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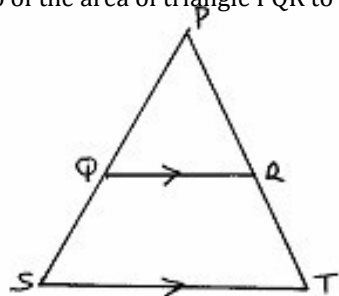
KCSE MATHEMATICS PREDICTION EXAMS JULY EDITION

MATHEMATICS PAPER 1 JULY EDITION 2022 KCSE PREDICTION 1 2022

SECTION I: (50 MARKS)

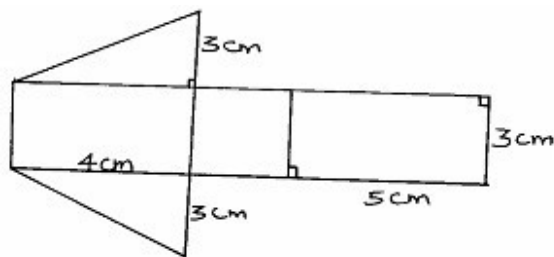
Answer all the questions in this section in the spaces provided.

1. If $(5x + 6y) : (2x + 10y) = 22 : 10$ find $x : y$. (3mks)
2. A radio has a marked price of Sh.4000, Winnie managed to convince the shopkeeper to drop the marked price by 15% which he did. The shopkeeper still made a profit of 20%. What was the shopkeeper's cost of the radio? (3mks)
3. Solve the following inequality and show your solution on a number line. (3mks)
 $4x - 3 \leq \frac{1}{2}(x + 8) < x + 5$
4. Evaluate using square root, reciprocal and square tables only. (4mks)
 $\left[\frac{1}{\sqrt{0.7235}} \right]^2 - \frac{1}{10.56}$
5. Find the equation of the perpendicular bisector of line AB where A is (3, 9) and B (7, 5) giving your answer in the form $ax + by + c = 0$. (3mks)
6. Simplify: $\frac{x^2 + x - 4x - 4y}{(x+1)(4y^2 - x)}$. (3mks)
7. (a) A translation $T \begin{pmatrix} 4 \\ -1 \end{pmatrix}$ maps point P onto $P^1(6, 5)$. Find P. (1mk)
- (b) Point X^1 is the image of X (3, 2) under the same translation. Find the length of PX^1 leave your answer in surd form. (3mks)
8. Solve for θ in $\cos 3\theta = \sin 6\theta$. (2mks)
9. Find the value of x in the following equation. (4mks)
 $64^{x+1} + 8^{2x} = 1040$
10. A tourist exchanged X US dollars for Kenya shilling when he arrived in Kenya. He spent three days in the country and paid Ksh.45,600 for expenses. He later left the country and exchanged the remainder back to US dollars. He went back with 1200 dollars. Find the value of X.
 Buying 1 US dollar = Ksh.98.36
 Selling 1 US dollar = Ksh.98.54 (3mks)
11. Solve the simultaneous equations. (4mks)
 $xy = 4$
 $x + y = 5$
12. The image of P (5, 5) under an enlargement scale factor -2 is $P^1(8, 7)$. Find the coordinates of the centre of enlargement. (3mks)
13. In the figure below, triangle PQR is similar to triangle PST and QS is parallel to ST. Given that the ratio PQ: PS is 3:5, find the ratio of the area of triangle PQR to that of the trapezium QRST. (3mks)



14. Ruto is 12 years old. In three years time he will be $\frac{1}{3}$ of his father's present age. How old was his father 12 years ago. (3mks)
15. Four interior angles of a hexagon are 100° , 140° , 125° and 105° . The fifth interior angle is four times the sixth angle. Find the fifth interior angle. (3mks)

16. The figure below shows a net of a solid.



(a) Sketch the solid of the net showing the hidden edges with dotted lines. (1mk)

(b) Find the surface area of the solid. (2mks)

SECTION II: (50 MARKS)

Answer only any FIVE questions in this section.

17. From a reservoir, water flows through a cylindrical pipe of diameter 0.2m at a rate of 0.35m/s.

(a) Determine the number of litres of water discharged from the reservoir in one hour. (4mks)

(b) The water flows from the reservoir for 18 hours per day for 25 days per month and serves a population of 2500 families. Determine the average consumption of water per family per month giving your answer to nearest 100 litres. (4mks)

(c) The water is charged at the rate of Sh.450 per 100 litres calculate the average water bill per family per month. (2mks)

18. Two airports A and B are such that B is 500km due east of A. Two planes P and Q take off from A and B respectively and at the same time. Plane P flies at 360km/hr on a bearing of 030° . Plane Q flies at 240km/hr on a bearing of 315° . The two planes land after 90 minutes. Using a scale of 1: 10,000,000.

(a) Show the positions of the planes after 90 minutes. (4mks)

(b) Find the distance between the planes after 90 minutes. (2mks)

(c) Find: (i) the bearing of plane P from plane Q. (2mks)

(ii) the bearing of plane Q from the plane P after 90 minutes. (2mks)

19. The marks scored by 50 students in a Geography examination are as follows.

60	54	40	67	53	73	37	55	62	43
44	69	39	32	45	58	48	67	39	51
46	59	40	52	61	48	23	60	59	47
65	58	74	47	40	59	68	51	50	50
71	51	26	36	38	70	46	40	51	42

(a) Prepare a frequency distribution table using a class interval of 10. (3mks)

(b) Draw a histogram to represent the distribution. (3mks)

(c) Use your histogram to estimate the modal class. (1mk)

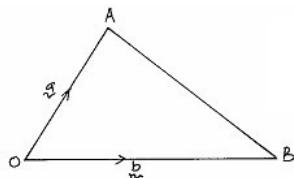
(d) Calculate the percentage of students who scored in the range $50 < x \leq 70$. (3mks)

20. A bus left Makindu at 11.45am and travelled towards Mombasa at an average speed of 80km/h. A Nissan matatu left Makindu at 1.15pm on the same day and travelled along the same road at an average speed of 120km/h. The distance between Makindu and Mombasa is 400km.

(a) Determine the time of the day the Nissan overtook the bus. (5mks)

(b) Both vehicles continue towards Mombasa at their original speeds. Find how long the matatu had to wait at Mombasa before the bus arrived. (5mks)

21. The position vectors of points A and B in triangle OAB below are a and b respectively. Points M and N are on sides OA and AB respectively such that $3OM = OA$ and $2AN = 3NB$.



(a) Express in terms of a and b.

(i) MB. (1mk)

(ii) ON. (1mk)

(b) ON and MB intersect at X. Given that $MX = hMB$ and $OX = kON$, where h and k are constants. Express OX in terms of

(i) a, b and k. (1mk)

(ii) a, b and h. (1mk)

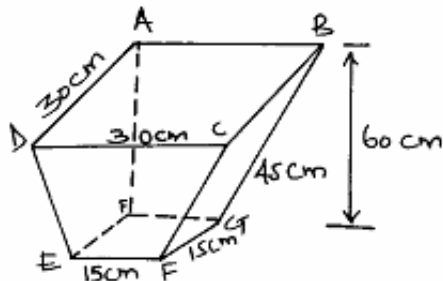
(c) Determine the values of h and k. (4mks)

(d) Determine the ratio OX: XN. (2mks)

22. A group of young men decided to raise Ksh.480,000 to start a business. Before actual payment was made four members pulled out and each of the remaining had to pay an additional Ksh.20,000. Write an expression in terms of

P for.

- (a) (i) Original contribution of each member. (1mk)
 (ii) Contribution after withdrawal of four members. (1mk)
 (b) Form an equation in P and hence determine the number of initial members. (5mks)
 (c) Three men Kamau, James and Hassan shared Shs.480,000 such that Kamau: James is 3: 2 and James: Hassan is 4: 2. Find how much each got. (3mks)
23. The figure below shows an open waste paper basket in the form of a frustrum of a right square pyramid of height 60cm. The depth of the basket is 40cm and the other measurements are as shown in the figure. (5mks)



- (b) The total surface area of the basket. (5mks)
24. The equation of a curve is $y = (\chi - 1)(\chi + 3)^2$. (5mks)
- (a) Find
- (i) the χ -intercept of the cone. (2mks)
 (ii) the y-intercept of the cone. (1mk)
- (b) (i) Determine the stationary points of the curve. (2mks)
 (ii) For each of the points in (b)(i) above, determine whether it is a maximum or a minimum. (2mks)
- (c) Sketch the curve. (2mks)

121/2
MATHEMATICS
PAPER 2

TIME: 2½ HOURS

SECTION I: (50 MARKS)

Answer all the questions in this section in the spaces provided.

- The length and breadth of a metal sheet are measured to the nearest centimetre and recorded as 25cm and 16cm respectively.
 - Find the maximum possible error in the area of the sheet. (1mk)
 - Calculate to one decimal place the percentage error in the area of the sheet. (2mks)
- Given the column vectors

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

express P as a column vector and hence calculate its magnitude to 3 significant figures. (3mks)
- Solve for θ in the equation

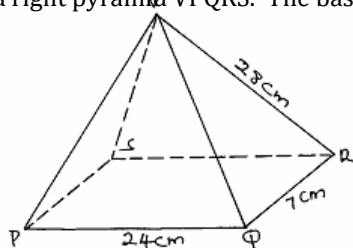
$$6 \cos^2 \theta - \sin \theta - 4 = 0$$
 in the range $0^\circ \leq \theta \leq 180^\circ$. (3mks)
- Expand $(1 - 2\chi)^6$ upto the term containing χ^3 . Hence use the expansion to estimate 0.98^6 to four decimal places. (3mks)
- Solve the equation:

$$3 \log 4 - \log \chi = \log (\chi - 12)$$
 (4mks)
- Make χ the subject of the formula.

$$\sqrt{\frac{(2\chi + r)^2}{4}} = \chi + r$$
 (3mks)
- Wambua invested Sh.6400 at 15% per annum compound interest for 3 years. Muinde invested twice that amount at 12½% per annum simple interest for the same period of time. Find whose investment earned more interest and by how much. (4mks)
- Rationalize the denominator and leave your answer in surd form.

$$\frac{3}{2\sqrt{5} - \sqrt{2}}$$
 (3mks)
- A quantity P is partly constant and partly varies as the square of Q. When $Q = 2, P = 40$ and when $Q = 3, P = 65$, determine the value of P when $Q = 4$. (4mks)
- Kamau sold a mixture of two types of coffee which were costing Sh.50 per kg and Sh.60 per kg at Sh.324 for 5kg of the mixture after making a profit of 20%. Find the ratio of the mixture. (3mks)
- Evaluate:

$$\int_1^2 (3\chi^2 - 2\chi + 3) d\chi$$
 (3mks)
- The figure below is a right pyramid VPQRS. The base PQRS is a rectangle whose length is 24cm and width 7cm.



- Find the angle between VR and the base. (3mks)
- The diameter AB of a circle passes through point $(-4, 1)$ and B $(2, 1)$ find the equation of the circle and the radius. Leave your answer in the form $\chi^2 + y^2 + a\chi + by = c$. (3mks)
 - A point C is on a line PQ where $PQ = 9\text{cm}$, C divides PQ such that $PC = \frac{4}{7}PQ$. By construction locate C. (3mks)

15. A city P is (30°N , 31°E). Another city Q is located a distance of 4365 nautical miles east of P. Find the position of Q. (3mks)
16. In a transformation an object of area 64cm^2 is mapped onto image whose area is 32cm^2 . Given that the matrix of transformation is $\begin{pmatrix} \chi+4 & \chi \\ 2 & 1 \end{pmatrix}$. Find the value of χ . (3mks)

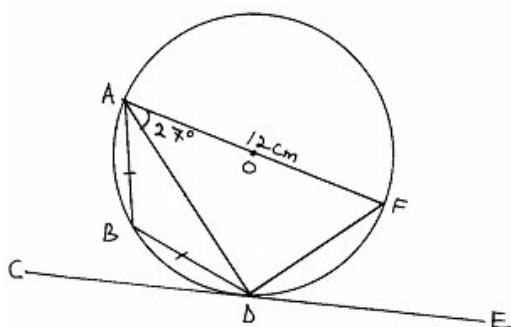
SECTION II: (50 MARKS)**Answer only any FIVE questions in this section.**

17. Mr. Omollo, a civil servant earns a basic salary of Sh.38,300 house allowance of Sh.12,000 and medical allowance of Sh.3,600 every month. He claims a family relief of Sh.1,172 and insurance relief of 3% of the premium paid. Using tax ratio table below.

Taxable income £/p.a	Tax Ksh/E
1 – 8800	2
8801 – 16800	3
16801 – 24800	5
24801 – 36800	7
36801 – 48800	9
Over 48800	10

- (a) Calculate Mr. Omollo's annual taxable income in Kenya pound per annum. (2mks)
- (b) Tax due every month from Mr. Omollo. (4mks)
- (b) If further deductions are made every month from his salary:
- WCPS of 2% of basic salary.
 - Life insurance premium of Sh.4600.
 - Sacco loan repayment of Sh.14,200
- Calculate
- (i) Total deductions. (2mks)
- (ii) His net pay for every month. (2mks)
18. Veterinary researchers were experimenting with a new drug on fowls in a research station. A sample of fowls which were known to have the disease was used. In this sample 30 fowls were treated with the drug and the remaining 18 fowls were not treated.
- (a) Calculate the probability that a fowl selected at random from the sample as
- (i) treated with the drug. (1mk)
- (ii) not treated with the drug. (1mk)
- (b) The probability that a fowl treated with the drug will die is $\frac{1}{10}$, while the probability that one which is not treated will die is $\frac{7}{10}$. Calculate the probability that a fowl picked at random from the sample is
- (i) treated with the drug and will die. (2mks)
- (ii) not treated with the drug and will die. (2mks)
- (iii) treated with the drug and will not die. (2mks)
- (iv) not treated with the drug and will not die. (2mks)
19. Two variables A and B are connected by the equation. $A = kBn$
Where k and n are constants.
The table below gives values of A and B.
- | | | | | | |
|---|------|------|------|------|------|
| A | 1.5 | 1.95 | 2.51 | 3.20 | 4.50 |
| B | 1.59 | 2.51 | 3.98 | 6.31 | 11.5 |
- (a) Find a linear equation connecting A and B. (2mks)
- (b) On square paper draw a suitable line graph to represent the relation in (a) above (scale 1cm to represent 0.1 units on both axis). (5mks)
- (c) Use your graph to estimate the values of k and n in to one decimal place. (3mks)
20. (a) Using a ruler and a pair of compasses only construct triangle ABC such that $AB = BC = 5\text{cm}$ and angle $BAC = 30^{\circ}$. (3mks)
- (b) Construct the locus of point T above AC such that $2 \angle ATC \geq \angle ABC$. (3mks)
- (c) Find the area within the locus of T that is outside triangle ABC. (4mks)
21. A tailor uses 6hrs to make a shirt and 4 hours to make a dress. It takes the tailor at least 240 hours to make X shirts and Y dresses. The labour cost of making a shirt is Sh.60 and that of a dress is Sh.70. The total labour cost should not exceed Sh.4200. The tailor must make at least 20 shirts and more than 16 dresses.
- (a) Write inequalities to represent the above information. (4mks)
- (b) Represent the inequalities in part (a) above on the grid provided. (4mks)
- (c) If the tailor makes a profit of Sh.140 per shirt and Sh.180 per dress, use the graph in part (b) above to determine the maximum profit that the tailor can make. (2mks)

22. In the figure below, circle ABDF has centre O. CE is a tangent to the circle at D and AF = 12cm is the diameter, AB = BD and angle DAF = 27° .



- (a) Find the size of
 (i) Angle ADE. (2mks)
 (ii) Angle ADB. (2mks)
- (b) Find the length of
 (i) AD. (2mks)
 (ii) BD. (4mks)
23. The sum of 21st and 65th terms of an arithmetic sequence is 368. Given that the seventh term of the sequence is 40, find;
 (a) the common difference. (3mks)
 (b) the first term. (2mks)
 (c) the sum of the first 16 terms of the AP. (2mks)
 (d) Given further that the 1st, 5th and 13th terms of the arithmetic sequence form the first 3 consecutive terms of a geometric progression, find;
 (i) common ratio. (1mk)
 (ii) the sum of the first 20 terms of the G.P. (2mks)
24. (a) Complete the table for the functions $y = 3 \cos \chi$ and $y = 4 \sin (2\chi - 10)$. (2mks)
- | χ | 0 | 15 | 30 | 45 | 60 | 75 | 90 | 105 | 120 | 135 | 150 | 165 | 180 |
|-----------------------|-------|------|------|------|------|----|------|-------|-------|-----|-------|-----|-------|
| $3 \cos \chi$ | 3.0 | | 2.60 | | 1.50 | | 0 | -0.75 | | | | | -3.0 |
| $4 \sin (2\chi - 10)$ | -0.69 | 1.37 | | 3.94 | 3.76 | | 0.69 | | -3.06 | | -3.76 | | -0.69 |
- (b) (i) Taking 1cm rep 15° on χ -axis and 1cm rep 2 units on y-axis on the same grid draw the graphs of the functions $y = 3 \cos \chi$ and $y = 4 \sin (2\chi - 10^\circ)$. (5mks)
 (ii) Hence solve for $3 \cos \chi = 4 \sin (2\chi - 10)$. (1mk)
 (iii) From the graphs determine the period of the two curves. (2mks)

KCSE PREDICTION 2 2022
121/1
MATHEMATICS
PAPER 1

TIME: 2½ HOURS

SECTION I: (50 MARKS)

Answer all the questions in the section.

- Evaluate: $\frac{28 - (-18)}{-2} - \frac{15 - (-2)(-6)}{-3}$. (3mks)
- John spent $\frac{2}{3}$ of his salary on food $\frac{1}{3}$ of the remainder on rent and saved the rest. What fraction of his salary did he save? If he spent Sh.1200 on food, how much did he spend on rent. (3mks)
- Given that $\sin \theta = \frac{1}{\sqrt{5}}$ where θ is an acute angle, find without using Mathematical tables or 'a calculator'.
 - $\cos \theta$ in the form $a\sqrt{b}$. (2mks)
 - $\tan (90^\circ - \theta)$. (1mk)
- Use tables 1 and table 2 below to find the average speed that the Nairobi-Mombasa passenger train uses to travel between Konza and Masongaleni. (3mks)

Table 1: Shows the rail distance in km between selected stations from Mombasa to Nairobi.

Table 2: Shows the departure and arrival time between selected stations from Mombasa to Nairobi.

Table 1 – is a travel table for a passenger train from Nairobi to Mombasa

w.e.f. 15/10/2001	Passenger train	
Station	ARR	DEP
Nairobi Yard		1900
Athi River	1952	1954
Konza	2055	2057
Sultan Hamad	2234	2236
Makindu	2354	2356
Kibwezi	0025	0027
Masongaleni	0057	0059
Mtito Andei	0158	0213
Voi	0423	0438
Mariakani	0718	0720
Mazeras	0740	0742
Mombasa	0825	

ARR – Arrival time at station

DEP – Departure time from station

Table 1

Nairobi	Athi River	Konza	Sultan Hamud	Makindu	Kibwezi	Masongaleni	Mtito Andei	Voi	Mariakani	Mazeras	Mombasa
29.6											
73.7	44.1										
130	100.4	56.3									
193.4	163.8	119.7	63.4								
215.3	185.7	141.6	85.3	21.9							
233.1	203.5	159.4	103.1	39.7	17.8						
266.6	237	192.9	136.6	73.2	51.3	33.5					
365.9	336.3	292.2	235.9	172.5	150.6	132.8	99.3				
492	462.4	418.3	362	298.6	276.7	258.9	225.4	126.7			
506.4	476.8	432.7	376.4	313	291.1	273.3	239.8	140.5	14.4		
530.3	500.7	456.6	400.3	336.9	315	297.2	263.7	164.4	38.3	23.9	

Table 2

- Solve the following simultaneous equations. (3mks)

$$x^2 + y^2 = 26$$

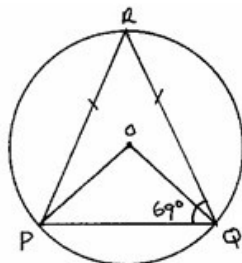
$$x + y = 4$$

6. A Kenyan company received US Dollars 100,000. The money were converted into Kenya shillings in a bank which buys and sells foreign currencies as follows.

	Buying (Ksh)	Selling (Ksh)
1 US Dollar	77.24	77.44
1 Sterling Pound	121.93	122.27

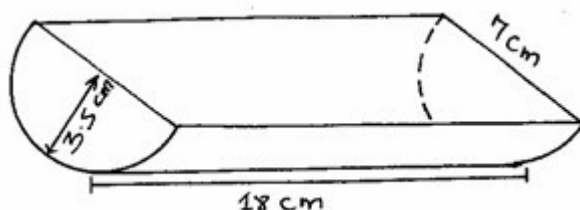
- (a) Calculate the amount of money, in Kenya shillings, the company received. (2mks)
 (b) The company exchanged the Kenya shillings calculated in (a) above, into sterling pounds to buy a car from Britain. Calculate the cost of the car to the nearest sterling pond. (2mks)

7.



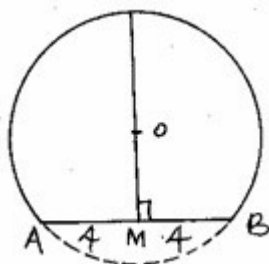
In the figure above O is the centre of the circle. Given that $PR = QR$ and $\angle PQR = 69^\circ$. Find $\angle RQO$.

8. Find the smallest number which leaves a remainder of 4 when divided by either 8 or 12 or 14. (2mks)
 9. Find the integral value of χ which satisfy the inequality.
 $3 + 2\chi < 3\chi - 1 \leq 2\chi + 7$ (3mks)
 10. A line L is perpendicular to $2\chi + y = 3$ and passes through point (4, -1). Determine
 (i) the equation of line L. (2 marks)
 (ii) the acute angle that line L makes with the χ -axis. (1 mark)
 11. The angle of elevation of the top of a storey building from point P is 23.61° . From another point Q six metres nearer to the base of the building, the angle of depression from the top of the building is 35° . Calculate to 1 decimal place the height of the building. (4mks)
 12. State the amplitude and the period of the function $y = \frac{3}{2} \cos(2\chi + 30^\circ)$. (2mks)
 13. 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. (3mks)
 14. The figure below is a semi-cylindrical solid of length 18cm and radius 3.5cm are shown.



Draw a labelled net of the sold.

15. Find the radius of the circle whose major segment is given below if $CM = AB = 8\text{cm}$. (3mks)



16. Given that $P = 3^y$ express the equation $3^{2y-1} + 2 \times 3^{y-1}$ in terms of P.
 Hence or otherwise find the value of y in the equation $3^{2y-1} + 2 \times 3^{y-1} = 1$. (3mks)

SECTION II: (50 MARKS)

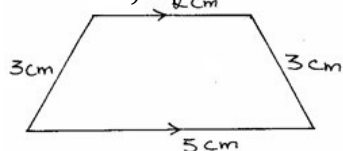
Answer only ANY FIVE questions in this section.

17. Mutwapa Primary School is 30km on a bearing of 015° from a tourist hotel. The nearest town is 45km from the school on a bearing of 120° .
 (a) Using a scale of 1cm to represent 15km, make a scale drawing of the positions of the school the tourist hotel and the town. (4mks)
 (b) How far is the tourist hotel from the town? (2mks)
 (c) What is the bearing of

(i) the town from the tourist hotel? (2mks)

(ii) the school from the town? (2mks)

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



(a) Calculate the volume of the prism. (3mks)

(b) Given that the density of the prism is 5.75g/cm^3 , calculate its mass in grams. (2mks)

(c) A second prism is similar to the first one but is made of a different material.

The volume of the second prism is 246.24cm^3 .

(i) Calculate the area of the cross-section of the second prism. (3mks)

(ii) Given that the ratio of the mass of the first prism to that of the second is 2: 5, find the density of the second prism. (2mks)

19. The distance between two towns A and B is 760km. A minibus left town A at 8: 15am and traveled towards B at an average speed of 90km/h. A matatu left B at 10:35am and on the same day and travelled towards A at an average speed of 110km/h.

(a) (i) How far from A did they meet? (4mks)

(ii) At what time did they meet? (2mks)

(b) A motorist starts from his home at 10:30am on the same day and travelled at an average speed of 100km/h.

He arrived at B at the same time as the minibus. Calculate the distance from B to his home. (4mks)

20. A jet flies from town Q (60°S , 24°E) to town R (60°S , 10°W) and then due north for 1200 nautical miles to town S.

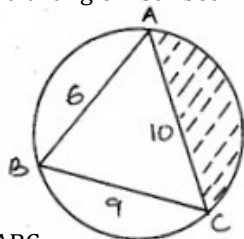
(a) Obtain the latitude of S. (3mks)

(b) Calculate the distance between Q and R in

(i) Nautical miles. (3mks)

(ii) km (2mks)

(c) Find the total flight time if the jet flies at an average speed of 800 knots. (2mks)

21. The figure below shows a triangle inscribed in a circle. $AB = 6\text{cm}$, $BC = 9\text{cm}$ and $AC = 10\text{cm}$.

Calculate

(a) the interior angles of $\triangle ABC$. (5mks)

(b) the radius of the circle. (2mks)

(c) the area of the shaded part. (3mks)

22. A triangle has vertices A (1, 2), B (4, 4) and C (6, 2).

(a) Draw triangle ABC on the grid provided. (1mk)

(b) Construct the image triangle $A^1B^1C^1$ image of triangle ABC under a rotation of 90° clockwise about the origin. (2mks)(c) Draw triangle $A^{11}B^{11}C^{11}$ the image of triangle $A^1B^1C^1$ under a reflection in line $y = x$, state the coordinates of $A^{11}B^{11}C^{11}$ (3mks)(d) Draw triangle $A^{111}B^{111}C^{111}$ the image of triangle $A^{11}B^{11}C^{11}$ under a reflection in the line $y = 0$ and state the coordinates of its vertices. (2mks)(e) Describe a single transformation that maps triangle $A^{11}B^{11}C^{11}$ onto triangle ABC. (2mks)23. In triangle OAB, $OA = a$ and $OB = b$. Points P and T divide OB and AB in the ratio 2:3 and 1:3 respectively. Lines OT and AP intersect at Q.

(a) Draw the diagram to represent the above information. (1mk)

(b) Express OP and AP in term of a and b. (2mks)

(c) Express OT in terms of a and b. (1mk)

(d) Given further that $OQ = tOT$ and $AQ = sAP$, express OQ in two ways and hence find the values of s and t. (6mks)24. The velocity of a particle, $V\text{m/s}$, moving in a straight line after t seconds is given by $V = 3t^2 - 3t - 6$

Find:-

(i) The acceleration of the particle after 2 seconds. (2mks)

(ii) The distance covered by the particle between $t = 1$ and $t = 4$ seconds. (3mks)

(iii) The time when the particle is momentarily at rest. (2mks)

(iv) The minimum velocity attained by the particle. (3mks)

121/2
MATHEMATICS
PAPER 2

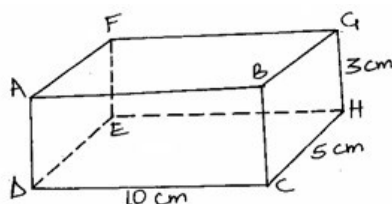
TIME: 2½ HOURS

SECTION I: (50 MARKS)

Answer all the questions in the section.

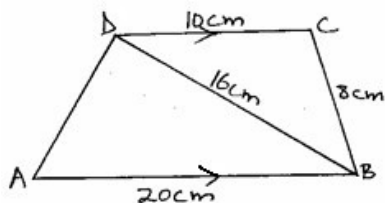
1. Evaluate using logarithms. (4 marks)

$$\sqrt[3]{\frac{(0.07432)^2 \times (48.38)^3}{8458}}$$
2. A rectangular plot measures 31.4m by 28.3m. What is the percentage error in getting its area. (3 marks)
3. Make M the subject in $K = \left(\frac{MV^2}{\chi + M} \right)^{\frac{1}{2}}$. (3 marks)
4. Solve the equation.
 $\sin(2\chi - 30^\circ) = \frac{1}{2}$ for $0^\circ \leq \chi \leq 360^\circ$. (3 marks)
5. y varies inversely as the square of χ . The difference between the value of y when $\chi = 6$ and when $\chi = 10$ is 16. Find the law connecting χ and y. (3 marks)
6. (a) Without using a calculator, expand $(10 - 2\chi)^5$. (2 marks)
 (b) Use your expansion in (a) above to find the value of $(9.8)^5$. (1 mark)
7. Solve the simultaneous equation.
 $\log_3(2\chi + y) = 2$
 $\log_2(3\chi + 4y) = 4$ (3 marks)
8. Find the inverse of the matrix $\begin{pmatrix} 2 & -2 \\ 3 & 1 \end{pmatrix}$ hence use the matrix method to solve the simultaneous equations. (3 marks)
 $2\chi - 2y = 6$
 $3\chi + y = 5$
9. A shopkeeper mixes sugar costing Sh.40 per kg with another type which costs Sh.60 per kg. Find the ratio in which the two types should be mixed so that if a kilogram of the mixture is sold at Sh.55, a profit of 10% is realised. (3 marks)
10. A point R divides vector PQ in the ratio 5: -2. Find the coordinates of R given that P (3, -6) and Q (-9, 2). (3 marks)
11. χ and Y are complementary angles and $\tan \chi = 3\sqrt{3}$. Find the value of $\frac{1}{2 - \tan y}$ hence rationalize the surd. (3 marks)
12. Find the distance between the centre A of a circle whose equation is $2\chi^2 + 2y^2 + 6\chi + 10y + 7 = 0$ and point B (-4, 1). (3 marks)
13. The figure is a cuboid. The dimensions of the cuboid are 10cm by 5cm by 3cm.



- (a) Find the angle between.
 - (i) lines CG and DE. (2 marks)
 - (ii) lines FG and DB. (2 marks)
14. Simplify: $\frac{\chi - 3}{\chi + 3} - \frac{\chi^2 - 3\chi}{\chi^2 - 9}$. (3 marks)
15. Evaluate: $\int_3^5 (\chi^3 - 7\chi^2 + 7\chi + 15) d\chi$ (3 marks)

16. In the figure below ABCD is a trapezium with DC parallel to AB. DC = 10cm, BC = 8cm, DB = 16cm and AB = 20cm.

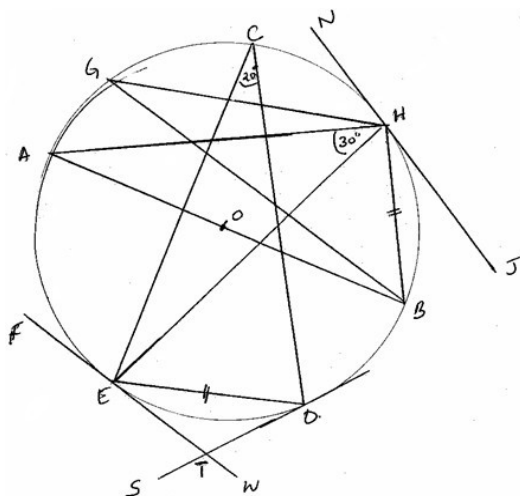


- (a) Calculate the sine of angle BDC. (2 marks)
 (b) Hence calculate the area of $\triangle ABD$. (1 mark)

SECTION II: (50 MARKS)

Answer only ANY FIVE questions in this section.

17. (a) A die and a coin (both fair) are thrown on a horizontal floor.
 (i) List all the possible outcomes. (2 marks)
 (ii) Find the probability of getting even number on the die and a tail on the coin or an odd number on the die and a head on the coin. (3 marks)
 (iii) Find the probability of getting a number greater than or equal to 3 on the die and a head on the coin. (2 marks)
- (b) The probability that a student gets grade A in Mathematics is $\frac{9}{10}$. If she gets grade A in Mathematics then the probability that she gets grade A in Physics is $\frac{4}{5}$. If she does not get grade A in Mathematics then the probability that she gets grade A in Physics is $\frac{3}{8}$. Calculate the probability that she gets grade A in Physics only. (3 marks)
18. The figure below shows a circle centre O, AB is a diameter. Chords ED and BH are equal NHJ, FET, STD are tangents to the circle angle $\angle ECD = 20^\circ$ and $\angle AHE = 30^\circ$. The figure is not drawn to scale.



Determine angles.

- (i) $\angle EHB$. (2 marks)
 (ii) $\angle ETS$. (2 marks)
 (iii) $\angle HGB$. (2 marks)
 (iv) $\angle EHJ$. (2 marks)
 (v) $\angle AOE$. (2 marks)
19. An arithmetic progression has the first term as a and the common difference as d .
 (a) Write in terms of a and d , the 3rd, 9th and 25th terms of the progression. (1 mark)
 (b) The progression is increasing and the 3rd, 9th and 25th terms form the first three consecutive terms of a geometric series. If the sum of the 7th term and twice the 6th term of the arithmetic progression is 78. Calculate:
 The first term and the common difference of the arithmetic progression. (6 marks)
 (b) Find the sum of the first nine terms of the A.P. (3 marks)

20. The table below shows tax rates in the year 2012.

Income in K£ p.a.	Rates of tax in %
1 – 5208	10
5209 – 9744	15
9745 – 14292	20
14293 – 18840	25
Over 18840	30

(a) Mrs. Mwangi pays Ksh.5400 as PAYE. She is entitled to a house allowance of Ksh.9000p.m and claims a monthly tax relief of Ksh.1093.

Calculate;

(i) Her gross tax per annum. (2 marks)

(ii) Her monthly basic salary in Ksh. (6 marks)

(b) She also has monthly contributions as follows:

(i) Cooperative society contribution of Ksh.2000.

(ii) Loan repayment of Ksh.2500.

Calculate her net monthly salary.

(2 marks)

21. The table below shows the marks scored by students in a Mathematics test.

Marks	30 - 39	40 - 49	50 - 54	55 - 59	60 - 64	65 - 69
No. of students	6	20	19	20	20	15

(a) Calculate the median mark. (3 marks)

(b) Using an assumed mean of 52, calculate the mean mark. (3 marks)

(c) On the grid provided, draw a histogram to represent the information shown above. (4 marks)

22. (a) Draw the graph of the function.

$$y = 6x + x^2 - x^3 \text{ for } -3 \leq x \leq 4$$

(b) By drawing a suitable straight line(s) on the graph in (a) above estimate the roots of the following equations.

(i) $6x + x^2 - x^3 = 0$

(ii) $2x + x^2 - x^3 = 0$

23. In a school trip there were x buses and y luxury vans. Each bus was hired at Ksh.1000 and could carry 60 students. Each van was hired at Ksh.2000 and could carry 30 students.

(a) Express the following statements as inequalities in x and y .

(i) There must be some van or vans. (1 mark)

(ii) There should at least 3 buses. (1 mark)

(iii) The school should be not spend more than Ksh.18000 on the trip. (1 mark)

(iv) Not more than 420 students are to go on the trip. (1 mark)

(b) Illustrate inequalities graphically. (4 marks)

(c) Use your graph to determine the maximum number of students that can go on the trip and corresponding expenditure. (2 marks)

24. Using a ruler and compasses only.

(i) Construct a parallelogram ABCD such that AB = 10cm, BC = 7cm and angle ABC = 105° . (3 marks)

(ii) Construct the loci of P and Q within the parallelogram such that AP $\leq$ 4cm and BQ $\leq$ 6cm. (3 marks)

(iii) Calculate the area within the parallelogram but outside regions bounded by the loci of P and Q. (4 marks)

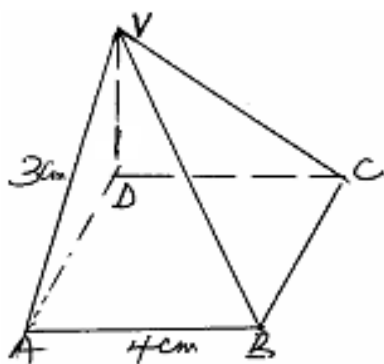
KCSE PREDICTION 3 2022
Kenya Certificate of Secondary Education
121/1
MATHEMATICS ALT A
PAPER 1

TIME: 2½ HOURS

SECTION I: (50 MARKS)

Answer all the questions in this section in the spaces provided.

- Find the greatest number which when divided into 167, 260 and 389 leaves remainders of 11, 8 and 5 respectively. (2 marks)
- The figure below shows a right pyramid with a square base of 4cm and a slant height of 3cm. Draw the net of the pyramid. (3 marks)



- A tourist arrived in Kenya with 10000 US dollar which he converted to Kshs on arrival. He spent Kshs.428,500 and converted the remaining amount to sterling pounds. How much did he receive in sterling pounds. The currency exchange rates of the day were as follows:-

Currency	Buying	Selling
1 Sterling pound	135.50	135.97
1 US dollar	72.23	72.65

- Without using calculators evaluate:

$$\frac{\frac{1}{2} + 2\frac{4}{5} \text{ of } 8 \div 6(2 \times 4\frac{2}{5})}{\frac{1}{2} \text{ of } 6(8 \div 3\frac{1}{3})}$$
 (3 marks)
- A man on top of a tower 300m sees two cars P and Q on a straight level road. The angle of depression of P was 48° and that of Q was 28° . Calculate the distance between the two cars. (Give your answer to 2d.p.). (3 marks)
- Solve for x and y in the simultaneous equation. (3 marks)
 $3^{2x} \times 3^y = 27$
 $2^{x-y} \times 2^x = 32$
- Use tables of squares, square roots and reciprocals to evaluate

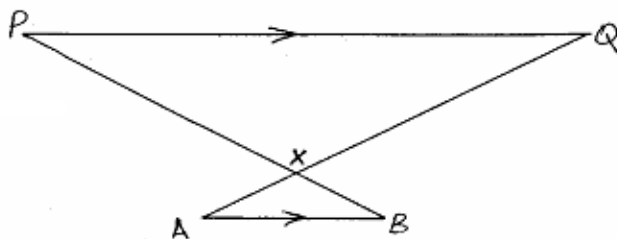
$$\sqrt{\frac{1}{0.2365} + \frac{20}{2.6228^2}}$$
 (4 marks)
- Given $\cos \chi = \frac{5}{13}$, find the values of the following without using tables or calculators.
 (a) $\sin \chi$ (1 mark)
 (b) $\tan^2 (90 - \chi)$. (2 marks)
- Line L_1 passes through the points A (2, -4) and B (6, -8). Find the equation of the line L_2 , the perpendicular bisector of AB leaving your answer in the form $ax + by + c = 0$. (3 marks)
- A point P has co-ordinates (2, 4, 6). If $PQ = 10i + 2j + 4k$, find
 (i) the co-ordinates of Q. (2 marks)
 (ii) the length of PQ. (1 mark)
- The volume of a cube is 1728cm^3 . Calculate to 1 decimal place, the length of the diagonal of a face of the cube. (3 marks)
- Find all the integral values of x which satisfy the inequality

$$3(1 + \chi) \leq 5\chi - 11 \leq \chi + 45.$$

(3 marks)

13. In the figure below $AB \parallel PQ$. PB and AQ meet at X . Given that $PQ = 15$, $AB = 2.5$ and $AQ = 10.5$ cm, find AX .

(3 marks)



14. Simplify the expression:

$$\frac{(\chi + 1)(4y^2 - \chi)}{\chi^2 + \chi - 4\chi - 4y}$$

(3 marks)

15. A circle centre O has the equation $\chi^2 + y^2 = 4$. The area of the circle in the first quadrant is divided into 5 vertical strips each of width 0.4cm.

- (a) Use the equation of the circle to complete the table below for values of y correct to 2d.p..

χ	0	0.4	0.8	1.2	1.6	2.0
y	2.00			1.60		0

(1 mark)

- (b) Use the trapezoidal rule to estimate the area of the circle.

(3 marks)

16. Find the area in hectares of a coffee field whose measurements are entered in a field book as shown below. Take $XY = 200$ m as the baseline.

(4 marks)

	Y	
	180	40 to Q
To R 80	140	
To S 160	100	
	40	100 to P
	X	

SECTION B: (50 MARKS)

Answer any FIVE questions from this section.

17. A transport company wishes to transport 288 tonnes of stones to sites P and Q.

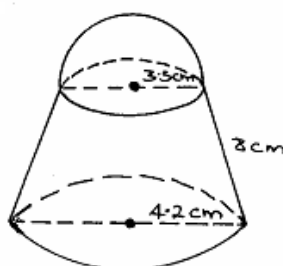
The company pays Shs.48,000 to transport 48 tonnes for every 28km. James transported 96 tonnes to site P, 49km away.

- (a) Find how much he was paid. (3 marks)
- (b) James spends Shs.6000 to transport every 8 tonnes of stones to site P. Calculate her total profit. (3 marks)
- (c) Kimani transported the remaining stones to site Q, 84km away. If he made 44% profit, find his transport cost. (4 marks)

18. A trailer left town P at 11.45am and travelled towards town Q at an average speed of 60km/hr. A car left town P at 2.15pm on the same day and travelled along the same road at an average speed of 100km/hr. The distance between towns P and Q is 500km.

- (a) Calculate the time of the day when the car overtook the trailer. (4 marks)
- (b) The distance from P when the car overtook the trailer. (3 marks)
- (c) After overtaking the trailer both vehicles continued towards Q at their original speeds. Find how long the car had to wait at town Q before the trailer arrived. (3 marks)

19. The figure below represents a solid made up of a conical frustum and a hemispherical top. The slant height of the frustum is 8cm and its base radius is 4.2cm.



If the radius of the hemispherical top is 3.5cm.

(a) Find the area of:

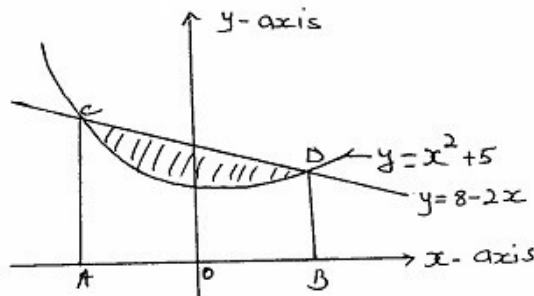
(i) the circular base. (2 marks)

(ii) the curved surface area of the frustrum. (4 marks)

(iii) the hemispherical surface. (2 marks)

(b) A similar solid has a total surface area of 81.51cm^2 . Determine the radius of its base. (2 marks)

20. The diagram below, not drawn to scale, shows part of the curve $y = x^2 + 5$ and the line $y = 8 - 2x$. The line intersects the curve at points C and D. Lines AC and BD are parallel to the y-axis.



(a) Determine the coordinates of C and D. (4 marks)

(b) Use integration to calculate the area bounded by the curve and the x-axis between points C and D. (3 marks)

(c) Calculate the area enclosed by the lines CD, CA BD and the x-axis. (2 marks)

(d) Determine the area of the shaded region. (1 mark)

21. Three people Kariuki, Juma and Mwangi are having their homes situated within the same town. Mwangi's home is 10km away from Juma's home on a bearing of 150° . Kariuki's home is $\text{N}30^\circ\text{E}$ from Mwangi's home and on a bearing of 135° from Juma's home.

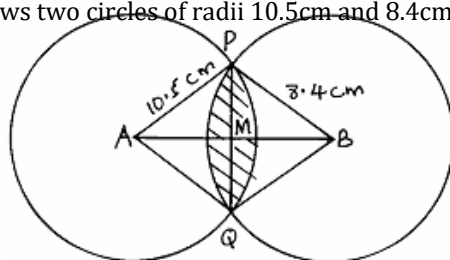
(a) Using a scale 1cm represent 2km, show the relative position of the three homes. (4 marks)

(b) Using your diagram, determine;

(i) bearing of Juma's home from Kariuki's home. (1 mark)

(ii) distance of Mwangi's home from Kariuki's home. (2 marks)

22. The figure below shows two circles of radii 10.5cm and 8.4cm and with centres A and B respectively. The common chord PQ is 9cm.



(a) Calculate angle PAQ. (2 marks)

(b) Calculate angle PBQ. (2 marks)

(c) Calculate the area of the shaded part. (6 marks)

23. Using a ruler and a pair of compasses only.

(i) Construct line $AB = 6\text{cm}$. (1 mark)

(ii) Construct triangle DAB where angle $DAB = 75^\circ$ and $AB = BD$. (2 marks)

(iii) Complete the parallelogram ABCD. (1 mark)

(iv) Drop a perpendicular from A to BD and hence find the area of the parallelogram. (3 marks)

(v) Construct a circle to touch line BC, AB produced and DC produced. Measure its radius. (3 marks)

24. Two towns X and Y lie on the same latitude in the southern hemisphere. When it is 9,00am at X, the time at Y is 11.00am.

(a) Given that the longitude of X is 12°E , find the longitude of Y. (3 marks)

(b) A plane leave X for Y and takes 2 hours to arrive at Y travelling at 600km/hr along a parallel of latitude. Find.

(i) the radius of circle of latitude on which towns X and Y lies. (3 marks)

(ii) The positions of the two towns. (4 marks)

Kenya Certificate of Secondary Education
121/2
MATHEMATICS ALT A
PAPER 2

TIME: 2½ HOURS

SECTION I: (50 MARKS)

1. Use logarithms to evaluate, correct to 4 decimal places.

$$\sqrt[3]{\frac{7.24 + 3.072}{23.2 \cos 70^\circ}} \quad (4 \text{ marks})$$

2. Make R the subject of the formula

$$A = \pi (R + r)(R - r) \quad (3 \text{ marks})$$

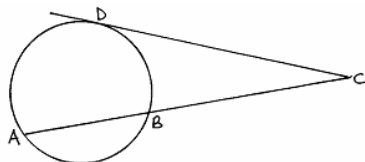
3. The seventh term of an arithmetic sequence is 17, three times the third term is 3.

Calculate the first term and the common difference of the sequence. (3 marks)

4. Find the value of χ given that

$$\begin{pmatrix} \chi & 6 \\ 4 & \chi - 2 \end{pmatrix} \text{ is a singular matrix.} \quad (2 \text{ marks})$$

5. In the figure below DC is a tangent to the circle at point D. Given that ABC is straight line where AB 9.45cm and BC = 5cm. Find the length of DC. (3 marks)



6. Tap A can fill a bath in 4min. Tap B can fill the same bath in 6min and tap C can empty the bath in 8min.

(a) Calculate how long it would take to fill the bath if all the taps were left running. (2 marks)

(b) Calculate how long it would take to fill the bath if all taps were left running for 3min after which tap C is closed. (2 marks)

7. Rose cocoa beans cost Sh.60 per kg while Wairimu beans cost Sh.90 per kg. In what ratio should they be mixed such that by selling the mixture at Sh.84 per kg, a profit of 20% is made. (3 marks)

8. A point Q divides a line PR internally in the ratio 2: 1 and a point T divides the line internally in the ratio 3: 1. In what ratio does T divide PQ? (3 marks)

9. Given that $y = \frac{\chi(\chi^2 - 1)}{\chi + 1}$ is the equation of a curve, find the gradient of the tangent to the curve at the point (2, 4). (3 marks)

10. Find the quartile deviation of the data below 2, 4, 6, 8, 10, 5, 6, 9, 4, 6. (3 marks)

11. Under a shear with χ -axis invariant a square with vertices A (1, 0), B (3, 0), C (3, 2) and D (1, 2) is mapped onto a parallelogram with vertices A¹ (1, 0), B¹ (3, 0), C¹ (7, 2) and D¹ (5, 2). Find the shear matrix. (3 marks)

12. Find the value of χ given that $\log (15 - 5\chi) - 1 = \log (3\chi - 4)$. (3 marks)

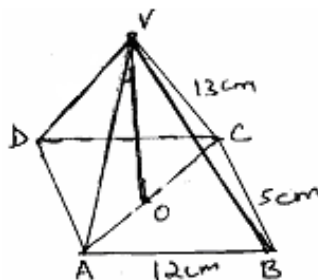
13. Simplify, without using tables or calculators

$$\frac{1 - \cos 60^\circ \sin 60^\circ}{1 + \cos 30^\circ \sin 30^\circ} \text{ leaving your answer in the form } a + b\sqrt{c}. \quad (4 \text{ marks})$$

14. A triangle ABC is such that AB = 9cm, BC = 7cm and AC = 11cm. Find the radius of a circle which passes through A, B and C correct to 2d.p. (3 marks)

15. Find the percentage error in using 0.67 as an estimate of $\frac{2}{3}$. (3 marks)

16. In the figure below, VABCD is a right pyramid on a rectangular base. Point O is vertically below the vertex V. AB = 12cm, BC = 5cm and CV = 13cm.



Calculate the angle between the edge CV and the base ABCD.

(3 marks)

SECTION B: (50 MARKS)

Answer any FIVE questions from this section.

17. Mobile dealer sells phones of two types Nokia and Motorola. The price of one Nokia and one Motorola phone is Ksh.2000 and Ksh.1600 respectively. The dealer wishes to have at least fifty mobile phones. The number of Nokia phones should be at least the same as those of Motorola phone. He has Ksh.120000 to spend on phones.

If he purchases x Nokia phones and y Motorola phones:

- Write down all the inequalities to represent the above information. (4 marks)
- Represent the inequalities in part (a) above on the grid provided. (4 marks)
- The profit on a Nokia phone is Ksh.200 and that on a Motorola phone is Ksh.300. Find the number of phones of each type he should stock. (3 marks)

18. Given that $-2x^2 - 3x + 11 = y$

(a) Complete the table below.

x	-4	-3	-2	-1	0	1	2	3
y	-9		9		11		-3	

(2 marks)

(b) On the grid provided draw the graph of $y = -2x^2 - 3x + 11$ for values of x from -4 to 3. (3 marks)

(c) Use the graph to solve.

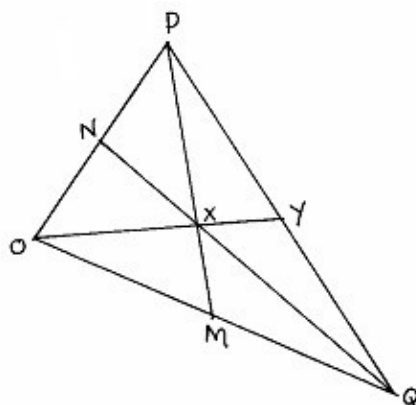
$$-2x^2 - 3x + 11 = 0$$

(2 marks)

$$-2x^2 - 5x + 10 = 0$$

(3 marks)

19. The figure below triangle OPQ in which OP = p and OQ = q. M and N are points on OQ and OP respectively such that ON = NP = 1:3 and OM:MQ = 2:1.



(a) Express the following vectors in terms of p and q.

(i) PM.

(ii) QN.

(iii) PQ.

(b) Lines PN and QM intersect at X such that PX = hpm and QX = KQN. Express OX in two different ways and find the value of h and K. (6 marks)

(c) OX produced meets PQ at Y such that PY:YQ = 3:2. Using the ratio theorem or otherwise, find OY in terms of p and q. (1 mark)

20. Income tax is charged on annual income at the rate shown below.

Taxable income K£ p.a.	Rate Ksh. Per £
1 – 2300	2
2301 – 6900	3
6901 – 9200	5
9201 – 11500	7
11501 and over	9

Mr. Njoroge earn a basic salary of Ksh.15000 per month and lives in a company house for which he pays a nominal-rent of Ksh.1250 per month. He enjoys personal relief of Ksh.1056 per month and insurance relief of Sh.270 per month. Calculate.

- Taxable pay is the employee's salary + 15% of salary less his taxable income nominal rent. Calculate Njoroge's taxable income in K£ p.a. (3 marks)
- The amount of tax he pays per month in Kenya shillings. (5 marks)
- His net monthly salary in shillings. (2 marks)

21. Use ruler and compasses only for all constructions in this question.

(a) Construct triangle ABC given that AC = 6cm, AB = 5.6cm and angle BAC = 75°. Measure BC. (3 marks)

(b) L₁ is the locus of points equidistant from BA and BC. Construct L₁. (2 marks)

- (c) Construct L_2 , the perpendicular from C to AB. (2 marks)
 (d) L_1 and L_2 meet at P. Locate P. (1 mark)
 (e) Find the point inside the triangle which is furthest from point P.
 What is the distance of that point from P? (2 marks)

22. The table below shows marks scored by 40 candidates in an examination.

Marks	Frequency
11 – 20	1
21 – 30	5
31 – 40	8
41 – 50	9
51 – 60	8
61 – 70	4
71 – 80	2
81 – 90	3

Using an assumed mean of 45.5 estimate:

- (i) Mean. (3 marks)
 (ii) Standard deviation. (3 marks)
 (iii) Calculate the quartile deviation. (4 marks)
23. Two bags X and Y contains ten and eight balls respectively. Bag X has 6 green and 4 red balls while bag Y has 3 and 5 red balls. A bag is selected at random and 2 balls selected without replacement.
- (a) Draw a tree diagram to represent the above information. (4 marks)
 (b) Find the probability of selecting a green ball the first time. (2 marks)
 (c) What is the probability of selecting at most one red ball? (2 marks)
 (d) Find the probability of selecting two green balls. (2 marks)
24. The length and the width of a rectangular are $(6\chi - 1)$ and $(\chi - 2)$ respectively. If the length and the width are increased by 4cm the new area is thrice that of the initial rectangle.
- (a) Find the dimension of the initial rectangle. (6 marks)
 (b) By what percentage does the area of the rectangle increase after the change? (2 marks)
 (c) What is the difference in size between the length and the width of the initial length? (2 marks)

KCSE PREDICTION 4 2022
MATHEMATICS
PAPER 1
JULY / AUGUST 2022
2 ½ HOURS

Section 1 (50 mks)

Answer all questions in this section in the spaces provided.

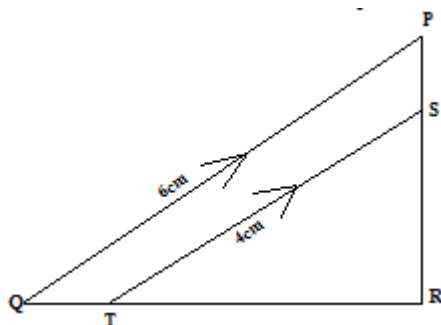
1. Given that
$$\frac{\frac{3}{5} \text{ of } 60 - 2\frac{2}{3} \times 1\frac{1}{2}}{5\frac{5}{8} + 1\frac{7}{9} - 5\frac{1}{2} \text{ of } 12\frac{1}{5} + 2\frac{4}{5} \cdot \frac{7}{10}} = \frac{p}{q}$$

find p/q (3 mks)

2. X (4, -3) and Y (-3, -2) are points on a straight line. Find the equation of the perpendicular bisector xy, write your answer in the form $\frac{x}{a} + \frac{y}{b} = 1$

3. A two digit number is such that the sum of its digit is ten. If the digits are reversed the number formed exceeds the original number by 18. Find the number. (3 mks)

4. The figure below represents a field where PQ and ST are two parallel fences. If the area of the field STR is 648cm². Calculate the area enclosed by PQTS. (4 mks)



5. Water and ethanol are mixed such that the ratio of the volume of water to that of ethanol; is 3:1. Taking the density of water as 1g/cm³ and that of ethanol as 1.2g/cm³, find the mass in grams of 2.5 litres of the mixture. (3 mks)

6. Given the inequalities $x - 5 \leq 3x - 8 < 2x - 3$,

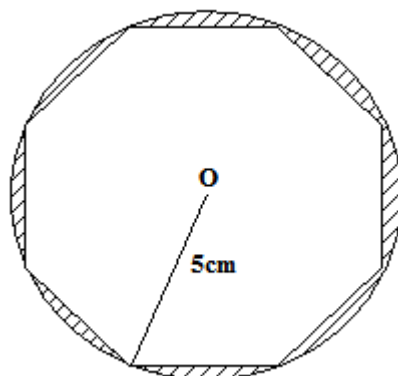
- a) Solve the inequalities and represent the solution on a number line. (3 mks)

7. Use the tables of squares, cubes, cuberoots and reciprocals to evaluate

$$\frac{5}{(0.293)^3} - \sqrt[3]{(4.125)^2}$$

(4 mks)

8. A regular octagon is inscribed in a circle of radius 5cm as shown in the diagram below. Find the area of the shaded region to 1d.p. (4 mks)



9. Simplify the expression. (3 mks)

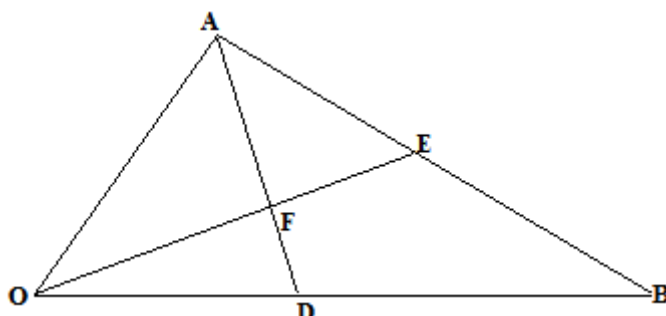
$$\frac{2x-2}{6x^2-x-12} \div \frac{x-1}{2x-3}$$

10. Mike paid sh. 180 for a shirt after getting a discount of 10%. The shopkeeper made a profit of 20% on the sale of the shirt. What percentage profit would the shopkeeper have made if no discount was allowed? (3 mks)

11. Determine the semi-interquartile range for the following set of data. (3 mks)
9, 4, 5, 7, 4, 6, 1, 2, 6, 8, 7
12. Find the value of n in (3 mks)
 $4^n + 1 + 2^{2n} + 1 = 384$
13. Given that $a = 3i - 2j + k$ and $b = 4i + j - 3k$ find the magnitude of c if $c = 3a + 2b$ to 4 significant figures. (3 mks)
14. ABC is an isosceles triangle such that $AB = BC$ and angle $BAC = 120^\circ$. The perpendicular distance from A to BC is $\sqrt{3}$ cm. Calculate the dimensions of triangle. (3 mks)
15. Without using tables or calculators evaluate (3 mks)
 $\frac{0.015 + 0.45}{-4.9 \times 0.2 + 0.07} \div 1.5$
16. To fence a shamba it requires 3 men working 8 hours a day for 5 days. How long will it take 10 men working 6 hours a day if they work at the same rate? (2 mks)

SECTION II (50 MARKS)**Answer ONLY five questions in this section.**

17. A carpenter constructed a closed wooden box with internal measurements 1.5m long, 0.8m wide and 0.4m high. The wood used in constructing the box was 1.0cm thick and had a density of 0.6g/cm^3 .
- a) Determine:-
- Volume of the wood used in constructing the box in cm^3 . (4 mks)
 - Mass of the box in kilograms. Give answer to one decimal place. (2 mks)
- b) Identical cylindrical tins of diameter 10cm, height 20cm with a mass of 120g each, were packed into the box. Calculate:-
- the maximum number of the tins that can be packed. (2 mks)
 - The total mass of box and the tins in kg. (2 mks)
18. a) On the grid provided draw triangle QRS given $Q(0, 0)$, $R(2, 0)$ and $S(2, 1)$. (1 mk)
- b) Triangle QRS is reflected in the line $y = x$ to give triangle $Q^1R^1S^1$. Draw $Q^1R^1S^1$ on the same axes and state its coordinates. (3 mks)
- c) Triangle $Q^1R^1S^1$ is then rotated 180° centre $(0,0)$ to give triangle $Q^{11}R^{11}S^{11}$. Find its coordinates and hence plot the image. (1 mk)
- d) Find a single matrix of transformation that would map triangle $Q^{11}R^{11}S^{11}$ onto triangle QRS. (3 mks)
- e) What type of congruency is existing between triangle $Q^{11}R^{11}S^{11}$ and triangle $Q^1R^1S^1$. (1 mk)
19. Three towns X, Y and Z are such that Y is 150km from X on a bearing of 060° . The bearing of Z from X is 125° . The bearing of Z from Y is 160° . Using a scale of 1cm represents 30km.
- Show the relative positions of towns X, Y and Z. (3 mks)
 - Determine the distance between towns X and Z. (2 mks)
 - A plane flies from town X on a bearing of 340° at 300km/hr. After 45 minutes of flying to another town P the pilot decides to fly directly to town Z. Determine
 - the time it would take to reach town Z from town P. (3 mks)
 - The bearing of town Z from P. (1 mk)
20. Nairobi and Eldoret are 600km apart. At 9.20a.m a lorry leaves for Nairobi at a speed of 60km/hr. At 10.00a.m a car leaves Eldoret for Nairobi along the same route at 120km/hr.
- Calculate the time the lorry arrived at Nairobi. (2 mks)
 - Find the time when the car overtakes the lorry. (4 mks)
 - Find the distance from Nairobi to the overtaking point. (2 mks)
 - Calculate how far the lorry is from Eldoret when the car arrives at Nairobi. (2 mks)
21. In the figure below, E is the midpoint of AB, $OD:DB = 2:3$ and F is the point of intersection of OE and AD.



- a) Given that $OA = a$ and $OB = b$, express in terms of a and b . (2 mks)
- OE

- ii) AD
- b) Given further $DF = tDA$ $OF = sOE$
- i) Express OF in two ways. (3mks)
- ii) Hence find the values of S and t. (3mks)
- c) Show that O, F and E are collinear. (2 mks)
21. a) Complete the table below for the function $y = 2x^2 - 4x - 9$ in range $-4 \leq x \leq 5$. (3 mks)
- | | | | | | | | | | | |
|---|----|----|----|----|---|---|---|---|---|---|
| x | -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
| y | | | | | | | | | | |
- b) On the grid provided draw the graph of $y = 2x^2 - 4x - 9$ (3 mks)
- c) Use the graph in (b) above to solve the quadratic equations.
- i) $2x^2 - 4x - 9 = 0$ (1 mk)
- ii) $2x^2 - 6x - 12 = 0$ (2 mks)
- d) Determine the coordinates of the turning point of the curve by calculation. (2 mks)
22. A particle moves along a straight line OS, Such that its distance S meters from the point O at time t seconds is given by $S = t^3 - 9t^2 + 15t$. Find:-
- a) Where the particle is at $t = 1$ (2 mks)
- b) At what time the particle is momentarily at rest. (3 mks)
- c) The acceleration at $t = 2$. (3 mks)
- d) The maximum velocity attained by the particle. (2 mks)
- 23.
- a) Using a ruler and a pair of compasses only. Construct triangle ABC in which $AB = 7\text{cm}$, $BC = 6.5\text{cm}$ and angle $BAC = 60^\circ$. (3 mks)
- b) On the same side of AB as C.
Determine the locus of a point P such that angle $APB = 60^\circ$ and $AP = 4\text{cm}$. (4 mks)
- c) Locate a point T on AB such that the angle ATC is 90° . Hence calculate the area of triangle ABC. (3mks)

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MATHEMATICS

PAPER 2

2 ½ HOURS

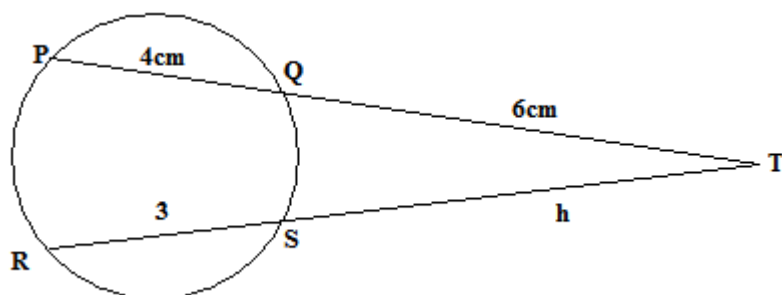
Section A (50 mks)**Answer all the questions in this section in the spaces provided.**

1. Use logarithms to evaluate. (3 mks)

$$\left(\frac{8.2 \times 61.5 \times 4.07}{3.14 \times 10.9^2} \right)^{1/4}$$

Leave your answer 4 d.p.

2. A rectangular flower garden measures 15.2m long and 10.56m wide. Find the percentage error in calculating the area of the garden to 3d.p. (3 mks)
3. Use matrix method to solve the equations; (4 mks)
- $$\log_2(2x + y) = 4$$
- $$\log_{17}(3x + 4y) = 1$$
4. In the figure below, chords PQ and RS intersect externally at T.



Given that PQ = 4cm, QT = 6cm and RS = 3cm, find RT. (3 mks)

5. Make P the subject of the formula in the simplest form. (3 mks)

$$\frac{1}{H} = \frac{\sqrt[3]{RP + GP}}{2}$$

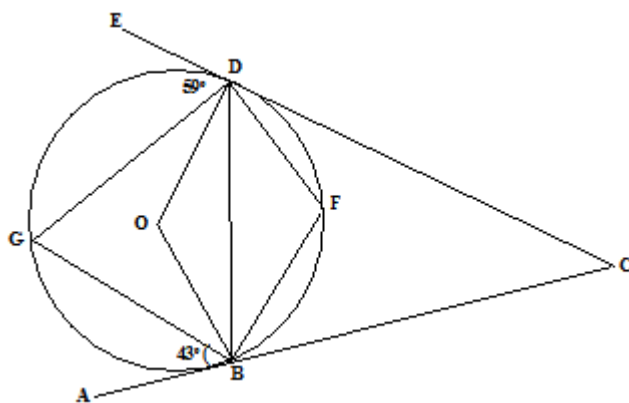
6. Solve the equation $6x^2 - 10x - 2 = 0$ by completing the square method. Leave your answer in surd form. (3 mks)
7. Expand $(1 - \frac{1}{3}x)^5$ upto the fourth term. Hence evaluate $(0.97)^5$ correct to 4d.p. (4 mks)
8. Solve the equation $\cos \theta - 2\sin^2 \theta + 1 = 0$ for $-\pi \leq \theta \leq \pi$ (4 mks)
9. Evaluate (2 mks)

$$\left[\frac{\text{Evaluate}}{x^2 - 2x^7 - 5} \right]_{-2}^1$$

10. M(30°N , 75°W) and N(30°N , 105°E) are two points on the earth's surface. Find the shortest distance between them in km. (Take $R = 6370\text{km}$ and $\pi = \frac{22}{7}$). (3 mks)
11. A tailor intends to buy a sewing machine which costs sh. 52,000. he borrows money from the bank. The loan has to be repaid at the end of the second year. The bank charges an interest of 24% p.a compounded semi-annually calculate the total amount payable to the bank to the nearest 10 shilling. (3 mks)
12. A quantity P is partly constant and partly varies as the square of Q. When $Q = 2$, $P = 40$ and when $Q = 3$, $P = 65$. Determine the value of P when $Q = 4$. (3 mks)
13. A coffee trader buys two grades of coffee at sh. 80 and sh. 100 per packet. Find the ratio at which she should mix them so that by selling the mixture at sh. 120 per packet, a profit of 25% is realised. (3 mks)
14. Your school is to participate in the County ball games finals. The probability of winning football and volleyball is $\frac{2}{3}$ and $\frac{1}{4}$ respectively. Find the probability of winning atleast one game. (3 mks)
15. The first term of A.P is -3. If the sum of the first five terms is 25. (2 mks)
- a) Find the common difference. (1mk)
- b) Hence withe the 9th term. (1mk)
16. Find the centre and radius of a circle whose equation is $x^2 + y^2 - 4x + 6y + 4 = 0$. (3 mks)

SECTION B (50 MARKS)**ANSWER ONLY FIVE QUESTIONS IN THIS SECTION**

17. A ship leaves Island Q(15°N , 30°E) and sails due West to Island R taking 80 hours. Given that its average speed was 24 knots;
- Find the position of Island R. (3mks)
 - Calculate the distance between the two Islands in kilometres. (Take radius of the earth to be 6370km) (4 mks)
 - If the local time at Q is 2.00p.m, find the local time at R. (3 mks)
 - Find the circumference of the latitude 30°N in nautical miles to 2 decimal places. (2mks)
18. In the figure below $\angle \text{EDG} = 59^{\circ}$ and $\angle \text{ABG} = 43^{\circ}$. The lines EDC and ABC are tangents to the circle at D and B respectively and $\text{DF} = \text{BF}$.



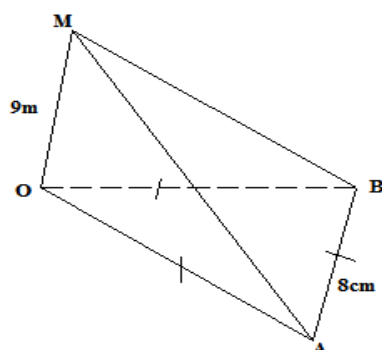
Find giving reasons:-

- $\angle \text{DGB}$ (2 mks)
- Obtuse angle DOB (2 mks)
- $\angle \text{DFB}$ (2 mks)
- $\angle \text{BCD}$ (2 mks)
- GDF (2 mks)

19. a) Complete the table below. (2 mks)

x	0	30	60	90	120	150	180	210	240	270	300	330	360
$y = \sin(x + 30^{\circ})$	0.50	—	—	—	—	0.00	-0.5	—	—	—	—	—	0.50
$y = 2\cos(x + 30^{\circ})$	1.73	-	0.00	-	-1.73	-	-	-	-	-	-	-2.00	1.73

- On the same axes, draw the graphs of $y = \sin(x + 30^{\circ})$ and $y = 2\cos(x + 30^{\circ})$. (4 mks)
 - Use your graph to solve the equation.
 - $2\cos(x + 30^{\circ}) = \sin(x + 30^{\circ})$ (1 mks)
 - $\cos(x + 30^{\circ}) = -1/2$ (2 mks)
 - State the amplitude of each curve. (1 mk)
20. An electric post OM, 9m high is held vertically by two wires MA and MB as shown below.



Points O, A and B are on the same level ground. Given that triangle OAB is equilateral with sides 8cm:-

- a) Find:-
 i) Angle AMB (3 mks)
 ii) The angle between planes AMB and OAB. (3 mks)
- b) If the four triangular shapes formed were covered with metallic plates, find the surface area of the metal used. (4 mks)
21. The distribution of marks of 80 students is shown in the table below.
- | Marks | 0 - 10 | 11 - 20 | 21 - 30 | 31 - 40 | 41 - 50 | 51 - 60 | 61 - 70 | 71 - 80 | 81 - 90 | 91 - 100 |
|-----------|--------|---------|---------|---------|---------|---------|---------|---------|---------|----------|
| Frequency | 1 | 6 | 10 | 20 | 15 | 5 | 14 | 5 | 3 | 1 |
- a) Draw a cumulative frequency curve for the distribution above. (4 mks)
- b) From the graph, estimate;
 i) The median. (1 mk)
 ii) Semi-interquartile range. (3 mks)
 iii) The pass mark if 60% of the students are to pass. (2 mks)
22. a) Use the trapezium rule with 10 strips to estimate the area bounded by the curve $y = x^2 - 3x - 4$ and the lines $x = -4$, $x = 1$ and the x axis. (5 mks)
 b) Calculate the exact area in (a) above and hence determine the percentage error in the estimate. (5 mks)
23. a) Three quantities P, Q and R are such that
 i) P varies as the square of Q and inversely as the square root of R. Given that $P = 20$ when $Q = 5$ and $R = 9$. Find P when $Q = 7$ and $R = 25$. (4 mks)
 ii) If Q is increased by 20% and R decreased by 36% find the percentage changes in P. (3 mks)
- b) Two matrices M and N are such that $M = \begin{pmatrix} x & 2 \\ 1 & -3 \end{pmatrix}$ and $N = \begin{pmatrix} 2 \\ 3 & 0 \end{pmatrix}$ Given that the determinant of $MN = 48$.
 Find the value of x. (3 mks)
24. A factory employs unskilled workers who earn sh. 6,000 per month and skilled workers who earn sh. 15,000 per month. The monthly wage bills must not exceed sh. 150,000. The machines require a maximum of 50 operators. Labour regulations demand that the number of skilled workers should be at most half the number of unskilled workers.
 a) If x is the number of unskilled workers and y the number of skilled workers, write down the inequalities for the above situation. (3 mks)
 b) Illustrate the results in (a) above on a graph. (5 mks)
 c) From your graph, obtain the range within which the number of unskilled labourers must lie. (2 mks)

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MATHEMATICS ALT. A

PAPER 1

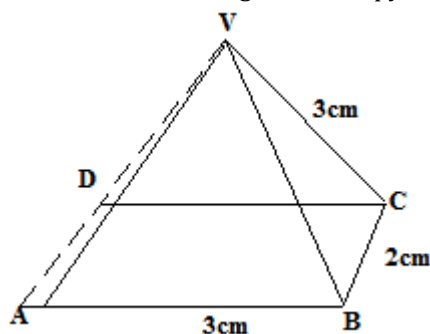
2 ½ HOURS

Section 1 (50 mks)**Answer all questions in this section in the spaces provided.**

1. Use logarithm tables to evaluate. (4 mks)

$$\frac{122.6 \times 0.396}{(3.563)^2}$$

2. The numbers zero to ten are written and then the square of numbers are listed in descending order to have the number m.
- a) State m. (1 mk)
- b) State the total value of the ten's digit in m. (1 mk)
3. Three taps A, B can fill a tank in 6 and 9 hours respectively, while tap C can empty the tank in 12 hours. Tap A and B are opened for two hours to fill the tank and then tap C opened after two hours.
- a) Find the proportion of the tank filled after two hours. (1 mk)
- b) Find how long the three taps take to fill the tank. (2 mk)
4. A metallic cube of side 6cm has a mass of 1.8kg. Calculate the density of the material making the cube. (3 mk)
5. The interior angle of a regular polygon is five times it's exterior angle.
- a) Find the number of sides of the polygon. (3 mk)
- b) Find the sum of interior angles. (1 mk)
6. The figure below shows a rectangular based pyramid.



- a) Draw the net of the solid. (3 mk)

7. Given that $R = 2a - 3b$ where $a = \begin{bmatrix} 5 \\ 2 \end{bmatrix}$ and $b = \begin{bmatrix} 1 \\ 3 \end{bmatrix}$

- a) Find vector R. (2 mk)

- b) Find R^1 the image of R under a translation vector $\begin{bmatrix} 2 \\ -3 \end{bmatrix}$ (1 mk)

8. Calculate the equation of a perpendicular bisector to the equation $3x + 2y = 4$ which passes through A(6, 4) and B(2, 0). (3 mk)

9. The table below show marks obtained by 50 students in mathematics exam.

Marks	0 - 10	10 - 15	15 - 20	20 - 30	30 - 35	35 - 40	40 - 50
No. of students	3	6	5	12	8	9	7

- a) On the grid provided draw a histogram to represent the above data. (3 mk)

10. Simplify

$$\frac{x^2 - 4y^2}{x^2 - 6xy + 8y^2}$$

(3 mk)

11. Mutua cycled at a speed of 10km/hr from home for 20 minutes before increasing his speed to 15km/h in the next fifteen minutes to reach school.

- a) Sketch a speed time graph for the motion. (1 mk)

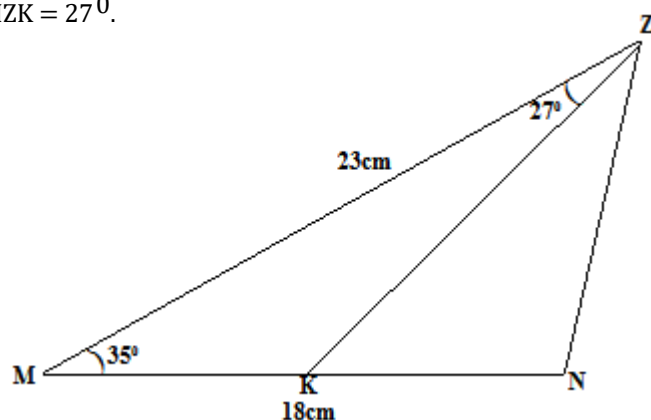
- b) From the graph determine the distance from Mutua's home to school to 3 decimal places. (3 mk)

12. The surface area of a cube is 311.04 determine the diagonal of the cube. (3 mk)

13. A boy bought two English text and five Chemistry texts for three thousands nine hundreds but if he could have bought three English texts and two Chemistry texts similar to the first ones he could have paid one thousand and nine hundred less. Calculate the cost of an English and Chemistry book. (3 mk)
14. A salesman bought a TV valued at fourty two thousands on hire purchase terms where he paid a down payment of fifteen thousands and then paid for one and half years three thousand shillings per month installment.
- Calculate the amount he paid on hire purchase. (2 mk)
 - Calculate the percentage profit the seller made. (1 mk)
15. Find the equation of the tangent to the curve $y = x^3 - 2x + 2$ at the point $x = 2$. (3 mk)
16. Solve the inequality
 $20 - x > 5 + 2x \geq x + 5$ (3 mk)

Section II**Answer only five questions in this section**

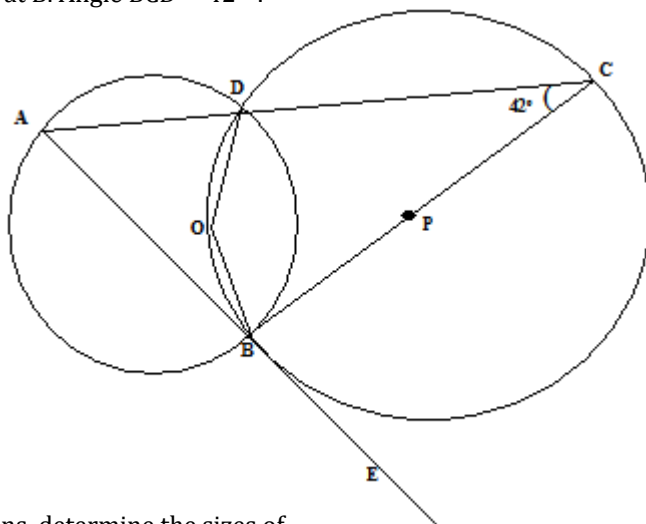
17. Three businessmen decided to contribute a total of one million, four hundreds thousands to buy a Nissan matatu in the ratio of 1 : 2 : 4 in a year.
- Find the amount of money contributed by each. (3 mk)
 - In the next two and a half years the matatu was in business earning an average of twenty five thousands per month and after that period they sold the matatu at nine hundred thousands; find the amount
 - Of money the matatu earned to members after two and a half years. (3 mk)
 - The profit earned when the matatu was sold after the business. (2 mk)
 - The percentage profit to the buying price of the matatu. (2 mk)
18. The distance between two towns is two hundred kilometres. Kamau drove at a speed of x km/h to cover the distance but Odhiambo increased his speed by 20km/hr and arrived half an hour earlier than Kamau. Find
- The speed of each (5 mk)
 - If both travelled from opposite directions at their earlier speed; Kamau starting the journey at 8.00a.m and Odhiambo at 8.45a.m.
 - Calculate the distance covered by Kamau by 8.45a.m. (1 mk)
 - At what time did the two meet. (3 mk)
 - What is the distance covered by Kamau at the time they met. (1 mk)
19. Using a ruler and a pair of compasses only construct
- the triangle ABC in which $BC = 10\text{cm}$, $AB = 6\text{cm}$ and $\angle CAB = 90^\circ$. (2 mk)
 - a rhombus BCDE such that $\angle CBE = 120^\circ$. (2 mk)
 - a perpendicular from F, the point of intersection of the diagonals of the rhombus to meet BE at G measure FG. (2 mk)
20. The figure below shows a triangle MNZ where $MN = 18\text{cm}$, $MZ = 23\text{cm}$ and K is a point on MN : $\angle ZMN = 35^\circ$ while $\angle MKZ = 27^\circ$.



Calculate, correct to three decimal places

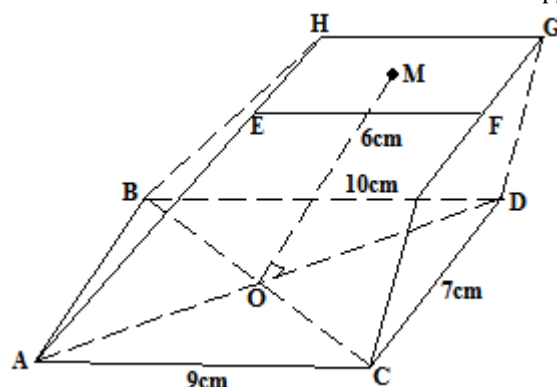
- The length of MK. (3 mk)
- The length of NZ. (3 mk)
- The area of triangle MNZ. (2 mk)
- The size of $\angle KZN$. (2 mk)

21. In the figure below points O and P are centres of intersecting circles ABD and BCD respectively. Line ABE is a tangent to circle BCD at B. Angle BCD = 42° .



- a) Stating reasons, determine the sizes of
- $\angle CBD$ (2 mk)
 - Reflex $\angle BOD$ (3 mk)
 - $\angle DAB$ (2 mk)
- b) Show that triangle ABD is isosceles. (3 mk)

22. The figure below shows a frustrum ABCDFGHE cut from a pyramid.



CD = 7cm, AC = 9cm, FE = 6cm and the perpendicular height of the frustrum MO = 10cm, AE = BH = CF = DG = 13cm.

Calculate

- The height of the pyramid of which the frustrum was made. (2 mk)
 - The slant height of the frustrum. (2 mk)
 - The length of the line AG. (2 mk)
 - The volume of the frustrum. (4 mk)
23. The points A (-2, 4) and B(3, -6) lies on a straight line AB; find
- The equation of line perpendicular to AB and passes at A. (3 mk)
 - The equation of a line parallel to AB and pass through the point (3, -1). (3 mk)
- b) The points B and C are translated by the vector $\begin{bmatrix} 2 \\ -1 \end{bmatrix}$ find
- the images of B and C. (2 mk)
 - The equation of the line of the images of b (i) above. (2 mk)

24. The table below shows the values of y for the curve $y = x^2 + x + 1$, correct to 2 decimal point.

x	0.5	1.5	2.5	3.5	4.5	5.5	6.5
y	1.75	4.75			25.75		49.75

- Fill in the value of y in the spaces above. (2 mk)
- Using the mid-ordinate rule and of a unit width; find the area under the curve $y = x^2 + x + 1$ for values of x $0 \leq x \leq 7$. (3 mk)
- Find the exact area under the curve in a (ii) above. (3 mk)
- Determine the percentage error in finding the area by mid-ordinate rule. (2 mk)
- a circle to touch all the sides of the rhombus. (1 mk)
- determine the area in the rhombus that lies outside the circle.

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MATHEMATICS ALT. A
PAPER 2

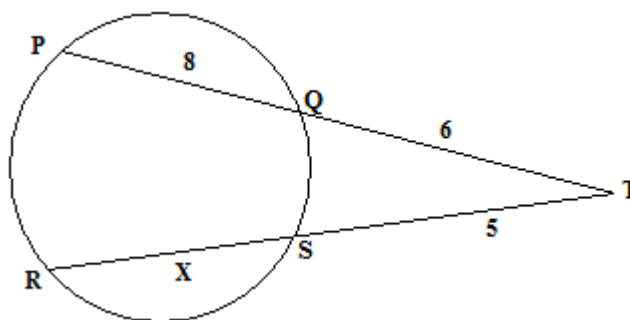
2 ½ HOURS

Section 1 (50 mks)

Answer all questions in this section in the spaces provided.

1. Factorise $x(x + 1) - y(y + 1)$ (3 mks)
2. Make t the subject of the formula. (3 mks)

$$L = \frac{pt}{t - x}$$
3. The area of a rectangle is 15cm^2 . The rectangle is transformed by the matrix T where $T = \begin{pmatrix} 3 & 2 \\ 1 & 2 \end{pmatrix}$
 Calculate the area of the image. (2 mks)
4. The position vector of P and q is $3i - 2j + k$ and $2i + j - 3k$ respectively. Determine the column vector PQ and hence calculate its length to 2 decimal places. (3 mks)
5. Solve for x (3 mks)
 $3\log_{10}2 + 2\log_{10}3 - \log_{10}(x + 2) = 1$
6. Two chords PQ and RS are produced to meet at T . Given that $PQ = 8\text{cm}$, $QT = 6\text{cm}$ and $ST = 5\text{cm}$. Find the length RS . (3 mks)



7. H varies as V and inversely as the square of r . Find the percentage change in h if V is increased by 20% and at the same time r is increased by 50%. (3 mks)
8. Calculate the value of a plot worthy ksh. 250,000 at 3 years. If it appreciates at 12.5% per annum to the nearest whole unit. (3 mks)
9. Solve for x .
 $4 \sin x = 3$ for $0 \leq x \leq 360^\circ$. (3 mks)
10. a) Expand
 $(1 + \frac{1}{2}x)^6$ upto the 5th term. (2 mks)
- b) Use the expansion above to find the value of $(1.2)^6$. (2 mks)
11. $P(20^\circ\text{N}, 5^\circ\text{E})$ and $Q(K^\circ\text{N}, 5^\circ\text{E})$ are two points on the earth surface. If the shortest distance between them along the line of longitude is 3000nm. Find the value of k . (3 mks)
12. A trader bought grade A tea at sh. 150 per kg and grade B at sh. 100 per kg. She mixed them to make a blend. Which she sold at a profit of 20%. If the selling price was sh. 144 per kg. Find the ratio in which she mixed grade A to grade B. (4 mks)
13. Find the radius and the centre of a circle given by the equation.
 $x^2 + y^2 = 4x + 6y - 9$ (3 mks)
14. Rationalise the denominator and simplify completely. (3 mks)

$$\frac{3}{2\sqrt{6} + \sqrt{3}}$$
15. Given matrix $m = \begin{pmatrix} 3 & -4 \\ 5 & 2 \end{pmatrix}$ find its inverse m^{-1} .

Hence solve the simultaneous equation below using matrix method.

$$\begin{aligned} 3x - 4y &= 17 \\ 5x + 2y &= 11 \end{aligned}$$

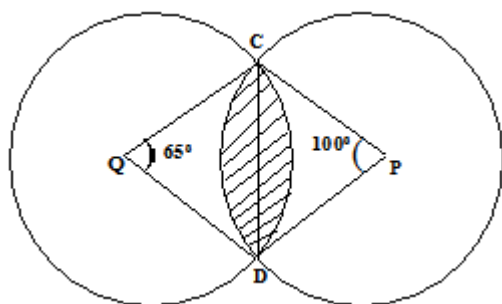
(3 mks)

16. The probability of Odhiambo wearing a jacket is $\frac{2}{3}$. If he does not wear the jacket the probability that it rains is $\frac{1}{3}$. Find the probability that he wears the jacket and it does not rain. (3 mks)

Section II

Answer only five questions in this section

17. Jane and Mary can dig a shamba in 12 and 15 days respectively. Jane did the work for three days alone and she was joined by Mary on the 4th day and both of them worked for next two days. Find
- The proportion of the work Jane had done before she was joined by Mary. (2 mks)
 - The work they had done in the first 5 days. (3 mks)
 - The work remaining undone by the end of the first five days. (1mk)
 - After five days they were joined by John who can dig the shamba alone in 10 days. How long will the three take to clear the remaining proportion of work. (4 mks)
18. In the figure below the circle centre Q radius 21cm represent the number of people in a town in Kenya who are affected with HIV/AIDS. The circle with centre P radius 14cm represent the number of people in the same town who are infected with T.B. The shaded area represents the number of people infected with both HIV/AIDS and TB.



Calculate:

- The area of the circle representing the number of people infected with HIV/AIDS. (2 mks)
- The area representing those infected with TB. (2 mks)
- The area representing those infected with both HIV/AIDS and TB. (6 mks)

19. The following table shows the rate at which income tax was charged during a certain year.

Monthly taxable income in Kenya shillings	Tax rate per cent (%)
0 - 9860	10%
9861 - 19720	15%
19721 - 29580	20%
29581 - 39440	25%
39441 - 49300	30%
49301 - 59160	35%
Over 59160	40%

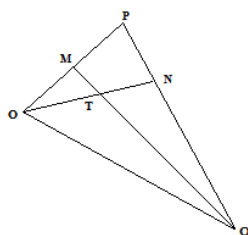
A civil servant earns a basic salary of ksh. 35 750 and a monthly house allowance of sh. 12 500. The civil servant is entitled to a personal relief of sh. 1062 per month.

- Calculate his net monthly tax. (6 mks)
- Apart from the salary the following deductions are also made from his monthly income.
WCPS at 2% of the basic salary.
Loan repayment ksh. 1325
NHIF sh. 480
Calculate his net monthly earnings. (4 mks)

20. The 2nd, 6th and 14th term of an A.P forms the first three consecutive terms of a G.P.

- Find the common ratio of the G.P. (5 mks)
- Given that the common difference of the AP is 2 find
 - The 1st and the 5th terms of the G.P. (3 mks)
 - The sum of the first 6 terms of the G.P. (2 mks)

21. In the figure below $OP = p$ and $OQ = q$. M and N are points on OP and PQ respectively, such that $OM:MP = 3:2$ and $PN:NQ = 1:3$. Lines ON and QM meet at T.



- a) Express the following in terms of p and q. (3mks)
- PQ
 - ON
 - QM
- b) Given that $OT = kON$ and $QT = hQM$. Express OT in two different ways hence solve for h and k. (5 mks)
- c) Find the ratio OT:TN and QT:TM. (2 mks)

22. a) Fill the table for the curves given by; $y = 3 \sin (2x + 30^\circ)$ and $y = \cos 2x$ for values of x in the range $0 \leq x \leq 180^\circ$. (2 mks)

x	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
$y = 3\sin (2x + 30^\circ)$	1.5		3	2.6	1.5		-1.5			-1.00	-1.50	0	1.5
$y = \cos 2x$	1		0.5	0		-0.87	-1.0	-0.87	0.5			0.87	1

- b) Using 1cm to represent 15° on the horizontal axis and 1cm to represent 1 unit on the vertical axis draw the graphs of $y = 3\sin (2x + 30^\circ)$ and $y = \cos 2x$ using the same grid. (4 mks)
- c) Use your graphs to solve the equation $3 \sin (2x + 30^\circ) = \cos 2x$. (1 mk)
- d) Determine the following from your graph.
- Amplitude of $y = 3\sin(2x + 30^\circ)$. (1 mk)
 - Period of $y = 3\sin(2x + 30^\circ)$ (1 mk)
 - Period of $y = \cos 2x$ (1 mk)
23. The heights of 100 maize plants were measured to the nearest centimeter and the results recorded in the table below.

Height x(cm)	frequency	d	d ²	fd	fd ²	cf
25 - 29	5			-15		
30 - 34	12					17
35 - 39	18	-1	1	-18		35
40 - 44	30	0	0	0		65
45 - 49	17					82
50 - 54	11	2				
54 - 59	7	3				100

- a) Complete the table. (2 mks)
- b) Calculate to the two decimal places.
- Mean (3 mks)
 - The standard deviation (3 mks)
 - The median (2 mks)
24. A businessman sells two types of mobile phones Samsung and Nokia. The price of one Samsung and one Nokia is ksh. 2000 and ksh. 1600 respectively. He wishes to have at least 20 mobile phones. The number of Samsung phones, should be less or equal to the number of Nokia phones. he has ksh. 96 000 to spend. The profit for Samsung phone is sh. 500 per phone while that of Nokia phone is sh. 300 per phone.
- If he buys x Samsung phone and y Nokia phones.
- Write all the five inequalities representing the information above. (3 mks)
 - Represent the inequalities in (a) above on the graph paper provided. (4 mks)
 - Find the number of phones he should sell to make maximum profit. (2 mks)
 - Determine the maximum profit. (1 mk)

KCSE PREDICTION 6 2022

MATHEMATICS (PAPER 1)

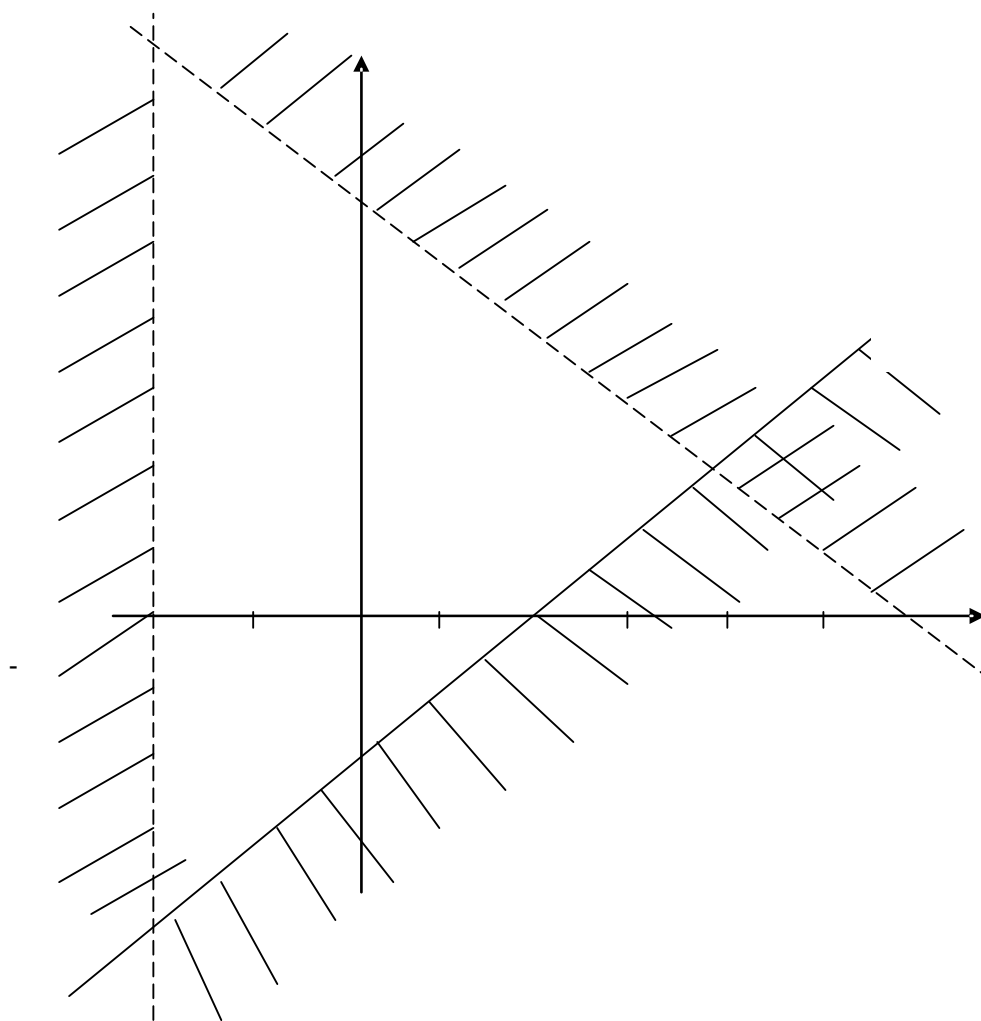
SECTION A (50 MARKS)

Answer all questions in this section in the spaces provided

1. Simplify without using table or a calculator to its lowest form. (3 marks)

$$1\frac{3}{4} - \frac{7}{16} \text{ of } 1\frac{11}{49} \div \left(\frac{3}{21} + \frac{11}{28}\right)$$

2. Abraham's money box contains only sh. 5 coins and sh. 10 coins. There are 24 coins and their total value is sh. 150. Find how many of each kind of coins there are in the box. (3 marks)
3. The gradient of a straight line M_1 passing through the points P (3, 4) and Q(x, y) is $-\frac{3}{2}$.
A line M_2 is perpendicular to M_1 and passes through the points Q and R (2, -1). Determine the values of X and Y. (3 marks)
4. Three inequalities define the region R shown below. Form the inequalities. (3 marks)



5. Given that $a = 10.5$, $b = 9.6$ and $c = 1.4$ all correct to the decimal place. Find the percentage error involved in the calculation of $\frac{a+b}{c}$ to 1 d.p. (3 marks)
6. The GCD of three numbers is 4 while the LCM is 360. If two of the numbers are 24 and 40. List two other possible numbers. (3 marks)
7. Given that $\frac{dy}{dx} = 2x^2 + 3$ and that $y = 3$ when $x = 0$, find the value of y when $x = \frac{1}{3}$. (3 marks)
8. After buying 52 Sterling pounds, a businessman decided to exchange his money for US dollars. Using the following currency exchange rate, calculate to 3s.f. the number of dollars he ended up with.
1 US dollars (\$) = ksh. 89.75

1 Sterling pound (£) = ksh. 135.47

(3 marks)

9. Solve for X and Y in

(3 marks)

$$4^x \times 4^y = 1$$

$$3^{2x-y} = 81$$

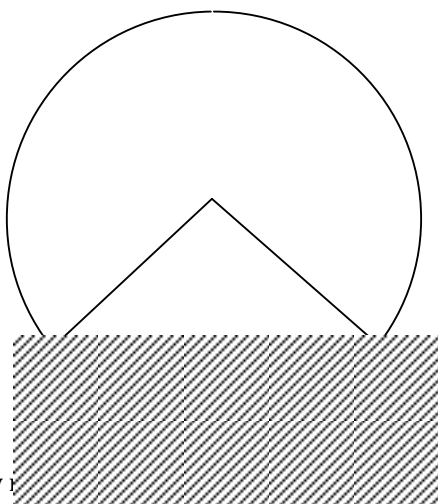
10. Given the number 11055. Show that the number is divisible by 3, 5 and 11 using necessary divisibility tests.

(3 marks)

11. Calculate the area of the shaded region in the figure below, given that;

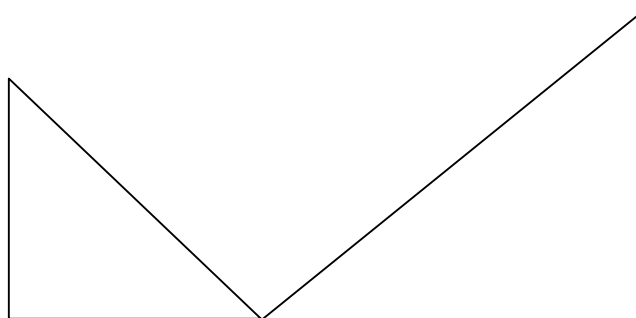
OX = OY = 10cm and XY = 16 cm. (Take $\pi = 3.142$)

(4 marks)



12. The figure below is drawn to scale. Complete the prism.

(3 marks)

13. Use reciprocal table to find the value of $\frac{1}{0.325}$. Hence evaluate $\frac{\sqrt[3]{0.000125}}{0.325}$.

(3 marks)

14. A poultry farmer has brown and white chicken; the brown chicken are twice as many as the white ones; of the white chicken $\frac{2}{5}$ are layers while the rest are cockerels; of the brown ones $\frac{5}{12}$ are layers while the rest are cockerels. If the chicken is picked at random in the dark, find the probability that it will be a cockerel.

(3 marks)

15. Triangle PQR has vertices P(3, 2), Q(-1, 1) and R(-3, -1). Under a rotation the vertices of $P^1Q^1R^1$ are P¹(1, 4), Q¹(2, 0) and R¹(4, -1). By construction find the centre and angle of rotation.

(4 marks)

SECTION B (50 MARKS)Answer any **five** questions in this section

17. Three hundred and sixty litres of a homogenous paint is made by mixing three types of 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 costs shs. 180 per litre, paint B shs. 240 per litre and paint C shs. 127.50 per litre and paint C shs. 127.50 per litre.

(a) The volume of each type of paint in the mixture.

(5 marks)

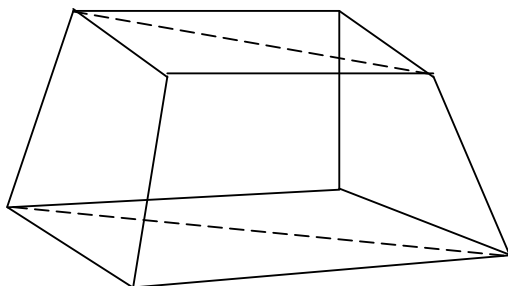
(b) The amount of money spent in making one litre of the mixture.

(3 marks)

(c) The percentage profit made by selling the mixture at shs. 221 per litre.

(2 marks)

18. The figure below is a solid frustum of a rectangular base ABCD and top rectangular EFGH. Given that AB = 6cm, AC = 10cm, HF = 5cm, FG = 4cm and CF = 25cm.



Calculate:

- (a) The height of the pyramid it was cut from giving your answer to the nearest whole number. (2 marks)
 (b) The surface area of the frustum. (5 marks)
 (c) The volume of the frustum. (3 marks)
19. (a) Complete the table below for the function $y = \frac{1}{2} \sin 2x$ where $0^\circ \leq x \leq 360^\circ$. (2 marks)

x	0°	30°	60°	90°	120°	150°	180°	210°	240°	270°	300°	330°	360°
2x	0°	60°	120°	180°	240°	300°	360°	420°	480°	540°	600°	660°	720°
Sin 2x	0°	0.866		0					0.866	0			
$y = \frac{1}{2} \sin 2x$	0	0.433		0									

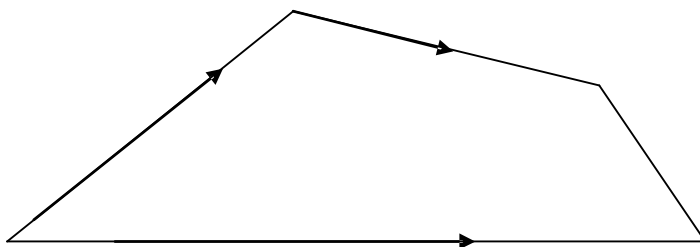
- (b) On the grid provided, draw the graph of the function $y = \frac{1}{2} \sin 2x$ for $0^\circ \leq x \leq 360^\circ$ using the scale 1 cm for 30° on the horizontal axis and 4cm for 1 unit of y-axis. (3 marks)
20. Using a ruler and a pair of compass only; Construct rectangle ABCD whose sides are AB = 10cm and BC = 7cm. Use the figure to:
- (a) Find the point R and S on AD and DC respectively, such that R is equidistant from AD and S is equidistant from DC. (2 marks)
- (b) Shade the region within the rectangle in which a variable point X must lie given that X satisfies the following conditions. (3 marks)
 (i) $X > 2\text{cm}$ from RS (3 marks)
 (ii) X is nearer to AB than to BC (3 marks)
 (iii) BX is more than 5cm (2 marks)
21. A youth group decided to raise ksh. 480,000 to buy a piece of land costing ksh. 80,000 per hectare. Before the actual payment was made, four of the members pulled out and each of those remaining had to pay an additional ksh. 20,000.
- (a) If the original number of the group members was X, write down;
 (i) An expression of how much was contributed originally. (1 mark)
 (ii) An expression of how much the remaining members were to contribute after the four pulled out. (1 mark)
 (b) Determine the number of members who actually contributed towards the purchase of the land. (4 marks)
 (c) Calculate the ratio of the supposed original contribution for the new contribution. (2 marks)
 (d) If the land was sub-divided equally, find the size of land each member got. (2 marks)
22. A train moving at 40km/h is moving in the same direction with a truck on a road parallel to the railway line at a speed of 75km/h. The truck takes $1\frac{1}{4}$ min to overtake the train completely.
- (a) Given that the truck is 5m long. Determine the length of the train in metres. (6 marks)
 (b) The truck and the train continued moving parallel to each other at the original speeds. Calculate the distance between them after 10 mins 15 sec from the time the truck overtook the train. (2 marks)
 (c) The truck stopped 50 minutes after overtaking the train. How long did the train take to catch up with the truck? (2 marks)
23. (a) Given that the position vectors of A, B and C are;

$$a = \begin{pmatrix} 3 \\ 2 \end{pmatrix}, b = \begin{pmatrix} 4 \\ 6 \end{pmatrix}, c = \begin{pmatrix} -2 \\ -3 \end{pmatrix}$$

Find;

- (i) AC (1 mark)
 (ii) AB (1 mark)
 (iii) BC (1 mark)

(b) In the figure below, $\mathbf{OR} = 5\mathbf{a}$, $\mathbf{OP} = 5\mathbf{b}$, and $\mathbf{PQ} = 2\mathbf{a} - \mathbf{b}$



(i) Express as simply as possible, vectors $\mathbf{OQ}$ and $\mathbf{RQ}$ in terms of $\mathbf{a}$ and $\mathbf{b}$. (2 marks)

(ii) Given that line $\mathbf{PQ}$ produced meet at $\mathbf{X}$ and that $\mathbf{PX} = k\mathbf{PQ}$ and

$\mathbf{OX} = h\mathbf{OR}$ where k and h are constants; form an equation connecting k , h , $\mathbf{a}$ and $\mathbf{b}$. Hence deduce the values of k and h . (5 marks)

24. Mr. Kamau earns a basic salary of ksh. 30,000 per month. He gets medical allowance of ksh. 4000 per month. He occupies a company house for which he pays a nominal rent of ksh. 1000 per month. He enjoys a tax relief of ksh. 600 per month. The following PAYE is in operation.

Income K£ P.a.	Rate of tax in Ksh. (£)
0 – 3600	2
3601 – 7200	3
7201 – 10800	5
10801 – 14400	7
14401 – 18000	9
18001 and over	10

(a) Calculate Kamau's taxable income in Kenya pounds per annum. (3 marks)

(b) Calculate Kamau's PAYE in Kenya shillings per month. (4 marks)

(i) In addition to the PAYE the following deductions were made on his salary every month. WCPs at 2% of basic salary

(ii) NHIF of ksh. 300

(iii) Cooperatives shares and loan recovery totaling ksh. 2,500 per month. Calculate Kamau's net pay in ksh. per month. (3 marks)

121/2
MATHEMATICS
PAPER 2

TIME: 2 ½ HOURS

1. Use logarithm tables to evaluate: (4 marks)

$$\frac{45.3 \times 0.00697}{0.534}$$

2. The external and internal diameters of a cement pipe are 20cm and 14cm respectively. Calculate the volume of cement required to prepare 1.4m long. Give your answer in cm^3 . (3 marks)

3. Make h the subject of the formula (3 marks)

$$\frac{E}{X} = \sqrt{\frac{h - 0.5}{1 - h}}$$

4. Solve for x in the equation $2 \sin^2 x - 1 = \cos^2 x + \sin$ for $0^\circ \leq x \leq 360^\circ$
5. The points A(-4,1) and B(-2,5) are the end points of a diameter of a circle. Determine the coordinates of the centre of the circle, hence calculate the equation in the form:
 $x^2 + y^2 = 2ax - 2by + c + d \dots = 0$
6. Solve the quadratic equation $3x^2 - 4x = 2$ (3 marks)
7. Evaluate by rationalizing the denominator and leaving your answer in surd form. (3 marks)

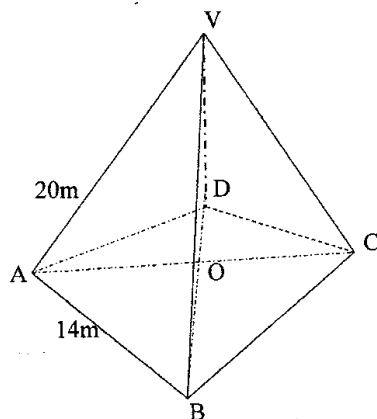
$$\frac{\sqrt{8}}{1 + \cos 45^\circ}$$

8. Expand $(2 + 3x)^6$ up to the term x^2 . Hence use your expansion to estimate $(2.09)^6$ (3 marks)
9. Two quantities M and N are such that M varies partly as N and partly as the square of N. Determine the relationship between M and N given that when M is 1050, $N = 10$ and when $M = 2200$, $N = 20$. (3 marks)
10. A dealer has two types of grades of tea, A and B. Grade A costs sh 140 per kg. Grade B costs sh. 160 per kg. If the dealer mixes A and B in the ratio 3:5 to make a brand of tea which he sells at sh. 180 per kg, calculate the percentage profit that he makes. (3 marks)
11. Onyango bought a refrigerator whose cash price is sh. 84,000 on hire purchase. He made a cash deposit of sh. 20,000 and the 15 monthly instalments of shs. 6,000. Calculate the rate of interest per month. (3 marks)
12. Given that $\mathbf{OA} = 2\mathbf{i} + 5\mathbf{k}$ and $\mathbf{OB} = 7\mathbf{i} - 5\mathbf{j}$. A point T is on AB such that $2\mathbf{AT} = 3\mathbf{TB}$. Calculate the magnitude of $\mathbf{OT}$ to 4 significant figures. (3 marks)
13. Find the sum of A.P having 15 terms, the fourth term being -3.2 and the eight term 8.4 (3 marks)
14. Use matrix methods to solve the following simultaneous equation (4 marks)
15. The volumes of two similar cylinders are 3240cm^3 and 960cm^3 . If the surface area of the larger cylinder was 792cm^2 . find the surface area of the smaller cylinder. (3 marks)
16. Estimate the area bounded by the curve $y = \frac{1}{2}x^2 + 1$, $x = 0$, $x = 3$ and the x-axis using the mid-ordinate rule. Use three strips (3 marks)

SECTION B: (50 marks)

17. The angle of elevation of the top of a flag post from a point P on a level ground is 20° . The angle of elevation of the top of the flag post from another point Q nearer to the flag post and 110m from P is 32° . Q is between P and the flag post.
- a) Draw a sketch diagram to show the above arrangement (2 marks)
- b) calculate correct to 2 d.p
- (i) The distance from the point Q to the top of the flag post (5 marks)
- (ii) The length of the rope tied from the top of the flag post to the point P on the ground, if 0.5m of the rope is used for tying the knots. (3 marks)

18. The diagram below shows a right pyramid with a square base ABCD and vertex V. O is the centre of the base. AB = 14m, VA = 20m and N is the midpoint of BC.



Find;

- The lengths of BO, VO and VN (3 marks)
 - The angle between VO and plane VBC (3 marks)
 - The angle between VB and base ABCD (2 marks)
 - The angle between VDC and VBC (2 marks)
19. A number of students were asked to cut 30cm lengths of binding wire without measuring. Later 100 pieces area collected and measured correct to the nearest 0.1 cm the data below was collected.

Length l (cm)	28.0 – 28.4	28.5 – 28.9	29.0 – 29.4	29.5 – 29.9	30.0 – 30.4	30.5 – 30.9	31.0 – 31.4	31.5 – 31.9
Frequency	5	8	30	X	10	20	10	4

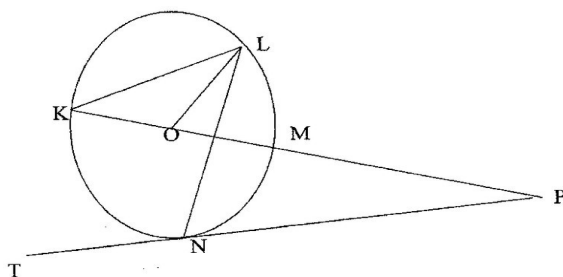
- Calculate the value of x (1 mark)
 - State the modal class (1 mark)
- Using 29.7 as a working mean calculate;
 - the mean (4 marks)
 - the standard deviation (4 marks)

20. A transformation represented by matrix $\begin{bmatrix} 2 & 1 \\ 1 & -2 \end{bmatrix}$

Maps A(0,0), B(2,0), C(2,3) and D(0,3) onto A¹B¹C¹ and D¹ respectively

- Draw ABCD and its image A¹B¹C¹D¹ (4 marks)
- A transformation represented by $\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$ maps A¹B¹C¹D¹ on A¹¹B¹¹C¹¹D¹¹. Plot A¹¹B¹¹C¹¹D¹¹ on the same graph. (3 marks)
- Determine the matrix of a single transformation that maps A¹¹B¹¹C¹¹D¹¹ onto ABCD (3 marks)

21. In the figure K, L, M and N are points on the circumference of a circle centre O. The points K, O, M and P lie on a straight line.



PT is a tangent to the circle at N. Given that $\angle MKN = 40^\circ$, find the values of the following angles stating reasons.

- $\angle MLN$ (2 marks)
 - $\angle OLN$ (2 marks)
 - $\angle LNP$ (2 marks)
 - $\angle MPN$ (2 marks)
 - $\angle KLM$ (2 marks)
22. The position of 3 cities P, Q and R are (15°N, 20°W), (50°N, 20°W) and (50°N, 60°E) respectively.
- Find the distance in nautical miles between:
 - Cities p and Q (2 marks)
 - Cities P and R, via city Q (3 marks)

- b) A plane left city P at 0250h and flew to city Q where it stopped for 3 hours then flew on to city R, maintaining a ground speed of 900 knots throughout.
- (i) The local time city R when the plane left city P (3 marks)
- (ii) The local time (t the nearest minute) at city R when the plane landed at R. (2 marks)
23. The table below is for function $y = x^3 - 7x + 6$ for the range $-3 \leq x \leq 3$.

X	-3	-2	-1.5	-1	0	1	1.5	2	3
Y									

- a) Complete the table above. (2 marks)
- b) Draw the graph of the function $y = x^3 - 7x + 6$ for the range $-3 \leq x \leq 3$ (3 marks)
- c) Use the graph above to estimate the roots of the following;
- (i) $x^3 = 7x - 6$ (1 mark)
- (ii) $-x^3 + 8x - 2 = 0$ (2 marks)
- d) By drawing a tangent, estimate the gradient of the curve $y = x^3 - 7x + 6$ at $x = -2$ (2 marks)
24. a) The acceleration of a particle t seconds after passing a fixed point P is given by $a = 3t - 3$. Given that the velocity of the particle when $t = 2$ is 5 m/s, find;
- (i) Its velocity when $t = 4$ seconds (3 marks)
- (ii) Its displacement at this time (3 marks)
- (iii) find the exact area bounded by the graph $x = 9y - y^3$ and the y-axis (4 marks)

KCSE PREDICTION 7 2022

Kenya Certificate of Secondary Education (K.C.S.E)

MATHEMATICS

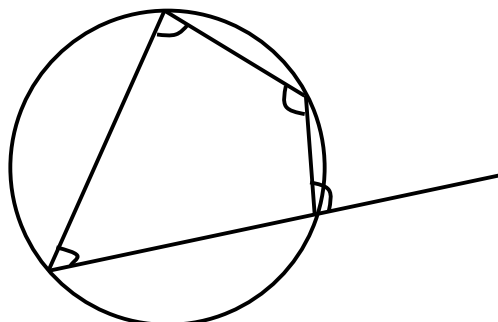
Paper 1

Time: 2 ½ Hours

SECTION A (50 MARKS)

ALL QUESTIONS IN THIS SECTION

- The recurring decimal $3.\overline{42}$ can be expressed as $3\frac{x}{y}$ find the value of $y - x$. (3 marks)
- The perimeter of a sector of a circle of radius 7cm is 22.8cm. Calculate the angle that arc subtends at the center of the circle. (3 marks)
- The figure alongside shows a cyclic quadrilateral PQRS in which PQT is a straight line. $\angle LQT = 50^\circ$ and $\angle SPQ = 72^\circ$ find angles marked x° and y° . (3 marks)

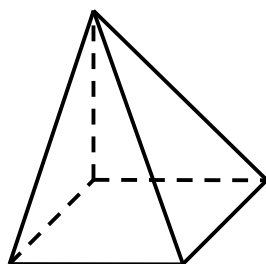


- (a) Express the number 7056 in its prime factors. (1 mark)
(b) Hence calculate $\sqrt{7056}$ leaving your answer in prime factors. (2 marks)
- Evaluate $\int_1^3 (x^2 - 2x) dx$ (3 marks)
- A line L is perpendicular to $2x + y = 3$ and passes through the point (4, -1). Calculate the acute angle the line L makes with x - axis. (3 marks)
- Simplify: $\frac{12x^2 - 16x}{20 - 11x - 3x^2}$ (4 marks)
- Find the reciprocal of 0.342 hence or otherwise evaluate, $\frac{\sqrt{0.0625}}{0.342}$ correct to 2 decimal places. (3 marks)
- Construct triangle PQR such that PQ = 7cm, QR = 5cm and $\angle LPQ = 30^\circ$. Construct locus of L_1 of points equidistant from P and Q to meet the locus L_2 of points equidistant from Q and R at M. Measure PM. (4 marks)
- The distance between town A and B is 288km. A car travelling at 108km/hr started from town A at 11.35 a.m. and travelled to town B. At what time did the car reach its destination. (Give your answer in 24 hr clock) (3 marks)
- John an American tourist arrived in Kenya with 10000 dollars and converted the whole amount into Kenyan shillings. He spent KSh. 390,000 and changed the balance to sterling pounds before leaving for United Kingdom. A Kenyan bank buys and sells foreign currencies as shown.

	Buying (KSh.)	Selling (KSh)
1 US dollar	105.24	106.10
1 Sterling pound	132.51	133.05

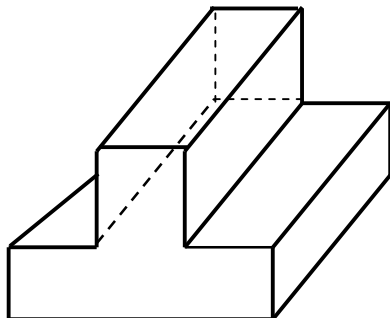
Calculate the amount he received to the nearest sterling pound (4 marks)

- Below is a right pyramid of sides 4cm and slant edges are all 6cm long.



Draw the net of the pyramid hence find total surface area of the pyramid. (4 marks)

13. Solve the inequality and state the integral values of $4 - 3x < x + 12 \leq -\frac{3x+29}{2}$ (3 marks)
14. Solve for x in the equation. (3 marks)
 $2^{(2x-1)} \times 16^{(2x-1)} = 1$
15. The diagram below represents a solid block of wood which is 40cm long. All other dimensions are in cm and all angles are right angles.



- (a) Calculate the volume of the block in cm^3 . (2 marks)
- (b) Calculate the density of the block in kg/m^3 if the block has a mass of 23.04kg. (2 marks)
16. Given that determinant of $\begin{pmatrix} 3 & n \\ 7 & 0 \end{pmatrix} = 2 \times \text{determinant of } \begin{pmatrix} m & 2 \\ n & 2 \end{pmatrix}$ find n. (3 marks)

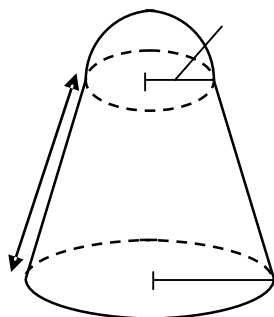
SECTION II (50 Marks)

Answer any Five Questions in this section

17. The table below shows marks obtained by 40 form four students of Maji Nyingi Secondary School in Ukwala Township in Biology end term examination.

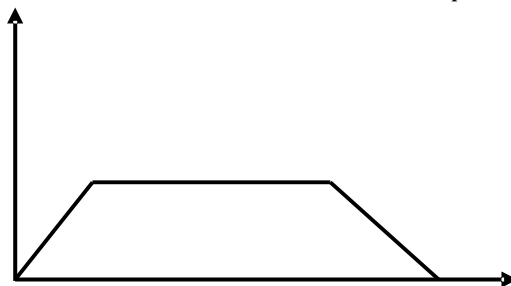
60	70	72	40	52	60	22	31	78	53
56	55	28	67	63	54	57	48	47	56
55	62	72	78	75	38	37	44	62	64
58	39	45	48	56	59	65	58	50	58

- (a) Make a grouped frequency table using classes 20 – 29, 30 – 39, 40 – 49 etc (4 marks)
- (b) (i) State the modal class. (1 mark)
- (ii) On the graph paper provided draw both a frequency histogram and a frequency polygon on the same axes
18. A solid is made of a conical frustum and a hemispherical as shown in the figure below. The dimensions are as indicated in the diagram.



- (a) Find the area of
- (i) The circular base (2 marks)
- (ii) The curved surface of frustum (4 marks)
- (iii) The hemispherical surface (2 marks)
- (b) A similar solid has a total area of 81cm^2 . Determine the radius of its base (2 marks)
19. A number of people working at a factory decided to raise KSh. 72,000 to buy a plot of land. Each person was to contribute the same amount. Before contributions five people retired from working at the factory and thus does not contribute. The same target of KSh. 72,000 was still to be met by the remaining.
- (a) If n stands for the number of people working in the factory originally, show that the increase in the contribution per person was $\frac{360,000}{n(n-5)}$ (3 marks)
- (b) If the increase in contribution per person Sh. 1200, find the number of people originally working at the factory. (4 marks)
- (c) Calculate the percentage increase in the contributions per person caused by retirement, giving your answer to one decimal place. (3 marks)

20. Three warships A, B and C are at sea such that ship B is 500km on a bearing $N30^{\circ}E$ from ship A, ship C is 700km from ship B on a bearing of 120° . An enemy ship D is sighted 800km due south of ship B.
- (a) Taking a scale of 1cm to represent 100km locate the positions of ships A, B C and D. (4 marks)
- (b) Find the bearing of
- (i) ship A from D (1 mark)
- (ii) ship D from C (1 mark)
- (c) Use scale drawing to determine the distance between
- (i) D and A (1 mark)
- (ii) C and D (1 mark)
- (d) Measure the angle DAC and angle BCD (2 marks)
21. The points P (1, 5), Q (2, 2) R (1, 1) and S (4, 2) are vertices of a quadrilateral PQRS.
- (a) On the grid provided, draw the quadrilateral PQRS. (2 marks)
- (b) On the same grid draw $P^I Q^I R^I S^I$ the image of PQRS under a rotation of positive quarter turn about the origin. State the coordinates of $P^I Q^I R^I$ and S^I . (3 marks)
- (c) The points $P^{II} Q^{II} R^{II} S^{II}$ are images of $P^I Q^I R^I S^I$ under a reflection in the x – axis, on the same grid draw quadrilateral $P^I Q^I R^I S^I$ and state its coordinates. (3 marks)
- (d) Quadrilateral $P^{II} Q^{II} R^{II} S^{II}$ is the image of PQRS under a certain reflection. On your graph draw the mirror line L_1 for the reflection and state its equation. (3 marks)
22. The diagram below shows the speed-time graph for a train travelling between two stations. The train starts from rest and accelerates uniformly for 150 seconds. It then travels at a constant speed for 300 seconds and finally decelerates uniformly for 200 seconds.



Given that the distance between the two stations is 10450m, calculate the

- (a) maximum speed in km/h the train attained (3 marks)
- (b) acceleration during the first part of journey (2 marks)
- (c) distance the train travelled during the last 100 seconds (3 marks)
- (d) time the train takes to travel the first half of the journey (3 marks)
23. A trader sold an article at KSh. 4800 after allowing his customer a 12% discount on the marked price of the article. In so doing he made a profit of 45%.
- (a) Calculate to 2 decimal place
- (i) the marked price of an item (3 marks)
- (ii) price at which the trader had bought the article (2 marks)
- (b) If the trader had sold the same article without giving a discount, calculate the percentage profit he would have made (3 marks)
- (c) To clear his stock the trader decided to sell the remaining articles at a loss of 12.5%. Calculate the price at which he sold each article (2 marks)
24. A particle starts off from OM with a velocity V m/s given by $V = at^4 - \frac{1}{2}t^2 + bt$. Its acceleration is 1 m/s initially and its displacement is 6m after 2 seconds. Find
- (a) The value of a and b (3 marks)
- (b) (i) The velocity after 4 seconds (3 marks)
- (ii) The acceleration after 4 seconds (2 marks)
- (iii) The displacement from O when $t = 4s$ (2 marks)

Kenya Certificate of Secondary Education (K.C.S.E)
MATHEMATICS
Paper 2
July/August 2022

1. Simplify $(1 + \sqrt{2})(1 - \sqrt{2})$ (1 mark)
 hence evaluate $\frac{1}{1+\sqrt{2}}$ to 3 significant form given that $\sqrt{2} = 1.4142$ (2 marks)
2. Mr. Ogingo Onur invested KSh. 100,000 at 11% simple interest for 3 years and KSh. 150,000 at x% simple interest for 3 years. If the total interest earned was KSh. 79,000, calculate the value of x. (3 marks)
3. Construct a circle centre P and radius 3cm, construct a tangent from point Q 7cm from the centre P to touch the circle at R. Measure the length of QR. (4 marks)
4. Matrix A is given by $\begin{pmatrix} p & 4 \\ -3 & q \end{pmatrix}$
 (a) Determine A^2 (2 marks)
 (b) If $A^2 = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$, determine the possible pairs of values of p and q (2 marks)
5. Find the range of values within which the difference of $3.492 - 2.141$ lies (3 marks)
6. Make x the subject of the formula in a $\sqrt{\frac{x^2 - m}{m}} = \frac{a}{b}$ (3 marks)
7. Three people Odago, Oronyi and Nyamohanga working together, take 30 min to do some work. Odago and Oronyi together would take 40 minutes, Odago and Nyamohanga together would take 45 minutes. How long would each take working alone. (3 marks)
8. In a transformation, an object with area 9cm^2 is mapped onto an image whose area is 54cm^2 , given that the matrix of transformation is $\begin{pmatrix} x & x-1 \\ 2 & 4 \end{pmatrix}$ find the value of x. (3 marks)
9. Two variables m and n are such that m is directly proportional to x and n is inversely proportional to x. When $x = 2$ their sum is 8 and when $x = 3$ their sum is 7. Find the constants of proportionality. (4 marks)
10. Determine the quartile deviation for the following set of numbers (3 marks)
 4,9,5,4,7,6,2,1,6,7,8
11. Solve the equation (3 marks)
 $\log_{10}(6x - 2) - 1 = \log_{10}(x - 3)$
12. with co-ordinates (7,5) and (-3,-1) are the ends of a diameter of a circle centre M. Determine
 (a) the co-ordinates of m. (1 mark)
 (b) the equation of the circle, expressing it in the form $x^2 + y^2 + ax + by + c = 0$. Where a, b and c are constants. (3 marks)
13. Two places A and B are A (36°N , 125°E) and B (36°N , 55°W) respectively. Calculate the shortest distance in nautical miles between A and B. (3 marks)
14. Expand and simplify the expression. (3 marks)
 $(x + \frac{1}{2})^4 + (x - \frac{1}{2})^4$
15. A point Z is the mid-point of CD. Given that the position vectors of C and D are $i - j + k$ and $2i + \frac{3}{2}k$ respectively, find the position vector of D in terms of i, j and k. (3 marks)
16. Solve the equation $\sin(3x + 30^\circ) = \frac{\sqrt{3}}{2}$ from $0^\circ \leq x \leq 90^\circ$ (4 marks)

SECTION B: 50 MARKS

Answer any FIVE questions in this section

17. Two boys A and B contain identical balls except for the colours. Bag A contains 4 red balls and two yellow balls. Bag B contains 2 red balls and 3 yellow balls.
 (a) If a ball is drawn at random, find the probability that the ball is red in colour. (4 marks)
 (b) If two balls are drawn at random one ball at a time with replacement, find the probability that
 (i) draw the tree diagram are yellow. (4 marks)
 (ii) find the probability that the two balls drawn are both yellow (4 marks)
 (iii) find the probability that the balls drawn are of different colours. (2 marks)

18. The table below shows monthly income tax rates for year 2016.

Monthly taxable in KSh.	Tax rates (percentages)
1 – 9680	10%
9681-18800	15%
18801-27920	20%
27921-37040	25%
37041 and above	30%

In the year 2016, Robi's monthly earnings were as follows:

Basic salary	KSh. 20,800
Non taxable risk allowance	KSh. 2,500
House allowance	KSh. 11,800
Medical allowance	KSh. 2,800
Transport	KSh. 540

Robi was entitled to a monthly tax relief of KSh. 1900. Calculate

- his monthly taxable income (2 marks)
 - the net tax paid by Robi per annum (6 marks)
 - the monthly net salary earned by Robi (2 marks)
19. The product of the first three terms of a geometric progression is 64. If the first term is a and the common ratio is r .
- Express r in terms of a . (3 marks)
 - Given that the sum of the three terms is 14.
 - Find the values of a and r and hence write down two possible sequence each upto the fourth term. (5 marks)
 - Find the product of the 40th terms of the two sequences. (2 marks)

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

x^0	0	30	60	90	120	150	180
$\sin x^0$	0	1		2			
$1 - \cos x^0$			0.5	1			2

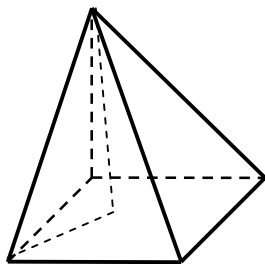
- (b) On the grid provided, using the same scale and axes draw the graphs of $y = 2\sin x^0$ and $y + \cos x = 1$ for $0^0 \leq x \leq 180^0$.

Take the scale: 2cm for 300 on the x - axis
2cm for 1 unit on the y - axis

- (c) Use the graph in (b) above to
- Solve the equation $2 \sin x - 1 = 1 \cos x$ (1 mark)
 - determine the range of values of x for which $2 \sin x^0 \geq 1 - \cos x^0$ (1 mark)
 - State the amplitude of $2 \sin x$ (1 mark)
21. The table below shows the distribution of marks in a mathematical test done by 100 form fours at Mahando School in 2015 pre-mock.

Marks	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89
No. of students	12	25	20	15	8	7	11	2

- State the modal class (1 mark)
 - Draw accumulative frequency curve to represent the above data. (4 marks)
 - Use the above graph to estimate
 - the median (1 mark)
 - the quartile deviation (2 marks)
 - The pass mark if 60% of the students passed (2 marks)
22. (a) Draw the graph of the function given below on the grid provided in the range $0 \leq x \leq 6$ $y = 2x^2 - 7x - 2$ (5 marks)
- (b) Use the graph in (a) above to estimate the area under curve using the mid ordinate rule with six strips between the curve $y = 2x^2 - 7x - 2$, x - axis, $x = 0$ and $x = 6$ (5 marks)
23. ABCDV is a right pyramid on a square base ABCD of side 4cm, the slant edges of the pyramid are 6cm long.



- Find the height VO (2 marks)
- Find the angle
 - that VA makes with the plane (3 marks)

(ii) between ABCD and VAD (3 marks)

(iii) between VA and BC. (2 marks)

24. A building contractor has two lorries A and B, used to transport atleast 42 tonnes of sand to a building site. Lorry A carries 8 tonnes of sand per trip while lorry A uses 4 litres of fuel per trip while lorry B uses 8 litres per trip, the lorries are to use less than 320 litres of fuel. The number of trips made by lorry A should be less than 3 times the number of trips made by lorry B. Lorry A should make more than 20 trips.

(a) Taking x to represent the number of trips made by lorry A and y to represent the number of trips made by lorry B. Write the inequalities that represent the above information. (4 marks)

(b) On the grid provided, draw the inequalities. (4 marks)

(c) Use the graph in (b) to determine the number of trips made by lorry A and by lorry B to deliver greatest amount of sand. (2 marks)

KCSE PREDICTION 8 2022
MATHEMATICS ALT. A
PAPER 1

TIME: 2½ HOURS

SECTION 1: (50 MARKS)

Answer ALL Questions in this section

1. Solve for x

$$3x^2 + 5x - 12 = 0$$

(3mks)

2. Use reciprocal tables to evaluate y if:

$$\frac{1}{15.4} + \frac{1}{25} = \frac{1}{y}$$

3. The GCD and the LCM of three numbers are 12 and 120 respectively. If two of the numbers are 24 and 36, find the third number. (3mks)
4. It takes 40 road construction workers 8 days working 10 hours a day to complete a section of a road. How many days would 60 Road Construction Workers working 8 hours a day take to complete the same section of the road working at the same rate? (3mks)
5. Solve for x in the equation: (3mks)
- $$8^{x-1} \times 2^{x+2} = 4^{3-x}$$
6. A Kenyan athlete left the USA for Japan with 1000 US dollars. While in Japan he bought a watch worth 300 US dollars. He later left Japan for Kenya where he converted the remaining amount in US dollars to Kenyan Shillings. Using the table below, find:-

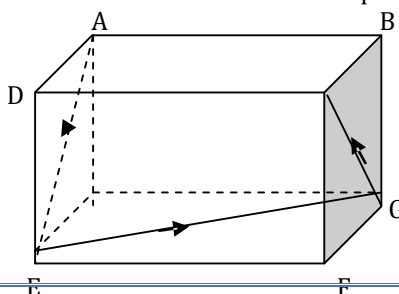
1 US Dollar	= 116 Japanese Yen
1 US Dollar	= 80 Kenyan shillings

- (i) The cost of the watch in Japanese Yen. (1mk)
- (ii) How much he got in Kenyan shillings after converting the remaining amount at the end of the journey. (2mks)
7. Solve the simultaneous equations using substitution method if $z = 2$. (4mks)
- $$z + x + y = 9$$
- $$z + 2x - y = 7$$
8. Given the inequalities:
- $$x + 1 \leq 2x + 3 < x + 5$$
- (a) Solve the inequalities. (2mks)
- (b) Use the integral values of x that satisfy the inequalities of the combined solution. (1mk)
9. If Q is (x, y) , P is $(-2, 5)$ and B is $(4, -3)$ and that $PQ = 3QB$, find the value of x and y . (3mks)
10. A rectangular lawn measures 50m by 40m. There is a path of width 1m all around it. What is the area of the path in hectares? (Give your answer correct to 2d.p). (3mks)
11. A cylindrical water tank has a diameter of 2.1m. To begin with, it is three quarters full of water. A leak starts at the bottom so that it loses 30 litres of water in $1\frac{1}{4}$ hours. How long will it take for the water level to fall by 0.5m? (Give your answer in days). (3mks)
12. Without using a calculator, evaluate:- (3mks)

$$2\frac{2}{5} + \frac{1}{3} \text{ of } 3\frac{3}{5} - 4\frac{5}{6}$$

$$1\frac{3}{4} - 2\frac{1}{5} \div 1\frac{2}{3} + 3\frac{1}{4}$$

13. On the surface of a square box A B C D E F G H of side 2cm a continuous path A E G C is drawn as shown by the arrows below.



- (a) Draw and label a net of the square box. (2mks)
 (b) On the net, show the path. (2mks)
 14. A regular polygon with $3x$ sides has interior angle 40° greater than of one with x sides. What is x ? (3mks)
 15. A line makes an angle of 68.2° with the x -axis. Given that the line passes through $(-2,3)$, find the equation of the line in the form $y = mx + c$. (3mks)
 16. The sides of a triangular plot of land are 170m, 190m and 210m. find the angles of the plot. (3mks)

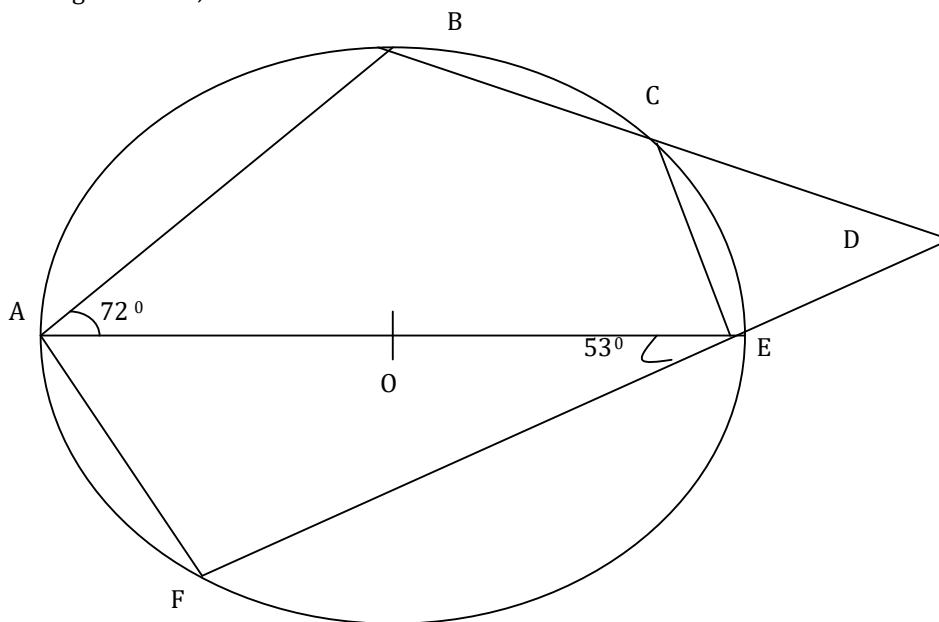
SECTION II (50 MARKS)**Answer any five questions in this section**

17. The table below shows marks scored by 40 students in a test.

Marks	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Frequency	1	5	8	12	7	4	2	1
Cumulative Frequency	1	6	14	26	33	37	39	40

- (a) Calculate the lower and upper quartiles. (4mks)
 (b) If 30% of the students failed the test, find the pass mark. (3mks)
 (c) The pass mark was set at 25 marks. How many students passed the test? (3mks)
 18. Measurements of a maize field using a baseline XY were recorded as shown below in metres.
- | | | | | |
|------|-----|-----|----|---|
| | Y | | | |
| | 240 | | | |
| TO R | 160 | | | |
| | 180 | 75 | TO | Q |
| | 150 | 50 | TO | P |
| TO S | 100 | | | |
| | 120 | | | |
| | 100 | 100 | TO | N |
| TO T | 30 | | | |
| | 50 | | | |
| | 20 | 20 | TO | M |
| | X | | | |
- (a) Show the map of the maize field by scale drawing. (4mks)
 (b) Find the area of the field in hectares. (4mks)
 (c) If the cost of one hectare is Ksh. 65,000, find the cost of the maize field. (2mks)
 19. The fences AB, BC, CD and DA of a game reserve are straight lines such that B is 16km on a bearing of $N40^\circ E$ from A; C is directly South of B and East of A and D is 12km on a bearing of $S60^\circ E$ from C.
 (a) Using a scale of 1cm to represent 2km, show the above information in a scale drawing. (3mks)
 (b) From the scale drawing, determine:-
 (i) The distance, in kilometres of A from D. (2mks)
 (ii) The bearing of A from D. (2mks)
 (c) Calculate the area of the game reserve ABCD in square kilometres. (3mks)
 20. Mr. Tirop made a journey of 800km partly by bus and partly by car. He started his journey at 6.00a.m. by bus which traveled at 60km/h. After alighting from the bus, he took a lunch break of 25 minutes. He then continued his journey by car which traveled at 80km/h. The whole journey took $10\frac{1}{2}$ hours.
 (a) Determine:-
 (i) The distance traveled by car. (4mks)
 (ii) The time Mr. Tirop started traveling by car. (3mks)
 (b) The car developed a mechanical problem after travelling 180km. It took 10 minutes to rectify the problem. Find the time taken to complete the remaining part of the journey. (3mks)
 21. A number of school staff in a certain school in Nandi County formed a welfare society with an intention of purchasing a 250 acre farm going at a Ksh. 120,000 per acre but after some time, the committed realized that they could not raise the required amount in time and so they decided to recruit 20 more members and this reduced the contribution of each member by Shs. 250,000. Find:-
 (a) The original number of welfare society members. (6mks)
 (b) The new contribution per member when new members joined the Sacco. (2mks)
 (c) After buying the farm, it was subdivided equally among all members. Determine how much land each member got. (2mks)

22. In the figure below, AOE is the diameter of the circle. $\angle BAE = 72^\circ$ and $\angle AEF = 53^\circ$, while $\angle CBE = 40^\circ$.



Giving reasons, calculate angle:-

- | | |
|-----------|--------|
| (i) BCE | (2mks) |
| (ii) EDC | (2mks) |
| (iii) BEC | (2mks) |
| (iv) BOE | (2mks) |
| (v) FCE | (2mks) |

23. Using a ruler and compasses only:-

- | | |
|---|--------|
| (a) Construct a triangle ABC such that $AB = 5\text{cm}$ $AC = 6\text{cm}$, angle $BAC = 67.5^\circ$ measure BC. | (4mks) |
| (b) On the same diagram construct a circle which passes through the vertices of the triangle ABC. Measure the radius. | (3mks) |
| (c) Calculate the area of the part that is outside the triangle but within the circle. | (3mks) |

24. The height of a model cylindrical tank is 5cm while the height of the actual tank is 4 metres. Find:-

- | | |
|---|--------|
| (a) Linear scale factor. | (2mks) |
| (b) Diameter of the model tank given the diameter of the actual tank is 560cm. | (2mks) |
| (c) Capacity of the actual tank in litres. | (3mks) |
| (d) If the above water tank belongs to three families which uses the drinking water in the ratio 2:3:5 per day, find the amount of water used by each family per day. | (3mks) |

121/2
MATHEMATICS ALT. A
PAPER 2

TIME: 2½ HOURS

SECTION 1: (50 MARKS)

Answer ALL Questions in this section

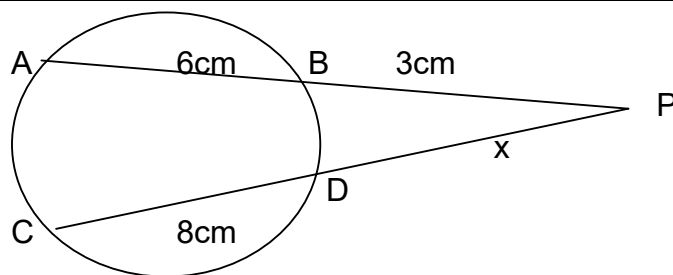
- Given that $2 \leq A \leq 4$ and $0.1 \leq B \leq 0.2$. Find the minimum value of $\frac{AB}{A-B}$ (3mks)
 - Calculate the shortest distance between X ($40^\circ N, 80^\circ W$) and Y ($40^\circ N, 100^\circ E$) in kilometers taking $\pi = \frac{22}{7}$ and radius = 6370km. (Give your answer to the nearest whole number. (3mks)
 - Evaluate the following leaving your answer in surd form. (3mks)

$$\frac{11}{\sqrt{7}-\sqrt{3}} - \frac{5}{\sqrt{7}+\sqrt{3}}$$
 - Given the arithmetic sequence 4, 11, 18, Find:
 - The common difference. (1mk)
 - The sum of the first eight terms. (2mks)
 - Find the expansion in ascending powers of x of $\left(1 - \frac{x}{3}\right)^7$ up to the term in x^2 . (2mks)
 - Hence evaluate $(0.99)^7$ to four significant figures. (2mks)
 - The cost of maize flour and millet flour is Ksh. 40 and Ksh. 52 respectively. Calculate the ratio in which they were mixed if a profit of 15% was made by selling the mixture at ksh. 52.90 per kilogram. (3mks)
 - The matrix $\begin{pmatrix} x & -3 \\ 0 & x-1 \end{pmatrix}$ is a singular matrix. Find the values of x. (3mks)
 - Every week the number of absentees in a school was recorded. This was done for 39 weeks. These observations were tabulated as shown below:-

Number of absentees	0-3	4-7	8-11	12-15	16-19	20-23
(Number of weeks)	6	9	8	11	3	2
- Estimate the median absentee rate per week in the school. (3mks)
- Alicent Jepkoech bought a machine at sh. 110,000. If depreciation is 15%p.a, calculate the number of years it will take for the value to depreciate to sh. 60,000. (4mks)
 - Find the value of x without using mathematical tables in the following:- (3mks)

$$\log_8(x+5) - \log_8(x-3) = \frac{2}{3}$$
 - Use table of logarithms to evaluate: (4mks)

$$\left(\frac{6.79 \times 0.391}{\log 5} \right)^{\frac{3}{4}}$$
 - What must be added to $x^2 + 10x$ to make it a perfect square? (2mks)
 - A boy at the top of a cliff 30m high observes two boats P and Q at the sea. The boats and the foot of the cliff are in the same straight line. The angle of depression from the boy to P and Q are 42° and 27° respectively. Calculate the distance between the two boats. (3mks)
 - A body is moving in a straight line such that its velocity Vm/s after t seconds is given by $v = 5t^2 - \frac{1}{2}t + 3$. Find the distance traveled during the third second. (4mks)
 - Find the length of DP in the figure below. (3mks)

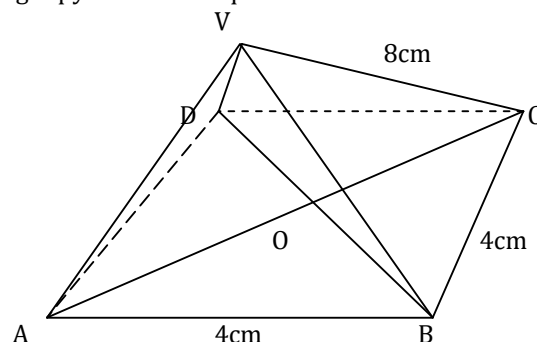


16. If θ is an obtuse angle, solve the equation:
 $\sin \theta = \log(\tan 75^\circ)$

(2mks)

SECTION II (50 MARKS)**Answer any five questions in this section**

17. The figure below shows a right pyramid on a square base ABCD of sides 4cm.
 $VA=VB=VC=VD=8\text{cm}$.



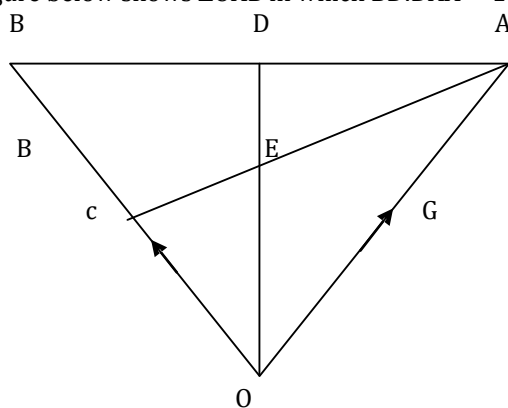
- (a) Find the height VO of the pyramid.
 (b) The angle between slant edge and the base ABCD.
 (c) The angle between the planes VCB and ABCD.
 (d) Find the volume of the pyramid in litres.
18. The figure below shows $\triangle OAB$ in which $BD:DA = 1:2$, $OE:ED = 3:2$ and c is the midpoint of OB.

(3mks)

(3mks)

(2mks)

(2mks)



- (a) Given that $OA = a$ and $OB = b$ express the following vectors in terms of:
 (i) AB
 (ii) OD
 (iii) AE
- (b) Show that points A, E and C lie on a straight line. Hence, determine the ratio of CE:EA.
19. Two quantities P and n, are connected by the equation $P = AK^n$, where A and K are constants. The table below shows some corresponding values of n and P.

n	2	4	6	8	10
P	9.8	19.4	37.4	74.0	144.0

- (a) State the linear equation connecting P and n.
 (b) On the grid provided, draw a suitable straight line.
 (c) Use your graph to estimate the value of A and k.
20. The points P(2,1), Q(4,1), R(4,3) and S(3,3) are co-ordinates of a quadrilateral.
 (c) On the grid provided and using a scale of 2cm to represent 2 units on both axes and taking $-8 \leq x \leq 8$ and $-5 \leq y \leq 8$, draw and label the quadrilateral PQRS.

(2mks)

(5mks)

(3mks)

(1mk)

- (d) Find the co-ordinates of $P'Q'R'S'$ under the transformation $M = \begin{pmatrix} 1 & 1 \\ 2 & 0 \end{pmatrix}$ of the object. (2mks)
- (e) The image of PQRS under the transformation represented by the matrix, M is $P'Q'R'S'$. Draw and label $P'Q'R'S'$ on the same grid. (1mk)
- (f) The matrix $N = \begin{pmatrix} -2 & 1 \\ 0 & 1 \end{pmatrix}$. The image of quadrilateral $P'Q'R'S'$ under the transformation represented by the matrix N is $P''Q''R''S''$. Draw and label $P''Q''R''S''$ on the same grid. (3mks)
- (g) Determine the matrix that maps PQRS directly onto $P''Q''R''S''$. (3mks)
21. Three athletes Peter, Mark and John have the probability of $\frac{1}{3}$, $\frac{3}{4}$ and $\frac{2}{5}$ respectively to qualify for the finals of the high jump. If their attempts are independent, determine the probabilities that:-
- (a) All will qualify for the final. (2mks)
- (b) At least two of them will qualify. (2mks)
- (c) Neither will qualify. (2mks)
- (d) Only one will qualify. (2mks)
- (e) Only Peter will qualify. (2mks)
22. Two types of bread type x = 200cm², type y = 300cm². The pan is 1.5m by 1.2m and number of type y should be more than twice the number of type x. Profit of type x is sh. 2 and that of type y is sh.1. Form all the inequalities and determine the maximum profit. (10mks)
23. The table below shows monthly income tax rates.

Monthly taxable pay (in K£)	Rate of tax (Ksh. per £)
1 – 342	2
343 – 684	3
685 – 1026	4
1027 – 1368	5
1369 – 1710	6
1710 and above	7

Sylvia Mukeza who is a civil servant earns a monthly salary of Ksh. 20,000 and is provided with a house at a nominal rent of Ksh. 700 per month.

- (a) Calculate Mukeza's taxable monthly pay in K£. (2mks)
- (b) Calculate the total tax Mukeza pays in K£. (4mks)
- (c) If Mukeza is entitled to a personal tax relief of Ksh. 600 per month, what is the payable tax? (1mk)
- (d) Mukeza has the following deductions made on her pay:
Loan repayments of Ksh. 2100 per month, NSSF Ksh. 200 per month and WCPS calculated a 2% of the monthly salary. Calculate Mukeza's net pay. (2mks)
24. (a) Use the trapezoidal rule to find the area under a curve $y = x^2 + 1$ from $x=1$ to $x=15$ using seven strips. (5mks)
- (b) Using the method of integration, find the actual area under the curve $y = x^2 + 1$ from $x=1$ to $x=15$. (3mks)
- (c) Find the percentage error involved in using the trapezoidal rule to find the area under the curve to 4d.p. (2mks)

KCSE PREDICTION 9 2022

MATHEMATICS ALT. A

PAPER 1

JULY / AUGUST 2022

TIME: 2½ HOURS

SECTION 1: (50 MARKS)

Answer ALL Questions in this section

1. Without using a calculator, evaluate:- (2mks)

$$\frac{-2(5+3) - 8 \div 2 + 5}{-3 \times -5 + -2 \times 4}$$
2. Use mathematical tables to solve to 2 decimal places the value of: (3mks)

$$4.857^2 - \frac{1}{0.3386}$$
3. The line which passes through the points P(4,a) and (2a,2) is parallel to line whose equation is $2y - 3x = 6$. Find the value of a. (3mks)
4. A saleslady sold goods whose marked price was sh. 340,000 at a discount of 3%. She was paid sh. 16,490 as commission for the sale. Calculate the percentage rate of commission she was paid. (3mks)
5. Solve $2^2 - 5x - 3 = 0$ using completion of squares method. (3mks)
6. A solid metal cuboid measuring 7.2cm long, 4.8cm wide and 2.4cm high is melted down and casted into a spherical ball. Calculate to 2 decimal places the radius of the ball. (Take $\pi = 3.142$) (4mks)
7. Simplify the ratio $x:y = 2:3$, find the ratio $(5x-2y) : (x+y)$ (3mks)
8. Simplify the following expression by reducing into a single fraction. (3mks)

$$\frac{2x-3}{3} - \frac{x-2}{2} - \frac{1-x}{4}$$
9. Line $AB = 7.2\text{cm}$, $\angle AB_1B_2 = 30^\circ$ and $B_1B_2 = 9.7\text{cm}$. Using line AB , divide line B_1B_2 into six equal intervals and measure the length of 3 intervals (Use ruler and a pair of compass only). (3mks)
10. Solve the following simultaneous equation using matrix method. (4mks)

$$\begin{aligned} 3x - 5y &= -9 \\ 5x + 2y &= 16 \end{aligned}$$
11. In a form one class there are 5 more boys than girls. On a certain day, one quarter of the boys and one fifth of the girls went for a science contest. If 8 students from this class went to the science contest, find the number of students in the class. (3mks)
12. Simplify: (3mks)

$$\frac{x-2}{x+2} - \frac{2x-4}{x^2-4}$$
13. Find the number of sides of a regular polygon whose interior angle is five times the exterior angle. (3mks)
14. Object A of area 10cm^2 is mapped onto image B of area 60cm^2 by a transformation matrix whose matrix is given by $P = \begin{pmatrix} x & 4 \\ 3 & x+3 \end{pmatrix}$ find the value of x. (3mks)
15. Find the integral values that satisfy the inequalities and represent it on the number line. (3mks)

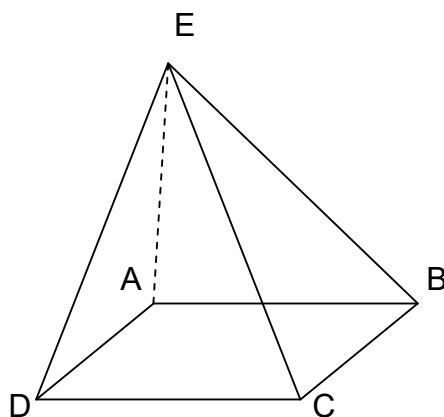
$$\begin{aligned} 4x - 6 &\geq x - 12 \\ 8 - 3x &\geq 2x - 7 \end{aligned}$$

16. Draw the net of the figure below.

(3mks)

$$AB = BC = CD = AD = 4\text{cm}$$

$$AE = BE = CE = DE = 5\text{cm}$$



SECTION II (50 MARKS)

Answer any five questions in this section

17. A cylindrical container has a capacity of 1.12 litres. The container is designed such that the new container is similar to the old container and has a capacity of 3.78 litres.

(a) Determine in the simplest terms possible:-

(i) The volume scale factor of this enlargement. (2mks)

(ii) The linear scale factor. (2mks)

(iii) The area scale factor. (2mks)

(b) Calculate the height of the new container given the height of the old container is 15cm. (2mks)

(c) The surface area of the new container is 540cm^2 . What is the surface area of the old container? (2mks)

18. The following measurements were recorded in a field book using XY as the base line. $XY = 40\text{m}$.

		Y		
C	60	340		
		300	120	D
		240	160	E
		220	160	F
B	100	140		
A	120	80		
		X		

(a) Using a scale of 1:4000, draw an accurate map of the farm. (4mks)

(b) Determine the actual area of the farm in hectares. (4mks)

(c) If the farm is on sale at sh. 80000 per hectare, find how much the farm costs. (2mks)

19. The angle of elevation of the top of a flagpole from a point A on a level ground is 13° . The angle of elevation of the top of the flagpole from another point B nearer the pole and 12m from A is 30° . Find:-

(a) (i) The height of the flagpole. (5mks)

(ii) The distance from point B to the top of the flagpole. (2mks)

(b) The distance from point A to the top of the flagpole. (3mks)

20. Forty students in form two class were weighed and their masses recorded to the nearest kilogram as shown below.

45	48	56	39	47	36	45	49	50	46
37	46	33	43	51	42	47	36	42	48
47	40	46	41	45	43	46	50	38	45
54	42	51	39	42	45	44	35	52	46

(a) Using class interval of 5kg, tabulate this data in a frequency table, the first class being 33 – 37. (3mks)

(b) Modify the table and use it to calculate mean mass of the students. (3mks)

(c) Estimate the median mass of the students. (4mks)

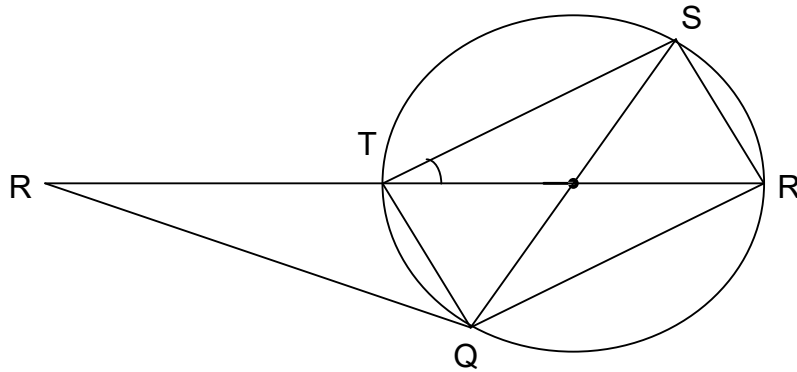
21. A Matatu and a Nissan left town A for town B 240km away at 8.00am travelling at a speed of 90km/hr and 120km/h respectively. After 20 minutes the Nissan had a puncture which took 30 minutes to mend.

(a) How far from town A did the Nissan catch up with the Matatu? (6mks)

(b) At what time did the Nissan catch up with the Matatu? (1mk)

(c) At what time did the Matatu reach town B? (3mks)

22. The diagram below shows a circle centre O. PQ is a tangent to the circle at Q and PTOR is a straight line QRST is a cyclic quadrilateral in which angle $RTS = 35^\circ$ and RT and QS are diameters.



Giving reasons for your answer, find the size of:-

- (a) Acute angle ROS. (2mks)
- (b) Angle RQS. (2mks)
- (c) Angle PQR. (2mks)
- (d) Angle QPT. (2mks)
- (e) Angle PQT. (2mks)
23. (a) Draw the graph of $y = 3x(4 - x)$ for $x = 1$ to $x = 5$ (3mks)
- (b) Hence use Trapezoidal rule to estimate the area bounded by the curve, the x-axis and the lines $x = 1$ and $x = 5$. (3mks)
- (c) Find the exact area and use it to find the percentage error in the area. (4mks)
24. In a certain mathematical relationship, the values of P and Q are found to obey the relationship $Q = CP + KP^2$ where C and K are constants.

P	1	2	3	4	5	6
Q	3.2	6.75	10.8	15.1	20	25.2

- By drawing a suitable straight line graph, determine the values of C and K. (8mks)
- Hence write the relationship between P and Q. (1mk)
- Determine the value of Q when P = 7. (1mk)

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MATHEMATICS ALT. A
PAPER 2

TIME: 2½ HOURS

SECTION I: (50 MARKS)

Answer ALL the Questions in this section in the spaces provided.

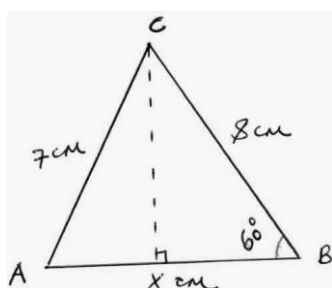
1. Evaluate using logarithms:

$$\sqrt{\frac{0.03215 \times 1.439}{0.0485}}$$

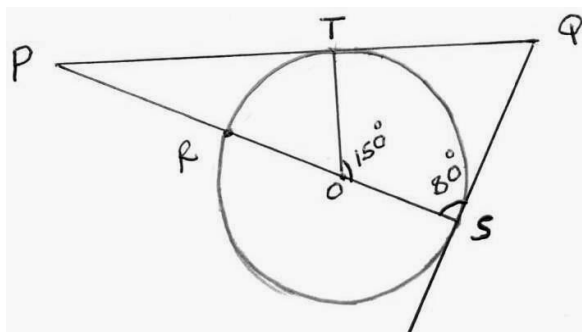
2. The surface area of a sphere is given as $4\pi r^2$. If there is an error of 0.24% in r and an error of 0.15% in π , calculate the percentage error in its surface area. (3mks)
3. Simplify $\frac{3}{\sqrt{7}-2} + \frac{1}{\sqrt{7}}$ leaving your answer in the form $a + b\sqrt{c}$, where a , b and c are rational numbers. (3mks)
4. Make s the subject of the formula:

$$\sqrt{p} = r\sqrt{w - as^2}$$

5. Solve the equation $2\sin^2 30 = \frac{1}{2}$ for $-90^\circ \leq \theta \leq 90^\circ$ (3mks)
6. The figure below shows triangle ABC where $AB = x$ cm, $BC = 8$ cm, $AC = 7$ cm and $\angle ABC = 60^\circ$. Calculate the area of the triangle correct to 2 significant figures. (3mks)



7. In the figure below, PQ is the tangent to the circle centre O and SORP is a straight line. Angle PSQ = 80° and $\angle TOS = 150^\circ$.



- (a) Find angle SPQ. (2mks)
- (b) Find angle RTO. (1mk)

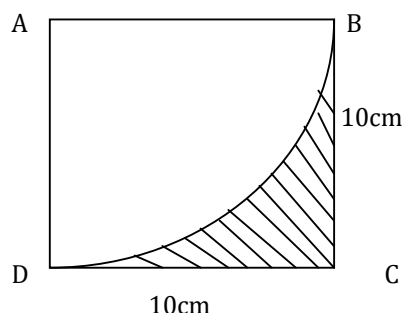
8. Solve for x in; $3 - \log_{10} x^2 = \left(\frac{1}{\log x^{10}}\right)^2$ (4mks)

9. A hosepipe can fill water butt in 5 minutes; the outlet tap can empty it in 6 minutes. The hosepipe is started with the tank empty and the tap opened, but this is noticed after three minutes and the tap is closed. How much longer does the butt take to fill? (3mks)

10. P, Q and R are three quantities such that P varies directly as a square of Q and inversely as a square root of R. If Q increases by 10% and R decreases by 25%, find the percentage increase in P. (3mks)
11. Calculate the standard deviation for the following set of data: (3mks)
34, 61, 49, 57, 53, 37, 59
12. Expand and simplify the expression: (3mks)

$$\left(x + \frac{1}{x}\right)^2 - \left(x - \frac{1}{x}\right)^4$$

13. Find the equation of the normal curve $y = (x - 1)(x + 3)$ at point where the curve cuts the y-axis. (3mks)
14. Calculate the area of the shaded region in the square below, given that BD is an arc of a circle whose center is at A. (3mks)



15. Three grades of tea: A, B and C costing shs. 280, shs. 190 and shs. 170 per kg respectively are mixed in the ratio 3:4:k. Find the value of k for which when the mixture is sold at shs. 250 per kg, 25% profit is realized. (3mks)
16. The points A(-6,-2) and B(2,-4) are ends of a diameter of a circle. Find:- (1mk)
- (a) Find the co-ordinates of the centre.
- (b) The equation of the circle in the form $x^2 + y^2 + ax + by + c = 0$ where a, b and c are constants. (2mks)

SECTION II (50 MARKS)

Answer any five questions in this section

17. The table below shows the tax rates for the year 2015.

TAXABLE MONTHLY INCOME IN (KSHS)	TAX PAYABLE RATES (%)
1 - 9860	10
9,861 - 18,800	15
18,801 - 27,920	20
27,921 - 37,040	25
37,041 - And above	30

Tonny's monthly earnings in 2014 were as follows:-

Basic salary Kshs. 35,000

House allowance Kshs. 12,000

Medical allowance Kshs. 2,800

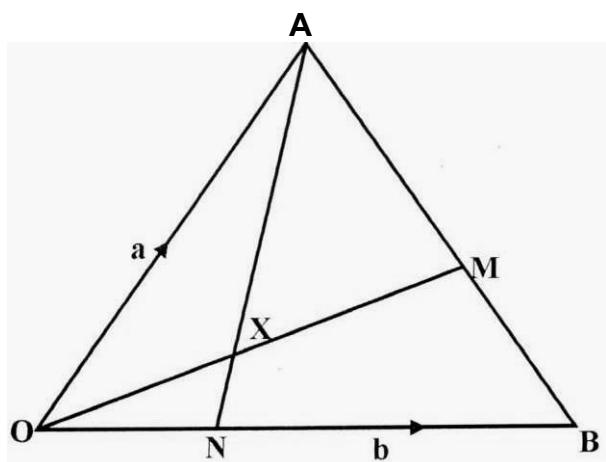
Commuter allowance Kshs. 5,000

If Tonny is entitled a tax relief of kshs. 1162, calculate:-

- (a) His monthly taxable income (2mks)
- (b) Tax he paid. (6mks)
- (c) Tonny joins an insurance cover and he is further given 8% tax relief. Calculate his net pay. (2mks)
18. The first term of an arithmetic sequences is $(2x + 1)$ and the common difference is $(x+1)$. The product of the first and second term is zero. (2mks)
- (a) Find the value of x. (4mks)
- (b) Find the three terms of the two possible sequences. (4mks)
- (c) The first 3 terms of a geometric progression are the first, fourth and tenth terms of an arithmetic sequence. Given that, the first term of a geometric progression is 6, find the common difference (d) of the arithmetic progression. (4mks)
19. An aeroplane left town $P(65^\circ N, 15^\circ E)$ to another town $Q(65^\circ N, 165^\circ W)$ at a speed of 200 knots using the shortest route. (2mks)
- (a) (i) Find the distance travelled in nautical miles. (2mks)
- (ii) The time taken to travel from P to Q in hours. (2mks)
- (b) Another aeroplane left P at 1:30p.m. local time and travelled to $T(65^\circ N, 60^\circ E)$ along the parallel of latitude. Find:-

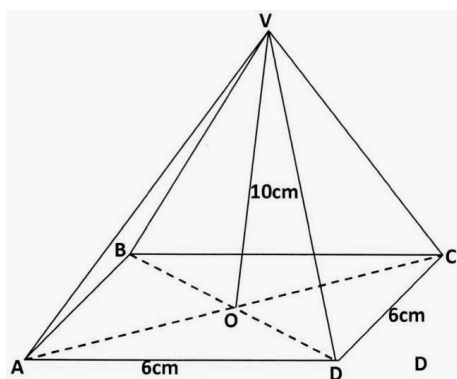
- (i) The distance between towns P and T to the nearest km. ***(Take $\pi = \frac{22}{7}$ and $R = 6370\text{km}$)*** (3mks)
- (ii) The local time of arrival at town T; if the plane flew at a speed of 470km/hr. (3mks)

20. In the figure below OAB is a triangle, $OA = a$, $OB = b$. point M lies on AB such that $AM:MB=1:3$ and N lies on OB such that $OB:BN = 7:5$. Line OM and AN intersect at X.



- (a) Express in terms of a and b ;
- OM (2mks)
 - AN (1mk)
- (b) Given that $OX = kOM$ and $AX = hAN$ where k and h are scalars.
- Write down two expressions for OX in terms of a , b , h and k . (2mks)
 - Find the values of h and k . (4mks)

21. The figure below is a square based pyramid ABCDV with $AD = DC = 6\text{cm}$, and height $VO = 10\text{cm}$.



- (a) State the projection of VA on the base ABCD. (1mk)
- (b) Find:
- The length of VA. (3mks)
 - The angle between VA and ABCD. (2mks)
 - The angle between the planes VDC and ABCD. (2mks)
 - Volume of the pyramid. (2mks)
22. A shop is stocked with plates, which come from two suppliers A and B. They are bought in the ration 3:5 respectively 10% of plates from A are defective and 6% of plates from B are defective.
- (a) A buyer chooses a plate at random. Find the probability that:
- It is from A. (2mks)
 - It is from B and it is defective. (2mks)
 - It is defective. (2mks)
- (b) Two plates are chosen at random. Find the probability that:
- Both are defective. (2mks)
 - At least one is not defective. (2mks)
23. (a) Using only a ruler and a pair of compasses draw a line AB of length 8cm long. Hence draw the locus of all points P such that $\angle APB = 52.50^\circ$. (5mks)
- (b) If the region above represents a map of an estate drawn to a scale of 1cm representing 1km. Show the region to be fenced if $\angle AMB \leq 90^\circ$ by shading the unwanted region. (3mks)
- (c) Find the area of this region. (2mks)

24. During installation of electricity bulbs in street lighting, a dealer is required to supply two types of bulbs A and B. The total number of bulbs should not be more than 400. He must supply more of A than B and type A bulbs should not be more than 300 and B should not be less than 80.
- (a) Write down in terms of x and y all inequalities representing the information above. (3mks)
 - (b) On the grid provided draw all the inequalities and shade the unwanted region. (4mks)
 - (c) If type A costs Kshs. 450 per piece and B Kshs. 350 per piece and that the higher the cost the higher the profit:
 - (i) Use the graph to determine the number of each type of bulb that he should supply to maximize profit. (1mk)
 - (ii) Calculate the maximum cost of lighting the streets. (2mks)

KCSE PREDICTION 9 2022

121/1

MATHEMATICS

JULY/AUGUST, 2022

PAPER 1

TIME: 2½ HOURS

SECTION I (50 MARKS)*Answer ALL the questions in this section*

1. Without using a calculator or a mathematical table evaluate. (3 marks)

$$\frac{\frac{6}{7} \text{ of } \frac{14}{3} \div 8 \times \frac{-2}{3}}{-2 \times 3 + (14 \div 7) \times -3}$$

2. By using substitution $y = 3^x$ or otherwise solve, (4 marks)

$$9^{x+1} - 3^x = 3^{x+3} - 3$$

3. Simplify: (3 marks)

$$\frac{12x^2 - 27}{4 - (2x + 1)}$$

4. A line L_1 is perpendicular to the line $2x - 3y + 6 = 0$. Find the angle made by line L_1 and x axis. (3 marks)

5. Three - fifths of a certain work is done on the first day. On the second day, $\frac{3}{4}$ of the remainder is completed. If on the third day $\frac{7}{8}$ of what remained is done, what fraction of the work still remains to be done? (3 marks)

6. A bank in Kenya buys and sells foreign currency as shown in the table below.

	Buying	Selling
1 US dollar	100.87	100.97
1 Sterling pound	147.27	147.43

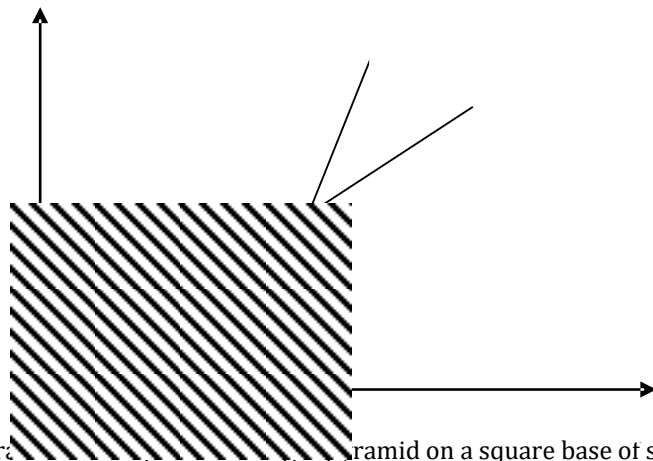
An American tourist came to Kenya with 15000 US dollars and converted the whole of it into Ksh. He then spent Ksh. 650,000 and converted the remaining money to sterling pounds. Calculate to the nearest pound the amount of money he remained with. (3 marks)

7. Use logarithm tables to evaluate (4 marks)

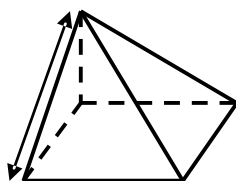
$$\frac{(0.07284)^2}{\sqrt[3]{0.06195}}$$

8. Under an enlargement scale factor -2, the image of A(2,4) is A'(-1,-2). Under the same enlargement, the image of D(x,y) is D'(3,-2). Find the coordinates of the object D. (3 marks)

9. The figure below shows two lines $2x - y = 6$ and $y = \frac{1}{2}x$, intersecting. Calculate the area of shaded regions. (4 marks)



10. The diagram shows a square-based pyramid on a square base of side 3cm. The slant edge of the pyramid is 4cm.



- (a) Draw a labeled 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)

11. A salesman is paid a salary of Sh. 10,000 per month. He is also paid a commission on sales above Sh. 100,000. In one month he sold goods worth Sh. 500,000. If his total earning that month was Sh. 56,000. Calculate the rate of

commission.

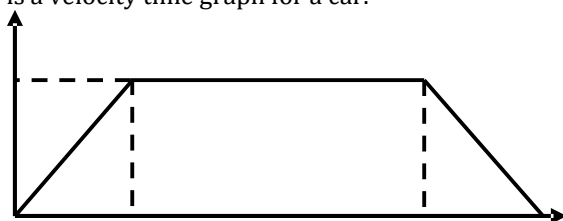
(3 marks)

12. Solve the following inequality and state the integral solutions. (3 marks)
 $\frac{1}{2}(24 - 4x) > 6(3x - \frac{4}{3}) \geq -\frac{2}{3}(42 + 3x)$
13. A regular polygon is such that its exterior angle is one eighth the size of interior angle. Find the number of sides of the polygon. (3 marks)
14. The position vector of P is $\mathbf{OP} = 2\mathbf{i} - 3\mathbf{j}$ and M is the mid - point of PQ. Given $\mathbf{OM} = \mathbf{i} + 4\mathbf{j}$, Obtain the vector $\mathbf{PQ}$. (3 marks)
15. A liquid spray of mass 384 g is packed in a cylindrical container of internal radius 3.2 cm. Given that the density of the liquid is 0.6g/cm^3 , calculate to 2 decimal places the height of liquid in the container (3 marks)
16. Given that $\sin(2\theta + 30) = \cos(\theta - 60)$. Find the value of $\tan \theta$ to two decimal places. (2 marks)

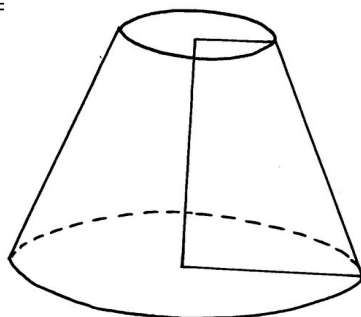
SECTION II (50 MARKS)

Answer any FIVE questions only in this section

17. Water flows through a circular pipe of cross-sectional area of 6.16cm^2 at a uniform speed of 10cm per second. At 6.00 a.m. water starts flowing through the pipe into an empty tank of base area are 3m^2 .
- a) What will be the depth of the water at 8.30 a.m.? (5 marks)
- b) If the tank is 1.2m high and a hole at the bottom through which water leaks at a rate of 11.6cm^3 per second. Determine the time at which the tank will be filled. (5 marks)
18. (a) The figure below is a velocity time graph for a car.



- (i) Find the total distance travelled by the car. (2 marks)
- (ii) Calculate the deceleration of the car. (2 marks)
- (b) A car left Nairobi towards Eldoret at 7.12 a.m. at an average speed of 90km/h. At 8.22 a.m., a bus left Eldoret for Nairobi at an average speed of 72km/hr. The distance between the two towns is 348km. Calculate:
- i) the time when the two vehicles met. (4 marks)
- ii) the distance from Nairobi to the meeting place. (2 marks)
19. Using a ruler and a pair of compass only.
- a) Construct a triangle ABC in which $AB=8\text{cm}$, $BC=7.5\text{cm}$ and $\angle ABC = 112.5^\circ$. Measure length of AC. (3 marks)
- b) By shading the required region show the locus of P within triangle ABC such that
- i) $AP \leq BP$ (2 marks)
- ii) $AP > 3$ (1 mark)
- c) Construct a normal line from C to meet AB at D. (1 mark)
- d) Locate the locus of R in the same diagram such that the area of the triangle ARB is $\frac{3}{4}$ area of triangle ABC. (3 marks)
20. The diagram below represents a solid consisting of a hemispherical bottom and a conical frustum at the top.
 $O_1O_2=4\text{cm}$, $O_2B=R=4.9\text{cm}$ $O_1A=$



- a) Determine the height of the chopped off cone and hence the height of the bigger cone. (2 marks)
- b) Calculate the surface area of the solid. (4marks)
- c) Calculate the volume of the solid. (4marks)

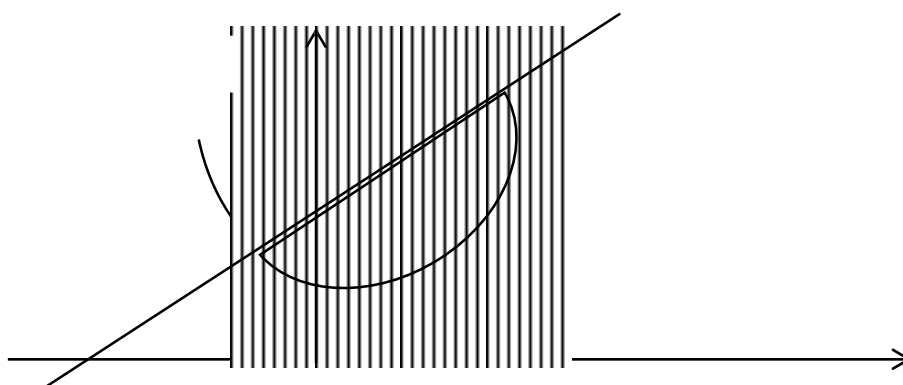
- a) Complete the table given below for the equation $y = -2x^2 + 3x + 3$ for the range $-2 \leq x \leq 3.5$ by filling in the blank spaces. (2 marks)

x	-2	-1.5	-1	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
y		-6		1						-2		-11

- (b) Use the values from the table above to draw the graph of $y = -2x^2 + 3x + 3$. (3 marks)
- (c) Use your graph to:
- (i) Determine the integral values of x in the graphs range which satisfy the inequality $2x^2 - 3x - 3 \geq 3$. (3 marks)
- (ii) Solve $-2x^2 + 2x + 5 = 0$. (2 marks)
21. Triangle ABC has vertices A(3, 1), B(4, 4) and C(5, 2). The triangle is rotated through 90° about (1, 1) to give A'B'C'. Triangle A'B'C' is then reflected on the line $y - x = 0$ onto A''B''C''. Triangle A''B''C'' then undergoes enlargement scale factor -1 through the origin to give A'''B'''C'''. (8 marks)
- (a) On the graph paper, draw triangles A'B'C', A''B''C'' and A'''B'''C'''.
- (b) Describe the type of congruence between:
- i) $\triangle ABC$ and $\triangle A'B'C'$
- ii) $\triangle A'B'C'$ and $\triangle A''B''C''$ (2 marks)
22. The table below shows patients who attend a clinic in one week and were grouped by age as shown in the table below.

Age x years	$0 \leq x < 5$	$5 \leq x < 15$	$15 \leq x < 25$	$25 \leq x < 45$	$45 \leq x < 75$
Number of patients	14	41	59	70	15

- (a) Estimate the mean age (4 mark)
- (b) On the grid provided draw a histogram to represent the distribution. (3 marks)
- (Use the scales: 1cm to represent 5 units on the horizontal axis 2 cm to represent 5unit on the vertical axis)
- (c) i) State the group in which the median mark lies (1 mark)
- ii) A vertical line drawn through the median mark divides the total area of the histogram into two equal. Using this information estimate the median mark. (2 marks)
23. The figure below shows curve of $y = 2x^2 + 4x + 3$ and a straight line intersecting the curves at A and B.



If the x -intercept is -3.5 and y -intercept as 7, find

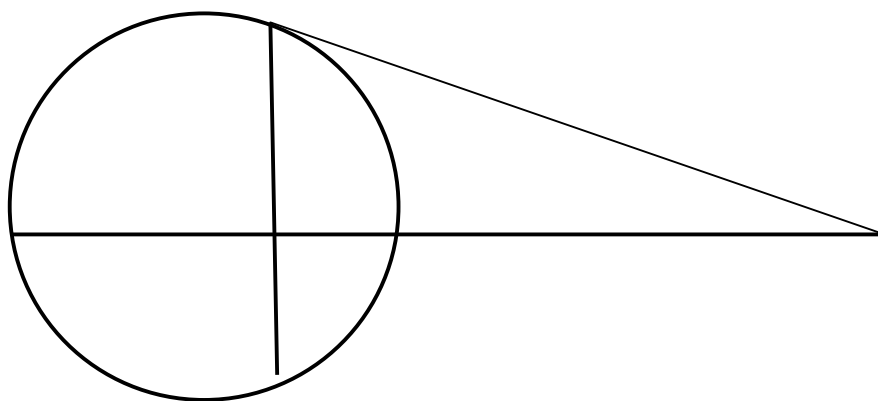
- a) The Equation of the straight line. (2 marks)
- b) The coordinates of A and B. (4 marks)
- c) The area of the shaded region. (4 marks)

121/2
MATHEMATICS
JULY/AUGUST, 2022
PAPER 2
TIME: 2½ HOURS

SECTION I (50 MARKS)

Answer all the questions in this section in the spaces provided below each question.

- Using an assumed mean of 50, calculate the standard deviation of the marks obtained in a test recorded as follows:
50, 52, 45, 40, 55, 51 56, 48, 55, 60 (2 marks)
- Make x the subject of the formula $P = \frac{1}{2} \sqrt{\frac{x+2w}{4x+3R}}$ (3 marks)
- Find the value of x in the equation
 $\log_3 X - 4\log_3 3 = -3$ (4 marks)
- a) Expand the binomial $(2 - \frac{1}{4}x)^5$ (2 marks)
b) Using the first 4 terms of the binomial above solve for 1.75^5 (2 marks)
- a) Find the inverse of the matrix $\begin{pmatrix} 1 & 1 \\ 3 & 1 \end{pmatrix}$ (1 mark)
b) Hence determine the point of intersection of the lines
 $x + y = 7$
 $3x + y = 15$ (2 marks)
- Rationalise the denominator and simplify the answer completely.
 $\frac{\sqrt{3}}{1+\sqrt{2}} + \frac{2+5\sqrt{3}}{\sqrt{3}-\sqrt{2}}$ (3Marks)
- Solve for x in the trigonometric equation $4\cos^2 x + 4\sin^2 x = 16\sin^2 x \cos^2 x$ in $0^\circ \leq x \leq 360^\circ$ (3 marks)
- The mass of a cylinder of a small material varies jointly as the square of the radius and as the height. If the radius is increased by 20% and the height by 10%. Find the percentage increase in mass. (3 marks)
- Given that the dimensions of a rectangle are 20.0cm and 25.0. Find the percentage error in calculating the area. (3 marks)
- Maina bought a new laptop on hire purchase. The cash value of the laptop was Ksh. 56,000. He paid a deposit of Ksh. 14,000 followed by 24 equal monthly installments of Ksh. 3500 each. Calculate the monthly rate at which the compound interest was charged. (3marks)
- Find the equation of tangent to a curve $x^2 = 4y+1$ at the point (2, 0.75) (3 marks)
- Object A of area 12cm^2 is mapped onto its image B of area 72cm^2 by a transformation. Whose matrix is given by $p = \begin{pmatrix} x & 4 \\ 3 & x+3 \end{pmatrix}$. Find the positive values of x (3 marks)
- In the figure below, AB is a tangent, meeting chord CDE at B. AD = 5cm, CD = 4cm, DF = 2cm, EB = 7.5cm and DE = x cm.



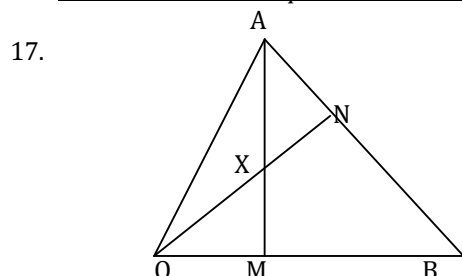
Determine:

- The value of x (1mark)
- The length of AB. (2 marks)

14. A ship covers 60km on a bearing of 230° . If then it changes course and heads due west for 80km, determine its direct distance from the starting point. (3 marks)
15. Find the centre and the radius of the circle whose equation is $x^2 + y^2 - 7x + 6 + 11y = 0$ (3marks)
16. The 2nd, 4th and 7th terms of A.P are the first 3 consecutive terms of a G.P. Find:
 (a) The common ratio (2Marks)
 (b) The sum of the first eight terms of the G.P if the common difference of the A.P is 2. (2Marks)

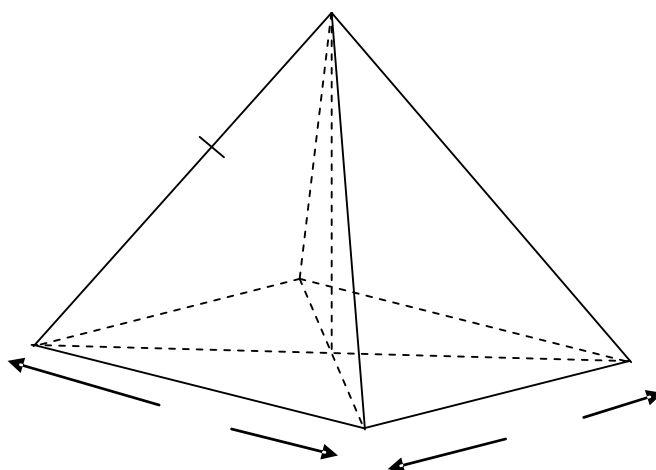
SECTION II(50 MARKS)

Answer **ONLY FIVE** questions in this section in the spaces provided.



In the figure above, M divides line OB in the ratio 1:2 and N divides $\overrightarrow{AB}$ in the ratio 2:3 $\overrightarrow{AM}$ and $\overrightarrow{ON}$ intersect at X. Given $\overrightarrow{OA} = 2\mathbf{a}$ and $\overrightarrow{OM} = \mathbf{b}$:

- a) Find in terms of $\mathbf{a}$ and $\mathbf{b}$:
- (i) $\overrightarrow{AB}$ (1 mark)
 (ii) $\overrightarrow{AM}$ (1 mark)
 (iii) $\overrightarrow{ON}$ (1 mark)
- b) If $\overrightarrow{AX} = h\overrightarrow{AM}$ and $\overrightarrow{OX} = k\overrightarrow{ON}$ where h and k are scalars
- (i) Express $\overrightarrow{OX}$ in two ways. (2 marks)
 Hence find the value of h and k (4 marks)
- c) Find the ratio of $\overrightarrow{AM}:\overrightarrow{MX}$ (1 mark)
18. The figure below shows a right pyramid with a rectangular base. The length of the rectangular base is 15cm and the width is 8cm. The slant edges are all equal to 20cm.



Calculate

- a) The volume of the pyramid. (3 marks)
 b) The angle VAB makes with ABCD (3 marks)
 c) The angle plane XBD makes with VBD given that point X lies on VA such that $VX:XA = 2:3$ (4 marks)
19. The number x is chosen at random from the set $\{0,3,6,9\}$ and the number y is chosen at random from the set $\{0,2,4,6,8\}$. Calculate the probability of each of the following separate events.
- (i) $x > 6$ (1 mark)
 (ii) $x + y = 11$ (2 marks)
 (iii) $x > y$ (3 marks)
 (iv) $xy = 0$ (2 marks)
 (v) $10x + y < 34$ (2 marks)

20. P and Q are two points on the same parallel of latitude $66^{\circ}25'1''$, whose longitudes differ by 120° . Calculate in kilometres.

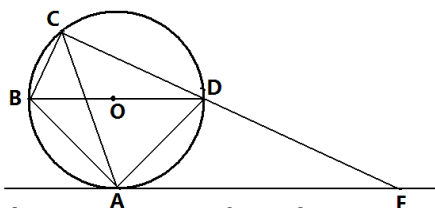
Radius of the earth = 6370.

- The radius of the parallel of latitude where P and Q lie. (2 marks)
 - The distance of P and Q measured along the parallel of latitude. (2 marks)
 - find the length of the straight line joining PQ (2 marks)
 - Find the distance between P and Q along the same latitude in nautical miles. (2 marks)
 - If an aircraft took 30min to fly from P to Q, Calculate its speed in knots. (2 marks)
21. a) Use the trapezium rule to estimate the area between the curve $y = 3x^2 + 1$, lines $x=1$ and $x=3$ and x-axis. Use five ordinates. (5 marks)
- b) Using integration method find the exact area under a curve $y=3x^2 + 1$ (3 marks)
- c) Find the percentage error in estimating the area. (2 marks)
22. The table below shows the rate at which income tax is charged for all income earned in a month in 2015.

Taxable Income p.m (Kenya pound)	Rate in % per Kenya pound
1 -236	10%
237 -472	15%
473 -708	20%
709 - 944	25%
945 and over	30%

A total of Ksh. 14,500 is deducted from Mrs. Momanyi monthly salary .She is entitled to a house allowance of Ksh. 8,000 a person relief of Ksh. 1064 month and Monthly insurance relief at the rate of 15% of the premium paid.
Every month she pays the following.

- Electricity bill shs.780
 - Water bill shs. 560
 - Co-operative shares shs. 1200
 - Loan repayment Ksh. 5000
 - Monthly insurance premiums of Ksh 1260
- Calculate her P.A.Y.E (2Marks)
 - Calculate her monthly taxable income . (6Marks)
 - Calculate her basic salary per month (2Marks)
23. Mr. Wanyama wishes to take student from wonderful mixed secondary school for a tour. The total number of pupils to be taken should not exceed 60. Each girl must contribute sh.10,000 and each boy sh.15,000 and money to be contributed must not exceed sh.120,000. If this trip is to be successful the number of boys must conditionally be greater than girls.
- Write down five inequalities to represent this information taking the number of boys and girls to be x and y respectively. (4 marks)
 - Represent the above information on the graph paper below. (4 marks)
 - What is the optimum number of boys and girls to be taken in order to be minimise cost. (2 mark)
24. In the figure below, line BD is the diameter of the circle, centre O and AE is a tangent.
Angle CBA = 110° and angle BAC = 26° .



Find the following angles, giving reasons for each answer.

- $\angle ABD$ (3marks)
- $\angle DAE$ (1mk)
- $\angle AED$ (3marks)
- $\angle AOD$ (3marks)

KCSE PREDICTION 10 2022

Kenya Certificate of Secondary Education (K.C.S.E)

PAPER 1

MATHEMATICS

TIME: 2 ½ HOURS

1. Without using logarithms tables evaluate. (3 mks)

$$\sqrt{\frac{284.16 \times 0.0625}{96.04}}$$

2. Simplify (3 mks)

$$\frac{2x}{6x^2 - x - 12} \div \frac{x-1}{2x-2}$$

3. Tenges is 74 km North West of Nakuru town. Kivunja market is 42km west of Nakuru. By using an appropriate scale drawing, find the bearing of bearing of Kivunja from Tenges. (3 mks)

4. Two points P and Q have co-ordinates (-2, 3) and (1,3) respectively. A translation map point P to P' (10,10); Find: (2 mks)

(a) The co-ordinates of QI the image of Q under the translation

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

Find the value of m and n

(3 mks)

5. A perpendicular to the line $-4x + 3 = 0$ passes through the point (8,5). Determine its equation (2 mks)

6. A Kenyan company received US Dollars 100,000. The money was converted into Kenya shillings in a bank which buys and sells foreign currencies as follows.

	Buying (in Kenya shillings)	Selling (in Kenya shillings)
1 US Dollar	77.24	77.44
1 Sterling pound	121.93	122.27

(a) Calculate the amount of money, in Kenya Shillings, the company received (1 mk)

(b) The company exchanged the Kenya Shillings calculated in (a) above into sterling pounds to buy a car from Britain. (2 mks)

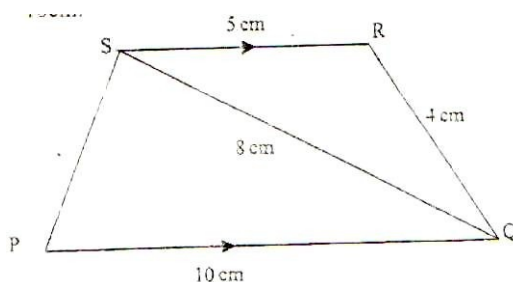
Calculate the cost of the car to the nearest sterling pound.

7. A bus left a petrol station at 9.20 a.m and travelled at an average speed of 75 km/h to town N at 9.40 a.m. A taxi travelling at an average speed of 95km/h, left the same petrol station and followed the route of the bus. Determine the distance, from the petrol station, covered by the taxi at time it caught up with the bus. (3 mks)

8. Use tables of reciprocals only to work out.

$$\frac{3}{0.6735} + \frac{13}{0.156}$$

9. In the figure below PQES is trapezium with SR parallel to PQ. SR = 5cm, RQ = 4cm, QS = 8cm and PQ = 10cm.

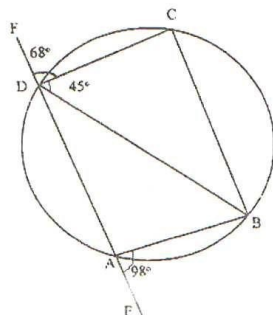


Calculate

(a) The size of angle QSR (2 mks)

(b) The area of triangle PQS (2 mks)

10. In the figure below, ABCD is a cyclic quadrilateral and BD is a diagonal. EADF is a straight line. $\angle CDF = 68^\circ$, $\angle BDC = 45^\circ$ and $\angle BAE = 98^\circ$. Calculate

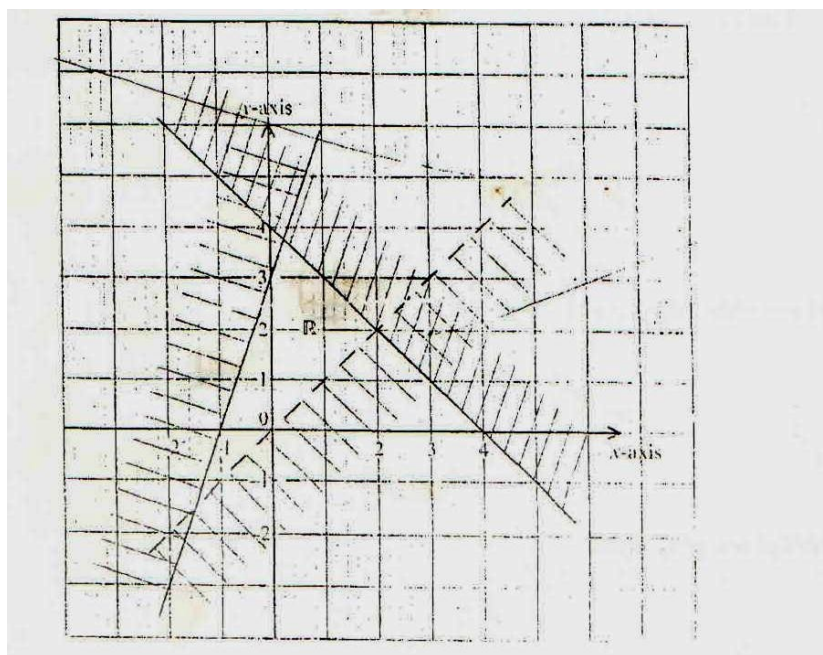


(a) $\angle ABD$ (2 marks)

(b) $\angle CBD$ (2 mks)

11. A man walks directly from point A towards the foot of a tall building 240m away. After covering 180m, he observes that the angle of elevation of the top of the building is 45° . Determine the angle of elevation of the top of the building from A.

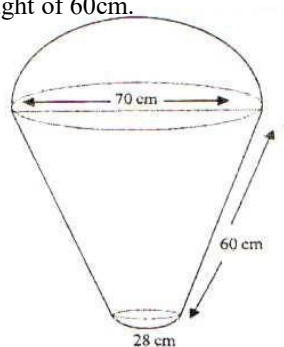
12. All prime numbers less than ten are arranged in descending order to form a number.
 (a) Write down the number formed (1 mk)
 (b) State the total value of the second digit in the number formed in (a) above (1 mk)
13. A rectangular tank of base 2.4m by 2.8 and a height of 3m contain 3,600 litres of water initially. Water flows into the tank at the rate of 0.5 litres per second. Calculate the time in hours and minutes, required to fill the tank (4 mks)
14. The sum of interior angles of a regular polygon is 1440° .
 (i) Find the number of sides of the polygon (1 mk)
15. Find the greatest common factor of x^2y^2 and $4xy^4$. Hence simplify completely the expression $x^3y^2 - 4xy^4$ (4 mks)
16. Form the three inequalities that satisfy the given region R. (3 mks)



SECTION II (50 MARKS)

Answer any five questions from this section

17. The figure below represents a model of a solid structure in the shape of a frustum of a cone with hemispherical top. The diameter of the hemispherical part is 70cm and is equal to the diameter of the top of the frustum. The frustum has a base diameter of 28cm and slant height of 60cm.



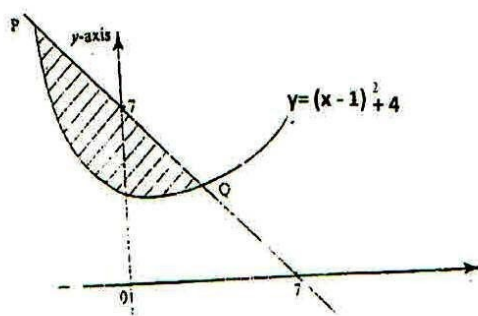
Calculate

- (a) the area of hemispherical surface. (4 mks)
 (b) the surface area of the curved surface (4 mks)
 (c) the total surface area of the model (2 mks)
18. (a) Complete the table below in the blank spaces. (2 mks)

x	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°
$3 \cos x$	3	2.598	1.5	0	-1.5	-2.598	-3	-2.598	-1.5	0	1.5		
$2 \sin (2x + 30^\circ)$	1		2	1.732	1	0		-1.732	-2	-1.732	-1	0	1

- (b) On the grid provided draw, on the same axis, the graph of $y = 3 \cos 2x$ and $y = 2 \sin (2x + 30^\circ)$ for $0^\circ \leq x \leq 180^\circ$. Take the scale: 1cm for 150 on the x axis and 2cm for 1 unit on the y – axis. (5 mks)
- (c) Use your graph to estimate the range of value of x for which $3 \cos 2x \leq \sin (2x + 30^\circ)$. Give your answer to the nearest degree. (3 mks)

19. A carpenter constructed a closed wooden box with internal measurements 1.5 metres long, 0.8 metres wide and 0.4 metres high. The wood used in constructing the box was 1.0cm thick and had a density of 0.6g/cm^3 .
- Determine the:
 - volume in cm^3 , of the wood used in constructing the box (4 mks)
 - mass of the box in kilograms, correct to 1 decimal place. (2 mks)
 - Identical cylindrical tins of diameter 10cm, height 20cm with a mass of 120g each were packed in the box. Calculate the:
 - maximum number of tins that were packed. (2 mks)
 - total mass of the box with the tins. (2 mks)
20. (a) The bill for completely covering the floor of a rectangular room with carpet cost Shs. 70 per square metre is Sh. 1960. If one side of the room is X m long; find the length of the other side.
- (b) By leaving a uniform width of $\frac{1}{2}$ m uncovered all round, Shs. 700 could have been saved. Use this information to form an equation in x. (4 mks)
- (c) Solve the equation and hence find the dimensions of the room. (3 mks)
21. The diagram below shows a straight line intersecting the curve $y = (x - 1)^2 + 4$ at the points P and Q. The line cuts x-axis at (7,0) and y axis at (0,7)



- Find the equation of the straight line in the form of $y = mx + c$ (3 mks)
 - Find the coordinates of P and Q (3 mks)
 - Calculate the area of the shaded region. (4 mks)
22. (a) Given that the matrix $A = \begin{pmatrix} 2 & 3 \\ 3 & 4 \end{pmatrix}$. Find A^{-1} the inverse of A (2 mks)
- (b) George bought 200 bags of sugar and 300 bags of rice for a total of KShs. 850,000. Kimani bought 90 bags of sugar and 120 bags of rice for a total of KShs. 360,000. If the price of a bag of sugar is KShs. X and that of rice is KShs. Y,
- Form two equations to represent the information above (2 mks)
 - Use the matrix A^{-1} to find the prices of one bag of each item. (4 mks)
- (c) Ogola bought 225 bags of sugar and 360 bags of rice. He was given a total discount of KShs. 33,300. If the discount on the price of a bag of rice was 2%, calculate the percentage discount on the price of a bag of sugar. (4 mks)
23. Using ruler and compasses only construct triangle ABC such that $AB = 4\text{cm}$, $BC = 5\text{cm}$ and $\angle ABC = 120^\circ$.
- Measure AC. (3 mks)
 - On the diagram, construct a circle which passes through the vertices of the triangle ABC. (2 mks)
 - Measure the radius of the circle (1 mk)
 - Measure the shortest distance from the centre of the circle to line BC. (1 mk)
 - Hence calculate the area of triangle ABC. (2 mks)
24. John bought 3 brands of tea A, B and C. The cost price of the brands were Sh. 25, Sh. 30 and Sh. 45 per kilogram respectively. He mixed the brands in the ratio of 5 : 2 : 1 respectively. After selling the mixture, made a profit of 20%.
- How much profit did he make per kilogram of the mixture? (4 mks)
 - After one year, the cost price of each brand was increased by 12%
 - For how much did he sell one kilogram of the mixture to make 20% profit to the nearest cent. (3 mks)
 - What would have been his percentage profit if he sold one kilogram of the mixture at Shs. 40.25? (3 mks)

Kenya Certificate of Secondary Education (K.C.S.E)

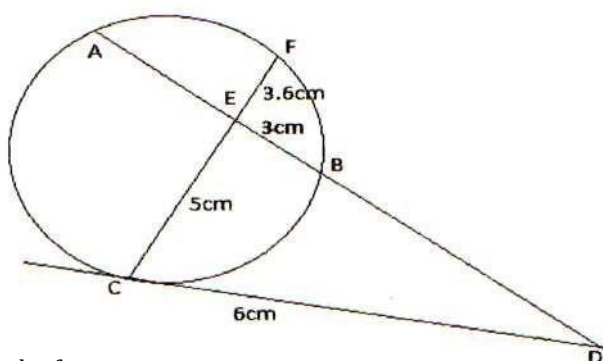
PAPER 2

MATHEMATICS

TIME: 2 ½ HOURS

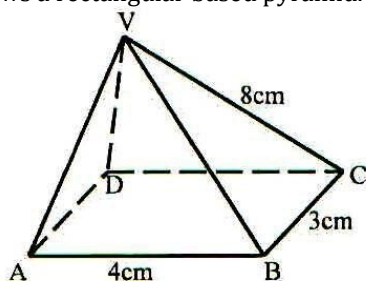
- The roots of a quadratic equation in x are -2 and 1. From the equation in the form $x^2 + bx + c = 0$ (3 mks)
- Make d the subject of the formula (3 mks)

$$a = b \sqrt{\left(\frac{d+e}{5f}\right)}$$
- A plane flies continuously for 3 hours 50 minutes from A (500N, 280W) to B(500N, 120E). Calculate to 2 decimal places the shortest distance covered by the plane from A to B in kilometres, along the parallel of latitude. Use $\pi = \frac{22}{7}$ and $R = 6370\text{km}$. (3 mks)
- Solve the equation $\log(6x - 2) - 1 = \log(x - 3)$. (3 mks)
- Find the radius and centre of circle whose equations is given as $x^2 + y^2 + 3x + 2 = 0$ (3 mks)
- In the figure below, CD is the tangent to the circle at C. AEBD and CEF are straight lines. EC = 5cm, EF = 3.6cm, EB = 3cm, EB = 3cm and CD = 6cm.

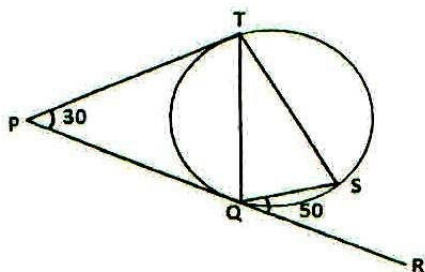


Find the length of:

- AE (2 mks)
 - BD (3 mks)
- The figure below shows a rectangular based pyramid. Find the angle between the planes ABCD and ABV. (3 mks)



- On the figure below PQR and PT are tangents to the circle at Q and T respectively. Angle RPT = 30° and angle RQS = 50° . Giving reasons for your answer, find the size of angle PTS. (2 mks)



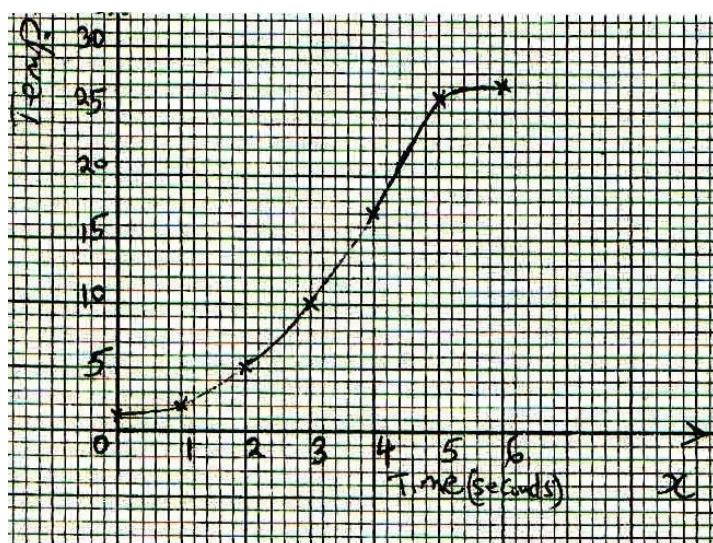
- If $x = 44$ and $y = 20.1$, calculate the greatest possible percentage error in $x - y$. Give your answer to 1 decimal place. (3 mks)
- Simplify $\frac{3-2\sqrt{3}}{3+2\sqrt{3}}$ giving your answer in the form $a + b\sqrt{c}$ (3 mks)
- (a) Expand and simplify $(2 + 2y)^5$ in ascending powers of y (1 mk)
 (b) Hence use the first 4 terms of the expansions in (a) above to approximate $(2.02)^5$ (2 mks)

12. Construct rectangle ABCD with AB = 10cm, and AD = 6cm. By shading unwanted regions, locate the point P within the rectangle such that:
- $AP \leq BP$
 - Angle APB $\geq 90^\circ$.
13. A two digit number is made by combining cards labelled with the digits 1, 4, 6 and 9 at random. The cards are picked at random with replacement.
- Make a table of possible numbers that can be made. (1 mk)
 - Find the probability that the number formed is a prime number or an even number (2 mks)
14. P varies directly as the square of Q and inversely as the square root of R. If Q is reduced by 10% and R is increased by 20%. Find the percentage change in P (4 mks)
15. Fill in the table below and use the mid-ordinate rule to find the area bounded by the curve $y = x^2 - 1$ from $x = -7$ and $x = -1$ using 6 strips. (3 mks)

Table of $y = x^2 - 1$

X	-7	-6.5	-6	-5.5	-5	-4.5	-4	-3.5	-3	-2.5	-2	-1.5	-1
Y	48		35		24		15		8		3		0

16. The following is the graph of temperature against time.

Find the average rate of change between 1st and 3.5th seconds.

(3 mks)

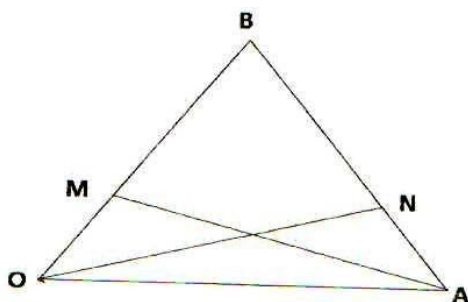
SECTION II: (50 MARKS). Answer any five questions in the spaces provided.

17. The following table shows the distribution of marks obtained by 50 students.

Marks	45-49	50-54	55-59	60-64	65-69	70-74	75-79
Frequency	3	15	13	9	4	1	5

Calculate

- mean (4 mks)
 - variance (4 mks)
 - standard deviation (2 mks)
18. The diagram below shows triangle OAB in which OM:MB = 1:3 and AN:NB = 1:2. The lines ON and AM meet at X. OA = **a** and OB = **b**.



- (a) Express the following vectors in terms of **a** and **b**.

- AB
- AM

(1 mk)

(1 mk)

(iii) ON

(2 mks)

(b) You are also given that $OX = hON$ and $AX = kAM$. Express OX in two ways hence solve for h and k .

(5 mks)

(c) Show that A, X and M are collinear

(2 mks)

19. The transformation T and S are defined as follows:

T = Reflection in the line $y = x$

S = Positive quarter turn about the origin

The points A (3,7), B(3,4) and C (-1,4) are the vertices of triangle ABC whose image under T is triangle A'B'C'.

(a) On the grid provided, draw triangle ABC and its image under T.

(3 mks)

(b) State the coordinates of A'B'C'

(1 mk)

(c) Draw triangle A''B''C'' the image of A'B'C' under S.

(1 mk)

(d) Find a single transformation that maps ABC onto A''B''C''

(3 mks)

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

Monthly taxable income in KSh.	Tax rate (percentage)
1 – 9680	10%
9681-18800	15%
18801-27920	20%
27921-37040	25%
37041 and above	30%

An employee earned a basic salary of Sh. 45000, commuter allowance of Sh. 6000 per month and is provided with a free house so that 15% of the basic salary will add to the taxable income. If his nominal rent is Sh. 1000 and provided with a personal relief of Sh. 1160 per month.

Calculate:

(a) The employee's taxable income per month in KSh.

(2 mks)

(b) The monthly tax paid by the employee

(6 mks)

(c) If he pays a WCPS of Sh. 500 and a loan repayment of Sh. 300 per month, calculate the employee's net salary per month.

(2 mks)

21. (a) Complete the table of the function: $y = 3 + x - 2x^2$

(2 mks)

x	-3	-2	-1	0	1	2	3
$-2x^2$	-18	-8		0	-2		
3	3	3	3	3	3	3	3
y-18					2		

(b) Draw the graph of the function: $y = 3 + x - 2x^2$ on the graph paper provided.

(3 mks)

(c) Use your graph to solve:

(i) $3 + x - 2x^2 = 0$

(1 mk)

(ii) $8 + 2x^2 = 0$

(2 mks)

(iii) $3 + 2x - 2x^2 = 0$

(2 mks)

22. (a) The first term of a G.P is 4 and the common ratio is 2. Find the greatest number of the terms that will give a sum less

than 40.

(3 mks)

(b) The second, fourth and seventh terms of an A.P are the first three consecutive terms of a G.P. Find

(i) the common ratio

(3 mks)

(ii) the sum of the first 8 terms of the G.P

(2 mks)

(iii) the 10th term of the A.P

(2 mks)

23. A carpenter makes two types of chairs for Excel Secondary School. To make a type A chair requires 6 man-hours whereas a type B chair requires 4 man-hours. The cost of material for type A is Sh. 120 and that of type B is Sh. 100. The total weekly cost of material for all chairs should not exceed Sh. 6000. The carpenter has to abide by the following conditions:

(i) A contract to supply 15 of type A and 10 of type B per week has to be fulfilled.

(ii) Only 300 man-hours are available each week.

(a) Form all the inequalities satisfying these conditions by letting x and y represents the number of chairs per week for type A and B respectively.

(4 mks)

(b) Represent this information on the grid provided and show the required region by shading out the unwanted.(4 mks)

(c) If the profit per chair on type A is Sh. 80 and that of Sh. 60, determine the maximum values of x and y.

(1 mk)

(d) Calculate the maximum profit

(1 mk)

24. A ball is thrown upwards and its height after t seconds is $S = 10t - 4t^2$

Find;

(a) The time when the greatest height was reached.

(3 mks)

(b) The greatest height reached

(2 mks)

(c) The time when the particle returns to its original position

(2 mks)

(d) The velocity of the ball after 3 seconds

(2 mks)

(e) The acceleration

(1 mk)