no. 18 corrections

KENYA CERTIFICATE OF SECONDARY EDUCATION(KCSE)

SULIMO-JOINT EVALUATION TEST

121/1

Paper 1

MATHEMATICS

JULY. 2025 -2 $\frac{1}{2}$hours

Name..M/SCHEME.....**Admno**.....**Class**.....

Candidate'ssignature.....**Date**.....

Instructions to candidates

(a) Write your name and admission number in the spaces provided above

(b) Sign and write your name, admission number, class and the date of examination in the spaces provided above

*(c) This paper consists of **two** sections: **Section I** and **section II.***

(d) Answer all questions in Section I and ONLY 5 questions in section II

(e) Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.

(f) Marks may be given for correct working even if the answer is wrong

(g) Non programmable silent electronic calculator and KNEC Mathematical tables may be used, except where stated otherwise

(h) This paper consists of 15 printed pages

(i) Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.

(j) Candidates should answer the questions in English

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

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

1. Evaluate without using a calculator. (3 marks)

$$\frac{\frac{1}{2}\text{ of } 3\frac{1}{2}+1\frac{1}{2}\left(2\frac{1}{2}-\frac{2}{3}\right)}{\frac{3}{4}\text{ of } 2\frac{1}{2}\div\frac{1}{2}}$$

N: $\frac{7}{4}+\frac{11}{4}=\frac{18}{4}$ or $\frac{9}{2}$ M_1

D: $\frac{3}{4}\times\frac{5}{2}\times\frac{2}{1}=\frac{15}{4}$ M_1

$\frac{9}{2}\div\frac{15}{4}$

$\frac{9}{2}\times\frac{4}{15}=\frac{6}{5}$ or $1\frac{1}{5}$ A_1

2. A steel company wishes to make nails from steel rods of length 5.12m, 7.60 m and 9.28 m. Find the least number of nails that can be obtained from the three steel rods.(3 marks)

GCD $= 8$ M_1

$\frac{512}{8}+\frac{760}{8}+\frac{928}{8}$ M_1

$64 + 95 + 116$

275 A_1

3. Factorise completely; $(a+b)(3a-4b)-(a+b)^2$ (3 marks)

$(a+b)(3a-4b)-(a+b)(a+b)$ M_1

$(a+b)[3a-4b-a-b]$ M_1

$(a+b)(2a-5b)$ A_1

4. Solve the equation: $27^x + 3^{3x-1} - 4 = 104$ (3 marks)

$3^{3x} + 3^{3x} \div 3^1 = 108$ M_1

Let $3^{3x} = y$

$y = \frac{108 \times 3}{4} = 81$ M_1

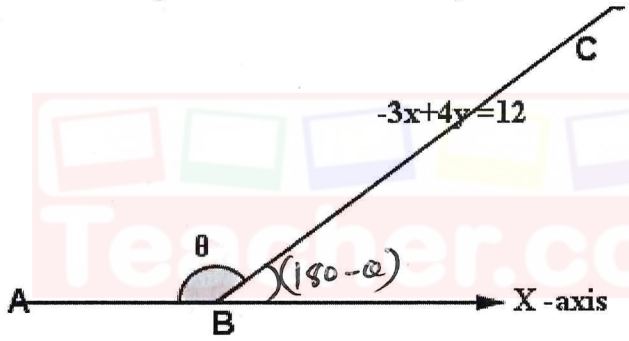
$3^x = 81$

$3^{3x} = 3^4$

$3x = 4$

$x = 4/3$ or $1\frac{1}{3}$ A_1

5. Find the obtuse angle θ that line $-3x + 4y = 12$ makes with the x-axis (3 marks)



$\tan(180-\theta) = 0.75$ M_1

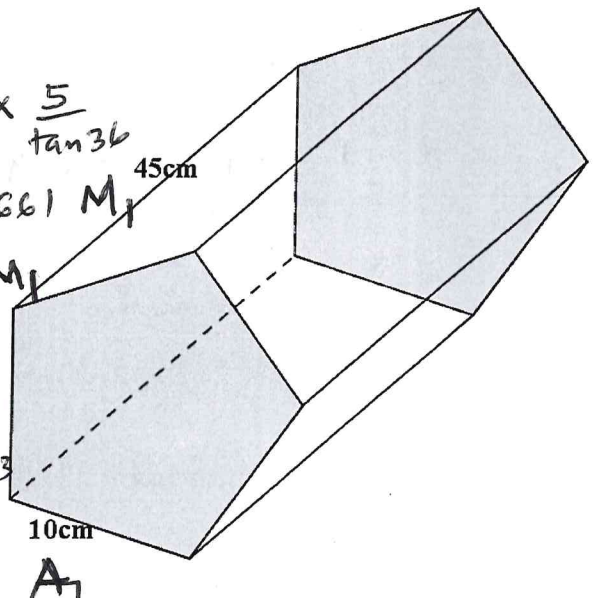
$180-\theta = \tan^{-1} 0.75$

$= 36.87$ M_1

$\theta = 180 - 36.37$

$= 143.1^\circ$ A_1

6. The figure below shows wooden pentagonal prism of side 10cm and length 45cm. If it weighs 3.5kg, find its density in kg/cm^3. (3 marks)



$V = 5 \times \frac{1}{2} \times 10 \times \frac{5}{\tan 36}$

$= 1548.429661$ M_1

$\Delta = \frac{3500}{1548.429661}$ M_1

$= 2.260 \text{ g/cm}^3$

$2.260 \times 1000 \text{ kg/m}^3$

$= 2260 \text{ kg/m}^3$ A_1

7. Two interior angles of an irregular polygon each measures 90^0. All the other remaining interior angles each measure 150^0. Determine the number of sides of the polygon. (3 marks)

$90+90+30n=360$ M_1

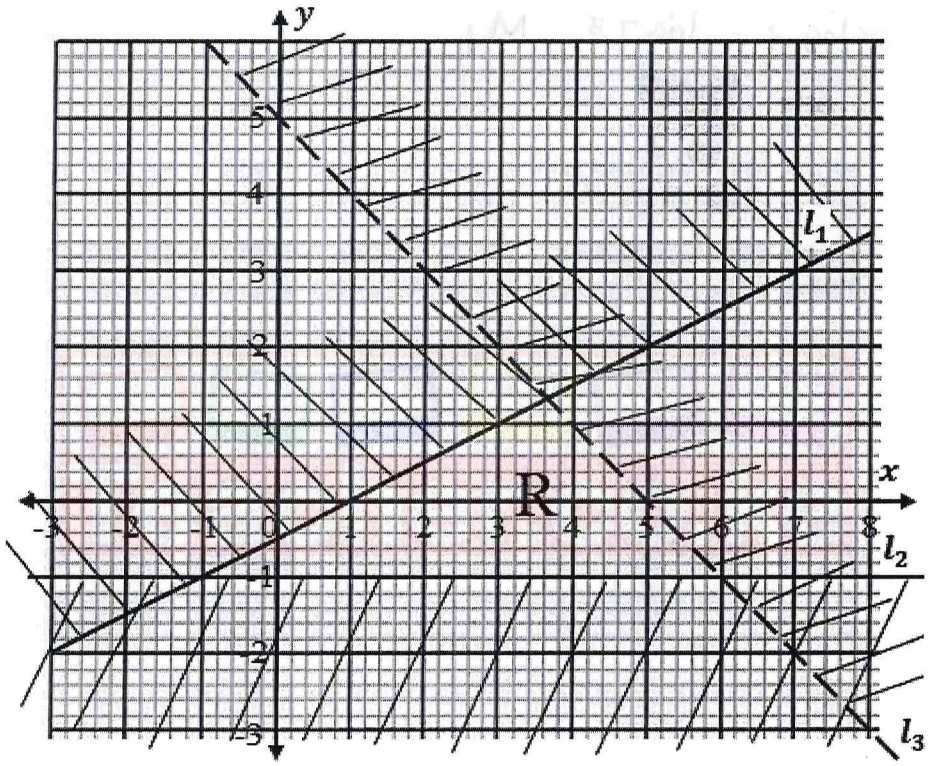
$\frac{30n}{30}=\frac{180}{30}$

$n=6$ M_1

no. of sides $=6+2$

$=8$ A_1

8. Generate the inequalities that define region R in the figure below: (3 marks)



$y \leq -1$ B_1

$x+y<5$ B_1

$2y \leq x-1$ B_1 check for $y \leq \frac{1}{2}x-\frac{1}{2}$

9. The distance between towns T and S is 418km. At 9.45a.m a truck left town T and travelled towards town S. At the same time a car left town S and travelled towards town T along the same road. Given that the car travels 30km/h faster than the truck and that the two vehicles meet at 1:33p.m, find the speed of each vehicle. (3 marks)

$\frac{418}{2x+30} = \frac{19}{5}$ M_1

$x = 40$ M_1

Speed of the truck = 40km/h

Speed of the car = 40 + 30

= 70km/h } A_1

10. Given that $\mathbf{OP} = -6\boldsymbol{i} - 3\boldsymbol{j}$, $\mathbf{OQ} = -2\boldsymbol{i} - \boldsymbol{j}$ and $\mathbf{OR} = 6\boldsymbol{i} + 3\boldsymbol{j}$, express **PQ** and **QR** as column vectors and hence show that the points P,Q and R lie on a straight line.(4 marks)

$\vec{PQ} = \begin{pmatrix} 4 \\ 2 \end{pmatrix}$ B_1

$\vec{QR} = \begin{pmatrix} 8 \\ 4 \end{pmatrix}$ B_1

$PQ = kQR$

$\begin{pmatrix} 4 \\ 2 \end{pmatrix} = k\begin{pmatrix} 8 \\ 4 \end{pmatrix}$

$k = \frac{1}{2}$

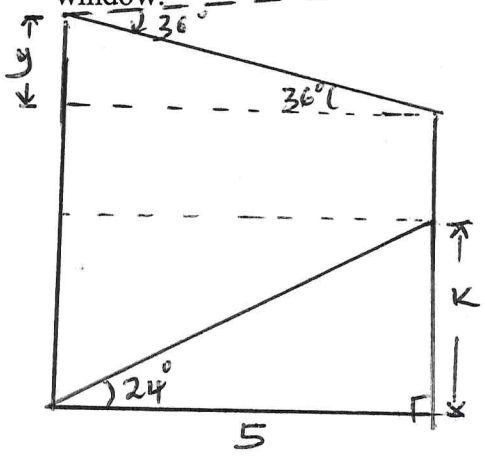
$PQ = \frac{1}{2}QR$ B_1

$PQ \parallel QR$

Q is a common point } B_1

Hence points are collinear

11. From the foot of a tower, the angle of elevation of the lower frame of a window is $\frac{2\pi^c}{15}$. From the top of the tower, the angle of depression of the top frame of the same window is $0.2\pi^c$. If the tower 7m tall and 5m away from the building, determine the height of the window. (4 marks)



$\tan 24 = \frac{k}{5}$

$k = 5\tan 24 = 2.226m$

$\tan 36 = \frac{y}{5}$ } $M_1 M_1$

$y = 5\tan 36 = 3.633$

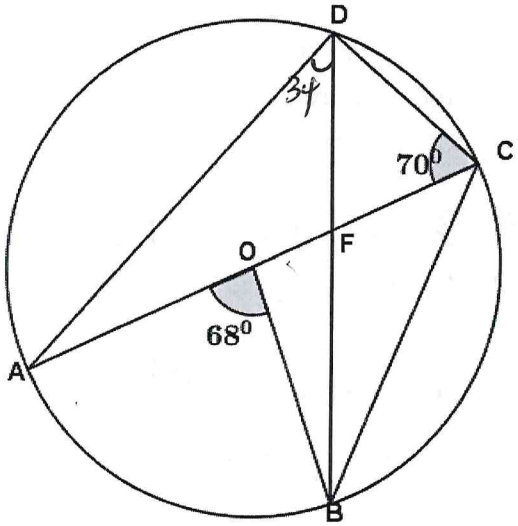
$2.226 + 3.633 = 5.859$ M_1

Height = $7 - 5.859$

= 1.141m A_1

12. The figure below shows a circle centre O and AOC is its diameter. Chords BD and AC intersect at F. Given that angle AOB =68^0 and angle ACD = 70^0, find the size of angles; (3 marks)

(a) DAC $= 20$ B_1



(b) BFC

DFC = 54 B_1

BFC = 180 − 54

= 126 B_1

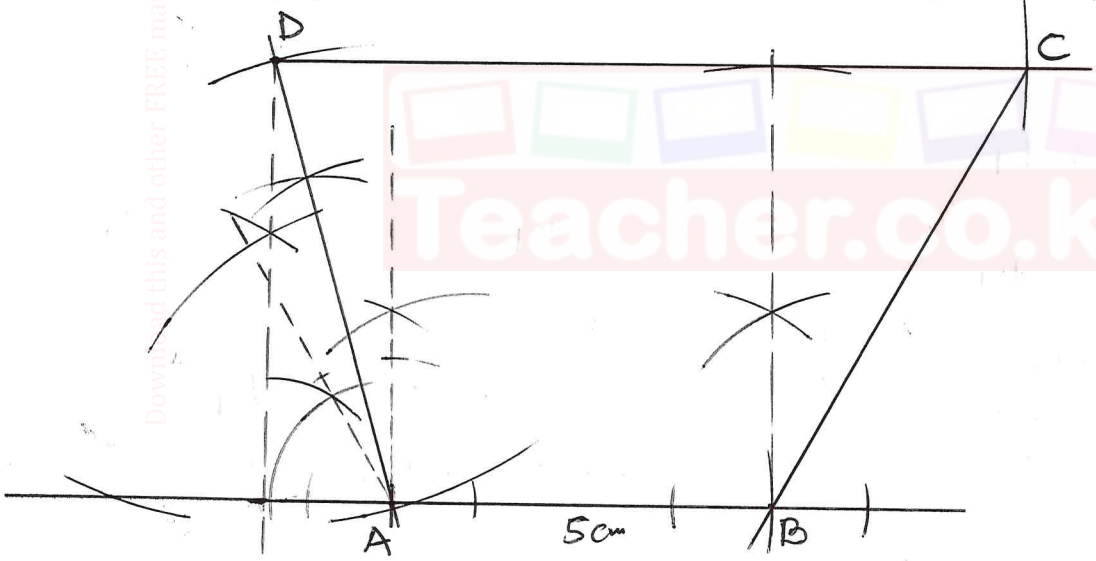
Alternatively

∠ADB = ½ × 68 = 34 B_1

BFC = 180 − (20 + 34)

= 126° B_1

13. Using a ruler and a pair of compasses only, construct a trapezium ABCD in which AB=5cm, AD=6cm, DC=10cm ∠BAD=105^0 and AB is parallel to DC. Draw a perpendicular from B to DC hence measure the height of the trapezium. (3 marks)



B_1 for Constr 105°

B_1 for Complete trapezium

Height = 5.7 ± 0.1 B_1

14. A sales agent is paid a commission of x% on sales over sh.80000. During a particular month he received a commission of sh. 14680 after selling 50 bicycles at a discount of 12%. If the marked price of a bicycle was sh. 18500, determine the value of x. (3 marks)

$SP = \frac{88}{100} \times 18500 \times 50$

= sh. 814 000 M_1

$\frac{x}{100} \times 734\,000 = 14680$ M_1

$x = \frac{14680}{7340}$

$= 2\%$ A_1

15. Use tables of reciprocal to evaluate $\frac{1}{0.0247}$ hence evaluate $\frac{\sqrt{30.25}}{2.47\times10^{-2}}$ (3 marks)

$\frac{1}{0.0247} = 0.4049\times10^{2}$ B1

$\sqrt{30.25} = \sqrt{\frac{3025}{100}}$

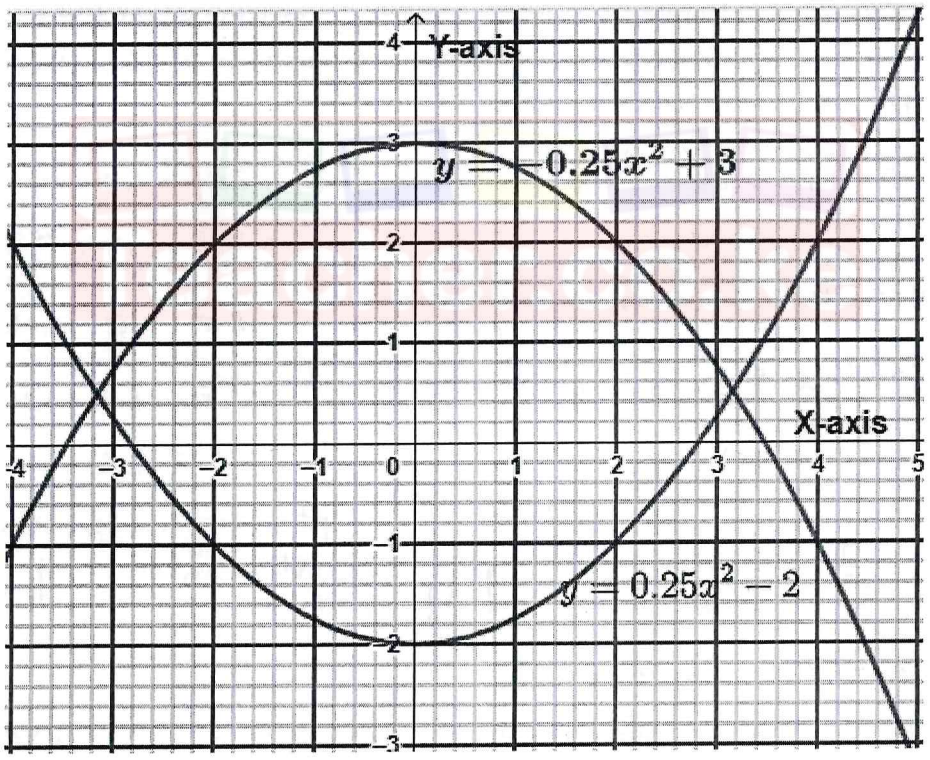
$= \sqrt{\frac{5^2\times11^2}{10^2}}$

$= 5.5$

40.49×5.5 M1

222.695 A1

16. Use mid-ordinate rule with 6 strips to estimate the area bounded by the curves and lines $x = -3$ and $x = 3$ (3 marks)



$h = \frac{3+3}{6} = 1$

x	-2.5	-1.5	-0.5	0.5	1.5	2.5
y	1.875	3.875	4.875	4.875	3.875	1.875

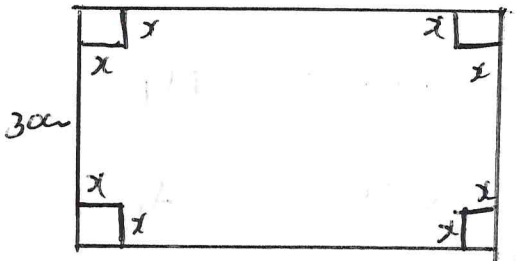
B1

$1[1.875 + 3.875 + 4.875 + 4.875 + 3.875 + 1.875]$ M1

$= 21.25$ sq. units A1

SECTION II: (Answer **ONLY 5** questions in this section)

17. (a) A rectangular piece of cardboard measuring 40cm by 30cm is to be made into an open box with a base of $936cm^2$ by cutting equal squares from the four corners and then binding up the sides. Find the length of the side of the square that must be cut from each corner. (4 marks)



M_1 (for expressions of the dimensions)

$(40-2x)(30-2x)=936$

$4x^2-140x+264=0$ M_1

$x^2-35x+66=0$

$x(x-33)-2(x-33)=0$

$(x-2)(x-33)=0$

$x=2$ or 33 M_1

Disregard 33

$\therefore x=2$ A_1

(b). A shopkeeper purchases a certain number of books for \$1200. If the cost per book was \$10 less, the number of books that could be purchased for \$1200 would be 4 more. Find the original cost of each book. (3 marks)

Let the original cost of a book be \$x

Original no. of books $= \frac{1200}{x}$

Reduced cost $= x-10$

New no. of books $= \frac{1200}{x-10}$

$\frac{1200}{x-10}-\frac{1200}{x}=4$ M_1

$x^2-10x-3000=0$

$x(x-60)+50(x-60)=0$

$(x+50)(x-60)=0$

$x=-50$ or 60 M_1

Rejecting $x=-50$

$\therefore x=60$

Hence the original cost of the book = \$60 A_1

(c) The sum of squares of two consecutive even integers is 244. Find the numbers. (3 marks)

Let the two consecutive even integers be x and $x+2$

$x^2+(x+2)^2=244$ M_1

$x^2+2x-120=0$

$(x+12)(x-10)=0$

$x=-12$ or $x=10$ M_1

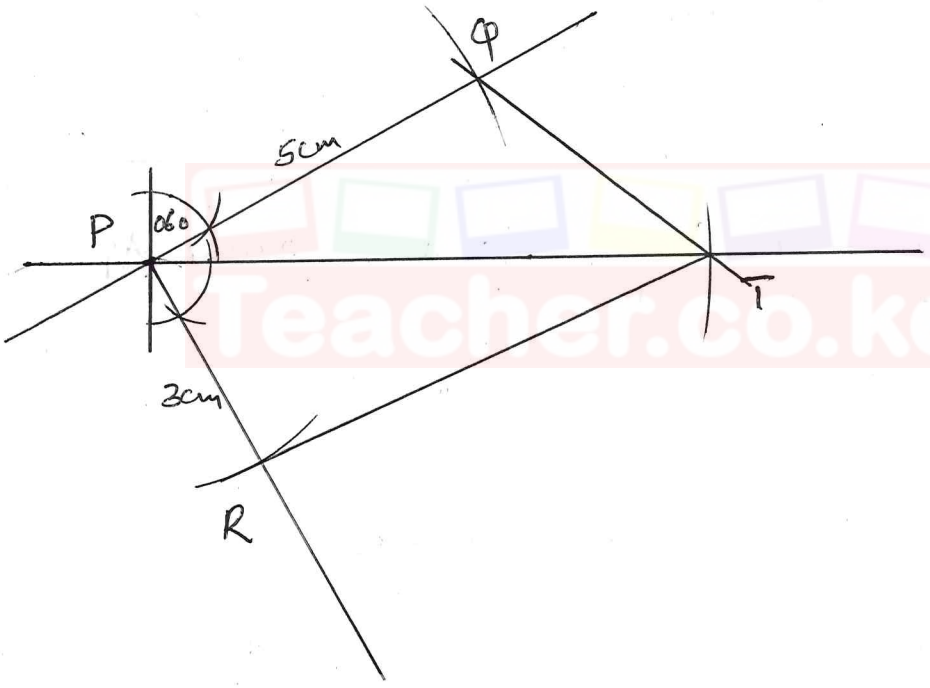
When $x=-12$ integers, -12 and -10

When $x=10$ integers are $10, 12$ A_1

18. At noon two ships Q and R leave for port P and sail out to sea. Ship Q sails at a steady speed of 50km/h on a bearing of 060^0 while ship R sails at a steady speed of 30km/h on a bearing of150^0. At 1600h both ships radio back to the port giving their positions. At the same time a third ship T gives its position at 300km due east of P.

(a) Using a ruler and compasses only, construct a scale drawing showing the positions of P, Q, R and T at 1600h. (Scale 1cm=40km) (4 marks)

Time from noon to 1600h = 4h
Distance PQ = 50x4 = 200km
Distance PR = 30x4 = 120km } M_1



B_1 for point Q
B_1 for point R
B_1 for point T

(b) Use your scale drawing to determine the distance

(i) Q from R (2 marks)

5·8x40 = 232±4km B_1B_1

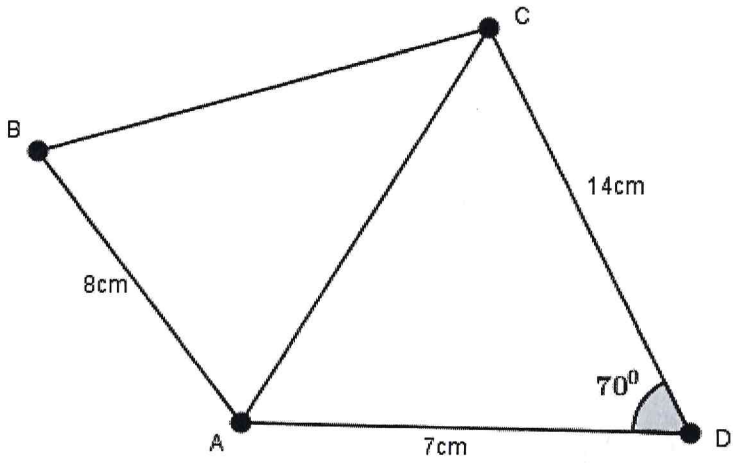
(ii) T from R (2 marks)

3·9x40 = 156±4km B_1B_1

(iii) R from T (2 marks)

6·5x40 = 262±4km B_1B_1

19. The figure below shows quadrilateral ABCD(not drawn to scale) with AB = 8cm, AD = 7cm, CD = 14cm and angle ADC = 70^0.



(a) Calculate to 4 significant figures, the length of side AC (3 marks)

$d^2 = 7^2 + 14^2 - 2 \times 7 \times 14 \cos 70^\circ$ M_1

$d^2 = 177.9640519$

$d = \sqrt{177.9640519}$ M_1

$= 13.34$ A_1

(b) Calculate to 2 decimal places, the size of angle ACD (2 marks)

$\frac{13.34}{\sin 70} = \frac{7}{\sin C}$ M_1 $\therefore ACD = 29.54$ A_1

$C = \sin^{-1} 0.493092079$

$C = 29.54^\circ$

(c) Given that angle ABC is 110^0 find to 1 decimal place

(i) Length BC (3 marks)

$\frac{13.34}{\sin 110} = \frac{8}{\sin C}$

$\angle C = 34.30$ M_1

$\frac{BC}{\sin 35.7} = \frac{13.34}{\sin 110}$ M_1

$BC = \frac{13.34 \sin 35.7}{\sin 110}$

$BC = 8.28$

$\simeq 8.3$ cm A_1

(ii) A circle is drawn through points A,B and C. Find the length of the largest chord of the circle (2 marks)

$\frac{13.34}{\sin 110} = 2R$ M_1

$D = 14.20$ A_1

20. (a). Find the inverse of $\begin{pmatrix} 16 & 5 \\ 4 & 3 \end{pmatrix}$ (2 marks)

$\det = 16\times3 - 4\times5$

$= 28$

$\text{Inverse} = \frac{1}{28}\begin{bmatrix} 3 & -5 \\ -4 & 16 \end{bmatrix} = \begin{bmatrix} \frac{3}{28} & -\frac{5}{28} \\ -\frac{1}{7} & \frac{4}{7} \end{bmatrix}$

(b). In a certain day, a business man total sales from 16 blouses and 5 pairs of trousers was sh.8000. On the following day, his total sales went down by 57.5% . If he had sold 4 blouses and 3 pairs of trousers during the second day, determine by the matrix method, the price of each item. (4 marks)

$16b + 5t = 8000$

$4b + 3t = 3400$

$\begin{bmatrix} 16 & 5 \\ 4 & 3 \end{bmatrix}\begin{pmatrix} b \\ t \end{pmatrix} = \begin{bmatrix} 8000 \\ 3400 \end{bmatrix}$ M_1

$\begin{bmatrix} \frac{3}{28} & -\frac{5}{28} \\ -\frac{1}{7} & \frac{4}{7} \end{bmatrix}\begin{bmatrix} 16 & 5 \\ 4 & 3 \end{bmatrix}\begin{pmatrix} b \\ t \end{pmatrix} = \begin{bmatrix} \frac{3}{28} & -\frac{5}{28} \\ -\frac{1}{7} & \frac{4}{7} \end{bmatrix}\begin{bmatrix} 8000 \\ 3400 \end{bmatrix}$

$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} b \\ t \end{pmatrix} = \begin{bmatrix} \frac{3}{28}\times8000 + -\frac{5}{28}\times3400 \\ -\frac{1}{7}\times8000 + \frac{4}{7}\times3400 \end{bmatrix}$ M_1

$\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}\begin{pmatrix} b \\ t \end{pmatrix} = \begin{pmatrix} 250 \\ 800 \end{pmatrix}$

Cost of a blouse = sh 250 A_1

Cost of a trouser = sh 800 A_1

(c). On the third day, the businessman reduced the price of a pair of trouser by 8% and increased that of a blouse by 12%. As a result he sold twice as many trousers as blouses. If the day's total sales were sh.10512, determine the number of blouses and pairs of trousers that he sold on the third day. (4 marks)

Trousers	blouses
$2x$	x

$\frac{92}{100}\times800 = \text{sh } 736$

$\frac{112}{100}\times250 = \text{sh } 280$ } M_1

$736(2x) + 280(x) = 10512$ M_1

$x = 6$

Blouses = 6 A_1

Pairs of trousers = 12 A_1

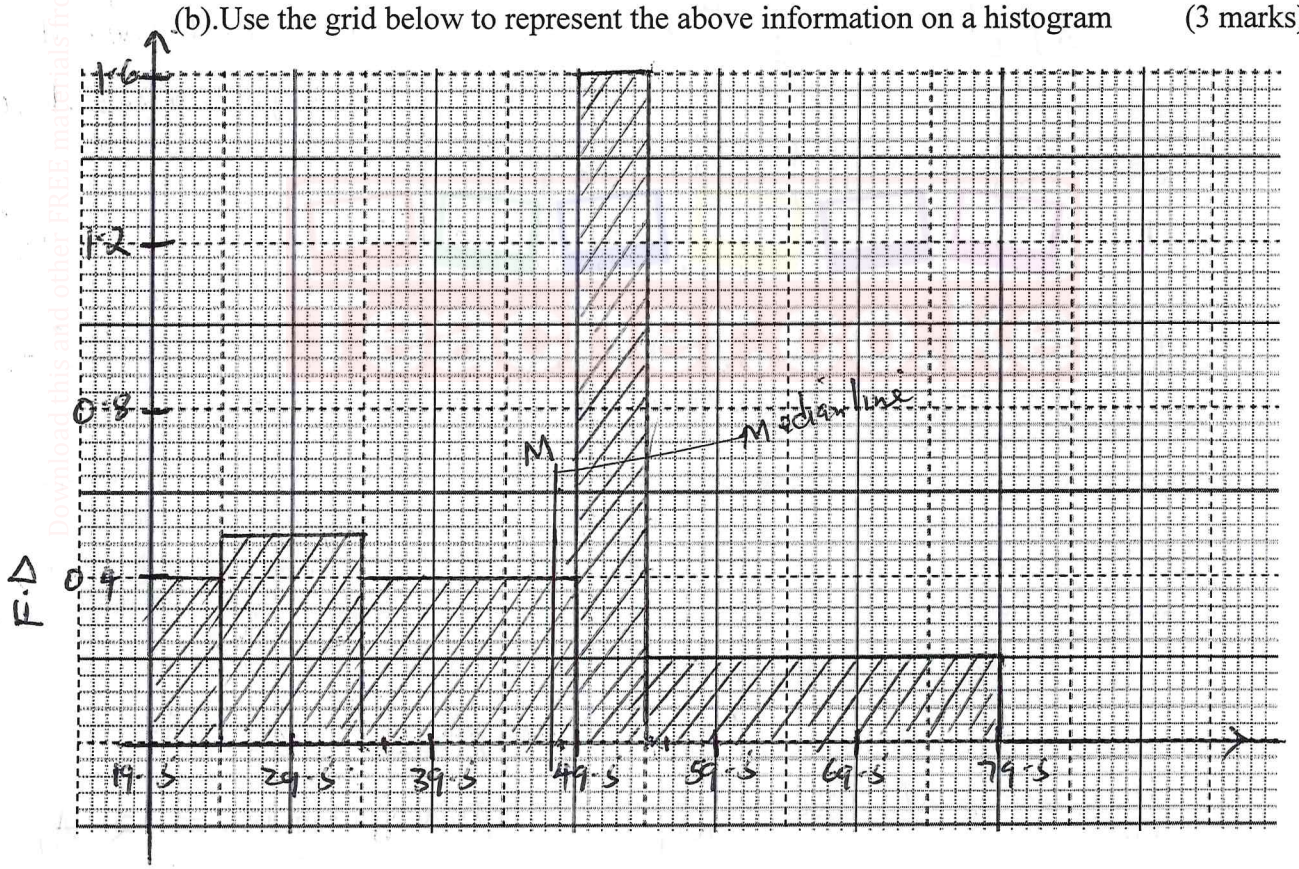
21. The masses in kilograms of patients who attended clinic on a certain day were recorded as follows:

69	54	48	26	53	33	50	39	21
54	30	46	72	50	63	28	51	36
23	25	53	45	59	37	52		

(a) Complete the frequency distribution table below for the above information. (2 marks)

Mass (kg)	No.of patients	Frequency density
20 – 24	2	$2/5 = 0.4$
25 – 34	5	$5/10 = 0.5$
35 – 49	6	$6/15 = 0.4$
50 – 54	8	$8/5 = 1.6$
55 – 74	4	$4/20 = 0.2$

(b).Use the grid below to represent the above information on a histogram (3 marks)



(c) Use the histogram to

i. estimate the median mass (3 marks

$0.4 \times 5 + 0.5 \times 10 + 0.4 \times w = 12.5$ M1 L1 (for line M).

$w = 13.75$

Median $= 13.75 + 34.5 = 48.25$ A1

ii. determine the number of patients whose mass is between 36kgs and 56kgs (2 marks)

$13.5 \times 0.4 + 1.6 \times 5 + 1.5 \times 2$ ✓M1

$= 13.7$

$\simeq 13$ patients ✓ A1

22. (a) On the grid provided below draw triangle ABC with vertices A(1,4),B(4,3) and C(3,2) (1 mark)

(b).On the same grid draw $\Delta A^{I}B^{I}C^{I}$ with vertices $A^{I}(2,-5),B^{I}(3,-2)$ and $C^{I}(4,-3)$ hence describe fully the transformation that maps ΔABC onto $\Delta A^{I}B^{I}C^{I}$. (4 marks)

Rotation through +270°, about (6,0) or

Rotation thr +90°, about (6,0)

(c).On the same grid draw $\Delta A^{II}B^{II}C^{II}$, the image of $\Delta A^{I}B^{I}C^{I}$ under enlargement scale factor -2, centre $(1,-2)$. State the coordinates of $\Delta A^{II}B^{II}C^{II}$. (3 marks)

$A^{II}(-1,4)$ $B^{II}(-3,-2)$ $C^{II}(-5,0)$

(a) ΔABC B_1

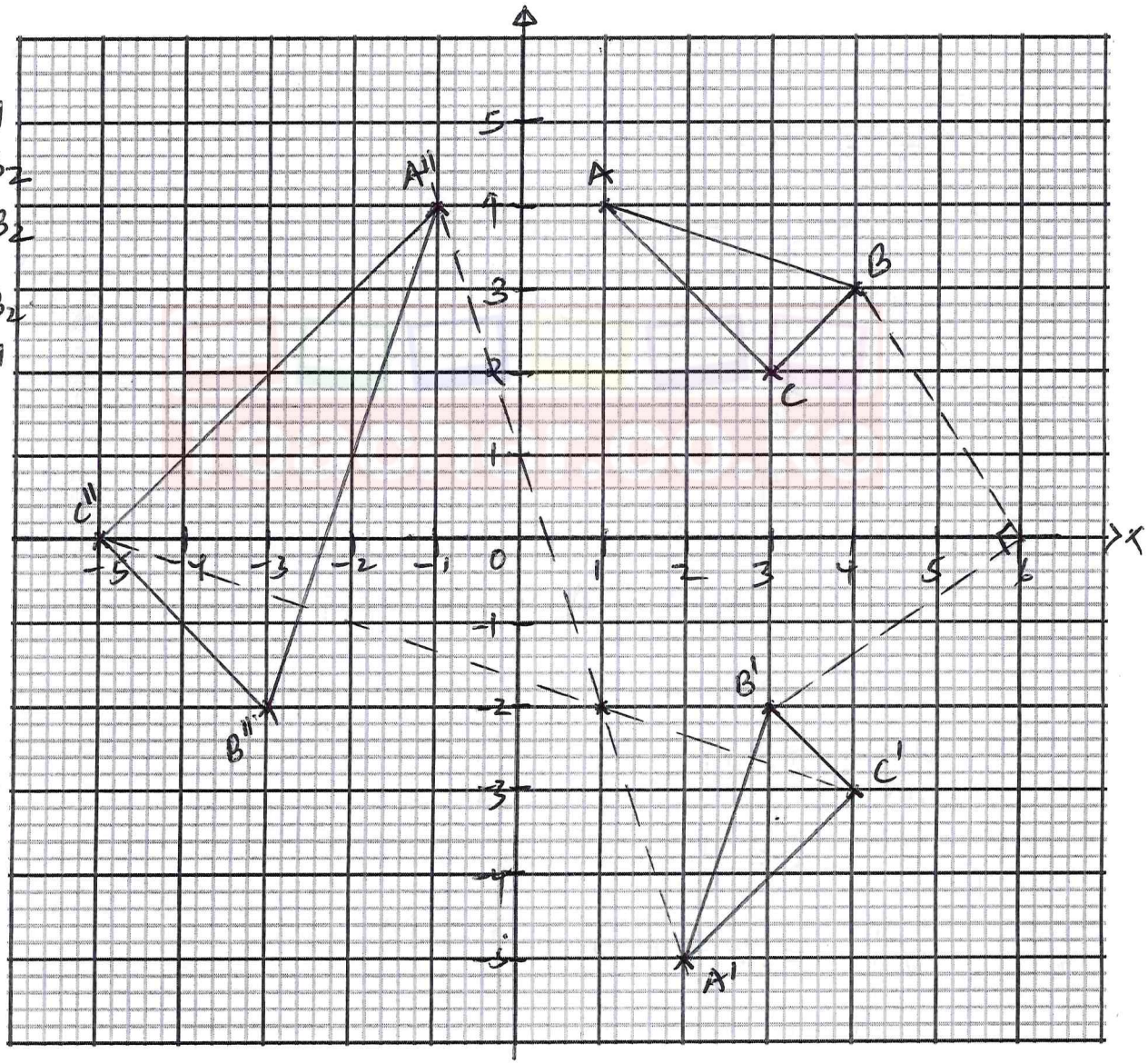
(b) $\Delta A'B'C'$ B_2

describing trans B_2

(c) $\Delta A^{II}B^{II}C^{II}$ B_2

coordinates B_1

(d) B_2



(d). If $\Delta A^{III}B^{III}C^{III}$ is the image of $\Delta A^{II}B^{II}C^{II}$ under translation vector $\begin{pmatrix}1\\-2\end{pmatrix}$, without drawing determine the coordinates the image. (2 marks)

$A^{III}(0,2)$ $B^{III}(-2,-4)$ $C^{III}(-4,-2)$

23. The displacement, S metres, of a particle moving along a straight line from point O, after t seconds is given by $S = 5 + 8t + t^2 - \frac{1}{3}t^3$

(a) Find displacement of the particle during the 5th second. (4 marks)

$S\Big|_{t=4} = 5 + 8(4) + (4)^2 - \frac{1}{3}(4)^3 = 31\frac{2}{3}$ M_1

$S\Big|_{t=5} = 5 + 8(5) + (5)^2 - \frac{1}{3}(5)^3 = 28\frac{1}{3}$ M_1

M_1

$28\frac{1}{3} - 31\frac{2}{3} = -3 m/s$ A_1

(b) Determine:

(i) The time when the particle is momentarily at rest. (3 marks)

$\frac{ds}{dt} = 8 + 2t - t^2$

$t^2 - 2t - 8 = 0$ M_1

$p = -8$ $r = -4 \times 2$

$s = -2$

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

$t = 4$ or -2 M_1

Disregard -2

$\therefore$ time = 4 second A_1

(ii) The maximum velocity attained by the particle. (3 marks)

$\frac{dv}{dt} = 2 - 2t = 0$ M_1

$t = 1$

$V\Big|_{t=1} = 8 + 2(1) - (1)^2$ M_1

$= 9 m/s$ A_1

24. A solid frustum of a cone with base radius 10.5 cm and top radius 7 cm is made of a material whose density is 10 g/cm^3.The mass of the solid is 58.52 kg.

(a) Determine the volume of:

(i) The frustum in cm^3. (2 marks)

$V = \frac{58520\,g}{10\,g/cm^3}$ M1

$= 5852 cm^3$ A1

(i) The cone that was cut off to obtain the frustum in cm^3. (3 marks)

$k.s.f = \frac{10.5}{7} = 1.5$ M1

$V.s.f = \left(\frac{10.5}{7}\right)^3 = 3.375$

Let volume of the small cone $= x$

$3.375 = \frac{5852 + x}{x}$ M1

$x = 2464 cm^3$ A1

(b) Find the height of:

(i) The cone that was cut off to obtain the frustum. Take$\pi = \frac{22}{7}$ (3 marks)

$2464 = \frac{1}{3} B.A \times Height$

$\frac{1}{3} \times \frac{22}{7} \times 7^2 \times h = 2464$ M1

$h = \frac{2464 \times 3}{154}$ M1

$= 48 cm$ A1

(ii) The frustum. (2 marks)

$1.5 = \frac{y + 48}{48}$ M1

$y = 24 cm$ A1