Name _____ Index No. _____

Date _____

Candidate's signature _____

121/1
MATHEMATICS
PAPER 1
AUGUST 2021
TIME: 2 ½ HOURS

GOLDEN ELITE EXAMINATION

CYCLE 1

Kenya Certificate of Secondary Education
Mathematics
Paper 1
2 ½ hours

INSTRUCTIONS TO CANDIDATES

1. Write your name and index number in the spaces provided at the top of this page.
2. The paper consists two sections: Section I and II.
3. Answer all the questions in section I and ONLY 5 in section II.
4. Show all the steps in your calculations giving your answers at each stage in the spaces below each question.
5. Marks may be given for correct working even if the answer is wrong.
6. Non-programmable silent electronic calculator and KNEC Mathematical tables may be used except where stated otherwise.

FOR EXAMINER'S USE ONLY

SECTION I

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

SECTION II

17	18	19	20	21	22	23	24	Total

GRAND TOTAL

This paper consists of 16 printed pages

SECTION I – (50 MARKS)

1. Use squares, square roots and reciprocal tables only to evaluate the following giving your answer correct to 2 decimal places. (3 marks)

$$\frac{2}{\sqrt{38.46}} + \frac{2}{(8.67)^2}$$

2. The GCD of 6480, 7200 and a third number is 144. The L.C.M of the three numbers is $2^5 \times 3^5 \times 5^2 \times 7^3$. Find the smallest third number. (3 marks)

3. (a) Factorise completely. $2x^2 - 8$ (1 mark)

(b) Hence simplify

$$\frac{4x^2 + 2x - 12}{2x^2 - 8} + \frac{1}{x - 2}$$

(3 marks)

4. The number of sides of two regular polygons are in the ratio 3 : 4. The sums of the interior angles of the two polygons are in the ratio 3 : 4. The sum of the interior angles of the two polygons are in the ratio 2 : 3. Calculate the number of sides of the two polygons. (3 marks)

5. Mr. Juma needs to import a car from Japan whose cost is US $ 5000 outside Kenya. He intends to buy the car through an agent who deals in Japanese Yen. The agent will charge him 20% commission on the price of the car and a further 80,325 Japanese Yen for shipment of the car. How many Kenya shillings will he need to send to the agent to obtain the car given that

   1 US $ = 105.00 Yen

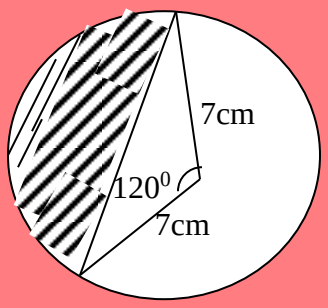
   1 US $ = Ksh. 63.00 (3 marks)

6. The straight line joining the points P (a, 7) and Q (13, a) is parallel to the line whose equation is 3y + 2x = 9. Find the value of a. (3 marks)

7. A truck left town A at 9.35 am and traveled towards town B at an average speed of X km/h. At the same time a lorry left town B and traveled towards town A along the same road. The distance between the two towns 322km and the two vehicles met at 2.11pm. Given that the lorry traveled 20km/hr faster than the truck, find the value of X. (4 marks)

8. Use completing the square method to solve. (x + 1) (x + 3) = 13 (4 marks)

9. Find the area of the shaded region. (4 marks)

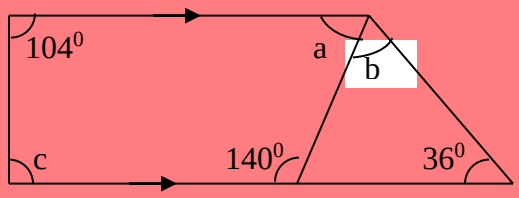


10. Given that log 3 = 0.4771 and log 5 = 0.6990 evaluate log 750. (3 marks)

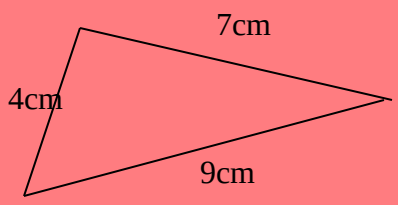
11. Solve for x

$2 \times 3^x = 162$ (2 marks)

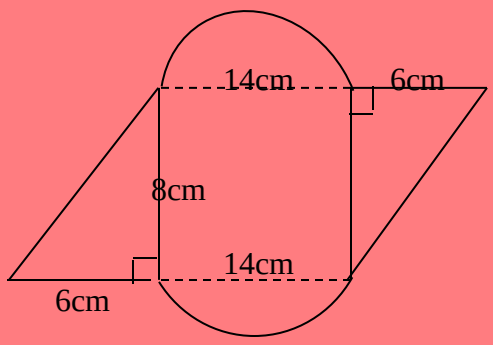
12. Find the value of a, b and c. (3 marks)



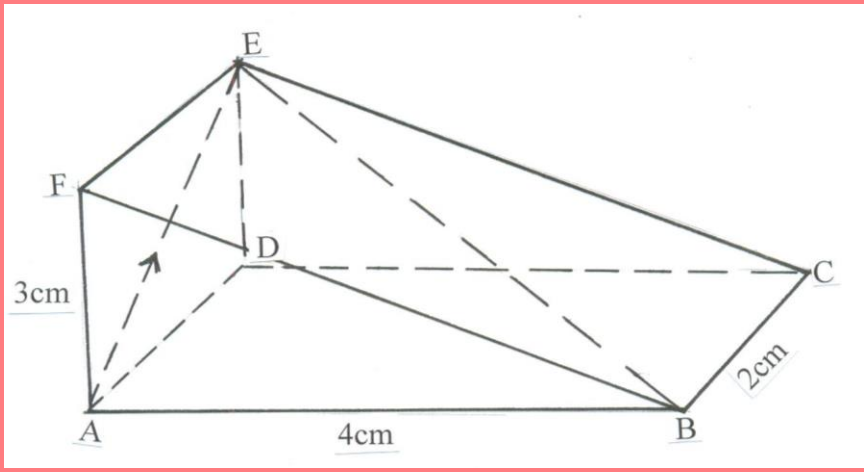
13. Find the area of the figure below. (3 marks)



14. Find the perimeter of the figure below. (Take $\pi = {}^{22}/_{7}$) (3 marks)



15. Draw the net of the solid shown below. (2 marks)



16. The radius of a small tank is 10m and the radius of a similar tank is 30m. If the volume of the smaller tank is $600m^3$, find the volume of the larger tank. (3 marks)

SECTION II – (50 MARKS)

17. Kamene is a sales executive earning a salary of Ksh. 25,000 and a commission of 8% for the sales in excess of Ksh. 100,000
If in May she earned a total of Ksh. 52,000 in salaries and commission.

(a) Determine the amount of sales she made in that month. (4 marks)

(b) If the total sales in the month of June and July increased by 18% and then dropped by 30% respectively, calculate

(i) Kamene's commission in the month of June. (3 marks)

(ii) Her total earnings in the month of July. (3 marks)

18. Construct triangle WXY such that angle XWY = 75^0, WX = 9.2cm and WY = 5.3cm. Construct the bisector of angle XWY to cut XY at M and the perpendicular bisector WX to cut XY at N. Measure angle MWN and the length of MN. (10 marks)

19. In a maths test, 40 students scored the following marks.

43	39	59	56	58	63	71	40
72	66	47	38	51	50	61	64
32	78	29	32	45	80	70	57
52	46	45	39	58	72	41	55
56	53	66	63	61	46	82	64

Make a frequency distribution table using a class intervals of size 5 and (25 – 29) as the first class. Calculate the;

(i) Modal class
(ii) Mean
(iii) Median (10 marks)

20. Two ladies Jane and Violet started a business in January 2004. Jane invested sh. 480,000 and Violet invested sh. 600,000.

(a) Given that sh. 324,000 profits was made in 2004. Calculate the amount received by the partners, if the profit was shared in proportion to their investment. (4 marks)

(b) In 2005 and 2006, they took salaries from the profit and they shared the remaining profits in proportion to their investments. Jane's salary was sh. 90,000 and that of Violet was sh. 72,000 each year.

(i) If in the year 2005 profit was sh. 450,000 find Jane's income in 2005. (3 marks)

(ii) In the year 2006 Violet received a total of sh. 192,000. Calculate the profit made in the year 2006. (3 marks)

21. Four towns A, B, C and D are such that town B is 150km on a bearing of 070^0 from town A. Town C is 200km on a bearing of 160^0 from town B. Town D is due West of town C and 135km due South of town A.

(a) Draw a sketch diagram showing the positions of towns A, B, C and D. (3 marks)

(b) Without using scale drawing calculate;
(i) the distance AC (3 marks)

(ii) to 3 significant figures the bearing of A from C. (3 marks)

(c) Calculate to the nearest whole number the distance CD. (3 marks)

22. The surveyor's field book had the following information.

	G	
	280	
F50	250	
	200	E 40
	150	D 100
C 120	100	
	40	B 50
	A	

(a) Draw a scaled diagram of the area using 1cm rep. 50m. (4 marks)

(b) Calculate the area in hectares of the field. (6 marks)

23. A triangle whose vertices are A (-2, 2), B (-4, 2) and C (-6, 4) is mapped onto triangle $A^1B^1C^1$ which vertices are A^1 (2, -1), B^1 (4, -1) and C^1 (6, -3).

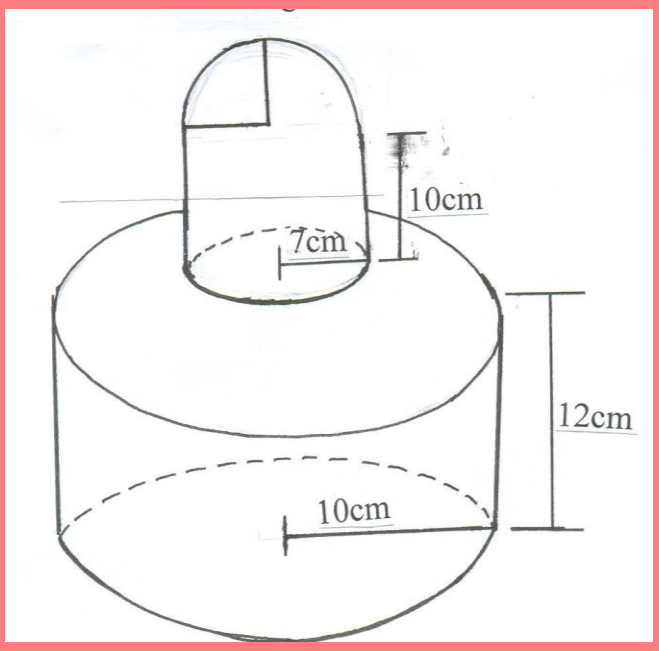
(a) Draw the triangles. (4 marks)

(b) Find the centre of rotation. (3 marks)

(c) Find the angle of rotation. (1 mark)

(d) If a point Q (4, 2) is rotated using the same angle and same centre of rotation find Q^1. (2 marks)

24. The figure below represents a solid consisting of a hemispherical dome fitted on a cylindrical part of radius 7cm and height 10cm. The unit is then centrally fixed onto a bigger cylinder of height 12cm and radius 10cm. Figure not drawn to scale.



Find the total surface area of the solid. Give your answer correct to 3 significant figures. (10 marks)

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121/2
MATHEMATICS
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CYCLE 1

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Mathematics
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Turn Over

SECTION I- 50 marks

Answer all the questions in the spaces provided.

1. Given that $q = 3^p$ express the equation $3^{2p-1} + 2x\,3^{p-1} = 1$ in terms of q. (1 mark)

   Hence or otherwise find the values of p in the equation
   $3^{2p-1} + 2 \times 3^{p-1} = 1$ (3 marks)

2. Without using a calculator evaluate
   $$\frac{-2(x+y) - 9 \div y + x}{(-y) \times (-x) + -2 \times 4}$$ given that x = 5, y = 3 (3 marks)

3. In a certain Equity Bank in Makueni County, customers may withdraw cash through one of the two tellers at the counter. On average, one teller takes 3 minutes while the other teller takes 5 minutes to serve a customer. If the two tellers start to serve the customers at the same time, find the shortest time it takes to serve 200 customers. (3 marks)

4. Use mathematical tables to evaluate.

$$\frac{1.34}{(5.24)^{0.8} \times 0.0029}$$

(4 marks)

5. Simplify the inequality

$2(2 - x) < 4x - 9 < x + 11$.

(3 marks)

6. Given that a = -2 find the values of b and c for the simultaneous equations.

$a + b - c = -1$

$a - 2b + c = -7$

(3 marks)

7. A particle moves such that its displacement after t seconds is given by $s = 2t^3 + t^2 + 2$.
Determine its acceleration after 4 sec. (3 marks)

8. (a) Expand $(1 + ½ x)10$ up to the term in x^3. (2 marks)

(b) Hence use the expansion above to solve $(0.95)^{10}$ correct to 3 dec. places. (2 marks)

9. Express the following expression in surd form and simplify by rationalizing. (3 marks)

$$\frac{\sqrt{3}}{1 - \tan 30}$$

10. The twenty fifth term of an arithmetic progression is 51 and the fifth term is 11.
Calculate the first term and the common difference of the progression . (2 marks)

11. Make y the subject of the formula

$$\frac{S}{T} = \frac{my - 2}{ny + 4}$$

(2 marks)

12. Find the centre and radius of the following circle whose equation is;

$2x^2 + 2y^2 - 32x + 48y + 254 = 0$ (3 marks)

13. A regular pentagonal figure has its sides marked 3, 4, 5, 6 and 7. Another regular one has its sides marked 6, 7, 8, 9 and 10. Both are tossed and the sum of the numbers appearing on the bottom face recorded.

(a) Draw a probability space to show the possible sums. (2 marks)

(b) Find the probability of getting a sum greater than 13. (2 marks)

14. The co-ordinates of a point A is (2, 8) and B is (-4, -8). A point P divides $\overrightarrow{AB}$ externally in the ratio 7 :3. Find the co-ordinates of P. (3 marks)

15. Find the area under the curve and the lines x = 0 and x = 6 for the graph represented by the following table.

X	0	1	2	3	4	5	6
Y	0.5	0.33	0.25	0.2	0.16	0.14	0.13

Use trapezium rule (3 marks)

16. The table below shows the marks obtained by 40 students in a test

Marks	5-9	10-14	15-19	20-24	25-29	30-34	35-39
Frequency	2	5	16	9	5	2	1

Calculate the quartile deviation. (4 marks)

SECTION II (50 MARKS)

Answer any 5 questions

17. The table below shows the P.A.Y.E table for a certain month.

Monthly taxable income Kshs. Per month	Tax rate %
1 – 9680	10
9681 – 18800	15
18801 – 27920	20
27921 – 37040	25
Above 37040	30

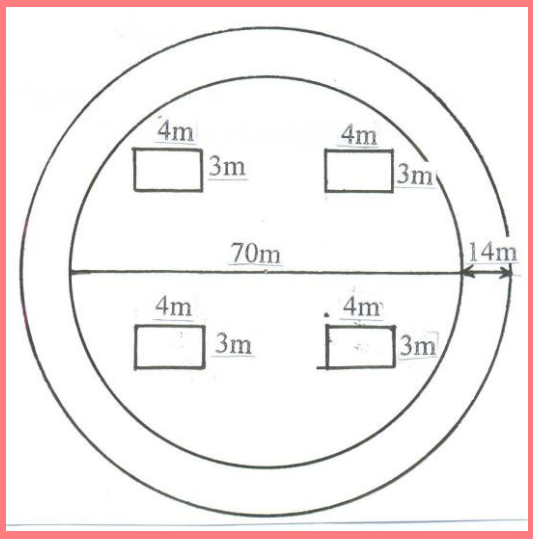
Mr. Kitavi a civil servant is provided with a house at a nominal rent of Ksh. 6260 per month. In addition he is given the following allowances. Medical at sh. 8,000, entertainment at sh. 6,000 and a car allowance sh. 2,000, all per month. He is entitled to a personal relief of sh. 1,800 per month. If his net tax is Ksh. 6,800 per month determine

(a) His gross tax per month. (2 marks)

(b) His taxable income per month. (5 marks)

(c) Basic salary per month. (3 marks)

18. The figure shows a circular path 14m which surrounds a field of diameter 70m. The path is to be carpeted and the field is to have a concrete slab with an exception of four rectangular holes each measuring 4m by 3m.



A contractor estimated the cost of carpeting the path at Ksh. 300 per square metre and the cost of putting the concrete slab at sh. 400 per square metre. He then made a quotation which was 15% more than the total estimate. After completing the job he realized that 20% of the quotation was not spent.

(a) How much money was not spent? (8 marks)

(b) What was the actual cost of the construction. (2 marks)

19. The table below shows values of x and the corresponding values of y for a given curve.

X	0	$\pi/12$	$\pi/6$	$\pi/4$	$\pi/3$	$5\pi/12$	$\pi/2$
Y	0	0.26	0.48	0.65	0.76	0.82	0.84

(a) Use the trapezium rule with seven ordinates and the values in the table only to estimate the area enclosed by the curve, x – axis and the line $x = \pi/2$ to four decimal places. (Take $\pi = 3.142$) (6 marks)

(b) The exact value of the area enclosed by the curve is known to be 0.8940. Find the percentage error made when the trapezium rule is used. Give the answer correct to two decimal places. (4 marks)

20. (a) Using a ruler and a pair of compasses only, construct triangle ABC in which AB = 9cm, BC = 8.5cm and $\angle$ BAC = 60^0. (3 marks)

(b) On the same side of AB as C;

(i) Determine the locus of a point P such that $\angle$ APB = 60^0. (3 marks)

(ii) Construct the locus R such that AR > 4cm. (2 marks)

(iii) Determine T such that $\angle$ ACT $\geq$ BCT. (2 marks)

21. Two quantities P and r are connected by the equation $p = kr^n$. The table of values of p and r is given below.

P	1.2	1.5	2.0	2.5	3.5	4.5
r	1.58	2.25	3.39	4.74	7.86	11.5

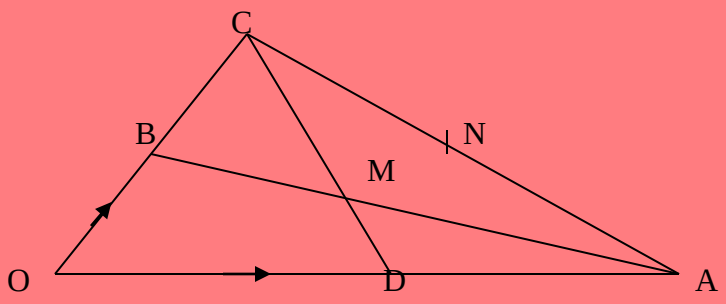
(a) State the linear equation connecting p and r. (2 marks)

(b) Using the scale 2cm to represent 0.1 units on both axes draw a suitable straight line graph on the grid provided. (4 marks)

(c) Use your graph to estimate the values of k and n. (4 marks)

22. In the figure below $\overrightarrow{OB}$ = b, $\overrightarrow{OC}$ = 3 $\overrightarrow{OB}$ and $\overrightarrow{OA}$ = a

(a) Given that $\overrightarrow{OD} = {}^1/_3\,\overrightarrow{OA}$ and $\overrightarrow{AN} = ½\,\overrightarrow{AC}$, CD and AB meet at M
Determine in terms of a and b (1 mark)



(i) $\overrightarrow{AB}$ (1 mark)

(ii) $\overrightarrow{CD}$ (1 mark)

(b) Given that $\overrightarrow{CM} = k\,\overrightarrow{CD}$ and $\overrightarrow{AM} = h\,\overrightarrow{AB}$. Determine the values of the scalars k and h. (5 marks)

(c) Show that O, M and N are collinear . (3 marks)

23. Complete the table below for the functions $y = 3 \cos \theta$ and $y = \sin 2\theta$ correct to 2 decimal places. (2 marks)

θ^0	-180^0	-150^0	-120^0	-90^0	-60^0	-30^0	0^0	30^0	60^0	90^0	120^0	150^0	180^0
$3 \cos \theta$	-3		-1.50	0		2.60	3	2.60		0	-1.50		-3
$\sin 2\theta$	0	0.87	0.87	0		-0.87	0	0.87		0			0

(a) Plot the graph of $y = 3 \cos \theta$ and $y = \sin 2\theta$ on the same axes, for $-180^0 \leq \theta \leq 180^0$. (5 marks)

(b) Use the graph in (a) to find

(i) The values of θ which satisfy the equation $3\cos\theta - \sin 2\theta = 0$ (2 marks

(ii) The difference in values of y when $\theta = 45^0$. (1 mark)

24. A company is considering to install two types of machines in its production unit.
Type A machines to be installed requires 2 operators and $5m^2$ of space of the floor.
Type B machines requires 5 operators and $8m^2$ of floor space.
The company decided to install x, machines of type A and y machines of type B.

(a) Write down the inequalities that express the following conditions. (4 marks)

(i) The number of operators available is 40.

(ii) The production space (floor) available is $80m^2$.

(iii) The company has to install not less than 3 machines of type A.

(iv) The number of type B machines must be more than a third of the number of type A machines.

(b) Represent the above inequalities in part (a) on the grid provided below. (4 marks)

(c) Determine the number of machines of each type that should be installed to maximize the daily profit given that type A earns sh. 1500 in profit and B sh. 2500 daily. (2 marks)