NAME MARKING GUIDE ADM NO............

DATE .... CLASS ....

SCHOOL ....

121/1
MATHEMATICS
PAPER 1
July 2023
TIME: $2^1/_2$ HOURS

NYAHOKAKIRA JOINT EXAMINATION
CLUSTER 2

INSTRUCTIONS TO THE CANDIDATES

*Write **your name** and **school and index number** in the spaces provided above*

- *This paper contains two sections; **Section 1** and **Section 11**.*
- *Answer **all** the questions in **section 1** and **only** five questions from **Section 11***
- ***Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.***
- *Marks may be given for correct working even if the answer is wrong.*
- *Non-Programmable silent calculators and KNEC Mathematical tables may be used **EXCEPT** where stated otherwise.*

FOR EXAMINERS'S USE ONLY

Section 1

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

Section 1I

Question	17	18	19	20	21	22	13	24	**Total**
Marks									

GRAND TOTAL

This paper consists of 14 printed pages. Candidates should check carefully to ascertain that all the pages are printed as indicated and no questions are missing.

SECTION I (50 Marks)

Answers all the questions in this section in the space provided.

1. In a game park $\frac{1}{5}$ of the animals are rhinos and $\frac{3}{4}$ of them are zebras. Two-thirds of the remaining animals are lions and the rest are warthogs. Find the fraction of warthogs in the game park. (3marks)

Rhinos $= \frac{1}{5}x$

Zebra $= \frac{3}{4}x$

Remaining $= x - \left(\frac{1}{5}x + \frac{3}{4}x\right)$ ✓

$= \frac{1}{20}x$

Lions $= \frac{2}{3}$ of $\frac{1}{20}x$

$= \frac{1}{30}x$

Warthogs $= \frac{1}{20}x - \frac{1}{30}x$ ✓

$= \frac{1}{60}x$ ✓

M1

M1

A1

3

2. The average mark scored by the first 27 students in a Mathematics test is 52. The average mark scored by the remaining 37 is 58. Calculate the mean mark for the whole class. (2 marks)

$$\frac{27 \times 52 + 37 \times 58}{27 + 37}$$ ✓

$= 55.46875$ ✓

M1

A1

2

3. Use square roots, reciprocal and square tables to evaluate to 4 significant figures the expression; (4 marks)

$$(0.06458)^{\frac{1}{2}} + \left(\frac{2}{0.4327}\right)^2$$

$(6.458 \times 10^{-2})^{\frac{1}{2}}$

$6.458^{\frac{1}{2}} \times 10^{-1}$

2.541×10^{-1}

0.2541 ✓

$2 \times \frac{1}{0.4327}$

$2 \times \frac{1}{4.327} \times 10^{1}$

$2 \times 0.2311 \times 10$

4.622^2 ✓

4.622^2

$= 21.36$ ✓

~~0.5~~

$0.2541 + 21.36$

21.6141 ✓

B1

B1

B1

B1

4

$1-4: 5/8$
$9-12$
$13-16$

4. Find the exact value of $5.\dot{4}\dot{3} - 1.\dot{6}$ (3marks)

$r = 5.434343 \quad \text{---}(1)$
$100r = 543.434343 \quad \text{----}(2)$
$99r = 538$
$r = 5\frac{43}{99}$ ✓

$r = 1.6666 \quad \text{---}(1)$
$100r = 16.6666 \quad \text{---}(2)$
$9r = 15$
$r = 1\frac{2}{3}$ ✓

$\therefore 5\frac{43}{99} - 1\frac{2}{3} = 3\frac{79}{99}$ ✓

B1
B1
B1
3

5. Makau, Wanjiru and Kemboi start a race at 9.03 a.m in the same direction to run round a circular course. Makau makes the circuit in 252 seconds, Wanjiru in 308 seconds and Kemboi in 198 seconds. If they start from the same point, at what time will they next be all at the starting point together? (3marks)

LCM of 252, 308, 198
$= 2^2 \times 3^2 \times 7 \times 11$
$= 2772$ seconds ✓
$= 46$ min 12 sec

$9.03.00$
$+ \; 46.12$ ✓
$9.49.12$ a.m. ✓

B1
M1
A1
3

6. Without using mathematical tables or a calculator, evaluate $243^{\frac{2}{5}} \times \left(\frac{729}{64}\right)^{-\frac{1}{6}}$ (3marks)

$(3^5)^{\frac{2}{5}} \times \left(\frac{2^6}{3^6}\right)^{\frac{1}{6}}$ ✓

$3^2 \times \frac{2}{3}$ ✓

$= 6$ ✓

M1
M1
A1
3

7. Solve the following inequalities and state the integral values
$2x - 2 \leq 3x + 1 < x + 8$ (3 marks)

$2x - 2 \leq 3x + 1$
$-x \leq 3$
$x \geq -3$ ✓

$3x + 1 < x + 8$
$2x < 7$
$x < 3.5$ ✓
$-3 \leq x < 3.5$

integral values
$-3, -2, -1, 0, 1, 2$ and 3 ✓

B1
B1
B1
3

8. Use the mid-ordinate rule with 3 strips to find the area bounded by the curve $y = -x^2 + 4$, the lines $x = -4$, $x = 2$ and $y = 0$ (4mks)

x	-4	-3	-2	-1	0	1	2
y	-12	-5	0	3	4	3	0

Mid-ordinate rule

$A = h(y_1 + y_2 + y_3)$

$h = \frac{6}{3} = 2$ ✓

Area $= 2(5 + 3 + 3)$ ✓

$= 2 \times 11$

$= 22$ sq. units ✓

B1 B1 M1 A1 4

9. 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 1 g/cm^3 and that of ethanol as $1.2 g/cm^3$, find the mass in grams of 2.5 litres of the mixture. (3 marks)

Let the total volume be x cm^3

$V_{water} = \frac{3}{4}x$

$V_{ethanol} = \frac{1}{4}x$

$Mass_{water} = 1 \times \frac{3}{4}x = \left(\frac{3}{4}x\right)g$

$Mass_{ethanol} = 1.2 \times \frac{1}{4}x = \left(\frac{1}{3}x\right)g$

$D_{mixt} = \dfrac{\frac{3}{4}x + \frac{1}{3}x}{\frac{3}{4}x + \frac{1}{4}x}$ ✓ $= 1.05 g/cm^3$

Mass $= \dfrac{2500 \times 1.05}{1000}$ ✓ kg

$= 2.625$ kg ✓ (3marks)

M1 M1 A1 3

10. Solve for x in: $\sin(150° \div x) = \cos(12x)°$

$\frac{150}{x} + 12x = 90$ ✓

$12x^2 - 90x + 150 = 0$

$2x^2 - 15x + 25 = 0$

$(2x - 5)(x - 5) = 0$ ✓

$x = 2.5$ or $x = 5$ ✓

M1 M1 A1 3

11. The equation of line A is given by $y = 3x + 5$ and line B is given by $y = x + 1$. A perpendicular to line A is drawn from the point of intersection. Find its equation in double intercept form(3marks)

$3x + 5 = x + 1$

$x = -2$

$y = -2 + 1 = -1$

point of intersection

$(-2, -1)$ ✓

$y = 3x + 5$

$m_1 = 3$

$3 \times m_2 = -1$

$m_2 = -\frac{1}{3}$

$\frac{y+1}{x+2} = -\frac{1}{3}$ ✓

$3(y+1) = -1(x+2)$

$3y = -x - 5$

$3y + x = -5$

when $x = 0$

$y = -1\frac{2}{3}$

when $y = 0$

$x = -5$

equation

$\frac{-x}{5} - \frac{y}{1\frac{2}{3}} = 1$ ✓

B1 M1 A1 3

53.6

12. Given the column vectors; $p = \begin{bmatrix}-2\\3\end{bmatrix}, q = \begin{bmatrix}12\\-8\end{bmatrix}, r = \begin{bmatrix}6\\-9\end{bmatrix}$ and $a = 2p - \frac{3}{4}q + \frac{2}{3}r$, express a as a column vector and hence calculate its magnitude $|a|$ to 4 significant figures (3 marks)

$2\begin{pmatrix}-2\\3\end{pmatrix} - \frac{3}{4}\begin{pmatrix}12\\-8\end{pmatrix} + \frac{2}{3}\begin{pmatrix}6\\-9\end{pmatrix}$ ✓

$\begin{pmatrix}-9\\6\end{pmatrix}$

$|a| = \sqrt{(-9)^2 + 6^2}$ ✓

$= 10.81$ ✓

M1
M1
A1
3

13. Simplify completely; (3 marks)

$(a + b)(3a - 4b) - (a - b)^2$

$a(3a-4b)+b(3a-4b)$
$3a^2-4ab+3ab-4b^2$
$3a^2-ab-4b^2$ ✓
$(a-b)(a-b)$
$a(a-b)-b(a-b)$

$a^2-ab-ab+b^2$
$a^2-2ab+b^2$ ✓
$\therefore 3a^2-ab-4b^2-(a^2-2ab+b^2)$
$3a^2-ab-4b^2-a^2+2ab-b^2$
$2a^2+ab-5b^2$ ✓

M1
M1
A1
3

14. A Kenyan bureau buys and sells foreign currencies as shown below

	Buying (In Kenya shillings)	Selling (In Kenya Shillings)
1 Hong Kong dollar	9.74	9.77
100 Japanese Yen	75.08	75.12

A tourists arrived in Kenya with 105 000 Hong Kong dollars and changed the whole amount to Kenyan Shillings. While in Kenya, she pent Ksh. 403 897 and changed the balance to Japanese Yen before leaving for Tokyo. Calculate the amount, to the nearest Japanese Yen, that she received. (3 marks)

$105\,000 \times 9.74 = 1\,022\,700$ ✓

bal $= 1\,022\,700 - 403\,897 = 618\,803$

100 JY = 75.12

? = 618 803

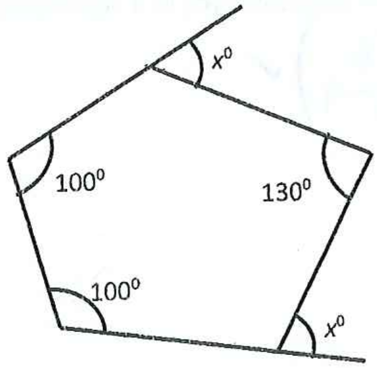
$= \frac{618\,803 \times 100}{75.12}$ ✓

$= 823\,752$ ✓

823753

M1
M1
A1
3

15. The figure below shows an irregular polygon



Find the value of x hence calculate the sum of internal angles of the polygon

(3 marks)

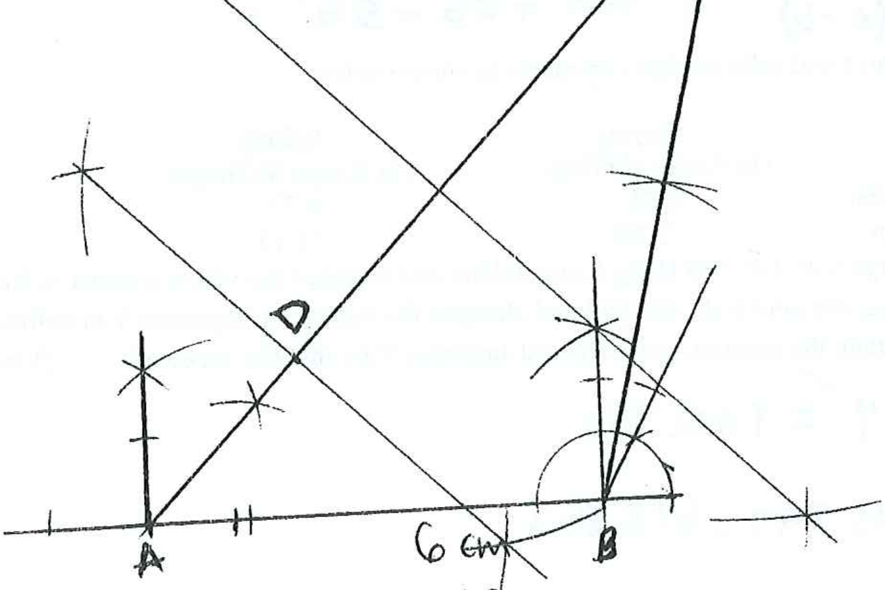
$(2\times5-4)90 = 540$ ✓   Allow alternative | M1

$100+100+130+2(180-x)=540$ ✓ | $80+80+50+2x=360$ | M1

$x = 75$ ✓ | A1

3

16. (a) Using ruler and a pair of compasses only, construct triangle ABC in which AB = 6cm and angle ABC = 105^0 and angle BAC = 45^0. Measure length of BC. (3marks)



B1 for ∠105

B1 for ∠45

B1 △

B1 for D

(b) Locate a point such that AD: DC = 1: 3 (1mark)

SECTION II (50 marks)

Answer only five questions in this section

17. A bus left Nairobi at 8.00am and traveled towards Busia at an average speed of 80km/hr. At 8.30 am a car left Busia for Nairobi at an average speed of 120km/hr. Given that the distance between Nairobi and Busia is 400km. Calculate:

a) The time the car arrived in Nairobi. (2marks)

$\frac{400}{120} = 3\frac{1}{3}h$ ✓

$= 3h\ 20min$

8·30
+ 3·20
11·50 a.m. ✓

M1
A1

b) The time the two vehicles met. (4marks)

Distance Covered by bus in 30 minutes

$80\ km/h \times \frac{1}{2}h = 40km$

Remaining Distance

$400 - 40 = 360\ km$

Relative speed $= 80 + 120$ ✓

$= 200\ km/h$

$200km/h = \frac{360}{T}$ ✓

$T = 1·8h$ or 1h48min

Time of meeting

8·30 a.m.
+ 1·48 am ✓
10·18 a.m ✓

B1
M1
M1
A1

c) The distance from Nairobi to the meeting point. (2marks)

$80 \times 1·8$

$= 144\ km$

$40 + 144 = 184\ km$ ✓ ✓

from Nairobi

Alternatively

$1·8 \times 120 = 216km$

$400 - 216$ ✓

$= 184km$ ✓

M1
A1

d) The distance of the bus from Busia when the car arrived in Nairobi. (2marks)

Expected arrival time of bus

$\frac{400km}{80km/h} = 5h$

Expected arrival time of Car

$\frac{400}{120} = 3h\ 20min$

Difference in Time

5h - 3h 20 min

~~14~~ 1h 40min

Distance $= 80 \times 1\frac{40}{60}$

$= 133\frac{1}{3}\ km$ $- 40 = 93\frac{1}{3}\ Km$

M1
A1
10

18. Innocent poured spirit into a test tube which has a hemispherical bottom of inner radius 1.5cm. He noted that the spirit is 8cm high. (Take $\pi = 3.142$)
Determine;

a) The surface area of the test tube that is in contact with spirit, correct to 2 decimal places (4marks)

$2\pi r^2 + \pi D h$

Hemisphere $= 2 \times 3.142 \times 1.5^2$ ✓ M1

$= 14.139$ ✓

Cylindrical part $= 3.142 \times 3.0 \times 6.5$ ✓ M1

$= 61.269$ ✓ M1

Total Area $= 14.139 + 61.269$ ✓ A1

$= 75.41$ ✓

b) The volume of spirit in the test tube, correct to 1 decimal place (4marks)

volume of hemisphere

$\frac{2}{3} \times 3.142 \times 1.5^3 = 7.0695$ ✓ M1

Volume of cylinder M1

$3.142 \times 1.5^2 \times 6.5 = 45.95175$ ✓ M1

$7.0695 + 45.95175$ ✓ A1

$= 53.0$ ✓

c) The density of the spirit in kg/m^3, if Innocent obtained the mass of the spirit as 10 grams (2marks)

$D = \frac{M}{V}$

$= \frac{10}{53.0} \times 1000$ ✓ M1

$= 188.7$ kg/m^3 ✓ A1

10

19. Three partners Atieno, Bogonko and Koech contributed Sh. 600,000, Sh. 400,000 and Sh. 800,000 respectively to start a business of a matatu plying Migori-Kaplong' route. The matatu carries 14 passengers with each paying Sh. 250. The matatu makes two round trips each day and was ever full. Each day Sh. 6000 is used to cover running costs and wages.

(a) Calculate their net profit per day. (2 marks)

$14 \times 250 \times 2 \times 2$ ✓ M1

$= 14000$

Profit $= 14000 - 6000 = 8000$ ✓ A1

(b) The matatu works for 25 days per month and is serviced every month at a cost of KSh.10,000. Calculate their monthly profit in June. (2 mark)

$25 \times 8000 = 200\,000 - 10,000$ ✓ M1

$= 190\,000$ ✓ A1

(c) The three partners agreed to save 40% of the profit, 24% is shared equally and the rest to be shared in the ratio of their contribution. Calculate Koech's share in the month of June.

(4 marks)

Shared Equally $= \frac{24}{100} \times 190\,000 = 45\,600$ ✓ B1

Proportionally $= \frac{36}{100} \times 190000 = 68\,400$ ✓ B1

Koech's $= \frac{45\,600}{3} + \frac{4}{9} \times 68\,400$ ✓ M1

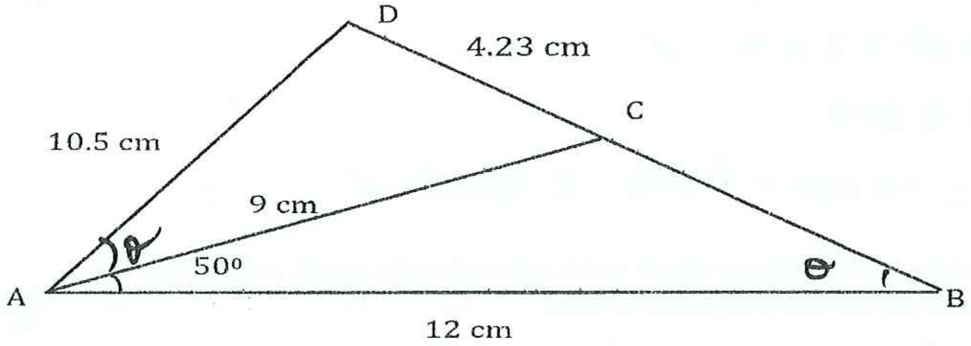
$= 45\,600$ ✓ A1

(d) The matatu developed mechanical problems and they decided to sell it through an agent who charged a commission of 5% on selling price. Each partner received KSh. 475,000 from the agent after he had taken his commission. Determine the price at which the agent sold the matatu. (2 marks)

$47500 \times 3 \times \frac{100}{95}$ ✓ $= 1\,500\,000$ ✓ M1 A1

10

20. In the figure below (not drawn to scale) AB = 12 cm, AC = 9 cm, AD = 10.5 cm, CD = 4.23 cm and angle CAB = 50^0.



Calculate to 1 decimal places;

(a)the length BC (3*marks*)

$BC^2 = 12^2 + 9^2 - 2 \times 12 \times 9 \cos 50$ ✓ M1

$= 225 - 138.8421$ M1

$= 86.1579$ A1

$BC = \sqrt{86.1579}$ ✓ $= 9.3$ ✓

(b) the size of angle ABC (2*marks*)

$\frac{9.3}{\sin 50} = \frac{9}{\sin \theta}$ ✓ M1

$\theta = \sin^{-1}\left(\frac{9 \sin 50}{9.3}\right)$

$\theta = 47.8°$ ✓ A1

(c) the size of angle $C\hat{A}D$ (3*marks*)

$4.23^2 = 10.5^2 + 9^2 - 4 \times 9 \times 10.5 \cos \theta$ ✓ M1

$17.8929 = 191.25 - 378 \cos \theta$ M1

$-173.3571 = -378 \cos \theta$

$\theta = \cos^{-1}\left(\frac{173.3571}{378}\right)$ ✓ $= 62.7°$ ✓ A1

(d) the area of triangle ACD (2*marks*)

$= \frac{1}{2} \times 10.5 \times 9 \sin 62.7°$ ✓ M1

Allow alternatives
→ Hero's formula

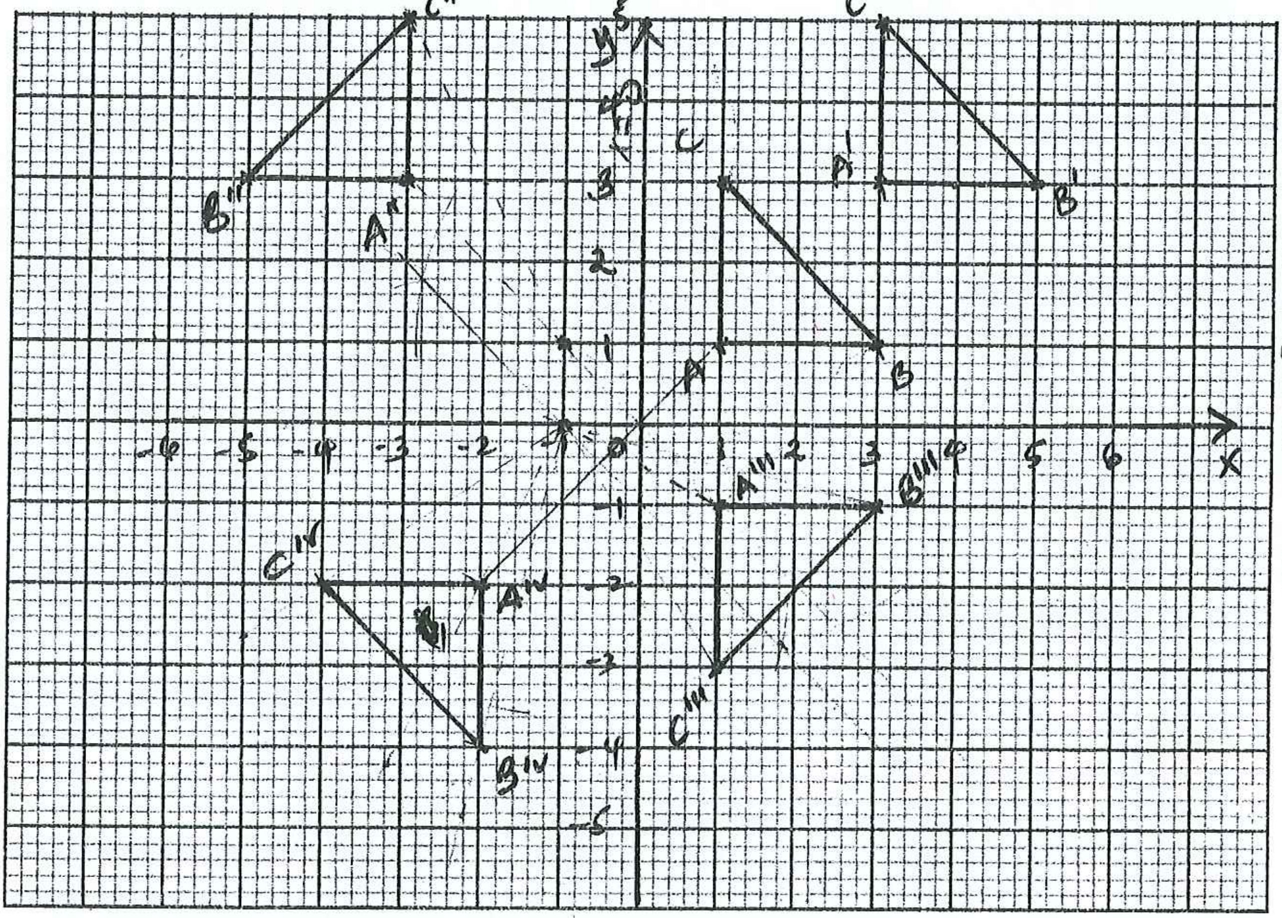
$= 41.987$

$= 42.0 \text{ cm}^2$ ✓ A1

10

21. The coordinates of a triangle ABC are A(1, 1) B(3, 1) and C (1, 3).

(a) Plot the triangle ABC. (1 mark)



B_1 ΔABC

B_1 ΔA'B'C'

B_1 ΔA''B''C''

B_1 ΔA'''B'''C'''

B_1 ΔA^iv B^iv C^iv

(b) Triangle ABC undergoes a translation vector $\binom{2}{2}$ to obtain triangle A' B' C '. on the same grid draw triangle A' B' C' (2marks)

$\begin{pmatrix} 2 \\ 2 \end{pmatrix} + \begin{pmatrix} 1 & 3 & 1 \\ 1 & 1 & 3 \end{pmatrix} = \begin{pmatrix} 3 & 5 & 3 \\ 3 & 3 & 5 \end{pmatrix}$ $A'(3,3)$ $B'(5,3)$ $C'(3,5)$ B_1

(c) A' B' C' undergoes a reflection along the line x = 0 to obtain triangle A" B" C". On the same grid draw triangle A" B" C" (1 mark)

(d) The triangle A" B" C" undergoes an enlargement scale factor -1, centre $(-1, 1)$. Obtain the coordinates of the image A''' B''' C''' and draw it $A'''(1,-1)$ $B'''(3,-1)$ $C'''(1,-3)$ (2marks) B_1

(e) The triangle A''' B''' C''' undergoes a rotation centre $(-1, 0)$ angle -90^0. Obtain the coordinates of the image $A^{iv}B^{iv}C^{iv}$. ~~Reflection in the mirror line y+x=-1~~ (1 mark)

$A^{iv}(-2,-2)$ $B^{iv}(-2,-4)$ $C^{iv}(-4,-2)$

(f) Describe fully the transformation that maps triangle $A^{iv}B^{iv}C^{iv}$ onto triangle ABC (2 marks)

Reflection B_1 in the mirror line $y+x=-1$ B_1 B_2

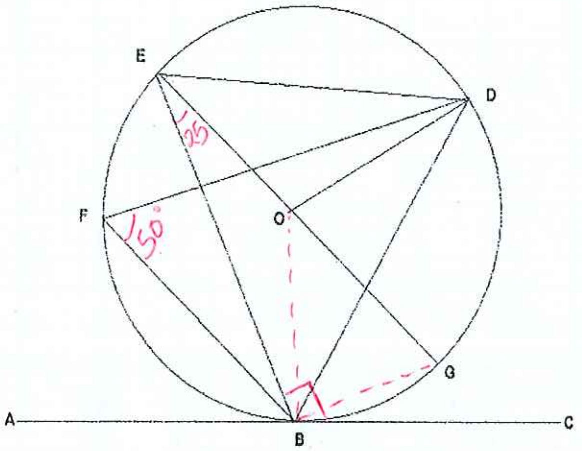
(g) State a pair of triangles that are directly congruent. (1mks)

ΔABC and ΔA'B'C' B_1

ΔA'''B'''C''' and A^iv B^iv C^iv

10

22. In the figure below, EG is the diameter of the circle center O. Points B,G,D,E and F are on the circumference of the circle .Angle BFD = 50^0,angle BEO =25^0 and line ABC is tangent to the circle at B.



Giving reasons, find sizes of the following angles;

a) Angle EBG (2marks)

90° (angle subtended by diameter GOE is 90°)

b) The reflex angle BOD (2marks)

$360 - (50 \times 2) = 360 - 100$

$= 260^\circ$ (Angles at a point add up to 360°)

c) Angle CBD (2marks)

$= 50^\circ$ (Angle in the alternate segment)

d) Angle EBA (2marks)

$180 - (65 + 50)$

$= 65^\circ$ (Angle in the alternate segment)

e) Angle BGD (2marks)

$180 - 50 = 130^\circ$ (Angles of a cyclic Quadrilateral EBGD are supplimentary)

10

20 - 28

28 -

23. The following are masses of patients taken in a clinic on a certain day

20	35	29	45	60
66	56	29	48	37
59	64	24	28	32
35	45	48	52	55
54	55	36	39	35

47

(a) Using a class width of 8 and starting with the lowest mass of the patients, prepare a frequency distribution table for the data. (2 marks)

Mass	20-27	28-35	36-43	44-51	52-59	60-67
No. of patients	2	7	3	4	6	3
C.F	2	9	12	16	22	25

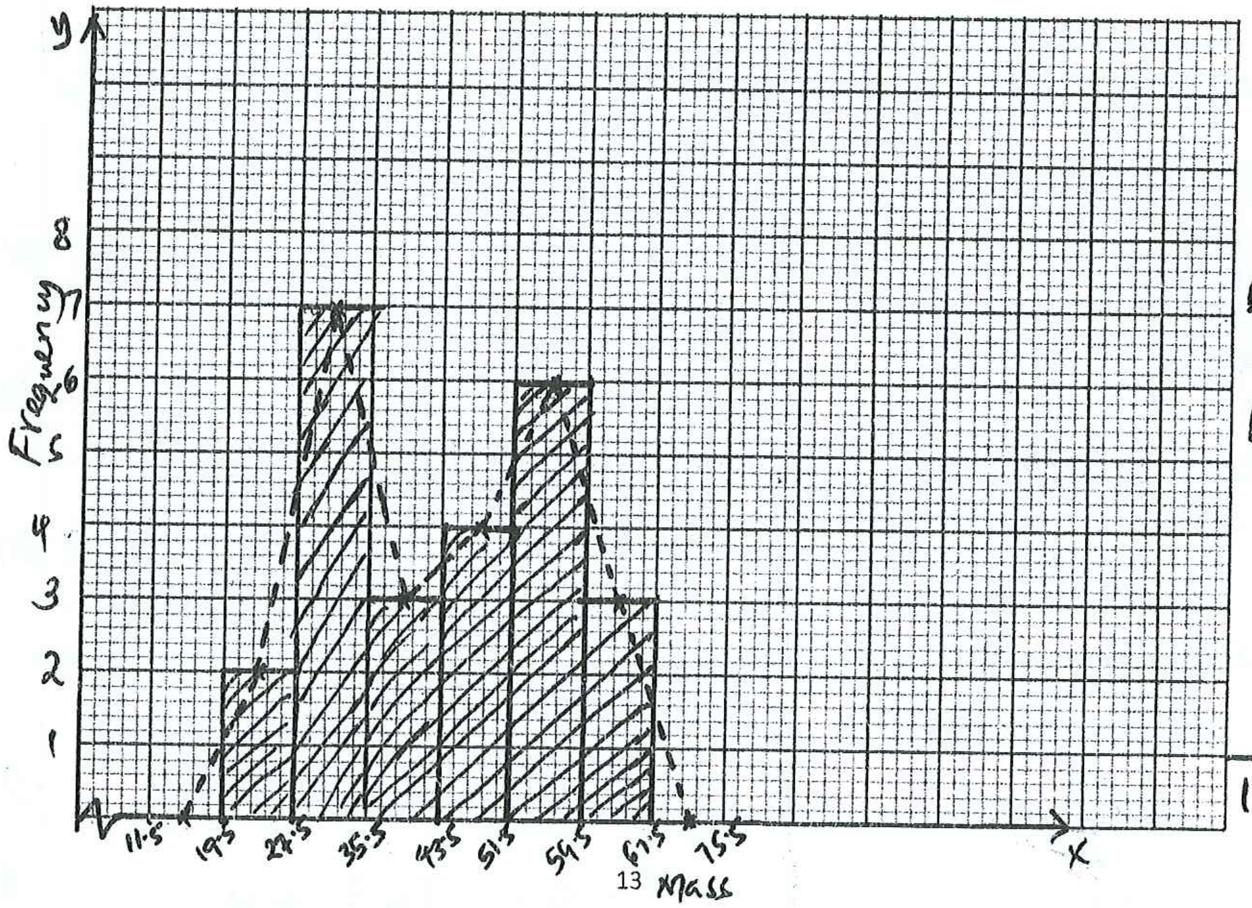
✓ B_1 for all classes
✓ B_1 for correct frequencies.
B_1 for cumulative frequency

(b) Calculate the median mass of the patients. (3 marks)

$$43.5 + \left[\frac{\frac{25}{2} - 12}{4}\right] \times 8 = 44.5$$

M1
A1

(c) On the grid provided, draw a histogram and a frequency polygon to represent the information. (5 marks)



S1
B2
B2
10

11.5-19.5

Mass	19.5-27.5	27.5-35.5	35.5-43.5	43.5-51.5	51.5-59.5	59.5-67.5	67.5-75.5
Freq 0	2	7	3	4	6	3	0

50 copies
~~Gitimolc~~

$\left(1\frac{2}{3}\right)$

24. A particle moving along a straight line passes through a fixed-point O. Its displacement **H** metres from point O after **t** seconds, is given by $H = t^3 - 5t^2 + 4t + 3$. Find: -

(a) Displacement of the particle 4 seconds after passing point O (2 marks)

$H = 4^3 - 5\times4^2 + 4\times4 + 3$ ✓ M1

$= 3\text{ m}$ ✓ A1

(b) Velocity of the particle at $t = 4$ (3 marks)

$v = \frac{dH}{dt} = 3t^2 - 10t + 4$ ✓ M1

$= 3\times4^2 - 10\times4 + 4$ ✓ M1

$= 12\text{ m/s}$ ✓ A1

(c) Value of t when the particle is momentarily at rest (3 marks)

$3t^2 - 10t + 4 = 0$ ✓

$a = 3,\ b = -10,\ c = 4$

$t = \frac{10 \pm \sqrt{(-10)^2 - 4\times3\times4}}{2\times3}$

$\frac{10 \pm \sqrt{100 - 48}}{6}$ M1

$\frac{10 \pm 7.211}{6}$ ✓ M1

Either $t = \frac{10 + 7.211}{6} = \cancel{8.6055}$ 2.8685

or $t = \frac{10 - 7.211}{6} = 0.4648$ ✓ A1

(d) The ~~maximum~~ Minimum velocity attained by the particle (2 marks)

At maximum velocity

$\frac{dv}{dt} = 0$

$6t - 10 = 0$

$t = 1\frac{2}{3}$ sec. ✓

$v = 3\times\left(1\frac{2}{3}\right)^2 - 10\left(1\frac{2}{3}\right) + 4$ B1

$= 8\frac{1}{3} - 16\frac{2}{3} + 4$ B1

$= -4\frac{1}{3}\text{ m/s}$ ✓

10

ANN

NYAHOKAKIRA
CLUSTER TWO EXAMINATION 2023
Kenya Certificate of Secondary Education

121/2 **MATHEMATICS ALT. A** **Paper 2**
JULY/AUGUST, 2023 – TIME: 2½ HOURS

Name: MARKING SCHEME Admission. No: ……………

School: …………………………………………………… Stream: ……………………

Instructions to Candidates

(a) Write your name, Adm. Number and stream in the spaces provided at the top of this page.
*(b) This paper consists of **TWO** sections: **Section I and Section II**.*
*(c) Answer **ALL** the questions in **Section I** and **only five** questions from Section **II**.*
(d) Show all the steps in your calculation, giving your answer at each stage in the spaces provided below each question.
(e) Marks may be given for correct working even if the answer is wrong.
*(f) **Non-programmable** silent electronic calculators and **KNEC** Mathematical tables may be used, except where stated otherwise.*
(g) This paper consists of 15 printed pages.
(h) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

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	

11 – 90

SECTION I (50 Marks)

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

1. Hannah has two grades of tea A and B .Grade A costs Sh.140 per kg while grade B costs Sh.160 per kg .Determine the ratio she should mix grade A and B so that she make a 60% profit when she sells the mixture at shs.232 per kg. (3marks)

Cost Price $= \frac{100}{160} \times 232$ ✓ M1

$= $ Sh. 145

A B

140 160

145 ✓ M1

15 : 5

3 : 1 ✓ A1

3

2. Find the percentage error in getting the curved surface area of a cone whose radius is 7.5cm and slant height is exactly 3cm. (3marks)

πRL ✓ M1

$\% E = \frac{0.05}{7.5} \times 100$ ✓ M1

$= 0.6667\%$ ✓ A1

3

ALT.

Actual $= \pi \times 7.5 \times 3 = 22.5\pi$

Max. $= \pi \times 7.55 \times 3 = 22.65\pi$

Min. $= \pi \times 7.45 \times 3 = 22.35\pi$

$A.E = \frac{1}{2}(22.65\pi - 22.35\pi)$ ✓ M1

$= 0.15\pi$

$\% E = \frac{0.15\pi}{22.5\pi} \times 100$ ✓ M1

$= \frac{2}{3}\%$ ✓ A1 / 0.6667%

3. Expand and simplify $(1+\sqrt{3})^4 + (1-\sqrt{3})^4$ (3 marks)

$1(\sqrt{3})^0 + 4\sqrt{3} + 6(\sqrt{3})^2 + 4(\sqrt{3})^3 + 1.(\sqrt{3})^4 +$ ✓ M1

$1(-\sqrt{3})^0 + 4(-\sqrt{3})^1 + 6(-\sqrt{3})^2 + 4(-\sqrt{3})^3 + 1(-\sqrt{3})^4$

$\Rightarrow 1 + 4\sqrt{3} + 18 + 12\sqrt{3} + 9 + 1 - 4\sqrt{3} + 18$

$- 12\sqrt{3} + 9$ ✓ M1

$= 56$ ✓ A1

3

4. Solve for x in the equation $\frac{1}{2}\log_2 81 + \log_2(x^2 - \frac{x}{3}) = 1$ (3 marks)

$\Rightarrow \log_2 \left(9(x^2 - \frac{x}{3})\right) = 1$ ✓M1

$\Rightarrow 9x^2 - 3x = 2 \Rightarrow 9x^2 - 3x - 2 = 0$

$\Rightarrow 9x^2 - 6x + 3x - 2 = 0$

$3x(3x-2) + 1(3x-2) = 0$

$(3x+1)(3x-2) = 0$ ✓M1

$x = -\frac{1}{3}$ or $\frac{2}{3}$ ✓A1

3

ALT

$\log_2(9x^2 - 3x) = \log_2 2$ ✓M1

$9x^2 - 3x - 2 = 0$

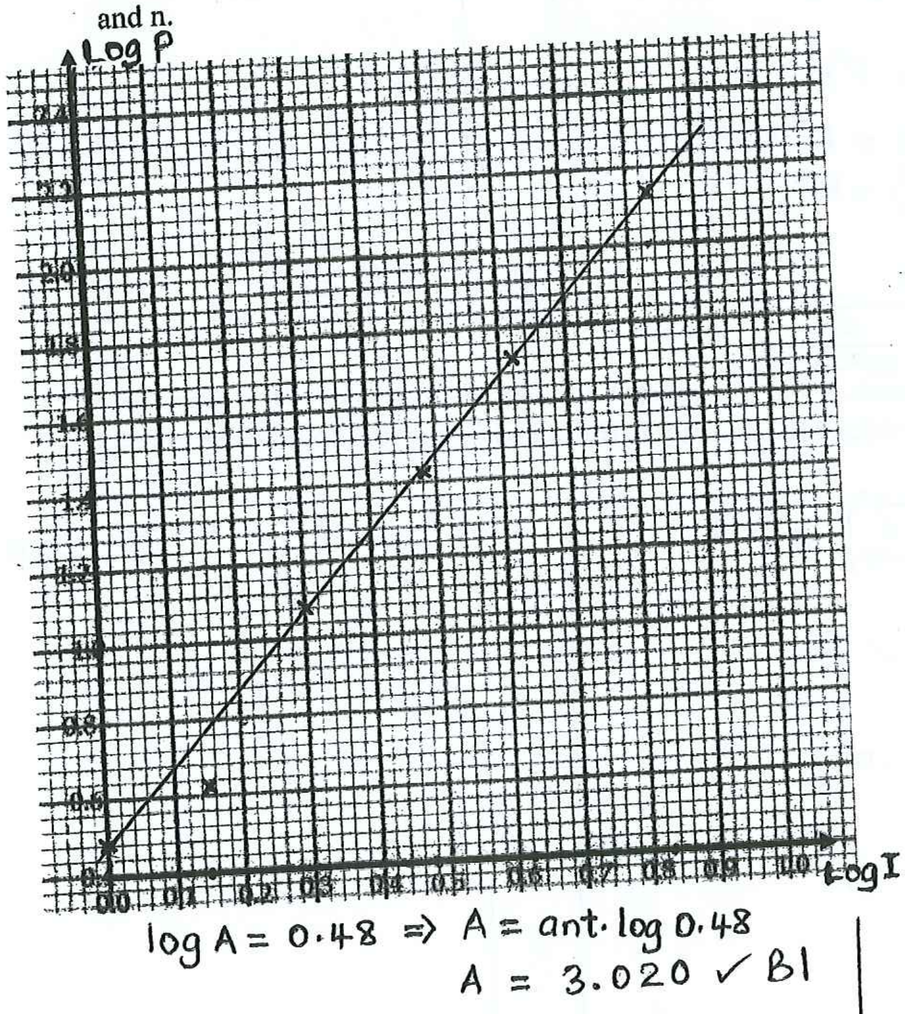
$(3x+1)(3x-2) = 0$ ✓M1

$x = \frac{2}{3}$ or $-\frac{1}{3}$ ✓A1

5. The power P and current I are related by the equation log P = log A + n log I, where A and n are constants. The table below gives the values of logP and corresponding values of log I.

Log I	0.00	0.15	0.30	0.48	0.62	0.83
Log P	0.48	0.63	1.08	1.43	1.72	2.14

Draw a straight line graph on the grid provided and use it to determine the values of A and n. (4marks)



P1

L1

$\log A = 0.48 \Rightarrow A = \text{ant.}\log 0.48$

$A = 3.020$ ✓B1

Gradient $\Rightarrow \frac{0.48 - 1.72}{0 - 0.62} = 2$

$\therefore n = 2$ ✓B1

4

6. A circle of radius 7 units has it's centre at the point of intersection between the lines $x + 2y + 1 = 0$ and $2x + 3y - 3 = 0$. Find the equation of the circle in the form: $x^2 + y^2 + gx + fy + c = 0$. Where g, f and c are constants. (3marks)

$\Rightarrow 2x + 3y = 3$

$2x + 4y = -2$ ✓ M1

$-y = 5 \Rightarrow y = -5,\ x = 9$; B1

Centre $\Rightarrow (9, -5)$ ✓ ~~A1~~ B1

Equation $\Rightarrow (x-9)^2 + (y+5)^2 = 7^2$ ✓M1

$\Rightarrow x^2 + y^2 - 18x + 10y + 57 = 0$ ✓B1 A1

3

7. Make P the subject of the formula $K = \frac{-PM}{\sqrt{P^2M+1}}$ (3marks)

$\Rightarrow K^2 = \frac{P^2M^2}{P^2M+1}$ ✓M1

$\Rightarrow K^2P^2M + K^2 = P^2M^2$

$P^2M^2 - K^2P^2M = K^2$ ✓M1

$P^2(M^2 - K^2M) = K^2$

$P^2 = \frac{K^2}{M^2 - K^2M}$

$\Rightarrow P = \pm\sqrt{\frac{K^2}{M^2 - K^2M}}$ ✓A1

3

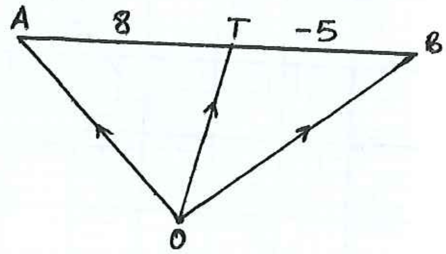
$P = \pm\sqrt{\frac{-K^2}{K^2M - M^2}}$

8. The position vectors of points A and B are given as $3i - 6j + 10k$ and $-9i + 6j - 14k$ respectively. A point T divides AB externally in the ratio 8:5. Find the coordinates of point T. (3 marks)

$\overrightarrow{OT} = \frac{-5}{3}\begin{pmatrix}3\\-6\\10\end{pmatrix} + \frac{8}{3}\begin{pmatrix}-9\\6\\-14\end{pmatrix}$ ✓M1

$= \begin{pmatrix}-29\\26\\-54\end{pmatrix}$ ✓ A1

$T(-29, 26, -54)$ ✓ B1



3

9. A mixed school can accommodate a maximum of 440 students. The number of girls must be at least 120 while the number of boys must exceed 150. Taking x to represent the number of boys and y to represent the number of girls, write down all the inequalities representing the information above. (3marks)

$x + y \leq 440$ ✓ B1

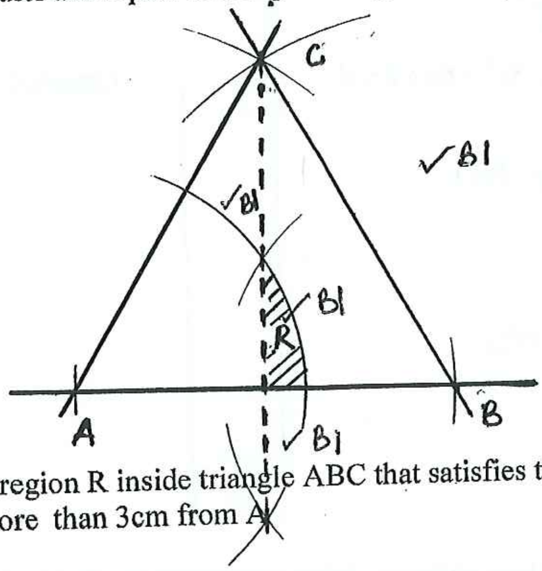
$x > 150$ ✓ B1

$y \geq 120$ ✓ B1

3

10. ABC is an equilateral triangle of sides 5cm.

(a) Using a ruler and a pair of compass only, Construct the triangle ABC (1 mark)



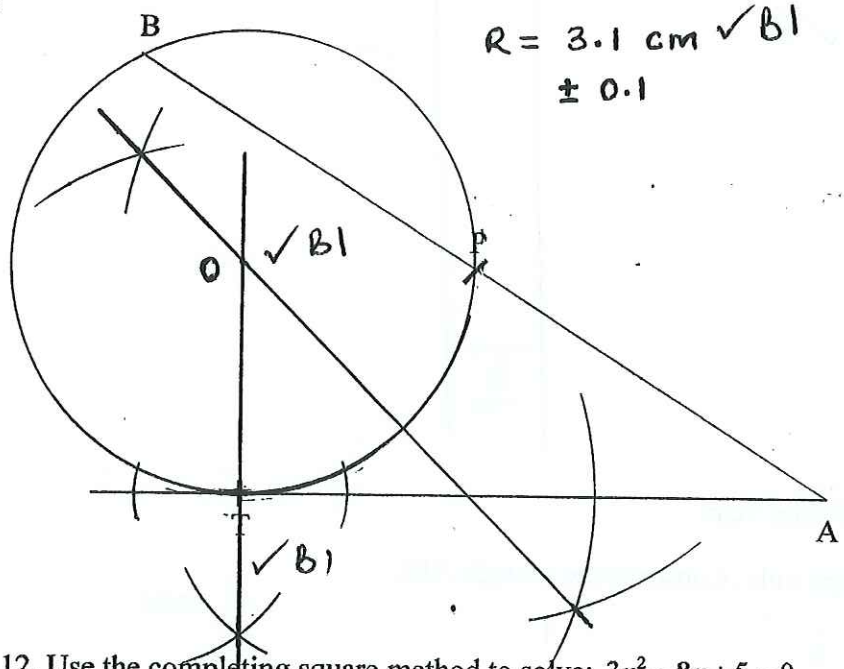
(b)Show the region R inside triangle ABC that satisfies the following conditions: (1 mark)

(i)R is not more than 3cm from A

(ii)R is nearer to B than to A (2 marks)

4

11. The figure below shows a secant AB and a tangent AT to a given circle. If the circle passes through point P and AT a tangent at T. Construct the circle and determine its radius. (3marks)



R = 3.1 cm ✓B1
± 0.1

B1 ⊥ at AT location of centre
B1 ⊥ bisector of a chord
B1 ✓ circle

3

12. Use the completing square method to solve; $3x^2 - 8x + 5 = 0$ (3marks)

$= x^2 - \frac{8}{3}x = -\frac{5}{3}$

$x^2 - \frac{8}{3}x + \left(-\frac{4}{3}\right)^2 = \left(-\frac{4}{3}\right)^2 - \frac{5}{3}$ ✓M1

$\left(\frac{1}{2}\cdot\frac{b}{a}\right)^2$ and added both sides

$\left(x - \frac{4}{3}\right)^2 = \frac{16}{9} - \frac{5}{3} = \frac{1}{9}$

$x - \frac{4}{3} = \pm\sqrt{\frac{1}{9}} = \pm\frac{1}{3}$ ✓M1

$x = \frac{4}{3} \pm \frac{1}{3}$

$x = 1\frac{2}{3}$ or 1 ✓A1

3

13. A newly married couple plans to have only three children. After consulting an expert, they found out that their probability of having a male child is $\frac{3}{7}$. Find the probability that:

Only one of their children is a boy (3marks)

$P(\text{Only One Boy}) = \left(\frac{3}{7} \times \frac{4}{7} \times \frac{4}{7}\right) + \left(\frac{4}{7} \times \frac{3}{7} \times \frac{4}{7}\right) + \left(\frac{4}{7} \times \frac{4}{7} \times \frac{3}{7}\right)$ ✓M1 ✓M1

$= \frac{48}{343} \times 3$

$= \frac{144}{343}$ ✓A1

ALT. ✓M1

$\Rightarrow \left(\frac{3}{7} \times \frac{4}{7} \times \frac{4}{7}\right) \times 3$ ✓M1

$= \frac{144}{343}$ ✓A1

3

14. Quantity Y varies party as x and partly as the cube of x. Given that $x = 2$ when $y = 28$ and $x = 4$ when $y = 104$. Determine the value of y when $x = 5$. (4 marks)

$Y = Kx + hx^3$

$\Rightarrow 2K + 8h = 28$

$4K + 64h = 104$

$\Rightarrow 4K + 64h = 104 -$

$4K + 16h = 56$ ✓ M1 attempt to solve'

$48h = 48$ ✓

$h = 1 \Rightarrow K = 10$ ✓A1 for both

$\Rightarrow Y = 10x + x^3$

$Y = 5 \times 10 + 5^3 \times 1$ ✓ M1 'sub 5'

$= 175$ ✓ A1

4

15. Solve the equation $cos^2\theta - sin^2\theta = -0.5$ for $0^0 \leq \theta \leq 360^0$ (3 marks)

$\Rightarrow Cos^2\theta - (1 - Cos^2\theta) = -0.5$ ✓ M1 expressing eqn in one ratio.

$2Cos^2\theta = 1 - 0.5 = 0.5$

$Cos^2\theta = 0.25$

$\Rightarrow Cos\theta = \pm 0.5$

$Cos^{-1} 0.5 = 60°$ ✓ A1

$\Rightarrow \theta = 60°, 300°$ and

$120°, 240°$ ✓ B1

3

16. Madam Mary bought a car valued at Ksh 1600000. The value of the car depreciated steadily at a rate of 4 % semi-annually. Determine correct to the nearest shilling, the value of the car after 5 years. (2 marks)

$1600000\left(1 - \frac{4}{100}\right)^{10}$ ✓ M1

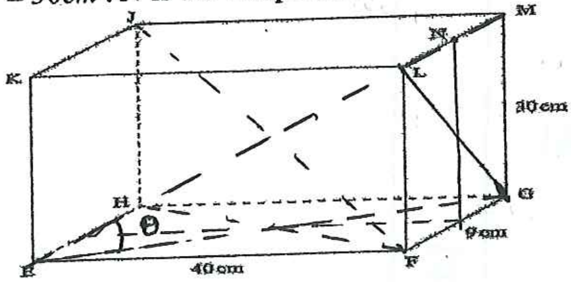
$=$ Ksh. 1,063,732 ✓ A1 C.A.O

2

SECTION II (50 Marks)

Answer **only five** questions from this section in the spaces provided

17. The figure below represents a cuboid ***EFGHJKLM*** in which $EF = 40cm$, $FG = 9cm$ and $GM = 30cm$. N is the midpoint of ***LM***.



Calculate correct to 4 significant figures

a) The length of GL (1mark)

$= \sqrt{9^2 + 30^2} = 31.32\ cm$ ✓B1

b) The length of FJ (2marks)

$= \sqrt{40^2 + 9^2 + 30^2}$ ✓M1

$= 50.80cm$ ✓A1

c) The angle between EM and the plane EFGH (3marks)

B1 for identification of angle

$\sin\theta = \frac{30}{50.80}$ ✓M1

$\Rightarrow \theta = \sin^{-1}\left(\frac{30}{50.80}\right)$ ✓~~M1~~

$= 36.20°$ ✓A1

$\Rightarrow \tan\theta = \frac{30}{41}$

$\Rightarrow \theta = 36.19°$

$\Rightarrow \cos\theta = \frac{41}{50.80}$

$\theta = 36.19°$

d) The angle between the planes EFGH and ENH (2marks)

$\tan\alpha = \frac{30}{40}$ ✓M1

$\alpha = 36.87°$ ✓A1

e) The angle between the lines EH and GL (2marks)

$\tan \beta = \frac{30}{9}$ ✓M1

$\beta = 73.30°$ ✓A1

10

18. The transformation matrix $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ maps triangle ABC onto triangle A′B′C′ with vertices A′ (2,-2), B′(5,0) and C′(2,4). Find the coordinates of A, B and C *(3 marks)*

Det $= 0 - -1 = 1 \Rightarrow$ Inv. $= \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ ✓B1

✓M1

$ABC = \begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}\begin{pmatrix} 2 & 5 & 2 \\ -2 & 0 & 4 \end{pmatrix} = \begin{pmatrix} 2 & 0 & -4 \\ 2 & 5 & 2 \end{pmatrix}$

A(2, 2) B(0, 5) C(-4, 2) ✓A1

multiplication

ALT

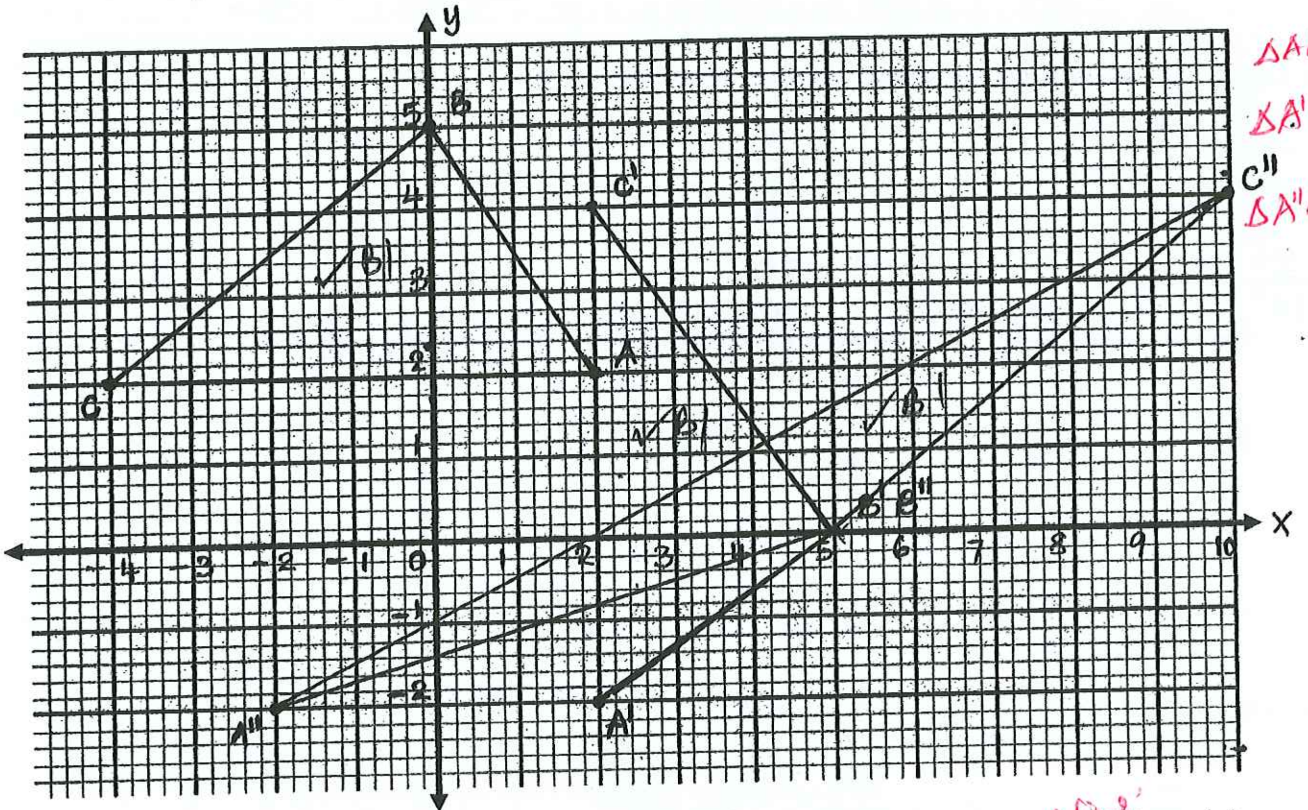
$\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}\begin{pmatrix} a & b & c \\ a' & b' & c' \end{pmatrix} = \begin{pmatrix} 2 & 5 & 2 \\ -2 & 0 & 4 \end{pmatrix}$

$\begin{pmatrix} a' & b' & c' \\ -a & -b & -c \end{pmatrix} = \begin{pmatrix} 2 & 5 & 2 \\ -2 & 0 & 4 \end{pmatrix}$ ✓M1

$\Rightarrow a = 2, a' = 2, b = 0, b' = 5$
$c = -4, c' = 2$. ✓A1

✓B1
A(2,2) B(0,5) C(-4,2)

b) On the grid provided below, draw the triangle ABC, A′B′C′ and A″B″C″ given A″(-2,-2), B″(5,0) and C″(10,4) *(use a scale of 1cm to represent one unit on both axes)* *(3 marks)*



ΔABC – B1
ΔA′B′C′ – B1
ΔA″B″C″ – B1

c) Describe the transformation which maps triangle A′B′C′ and A″B″C″ *(2 marks)*

Shear x-axis invariant, ✓B1
(Parallel to x-axis)
with A′(2, -2) → A″(-2, -2) ✓B1

point not on invariant line, Shear factor 2.

or C′(2, 4) → C″(10, 4)

d) Find the area of triangle A″B″C″ *(2 marks)*

Area of A″B″C″ = Area of A′B′C′

$\Rightarrow \frac{1}{2} \times 6 \times 3$ ✓M1

= 9 sq. units ✓A1

10

19. The set of data is for marks scored by 54 students in a test

35✓	49✓	69✓	57✓	58✓	75✓	48✓	36✓	29✓
40✓	46✓	86✓	47✓	81✓	67✓	63✓	55✓	49✓
56✓	80✓	36✓	62✓	49✓	46✓	26✓	29✓	66✓
41✓	58✓	68✓	73✓	65✓	59✓	72✓	47✓	40✓
64✓	70✓	64✓	54✓	74✓	33✓	51✓	68✓	33✓
73✓	25✓	41✓	61✓	56✓	57✓	28✓	70✓	39✓

a) Starting with the mark of 25 and using equal class intervals of 10, construct a frequency distribution table. (2 marks)

Marks	25-34	35-44	45-54	55-64	65-74	75-84	85-94	
F	7	8	10	13	12	3	1	✓B1
C.F	7	15	25	38	50	53	54	✓B1

b). Using assumed mean of 54.5 work out the standard deviation (5marks)

	7	8	10	13	12	3	1	54	
X	29.5	39.5	49.5	59.5	69.5	79.5	89.5		✓B1
d	-25	-15	-5	5	15	25	35		
d^2	625	225	25	25	225	625	1225		
fd	-175	-120	-50	65	180	75	35	10	✓B1
fd^2	4375	1800	250	325	2700	1875	1225	12550	✓B1

$$SD = \sqrt{\frac{12550}{54} - \left(\frac{10}{54}\right)^2} \quad \checkmark M1$$

$$= 15.24 \quad \checkmark A1$$

c) Calculate the range of marks scored by the middle 80% of the students. (3 marks)

$\Rightarrow 11^{th}$ percentile $\Rightarrow \frac{11}{100} \times 54 = 5.94^{th}$

$\Rightarrow 24.5 + (5.94) \times \frac{10}{7} = 32.99$ ✓M1

$\Rightarrow 90^{th}$ percentile $\Rightarrow 0.9 \times 54 = 48.6^{th}$

✓M1

$\Rightarrow 64.5 + (48.6 - 38) \times \frac{10}{12} = 73.33$

Range of Marks

32.99 − 73.33 ✓ A1

10

20. The table below shows the income tax rates in a certain year.

Annual taxable income in Ksh	Tax rate (%)
0–144,000	0
144,001– 300,000	10
300,001– 468,000	15
468,001– 648,000	20
648001– 840,000	25
Above 840,000	30

During that year, Trendah's annual gross tax in the sixth band was Sh.108, 000.

(a) Determine Trendah's annual gross tax. (3marks)

Slab 2 $\Rightarrow 156{,}000 \times 0.1 = 15{,}600$

3 $\Rightarrow 168{,}000 \times 0.15 = 25{,}200$ ✓~~B1~~ M1

4 $\Rightarrow 180{,}000 \times 0.2 = 36{,}000$

5 $\Rightarrow 192{,}000 \times 0.25 = 48{,}000$

Total $\Rightarrow 108{,}000 + 15{,}600 + 25{,}200 +$

$36000 + 48{,}000$ ✓M1

$=$ Ksh. $232{,}800$ ✓A1

(b) If she enjoyed an annual relief of Sh.21, 000, determine her monthly net tax. (2marks)

$\Rightarrow \dfrac{232{,}800 - 21{,}000}{12}$ ✓M1

$=$ Ksh. $17{,}650$ ✓A1

(c) Trendah had a basic salary of Sh. x per annum and enjoyed non-taxable allowances that is equivalent to 30% of her basic salary. Determine Trendah' s gross salary per month . (3marks)

Let the taxable income be x

$\Rightarrow (x - 840{,}000) \times 0.3 = 108{,}000$ ✓M1

$x = \dfrac{108{,}000}{0.3} + 840{,}000$

$=$ Ksh. $1{,}200{,}000$

Gross Sal. $\Rightarrow \dfrac{130}{100} \times \dfrac{1200000}{12}$ ✓M1

$=$ Ksh. $130{,}000$ ✓ A1

(d) The following deductions were also made from Trendah's salary every month; Cooperative shares sh.8,000,cooperative loans sh 12,000,pension scheme sh 4,000 Union dues sh.2,000. Determine Trendah's monthly net salary during that year.(2marks)

Total deductions ✓~~M1~~

$17{,}650 + 8000 + 12000 + 4000 + 2000$

$=$ Ksh. $43{,}650$ ✓M1

Net Sal. $\Rightarrow 130{,}000 - 43{,}650$

$=$ Ksh. $86{,}350$ ✓A1

10

21. An aeroplane flies due East at an average speed of 500 knots from an airport P (5°N, 45°E) to another airport Q. The flight took $4\frac{1}{2}$ hours.

(a) Calculate:

(i) the distance between P and Q in nautical miles (2marks)

$D = 500 \times 4\frac{1}{2}$ ✓M1

$= 2250$ nm ✓A1

(ii)the longitude of Q, to one decimal place, hence state the position of airport Q. (3marks)

$60\theta \cos 5^\circ = 2250$ ✓M1

$\theta = \frac{2250}{60 \cos 5^\circ} = 37.6^\circ$

$\Rightarrow$ Longitude $= 45 + 37.6$

$= 82.6^\circ E$ ✓A1

$Q(5^\circ N, 82.6^\circ E)$ ✓B1

(iii)the distance between P and Q inn kilometers, correct to the nearest kilometer.

(Take R = 6370km and $\pi = \frac{22}{7}$). (2marks)

$\frac{37.6^\circ}{360^\circ} \times 2 \times \frac{22}{7} \times 6370 \cos 5^\circ$ ✓M1

$= 4{,}166$ km ✓A1 C.A.O

(b) The local time at P when the plane took off was 11.15am. What was the local time at Q when the plane landed? (3marks)

Time difference ✓M1

$\Rightarrow 37.6 \times 4 = 150.4$ min

$\simeq 2$ hrs 30 min

A.T. $\Rightarrow$ ✓M1

11.15am + 4hrs 30min + 2 hrs 30min

= 1815h ✓A1 or 6.15 P.M

or 6:15:24 P.M

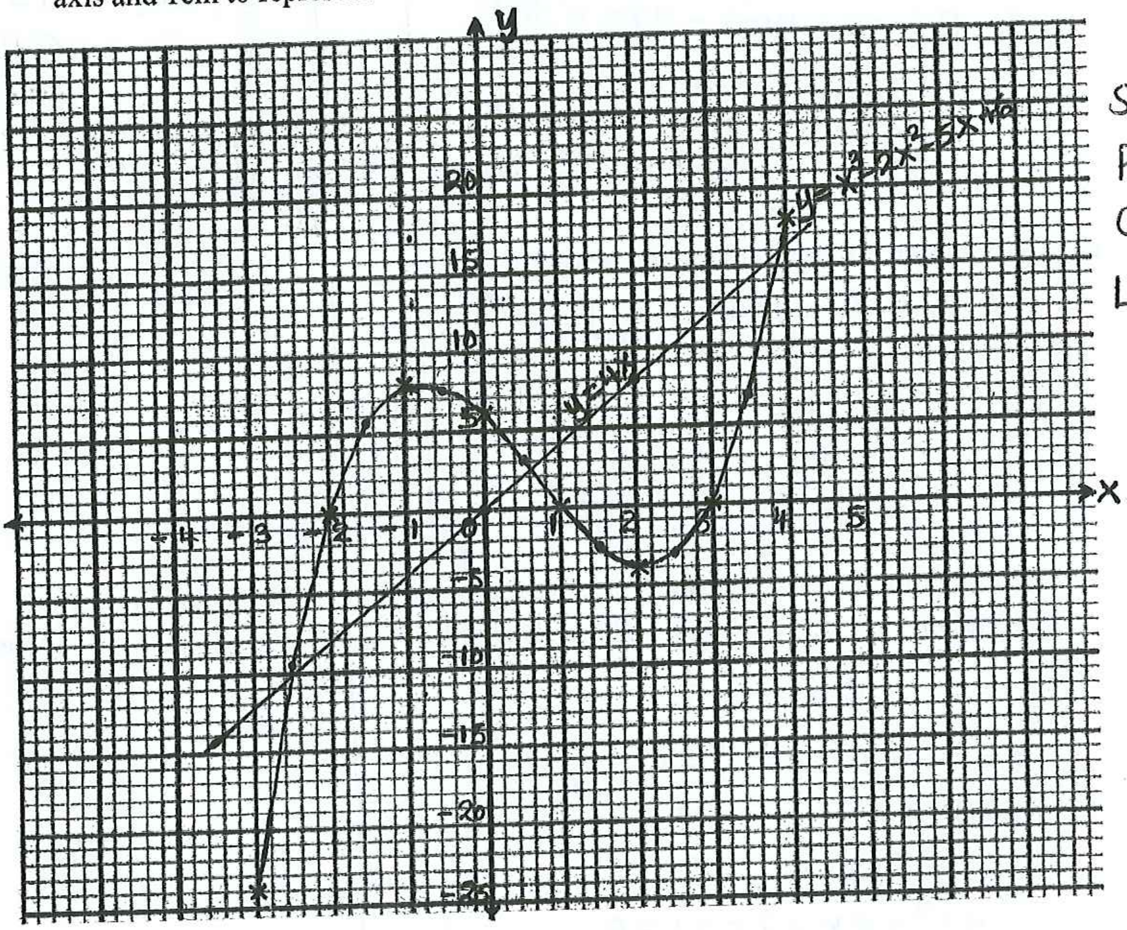
10

22. a) Complete the table below of $y = x^3 - 2x^2 - 5x + 6$. (2marks)

x	-3	-2	-1	0	1	2	3	4
y	-24	0	8	6	0	-4	0	18

✓B2
B1 for atleast 3 correct

b) Draw the graph $y = x^3 - 2x^2 - 5x + 6$ for $-3 \le x \le 4$. Use 1cm to represent 5 units on y – axis and 1cm to represent 1 unit on the x – axis. (3marks)



S1 ✓
P1 ✓
C1 ✓
L1 ✓

c) Use your graph to solve.

i) $x^3 - 2x^2 - 5x + 6 = 0$ (2marks)

$y = 0$ ✓B2

$\therefore x = -2$ or 1 or 3 B1 for 2 ✓

ii) $x^3 - 2x^2 - 9x + 6 = 0$ (3marks)

$\Rightarrow y = x^3 - 2x^2 - 5x + 6$
$0 = x^3 - 2x^2 - 9x + 6$

$y = 4x$ ✓ B1

✓B1

$\therefore x = -2.5$ or 0.6 or 3.9

± 0.1

10

23. An arithmetic progression is such that the first term is -5, the last term is 135 and the sum of the progression is 975.

a) Calculate:

(i) The number of terms in the series. (4marks) 3

$\Rightarrow -5+(n-1)d = 135 \ldots i$ ✓ ~~A1~~

$\therefore (n-1)d = 140$ ✓ ~~B1~~ 2 M1

$\Rightarrow \frac{n}{2}(-10+(n-1)d) = 975 \ldots ii$ ✓ ~~B1~~

$\therefore \frac{n}{2}(-10+140) = 975$ ✓M1

$65n = 975$

$n = \frac{975}{65} = 15$ terms ✓A1

ALT.

$\frac{n}{2}(-5+135) = 975$ ✓M1

$\frac{n}{2}(130) = 975$

$\frac{n}{2} = 7.5$ ✓ ~~M1~~ ✓

~~✓M1~~

$n = 7.5 \times 2 = 15$ ✓A1

(ii) The common difference of the progression. (2marks)

$(15-1)d = 140$ ✓M1

$d = \frac{140}{14}$

$= 10$ ✓A1

b) The sum of the first three terms of a geometric progression is 27 and the first term is 36.Determine the common ratio and the value of the fourth term. (4marks) 5

$a + ar + ar^2 = 27$

$36 + 36r + 36r^2 = 27$

$36r^2 + 36r + 9 = 0$ ✓M1

$\Rightarrow 4r^2 + 4r + 1 = 0$

$4r^2 + 2r + 2r + 1 = 0$

$2r(2r+1) + 1(2r+1) = 0$

$(2r+1)(2r+1) = 0$ ✓M1

$r = -\frac{1}{2}$ ✓A1

$\Rightarrow 4^{th}$ Term $=$

$36 \times \left(\frac{-1}{2}\right)^3 = -4\frac{1}{2}$ ✓M1 ✓A1

10

24. A particle is spotted at point O, moving at speed of 28m/s. the acceleration of the particle is represented by the equation $a = (1 - 4t)ms^{-2}$, where t is time in seconds after passing O. Determine :

a) The expression for velocity, V in terms of t. (3 marks)

$V = \int (1-4t)\,dt$

$V = t - 2t^2 + C$ ✓ M1

$28 = 0 - 2(0)^2 + C$ ✓M1 – Can be implied.

$\therefore C = 28$

$\Rightarrow V = t - 2t^2 + 28$ ✓A1

b) The time the particle was momentarily at rest. (3 marks)

$t - 2t^2 + 28 = 0$ ✓M1

$\Rightarrow 2t^2 - t - 28 = 0$

$2t^2 - 8t + 7t - 28 = 0$

$2t(t-4) + 7(t-4) = 0$

$(2t+7)(t-4) = 0$ ✓M1

$t = -3.5$ or 4

$\therefore t = 4$ Seconds ✓ A1

c) The velocity of the particle at t = 3. (1 mark)

$V = 3 - 2(3)^2 + 28$

$= 13m/s$ ✓B1

d) The distance travelled during the third second. (3 marks)

$D = \int_2^3 (t - 2t^2 + 28)\,dt$

$= \left[\frac{t^2}{2} - \frac{2}{3}t^3 + 28t\right]_2^3$ ✓ M1

✓M1

$\Rightarrow \left(\frac{3^2}{2} - \frac{2}{3}(3)^3 + 28(3)\right) - \left(\frac{2^2}{2} - \frac{2}{3}(2)^3 + 28(2)\right)$

$70\frac{1}{2} - 52\frac{2}{3} = 17\frac{5}{6}\,m$ ✓A1 | 10 | C.A.O

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