following table for the equation $y = 2x^3 + 3x^2 – 6x – 4$. (2 marks)

x	-4	-3	-2	-1	0	1	2
$2x^3$	-128	-	-16	-	0	2	16
$3x^2$	48	27	-	3	0	-	12
-6x	24	-	12	-	0	_	-12
-4	-4	-4	-4	-4	-4	-4	-4
Y	-60	-	4	-	-4	-	12

(b) On a graph paper draw the graph of $y = 2x^3 + 3x^2 – 6x – 4$ (3 marks)

(c) By drawing a suitable straight lines, use your graph to solve the equations.

(i) $2x^3 + 3x^2 – 4x – 2 = 0$ (3 marks)

(ii) $2x^3 + 3x^2 – 6x – 4 = 0$ (2 marks)\

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MARKING SCHEME

1.	N : $^3/_6 \div ½ - {}^4/_7 \times {}^1/_5$ of $^{11}/_{12}$ $^3/_6 \div ½ - {}^4/_7 \times {}^1/_5 \times {}^{11}/_{12}$ $^3/_6 \times {}^2/_1 - {}^4/_7 \times {}^1/_5 \times {}^{11}/_{12}$ $1 - \frac{44}{420}$ $\frac{376}{420} = \frac{94}{105}$ D: $4^1/_3 - 3^2/_5 = {}^{13}/_3 - {}^{17}/_5$ $= \frac{65 - 51}{15} = \frac{14}{15}$ $\frac{94}{105} \times \frac{15}{14} = \frac{47}{49}$	M1 M1 A1	
		03	
2.	$2a + b = 180$ $13a - b = 360$ $15a = 540$ $a = 36$ $2(36) + b = 180$ $72 + b = 180$ $b = 180 - 72$ $b = 108$ So, $a = 36$ and $b = 108$	B1 M1 A1	for √ equivalent
		03	
3.	$3^{2(2x - ¼)} \times 3^{3(x - ½)} = 3^{6(x + 1/3)}$ $2(2x - ¼) + 3(x - ½) = 6(x + {}^1/_3)$ $4x - ½ + 3x - {}^3/_2 = 6x + 2$ $7x - 2 = 6x + 2$ $x = 4$	M1 M1 A1	
		03	

This paper consists of 10 printed pages

Turn Over

4.	A.s.f = 12 : 108 = 1 : 9 L.s.f = $\sqrt{ASF}$ = 1 : 3 V.s.f = $(L.s.f)^3 = (1:3)^3 = 1:27$ V.s.f = 1 : 27 Volume(larger) $820cm^3$ Smaller bottle $\longrightarrow \frac{820}{27} = 30.4cm^3$	 B1 B1 M1A1	
		04	
5.	Relative speed = 66 – 50 = 16km/h Distance travelled before train B leaves the station $= \frac{48}{60} \times 50 = 40km$ Time taken to catch up $\longrightarrow \frac{40}{16} = 2\frac{1}{2}$ hrs	M1 M1 A1	
		3	
6.	$\cos 30^0 = \frac{\sqrt{3}}{2}$ $\therefore 90 - x = 30^0$ $x = 60^0$ $\cos 60^0 = \frac{1}{2}$ $\therefore \cos x = \frac{1}{2}$	 B1 M1 A1	
		03	
7.		B3 B2	If all arrows are correct If at least 3 are correct
		3	
8.	Let the digit be x and y $x + y = 13$ $(10x + y) - (10y + x) = 27$ $9x - 9y = 27$ Substitution $9(13 - y) - 9y = 27$ $117 - 9y - 9y = 27$ $117 - 27 = 18y$ $90 = 18y$ $y = 5$ $x = 8$ The number is 85	 B1 M1	both equations
		03	

9.	$y = 2x + 3$ $G_1 = 2 \quad G_2 = -2$ $y = -3$ $\therefore \quad -3 = 2x + 3$ $-6 = 2x$ $x = -3$ $\frac{y - {}^{-}3}{x - {}^{-}3} = -2$ $\frac{y + 3}{x + 3} = -2$ $y + 3 = -2x - 6$ $y = -2x - 9$ $9 = -2x - y$ $\frac{9}{9} = \frac{-2x}{9} \quad \frac{- y}{9}$ $1 = \frac{-2x}{9} - \frac{y}{9}$	B1 M1 A1 B1	
		4	
10.	1km length costs = $\frac{218{,}000{,}000}{1920}$ 480km costs → $\frac{218{,}000{,}000}{1920}$ x 480 US dollars = 54,500,000 = 54,500,000 x 87.04/= = 4743680000/=	 M1 M1 A1	
		03	
11.	Original total marks 41 x 30 = 1230 New total marks 42.5 x 30 = 1275 Marks added 1275 – 1230 = 45 Karimi $^{4}/_{9}$ x 45 = 20 Nduku $^{3}/_{9}$ x 45 = 15 Karimi got 5 more marks	 M1 M1 A1	all expre. both expression
		03	

12.	Vol. in cm = 150cm x 40cm x 25cm = $150,000cm^3$ Mass = D x V = 7.5g x 150,000 = 1,125,000g = $\frac{1125000}{1000}$ = 1125kg	M1 M1 M1A1	
		04	
13.	(a) $\angle ACE = 60^0 - 20^0 = 40^0$ $\angle ACE = \angle ABE$ ($\angle$s in same segment) $\therefore \quad \angle ABE = 40^0$ (b) $\angle ADC = 60^0$ (EQUILATERAL Δ) $\angle ABE + \angle EBC + \angle ADC = 180^0$ (Opposite cyclic) $40^0 + \angle EBC + 60^0 = 180$ $\angle EBC = 180 - 100$ $= 80^0$	 B1 B1 B1	
		03	
14.	Distance from the centre of circle to chord $= \sqrt{27^2 - 11^2}$ $= \sqrt{608}$ = 24.6577cm Distance from the chord to bottom of the wire 27 – 24.6577 = 2.3423 Distance from bottom of the wire and the groove bottom 10cm – 2.3423cm = 7.6577cm	 M1 M1 A1	
		3	
15.	$5x^2 - 7xy + 2y^2 = 0$ $5x^2 - 5xy - 2xy + 2y^2 = 0$ 5x (x – y) -2y (x – y) = 0 (5x – 2y) (x – y) = 0 5x – 2y = 0 5x = 2y or x = y $\quad x = {}^2/_5\, y$ or x = y	 M1 M1 A1	 both expressions
		03	
16.	L.C.M of 10, 15, 30, 40 10 = 2 x 5 15 = 3 x 5 30 = 2 x 3 x 5 $40 = 2^3$ x 5 L.C.M = 2^3 x 3 x 5 = 120 = 120 min or 2 hrs	 M1 A1 02	

SECTION II 50 MARKS

17. (a) Volume of actual aircraft = $3375 \times 10^3 cm^3$
Volume of model = $125 cm^3$
V.S.F = $\frac{3375 \times 10^3}{125}$
= 2700
L.S.F = $\sqrt{2700}$ = 30

Wing –span of model = $\frac{7.44 \times 100}{30}$ M1
= 24.8cm A1

(b) Area scale factor = $30^2 = 900$ B1
Surface area of actual aircraft
= $\frac{2420 \times 900 m^2}{100 \times 100}$ M1
= $217.8 m^2$ A1

(c) Cost of materials = $217.8 \times 10^4 \times 2.5$ M1
= 5.445×10^6
= 85.445 million A1

(d) $(5.445 \times 10^6 \times 80) = 435.6 \times 10^6$
$5.445 \times 10^6 \times 78 = 424.71 \times 10^6$
$\frac{10.89 \times 10^6}{424.71 \times 10^6} \times 100$
= 2.56% M1A1

10

18. (a) $a = \frac{\Delta s}{\Delta t}$

$2\frac{3}{4} = {}^{11}/_4 = \frac{22 - 0}{t - 0}$ M1

$11t = 22 \times 4$
$t = \frac{22 \times 4}{11 \times 1} = 8$ seconds M1A1

(b) Distance travelled during t = 8 secs
Distance = s x t = (22 x 8) x ½ M1
= 88m A1

(c) (½ x 22 x 8) + (32 x 22) + (½ x 22 x T) = 847 M1M1
88 + 704 + 11T = 847
11T = 847 – 795
11T = 55
T = 5 seconds A1

(d) Deceleration $\frac{\Delta S}{\Delta t} = \frac{22 - 0}{40 - 45} = \frac{22}{-5}$ $= -4^2/_5 \text{ m/s}^2$	M1 A1	
	10	
19. (a) $\frac{120}{360} \times \frac{22}{7} \times 18 \times 18$	M1	
$A = {}^{22}/_7 \times 6 \times 18$ $A = 339.42\text{cm}^2$	A1	
(b) Circumference of cone $\frac{120}{360} \times \frac{22}{7} \times 36$		
$= {}^1/_3 \times {}^{22}/_7 \times 36$ $= \frac{264}{7}$	M1	
$\frac{264}{7} = \frac{22}{7} \times 2r$		
$2r = 12$ $r = 6$	A1	
(c) Slant height = 18 $r = 6$ $6^2 + h^2 = 18^2$ $h^2 = 18^2 - 6^2$ $h = \sqrt{288}$ $h = 16.97\text{cm}$ $h = 16.97\text{cm}$	M1 M1 A1	
(d) V $= {}^1/_3$ (base area) x height $= {}^1/_3 \times {}^{22}/_7 \times 6 \times 6 \times 16.97$ $= {}^{22}/_7 \times 12 \times 16.97$ $= 640.03\text{cm}^3$	M1 A1	
	10	
20. (a)		

	(b)	(1) ½ x 30 x 42 = 630m^2 (2) ½ x (42 + 21) 40 = 1260m^2 (3) ½ x (21 + 33) 25 = 675m^2 (4) ½ x 5 x 33 = 82.5m^2 (5) ½ x 25 x 40 = 500m^2 (6) ½ x (40 + 25) 5 = 162.5m^2 (7) ½ (25 + 36)60 = 1830m^2 (8) ½ x 36 x 10 = 180m^2 5320m^2 $\frac{5320}{10,000}$ = 0.532ha	B1 B1 B1 B1 B1 B1 A1 B1	
			10	
21.	(a)	(i) D = 60 x $^5/_2$ D = 150km	M1 A1	
		(ii) Relative speed = 100 – 60 = 40km/h Time taken by the car to catch up with the bus, T = $^D/_S$ = $^{150}/_{40}$ 3 ¾ hrs Distance = $^{15}/_4$ x 100 = 375km	B1 M1 M1A1	
	(b)	Car's new speed be y km/h Distance traveled within 25min = 60 x $^{25}/_{60}$ = 25km Relative speed = (y – 60)km/h Time taken by the car to catch up in Nrb, a distance of 125km T = $^D/_S$ = $\left(\frac{25}{y-60}\right)$ hrs Distance travelled by the car; 125 = $\left(\frac{25}{y-60}\right)$ x y 25y = 125y – 7500 -100y = -7500 y = 75km/h	B1 B1 M1 A1	<u>Alternatively</u> Both should take equal time to reach Nrb BUs; T_1 = $^{100}/_{60}$ = $^5/_3$ hrs B1 Car, T_2 = $^{125}/_y$ – B1 $T_1 = T_2$ $\frac{125}{y}$ x $\frac{5}{3}$ M1 y = $\frac{125 \times 3}{5}$ = 75km/h A1
			10	
22.	(i)	$\frac{2,000,000}{x}$	B1	
	(ii)	$\frac{2,000,000}{x-40}$	B1	

(iii)	$\frac{2{,}000{,}000}{x-40} - \frac{2{,}000{,}000}{x} = 2{,}500$	B1M1	
	$\frac{2{,}000{,}000x - 2{,}000{,}000(x-40)}{(x-40)x} = 2{,}500$		
	$\rightarrow$ $2{,}000{,}000x - 2{,}000{,}000x + 80{,}000{,}000 = 2500(x^2 - 40x)$		
	$\rightarrow$ $2500x^2 - 100{,}000x - 80{,}000 = 0$		
	$\rightarrow$ $x^2 - 40x - 32{,}000 = 0$	M1	
	Product = -32,000 } 160, -200 Sum = -40	M1	
	$x^2 - 200x + 160x - 32{,}000 = 0$		
	$(x + 160)(x - 200) = 0$	M1	
	$x = 200$ people	A1	
(iv)	$\frac{2{,}500}{10{,}000} \times 100$	M1	
	= 25%	A1	
		10	
23. (a)	A : B = 3 : 2 B : C = 1 : 2 = 2 : 4		
	So, A : B : C = 3 : 2 : 4	B1	
	Vol of A = $^3/_9$ x 360 = 120L	B1	
	Vol of B = $^2/_9$ x 360 = 80L	B1	
	Vol of C = $^4/_9$ x 360 = 160L	B1	
(b)	Cost of A = 120 x 180 = 21,600/=		Using ratios
	Cost of B = 80 x 240 = 19,200/=	M1	$\frac{(3 \times 180) + (2 \times 240) + (4 \times 127.50)}{9}$
	Cost of C = 160 x 127.50/= = 20,400/=		$\frac{540 + 480 + 510}{9}$
	Total 621,200		= $^{1530}/_9$ = 170/= A1
	Cost per litre = $\frac{61{,}200}{360}$	M1	
	= Ksh. 170	A1	
(c)	Selling price = 221		
	Profit = 221 – 170		
	= 51/=	M1	
	% profit = $^{51}/_{170}$ x 100	M1	
	= 30%	A1	
		10	

24. (a)

x	-4	-3	-2	-1	0	1	2
$2x^2$	-128	-54	-16	-2	0	2	16
$3x^2$	48	27	12	3	0	3	12
-6x	24	18	12	6	0	-6	-12
-4	-4	-4	-4	-4	-4	-4	-4
y	-60	-13	4	3	-4	-5	12

B2 — For all entry; B1 for 8 entries; B0 – F0 less than 8 entry

(b) See graph

(c) (i) Equation of curve : $y = 2x^3 + 3x^2 - 6x - 4$

$0 = 2x^3 + 3x^2 - 4x - 2$

$y = -2x - 2$

Line $y = -2x - 2$ — B1

x	-4	0	2
y	6	-2	-6

Where line cuts the curve

$x = -2.15, -0.5, 1.1 (\pm 0.1)$ — B1

(ii) Equation of curve $y = 2x^3 + 3x^2 - 6x - 4$

$0 = 2x^3 + 3x^2 - 6x - 4$

$y = 0$ — B1

Values of x where curve cuts line $y = 0$

$x = -2.3, -0.6, 1.5 (\pm 0.1)$ — B1

10

24. (b)

$-y = -2x - 2$ $-y = 2x^3 + 3x^2 - 6x - 4$

-4	-3	-2	-1	0	1	2	3	x
Y	30	20	10	-	-10	-20	-30	-40	-50	-60

Scale	S_1
Plotting	P_1
Smooth curve	C_1
Line	L_1

Name _____ Index No. _____

Candidate's signature _____

Date _____

121/2
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SECTION A (50 MARKS)

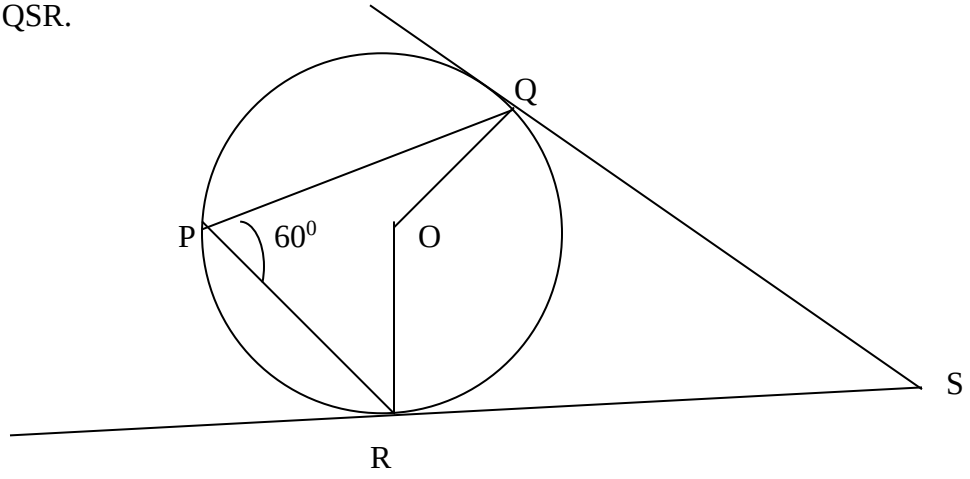
Answer all questions

1. Use a calculator to evaluate to 5 decimal places.

$$\sqrt[3]{\frac{36.5 \times 0.02573}{1.938}}$$

(2 marks)

2. In the figure below O is the centre of the circle SQ and SR are tangents touching the circle at Q and R respectively. Given that angle QPR = 60^0, determine the size of angle QSR. (2 marks)



3. Determine the inverse of T, if the matrix T = $\begin{pmatrix} 2 & 4 \\ 1 & -2 \end{pmatrix}$ hence find the co-ordinate to the point at which the two lines $2x = 8 - 4y$ and $x = 2y + 2$ meet. (4 marks)

4. The equation of a circle is $x^2 - 8x + y^2 + 12y + 16 = 0$
Determine the coordinates of the centre of the circle and its radius. (2 marks)

5. Make A the subject of the formula.

$$T = \frac{2m}{n}\sqrt{\frac{L - A}{3k}}$$ (3 marks)

6. A committee of three is to be selected from 6 men and 4 women. If the committee is selected at random, find the probability that it has two men and one woman. (3 marks)

7. The cost of water in Kenya is partly constant and directly proportional to the number of litres consumed. Kamene paid Ksh. 128.75 for 43 litres in February and Ksh. 136.25 for 49 litres in March. Calculate

(i) The charge per unit. (1 mark)

(ii) The fixed charge. (2 marks)

(iii) The bill if 23 litres were consumed. (1 mark)

8. Express $4 + \frac{2 + 2\sqrt{3}}{3 - 2\sqrt{3}}$ in the form $A + B\sqrt{C}$

hence write down the values of A, B and C. (3 marks)

9. Given the column vectors

$$\mathbf{a} = \begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix}, \quad \mathbf{b} = \begin{pmatrix} 6 \\ -3 \\ 9 \end{pmatrix} \quad \mathbf{c} = \begin{pmatrix} -3 \\ 2 \\ 3 \end{pmatrix}$$ and that

$P = 2a - {}^{1}/3b + c$

Express P as a column vector and hence calculate its magnitude to 3 significant figures. (3 marks)

10. The first and fifth term of an arithmetic progression are 30 and -10 respectively. Determine

(a) The third term. (2 marks)

(b) Given that the series has 10 terms. Find the sum of the last 8 terms. (2 marks)

11. (a) Expand $(2 + 2x)^5$ upto the forth term. (2 marks)

(b) Hence find the value of $(2.02)^5$ correct to 3 decimal place. (2 marks)

12. Find the limits within which the area of a rectangle lies if its dimensions are 8.3cm by 5.2cm, hence calculate the percentage error in the area. (4 marks)

13. Solve for y in the equation $2 \log y + \log 5 = 1 + 3\log 2$. (3 marks)

14. Solve for θ in the equation
$\sin (3\theta + 120^0) = \frac{\sqrt{3}}{2}$ for $0 \leq \theta \leq 180^0$
(3 marks)

15. Use an assumed mean of 342 to calculate the standard deviation of the set of five numbers 327, 332, 342, 347, 352. (3 marks)

16. Susan can do a certain piece of work in six hours. Atieno can do the same jobs in 10 hours while Kamau can do it in 12 hours. If the three girls work together for one hour, what fraction of the job is left incomplete? (3 marks)

SECTION B – 50 MARKS
Answer any five questions

17. In the figure below ABCD is right tetrahedron with AB = BC = CA = 8cm and DA = DB = DC = 10cm.

A B C D O

Calculate

(i) The height DO of the tetrahedron . (4 marks)

(ii) The length OC. (1 mark)

(iii) The angle between DC and plane ABC. (2 marks)

(iv) The angle between the plane DBC and ABC. (3 marks)

18. The transformations T_1 and T_2 are represented by matrices.

$$T_1 = \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \quad T_2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$$

(a) A single transformation T can replace transformations T_1 followed by T_2. Write down the matrix for T. (1 mark)

(b) The points $A^{11}B^{11}$ and C^{11} are images of A(4, 4) B (1, 1) and C(4, 1) under transformation T. Write down the coordinates of A^{11} B^{11} and C^{11}. (2 marks)

(c) Write down the coordinates of

(i) $A^1B^1C^1$ the images of ABC respectively under T_1.

(ii) $A^{11}B^{11}$ and C^{11} the images of A^1B^1 and C_1 respectively under T_2.

(d) On the grid provided draw the triangles ABC, $A^1B^1C^1$ and $A^{11}B^{11}C^{11}$. (3 marks)

(e) Describe fully the transformations T_1 and T_2. (2 marks)

19. In a triangle PQR, QR = 9cm RP = 5.8cm and PQ = 7.2cm. Draw triangle PQR.

(i) Construct the locus of X such that QX = XR, mark with the letter X the point where this locus meets QR. (1 mark)

(ii) Construct the locus such that angle QRY = PRY. Mark with letter Y the point where this locus meets PQ. (2 marks)

(iii) Construct the locus of W such that PW = 4cm with the letter W the point where this locus meets PR. (2 marks)

(iv) Shade and label the region T where QT ≥ TR and angle PRT ≥ angle QRT and PT ≤ 4cm. (3 marks)

20. Wanjiku earned a monthly salary of sh. 6.000. She also received a house allowance of sh. 3,000 and medical allowance of sh. 900. She is entitled to a personal relief of sh. 1056 per month. Income tax is charged on monthly income at the rate shown below.

Taxable income Ksh. Per month	Tax rate %
1 – 2,500	10%
2,501 – 4,500	15%
4,501 – 6,500	20%
6,501 – 9,000	25%
9,001 and above	30%

(a) How much tax does she pay per month. (8 marks)

(b) Calculate Wanjiku's net salary for each month if the following deductions are also made. Monthly NHIF Ksh. 230, Service charge Ksh. 100. (2 marks)

21. 40 standard one kids sat for English test and their marks were distributed as follows.

Marks	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
No. of kids	1	3	4	7	12	9	2	1	0	1

(a) State the modal class. (2 marks)

(b) Using 45.5 as working mean calculate

(i) The actual mean. (4 marks)

(ii) The standard deviation correct to 3 decimal places. (4 marks)

22. The acceleration in metres per second of a particle in motion is given by $a = 2t - 4$ where t is the time in seconds after the particle passes a fixed point O.

(a) Given that the initial velocity is 12m/s find;

(i) An expression for velocity V m/s in terms of t. (2 marks)

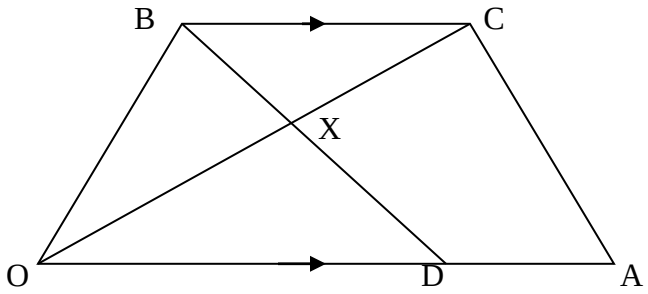
(ii) The velocity after time t = 2 seconds. (2 marks)

(b) (i) Write down an expression for displacement 5 metres from 0 after t seconds. (2 marks)

(ii) Determine the displacement after 3 seconds. (2 marks)

(c) Calculate the maximum velocity attained by the particle. (2 marks)

23.



In the diagram OACB is a trapezium in which OA is parallel to BC. D is on OA such that the ratio OD : OA 2 : 1 and OA = 3BC. The lines OC and BD meet at X such that OX = mOC and BX = nBD. Given that OB = b and BC = a. Express the following vectors in terms of a and b.

(a) (i) OC (1 mark)

(ii) BD (2 marks)

(b) By writing OX in two different ways, find the value of m and n. (7 marks)

24. Water is drawn to fill an empty tank whose capacity is 1200 litres using two types of buckets. It requires at least 30 type A buckets and 50 type B buckets to fill the tank. Two types A buckets are required to fill at most three type B buckets. Each type B bucket has a capacity of not more than 20 litres.

(a) Taking x litres and y litres to be the capacity of each type A bucket and each type B bucket respectively, write down 3 inequalities to represent the above information. (3 marks)

(b) Use graphical methods to determine the minimum capacity of each type of bucket. (7 marks)

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MATHEMATICS
PAPER 2
JULY / AUGUST 2011

KANGUNDO DISTRICT FORM FOUR MULTILATERAL EXAM.
Kenya Certificate of Secondary Education
MATHEMATICS
PAPER 2

MARKING SCHEME

1.	$\sqrt[3]{36.5 \times 0.02573}$ 1.938 $= \sqrt[3]{0.484594943}$ $= 0.78546$	 M1 A1	
		02	
2.	$\angle QOR = 120, QOS = 60^0$ Since $\angle OQS = \angle ORS = 90^0$ Then $\angle QSR = 180^0 - (90^0 + 60^0)$ $QSR = 30^0 \times 2 = 60^0$	 B1 B1 B1	
		03	
3.	det -4 - 4 = -8 $T^{-1} = \frac{-1}{8}\begin{pmatrix} -2 & -4 \\ -1 & 2 \end{pmatrix}$ $\begin{pmatrix} 2/8 & 4/8 \\ 1/8 & -2/8 \end{pmatrix} = \begin{pmatrix} ¼ & ½ \\ 1/8 & -¼ \end{pmatrix}$ $\begin{pmatrix} ¼ & ½ \\ 1/8 & -¼ \end{pmatrix}\begin{pmatrix} 2 & 4 \\ 1 & -2 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} ¼ & ½ \\ 1/8 & -¼ \end{pmatrix}\begin{pmatrix} 8 \\ 2 \end{pmatrix}$ $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 8/4 & 2/2 \\ 8/8 & -2/4 \end{pmatrix}$ $\begin{pmatrix} x \\ Y \end{pmatrix} = \begin{pmatrix} 3 \\ ½ \end{pmatrix}$ $x = 3, y = ½$	 M1 M1 M1 A1	
		04	
4.	$x^2 - 8x + y^2 + 12y = -16$ $x^2 - 8x + 16 + y^2 + 12y + 36 = 36$ $(x - 4)^2 + (y + 6)^2 = 36$ Centre of the circle (4, -6) $r = \sqrt{36}$ $= 6$ units (4, -6) ; 6 units	M1 1 2	

This paper consists of 11 printed pages

Turn Over

5.	$t = \frac{2m}{n} = \sqrt{\frac{L - A}{3K}}$ $\frac{nt}{3m} = \sqrt{\frac{L - A}{3K}}$ $\frac{n^2t^2}{4m^2} = \frac{L - A}{3K}$ $4m^2 (L - A) = 3Kn^2t^2$ $4Lm^2 - 4Am^2 = 3Kn^2t^2$ $A = \frac{4Lm^2 - 3Kn^2t^2}{4m^2}$	B1 B1 B1	
		03	
6.	P(2M and 1W) = P(MMW or MWM or WMM) $= ({}^6/_{10} \times {}^5/_9 \times {}^4/_8) + ({}^6/_{10} \times {}^4/_9 \times {}^5/_8) + ({}^4/_{10} \times {}^6/_9 \times {}^5/_8)$ $\frac{120}{720} + \frac{120}{720} + \frac{120}{720}$ $\frac{360}{720} = ½$	M1 M1 A1	
		03	
7.	(i) $C = K + nL$ $128.75 = K + 43n$ …… (i) $186.25 = K + 49n$ …… (ii) (ii) – (i) $7.5 = 6n$ $n = 1.25$ (cost per unit) (ii) The fixed charge $128.75 - 4391.25$ $128.75 - 53.73$ Sh. 75 (iii) $C = 75 + 23 (1.25)$ 103.75	 M1 A1 B1	
		04	
8.	$\frac{12 - 8\sqrt{3} + 2 + 2\sqrt{3}}{3 - 2\sqrt{3}}$ $\frac{14 - 6\sqrt{3}}{3 - 2\sqrt{3}} \times \frac{3 + 2\sqrt{3}}{3 + 2\sqrt{3}}$ $\frac{42 - 18\sqrt{3} + 28\sqrt{3} - 12 \times 3}{9 - 4 \times 3}$	 M1	

	$\frac{6 + 10\sqrt{3}}{-3} = -2 - \frac{10}{3}\sqrt{3}$	A1	
	$A = -2, B = {}^{-10}/_{3}$ $C = 3$	B1	
		03	
9.	$P = 2a - {}^{1}/_{3}b + c$		
	$= 2\begin{pmatrix} 1 \\ -2 \\ 1 \end{pmatrix} - {}^{1}/_{3}\begin{pmatrix} 6 \\ -3 \\ 9 \end{pmatrix} + \begin{pmatrix} -3 \\ 2 \\ 3 \end{pmatrix}$	M1	
	$= \begin{pmatrix} 2 \\ -4 \\ 2 \end{pmatrix} - \begin{pmatrix} 2 \\ -1 \\ 3 \end{pmatrix} + \begin{pmatrix} -3 \\ 2 \\ 3 \end{pmatrix}$		
	$= \begin{pmatrix} -3 \\ -1 \\ 2 \end{pmatrix}$	A1	
	$\left\| P \right\| = \sqrt{(-3)^2 + (-1)^2 + (2)^2}$		
	$= \sqrt{9 + 1 + 4}$		
	$= \sqrt{14}$		
	$= 3.74$	B1	
		03	
10.	(a) $a = 30$		
	$30 + 4d = -10$	M1	
	$4d = -40$		
	$d = -10$		
	$T_3 = 30 + 2(-10) = -30 - 20 = 10$	A1	
	(b) $T_{10} = 30 + 9(-10) = 30 - 90 = -60$	M1	
	$S_8 = {}^{8}/_{2}(10 + -60)$		
	$4(-50)$		
	$= -200$	A1	
		04	
11.	$(2 + 2x)^5$		
	Coefficients		
	1, 5, 10, 10		
	$2^5 + 5(2)^4(2x) + 10(2^3)(2x)^2 + 10(2^2)(2x)^3 + \ldots$	M1	
	$= 32 + 160x + 320x^2 + 320x^3 + \ldots\ldots$	A1	
	$(2 + 2x)^5 = (2.02)^5$		
	$2x = 0.02$		
	$x = 0.01$		

	$32 + 160(0.01) + 320\ (0.01)^2 + 320(0.01)^3 + \ldots$ $= 32 + 1.6 + 0.032 + 0.00032 + \ldots$ $= 33.63232$ $= 33.632$	M1 A1	
		04	
12.	Max area = 8.35 x 5.25 = 43.8 Min area = 8.25 x 5.15 = 42.48 Actual = 8.3 x 5.2 = 43.16 Absolute error = ½ (43.8375) $= 0.675$ % error = $\frac{0.675 \times 100}{43.16}$ $= 1.564\%$	M1 A1 M1 A1	
		04	
13.	$\text{Log } y^2 = \log (2^3 \times 10)$ $5y^2 = 80$ $y^2 = 16$ $y = \pm 4$	M1 M1 A1	
		03	
14.	$\text{Sin } 60^0 = \frac{\sqrt{3}}{2}$ $\therefore 3\theta + 120 = 60, 120, 420, 480$ $3\theta = -60, 0, 300, 360$ $\theta = -20, 0^0, 100^0, 1200$ $\therefore \theta = 0^0, 100^0, 120^0$	 M1 M1 A1	
		03	
15.	X: 352, 347, 342, 332, 327 X – A: 10, 5, 0, -10, -15 $\sum(X - A)$: -10 $S.d = \sqrt{\frac{450}{5} - \left(\frac{-10}{5}\right)^2}$ $\sqrt{90 - 4}$ $\sqrt{86}$ $= 9.274$	 M1 M1 A1	
		03	

16. $^1/_6 + ^1/_{10} + ^1/_{12}$

$\frac{10 + 6 + 5}{60}$ M1

$= ^{21}/_{60}$ A1

Job left

$1 - ^{21}/_{60} = ^{39}/_{60}$

$= ^{13}/_{20}$ B1

03

SECTION II

17. From the diagram

(i) OA = ½ AM M1

$AM = \sqrt{8^2 - 4^2}$

$= 64 - 16$

$= 6.928$

OA = ½ x 6.928 = 3.464 A1

OD = $\sqrt{100 - 3.464}$ = 9.825 M1A1

(ii) OA = OC = 3.464 B1

(iii) $\cos\theta = \frac{3.464}{10} = 0.3464$ M1

$\theta = \cos 0.3464$

$= 69.73^0$ A1

(iv) $\tan x = \frac{9.825}{2.309} = 4.2551$

$\tan^{-1} 4.2551$ M1

$x = 76.77^0$ A1

10

18. (a) T = Pre mult T_1 by T_2

$$T = \begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} = \begin{pmatrix} 2 & 0 \\ 0 & -2 \end{pmatrix}$$ B1

(b)
$$\begin{pmatrix} 2 & 0 \\ 0 & -2 \end{pmatrix} \begin{pmatrix} A & B & C \\ 4 & 1 & 4 \\ 4 & 1 & 1 \end{pmatrix} = \begin{pmatrix} A^{11} & B^{11} & C^{11} \\ 8 & 2 & 8 \\ -8 & -2 & -2 \end{pmatrix}$$ M1

Coordinates

A^{11} (8, -8) B^{11} (2, -2) C^{11} (8, -2) A1

(c) (i)
$$\begin{pmatrix} 2 & 0 \\ 0 & 2 \end{pmatrix} \begin{pmatrix} A & B & C \\ 4 & 1 & 4 \\ 4 & 1 & 1 \end{pmatrix} = \begin{pmatrix} A^1 & B^1 & C^1 \\ 8 & 2 & 8 \\ 8 & 2 & 2 \end{pmatrix}$$

	Coordinates A^1 (8, 8) B^1 (2, 2) C^1 (8, 2)	B1	
	(d) (ii) $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix} \begin{pmatrix} 8 & 2 & 8 \\ 8 & 2 & 2 \end{pmatrix} = \begin{matrix} A^{11} & B^{11} & C^{11} \end{matrix} \begin{pmatrix} 8 & 2 & 8 \\ -8 & -2 & -2 \end{pmatrix}$	B1	
	A^{11}(8, -8) B^{11} (2, -2) C^{11} (8, -2)		
	(e) T_1 in an enlargement centre O and Sf 2	B1	
	T_2 is a reflection in the x-axis.	B1	
		10	
18.	Scale Vert. 1cm : 1 unit Hori 1cm : 10 units 10 9 8 7 6 5 4 3 2 1 -1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -2 -1 1 2 3 4 5 6 7 8 9 10 B B^1 A A^1 C C^1 B^{11} C^{11} A^{11} Plotting ABC (Pts) drawn B1 $A^1B^1C^1$ (Pts) drawn B1 $A^{11}B^{11}C^{11}$ (Pts) drawn B1 03		

19. R W P Q Y T X X.T 7.2cm

(i)	B1 (i)	V pnt R
	B1	Correct Δ PQR Complete
(ii)	B1	√ Line and X
(iii)	B1	√ Besector
	B1	√Pnt Y
(iv)	B1	√ Locus
	B1	√ Pnt W
(v)	B1	√ Region T
	B1	√ Locus bisector of ∠ R
	B1	√ θ7 ≥ 7R
	10	

20. (a) Taxable income = sh. 9900

1st	2500 x $^{10}/_{100}$ = 250	M1	
	2000 x $^{15}/_{100}$ = 300	M1	
	2000 x $^{20}/_{100}$ = 400	M1	
	2500 x $^{25}/_{100}$ = 625	M1	
	900 x $^{30}/_{100}$ = 270	M1	
	Total tax sh. 1845 p.m	A1	
	Less relief 1056	M1	
	789 per month	A1	

(b) Net salary

9900 – 789 – 230 – 100	M1	
= sh. 8781	A1	
	10	

21.

Marks	X	F	d = X – A	fd	d^2	fd^2	CF
1 – 10	5.5	1	-40	-40	1600	1600	1
11-20	15.5	3	-30	-90	900	2700	4
21-30	25.5	4	-20	-80	400	1600	8
31-40	35.5	7	-10	-70	100	700	15
41-50	45.5	12	0	0	0	0	27
51-60	55.5	9	10	90	100	900	36
61-70	65.5	2	20	40	400	800	38
71-80	75.5	1	30	30	900	900	39
81-90	85.5	0	40	0	1600	0	39
91-100	95.5	1	50	50	2500	2500	40
		$\sum f = 40$		$\sum f = -70$		$\sum fd^2 = 11700$	

(a) Modal class 41 – 50 — B2

B1 fd column

B1 d^2

B1 fd^2

(i) Actual mean

$\bar{x} = A + \frac{\sum fd}{\sum f}$

$= 45.5 + \frac{(-70)}{40}$ — B1

$= 45.5 – 1.75$ — M1

$= 43.75$ — A1

Standard deviation

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

$\sqrt{\frac{11700}{40} - \frac{(-70)^2}{40}}$ — B1

$\sqrt{292.5 – 3.0625}$

$\sqrt{289.4375}$

$= 17.0128$

$= 17.013$ — A1

10

22. (a) (i) $a = \frac{dv}{dt}$

$V = \int(2t – 4)\, dt$

$V = t^2 – 4t + c$

$t = OV = 12$ — M1

$12\ (0)^2 – (4 \times 0) + c$

$C = 12$

$V = t^2 - 4 + 12$ — A1

	(ii) $t = 2 \quad v = ?$ $V = (2)^2 - 4 \times 2 + 12$ $= 4 - 8 + 12$ $= 8m/s$	M1 A1	
	(b) $V = \frac{ds}{dt}$ $S = \int (t^2 - 4t + 12)\, dt$ $= \frac{t^3}{3} - 2t^2 + 12t + C$ at O, $t = 0$ $S = 0$ $S = \frac{t^3}{3} - 2t^2 + 12t$	 M1 A1	
	(ii) When $t = 3 \quad S = ?$ $= \frac{3^3}{3} - 2 \times (3)^2 + 12 \times 3$ $= 9 - 18 + 36$ $= 27m$	M1 A1	
	(c) For maximum velocity $\frac{dv}{dt} = 0$ $2t - 4 = 0$ $2t = 4$ $t = 2$ seconds Maximum velocity $V = t^2 - 4t + 12$ $= (2)^2 - (4 \times 2) + 12$ $= 4 - 8 + 12$ $= 8m/s$	 M1 A1	
		10	
23.	(a) (i) $OC = b + a$ $\overrightarrow{OC} \quad \overrightarrow{b} \quad \overrightarrow{a}$	B1	
	(ii) $BD = -b + 2a$ $\overrightarrow{BD} \quad \overrightarrow{b} \quad \overrightarrow{a}$ $= 2a - b$ $\overrightarrow{a} \quad \overrightarrow{b}$	B1 A1	
	(b) $OX = OB + BX$ $BX = n\,(BD)$ $= b + n\,(-b + 2a)$ $\overrightarrow{b} \quad \overrightarrow{b} \quad \overrightarrow{a}$ $= b - nb + 2na$ $\overrightarrow{b} \quad \overrightarrow{b} \quad \overrightarrow{a}$ $(1 - n)b + 2na$ $\overrightarrow{b} \quad \overrightarrow{a}$	 M1 B1	

$OX = m\,OC$ $m(b + a)$ $mb + ma$ $(1 - n)b + 2na = mb + ma$ $1 - n = m$ … (i) $2n = m$ … (ii) $m = m$ $1 - n = 2n$ $1 = 3n$ $^1/_3 = n$ $n = {}^1/_3$ $2n = m$ $2 \times {}^1/_3 = m$ $^2/_3 = m$	B1 B1 B1 B1 A1	
	10	
24. (a) $30x + 50y \geq 1200$ $3x + 5y \geq 120$ $2x \leq 3y$ $y \leq 20$ (b) $3x + 5y \geq 120$	B1 B1 B1	

x	0	40
y	25	0

35 30 25 20 15 10 5 0 -10 -5
10 20 30 40 50 60
3x + 5y = 120 2x = 3y y = 20
Minimum point
(20.1, 1)