



MARANDA HIGH SCHOOL

Kenya Certificate of Secondary Education

MOCK EXAMINATIONS

121/1

MATHEMATICS

Paper 1

September 2022 – TIME $2\frac{1}{2}$ Hours

Name: **MARKING SCHEME** Adm No:

Class: Candidate's Signature: Date:/09/2022.

Instructions to Candidates

- Write your name, admission number and class in the spaces provided above.
- Sign and write the date of examination in the spaces provided above.
- This paper consists of **two** sections; **Section I** and **Section II**.
- Answer **all** the questions in **Section I** and **any five** questions from **Section II**.
- Show **all** the steps in your calculations, giving your answers at each stage in the spaces provided below each question
- Marks may be given for correct working even if the answer is wrong.
- Non-programmable silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.
- This paper consists of **16** printed pages.
- 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

Section I (50 Marks)

Answer ALL questions in the section in the space provided:

1. Evaluate without using a calculator 0.01% of $\left[\frac{\frac{1}{2} + 0.75 - \frac{3}{8}}{4.5 - \frac{1}{8} - \frac{2}{5}} \right]$. (4 marks)

$$\frac{0.01}{100} \text{ of } \left[\frac{\frac{4 + 6 - 3}{8}}{180 - 5 - 16} \right]$$

$$\frac{1}{10,000} \left[\frac{7}{8} \times \frac{40}{159} \right]$$

$$= \frac{1}{10000} \times \frac{7 \times 5}{159}$$

$$= \frac{7}{200 \times 159}$$

$$= \frac{7}{31,800}$$

2. The sum of the ages of three brothers; Mike, Charles and Abdul is 65 years. Mike is twice as old as Abdul and one and half times as old as Charles. Determine their ages. (3 marks)

$$M : C : A$$

$$2x : x$$

$$x : \frac{1}{2}x$$

$$2x : 3x : \frac{1}{2}x \quad \checkmark M_1$$

$$x = \frac{65}{13}$$

$$= 5$$

$$\begin{aligned} \text{Mike's Age} &= 30 \text{ yrs} \\ \text{Charles Age} &= 20 \text{ yrs} \\ \text{Abdul's Age} &= 15 \text{ yrs} \end{aligned} \quad \checkmark A_1$$

3. A supermarket has 18 apples, 30 oranges and 54 apples. The fruits are to be arranged in rows such that every row contains same number of fruits of one type only. Determine the least number of rows required for this arrangement to happen. (3 marks)

$$18 = 2 \times 3^2$$

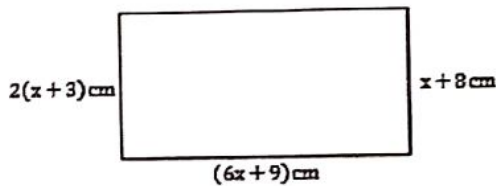
$$30 = 2 \times 3 \times 5$$

$$54 = 2 \times 3^3$$

$$\begin{aligned} \text{GCD} &= 2 \times 3 \quad \checkmark M_1 \\ &= 6 \quad \checkmark A_1 \end{aligned}$$

4. Find the area of the rectangle below.

(3 marks)



$$2x+6 = x+8 \quad \checkmark M_1$$

$$x = 2$$

$$L = 12+9$$

$$W = 2+8$$

$$A = 21 \times 10 \quad \checkmark M_1$$

$$= 210 \text{ cm}^2 \quad \checkmark A_1$$

5. Without using a Calculator or Mathematical Table evaluate the value of p :

(3 marks)

$$\frac{4}{p^2} = 221^2 - 220^2$$

$$\frac{4}{p^2} = (221-220)(221+220) \quad \checkmark M_1 \quad \text{Difference of two squares}$$

$$\frac{4}{p^2} = 441$$

$$\frac{1}{p} = \sqrt{\frac{441}{4}}$$

$$\frac{1}{p} = \pm \frac{21}{2} \quad \checkmark M_1 \quad \text{Square roots}$$

$$p = \pm \frac{2}{21} \quad \checkmark A_1 \quad \text{C.A.O}$$

6. Calculate the value of x given that $OA = \begin{pmatrix} x \\ 4 \end{pmatrix}$, $OB = \begin{pmatrix} 5 \\ 7 \end{pmatrix}$ and $|AB| = 5$ units.

(3 marks)

$$\begin{aligned} \vec{AB} &= \vec{AO} + \vec{OB} \\ &= -\begin{pmatrix} x \\ 4 \end{pmatrix} + \begin{pmatrix} 5 \\ 7 \end{pmatrix} \quad \checkmark M_1 \\ &= \begin{pmatrix} 5-x \\ 3 \end{pmatrix} \end{aligned}$$

$$\sqrt{(5-x)^2 + 3^2} = 5^2 \quad \checkmark M_1$$

$$9 + (5-x)^2 = 25$$

$$(5-x)^2 = 16$$

$$5-x = \pm 4$$

$$x = 1 \text{ or } 9 \quad \checkmark A_1$$

7. Solve for k in the equation $\frac{\sin(2k+10)^\circ}{\cos(3k-20)^\circ} = 1$.

(2 marks)

$$\Rightarrow \sin(2k+10)^\circ = \cos(3k-20)^\circ$$

$$2k+10 + 3k-20 = 90^\circ \quad \checkmark M1$$

$$5k = 100$$

$$k = 20^\circ \quad \checkmark A1$$

8. Solve for x in the equation $\sqrt{-2x-6} - 3 = x$.

(3 marks)

$$\sqrt{-2x-6} = 3+x$$

$$-2x-6 = x^2+6x+9 \quad \checkmark M1$$

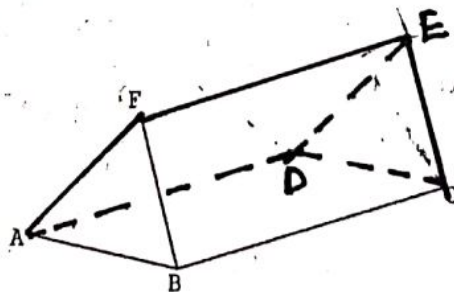
$$x^2+8x+15 = 0$$

$$x = \frac{-8 \pm \sqrt{64-60}}{2}$$

$$= \frac{-8 \pm 2}{2} \quad \checkmark M1$$

$$x = -5 \text{ or } -3 \quad \checkmark A1$$

9. In the figure below ABF is a uniform cross section of a solid. AB, BC and BF are some of the visible edges of the solid. Complete the sketch showing the hidden edges with broken lines. (3 marks)



$\checkmark B1$ All bear sides correctly drawn
 $\checkmark B1$ All the hidden sides correctly drawn in broken line
 $\checkmark B1$ All the pts correctly labelled

10. Mr. Charles who deals in electronics sells a radio to a customer at Kshs. 1,440 after giving him a discount of 10% but finds that he still makes a 20% profit. Find the profit Mr. Charles would make if he does not give a discount. (3marks)

$$M.P = \frac{1440 \times 100}{90} \checkmark M_1$$

$$= 1600/2$$

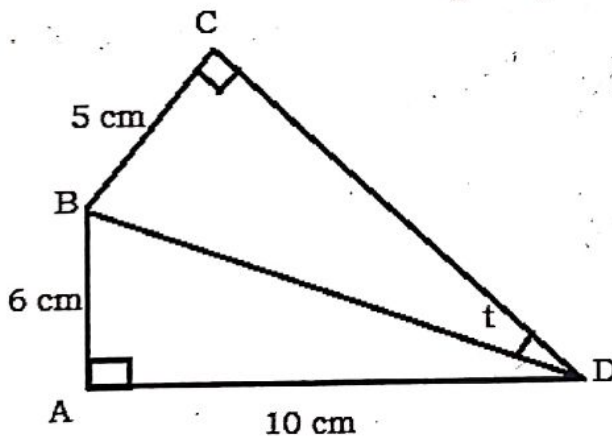
$$B.P = \frac{1440 \times 100}{120} \checkmark M_1$$

$$= 1200/2$$

$$Profit = 1600 - 1200$$

$$= 400/2 \checkmark A_1$$

11. The figure below shows a set of two right angled triangles ABD and BCD conjoined by side BD. Sides AB, BC and AD are 6cm, 5cm and 10cm in lengths respectively.



Calculate the size of angle $CDB = t$.

$$BD = \sqrt{10^2 + 6^2} \checkmark M_1$$

$$= 11.662 \checkmark A_1$$

$$\sin CDB = \frac{5}{11.662} \checkmark M_1$$

$$\angle CDB = 28.209^\circ \checkmark A_1$$

(3 marks)

12. Given that $\log 3 = 0.4771$ and $\log 5 = 0.6990$, find without using Mathematical table or calculator $\log 0.045$. (3 marks)

$$\log(0.045) = \log(3^2 \times 5 \times 10^{-3}) \checkmark M1$$

$$= 2\log 3 + \log 5 + \bar{3}$$

$$= 2(0.4771) + 0.6990 + \bar{3} \checkmark M1$$

$$= \bar{2}.6532 \checkmark A1$$

Alternatively:

$$2\log 3 + \log 5 - 3\log 10$$

$$2(0.4771) + 0.6990 -$$

$$-1.3468 \checkmark A1$$

13. Two towns A and B are 810km apart. A car left A at 8:00am moving towards B at an average speed of xkm/h. A bus left town B at 9:30am moving towards A at an average speed of 84km/h. Determine the average speed of the car, xkm/h, if the two vehicles met at 11:00am. (4 marks)

The distance covered by the car for $1\frac{1}{2}$ hrs = $1\frac{1}{2}x$ km

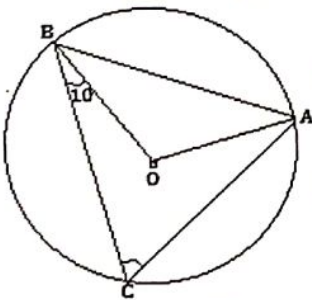
Remaining distance = $810 - 1\frac{1}{2}x$ $\checkmark M1$

$$\frac{810 - \frac{3}{2}x}{x + 84} = \frac{3}{2} \checkmark M1$$

$$1620 - 3x = 3x + 252 \checkmark M1$$

$$x = 228 \text{ km/h} \checkmark A1$$

14. In the figure given below, O is the centre of circle. If $\angle BCA = 80^\circ$ and $\angle CBO = 10^\circ$.



Determine the size of $\angle CAB$. (3 marks)

$$\angle OAC = \angle OCA = 70^\circ \checkmark M1$$

$$\angle OAB = 10^\circ$$

$$\angle CAB = 70^\circ + 10^\circ \checkmark M1$$

$$= 80^\circ \checkmark A1$$

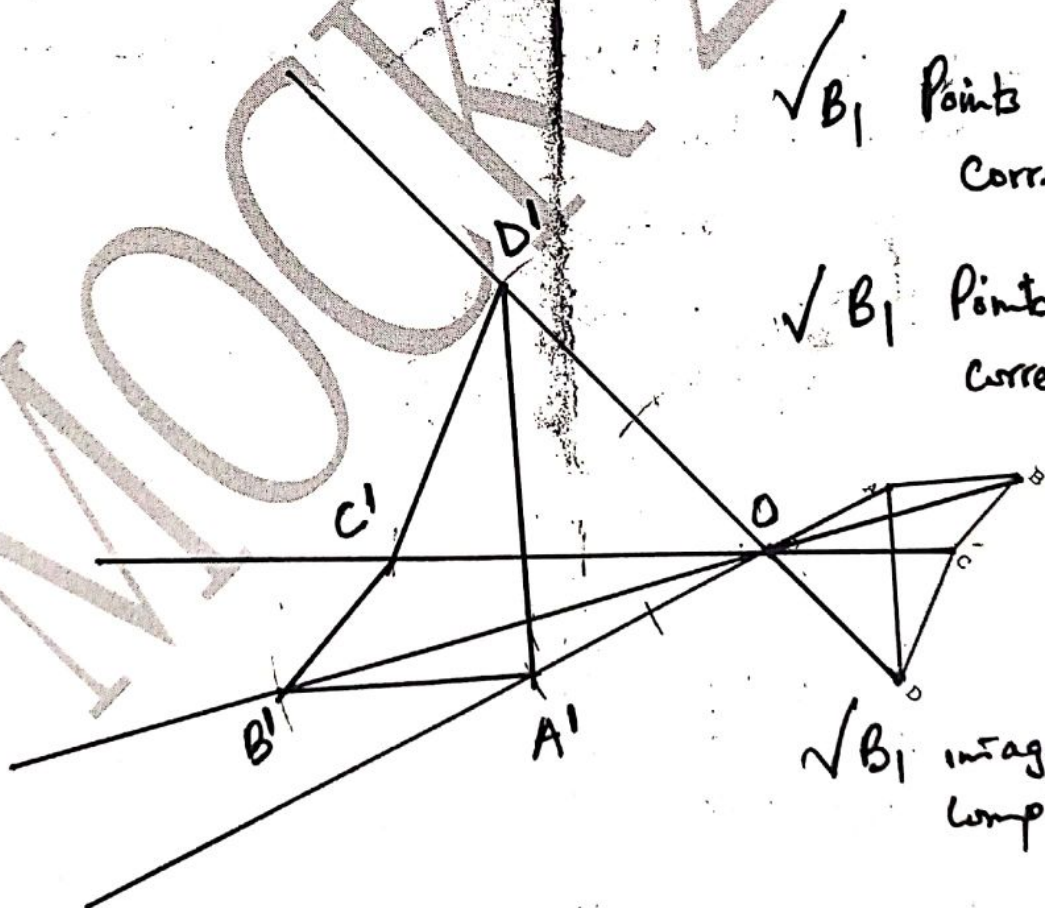
15. Using mid-ordinate rule with six strips estimate the area between the curve $y = 3x^2 + 4x + 10$,
 x - axis and the lines $x = -2$ and $x = 4$. (4 marks)

x	-1.5	-0.5	0.5	1.5	2.5	3.5	$\checkmark B_1$
y	10.75	8.75	12.75	22.75	38.75	60.75	$\checkmark B_1$

$$A = 1 [10.75 + 8.75 + 12.75 + 22.75 + 38.75 + 60.75] \checkmark M_1$$

$$= 154.5 \text{ square units } \checkmark A_1$$

- * 16. Construct $A'B'C'D'$ the image of quadrilateral $ABCD$ below, given that it undergoes under
 transformation enlargement with scale factor -2 and centre O . (3 marks)



Section II (50 Marks)

Answer ONLY FIVE questions in the section in the space provided:

17. The equation of line l_1 is $2x+3y+6=0$.

a) Find the gradient of line l_1

$$3y = -\frac{2}{3}x - \frac{6}{3}$$

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

$$m = -\frac{2}{3} \quad \checkmark B_1$$

(1 mark)

b) The line l_2 is perpendicular to l_1 and passes through the point P with coordinates (7, 2), find the equation of l_2 , giving the answer in the form $y=mx+c$ where m and c are constants. (3 marks)

$$-\frac{2}{3} \times m_2 = -1$$

$$m_2 = \frac{3}{2} \quad \checkmark B_1$$

$$\frac{y-2}{x-7} = \frac{3}{2} \quad \checkmark M_1$$

$$y = 1\frac{1}{2}x - 8\frac{1}{2} \quad \checkmark A_1$$

penalize improper fraction (3 marks)

c) The line l_1 and l_2 intersect at point Q. Find the coordinates of Q.

At Q $-\frac{2}{3}x - 2 = 1\frac{1}{2}x - 8\frac{1}{2} \quad \checkmark M_1$ hence the co-ordinates of Q is Q(3, -4) $\checkmark A_1$

$$\Rightarrow -2\frac{1}{6}x = -\frac{13}{2}$$

$$x = 3$$

$$y = -\frac{2}{3}(3) - 2 \quad \checkmark M_1$$

$$= -4$$

d) The line l_3 is parallel to l_1 and passes through point P. Find the equation of l_3 giving the answer in the form $ax+by=c$, where a , b and c are constants. (2 marks)

$$m_3 = -\frac{2}{3}$$

$$\frac{y-2}{x-7} = -\frac{2}{3} \quad \checkmark M_1$$

$$2x+3y = 20 \quad \checkmark A_1$$

e) Determine the x and y-intercepts of the line l_3 .

(1 mark)

y intercept is $6\frac{2}{3}$ } $\checkmark B_1$
 x intercept is 10

18. The Form Two Parents of Ushindi High School decided to buy laboratory equipment worth Kshs.900,000 by each student contributing equal amount of money. Before they made the contribution 50 students got transferred to other institutions and this made the remaining students to pay Kshs.600 more.

a) Taking x to represent the original number of students, write down an expression for:

i) The original contribution per student.

$$\frac{900000}{x} \quad \checkmark B_1$$

(1 mark)

ii) The new contribution per student.

$$\frac{900,000}{x-50} \quad \checkmark B_1$$

(1 mark)

b) Find the original number of students who were to contribute.

(4 marks)

$$\frac{900000}{x-50} - \frac{900000}{x} = \frac{600}{1} \quad \checkmark M_1$$

$$600(x^2 - 50x) = 900000x - 900000x + 45000000$$

$$600x^2 - 30,000x - 45,000,000 = 0 \quad \checkmark M_1$$

$$x = \frac{50 \pm \sqrt{2500 + 300,000}}{2}$$

$$= \frac{50 \pm 550}{2} \quad \checkmark M_1$$

$$x = 300 \text{ or } -250$$

$$\therefore x = 300 \text{ students} \quad \checkmark A_1$$

c) Calculate the percentage change in the students' contributions.

(2 marks)

$$\begin{aligned} \text{Original contribution} &= \frac{900,000}{300} \quad \checkmark M_1 \\ &= 3000 \end{aligned} \quad \begin{aligned} \text{Percentage change} &= \frac{600}{3000} \times 100\% \quad \checkmark \\ &= 20\% \quad \checkmark A_1 \end{aligned}$$

d) If the ratio of boys to girls that remained in Form 2 was 13:12 calculate the amount contributed by the boys alone.

(2 marks)

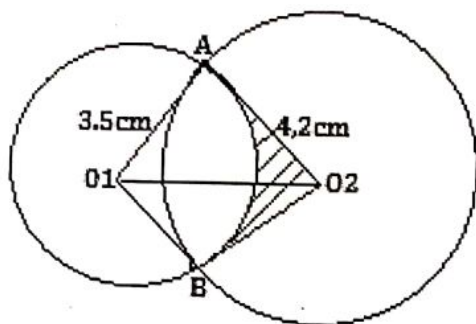
$$\text{Remaining students} = 300 - 50$$

$$= 250$$

$$\text{Boy's contribution} = 130 \times 3600 \quad \checkmark M_1$$

$$= 468,000 \quad \checkmark A_1$$

19. Two circles of radii 3.5 and 4.2 cm with centres O_1 and O_2 respectively intersect at points A and B as shown in the figure below. The distance between the two centres is 6 cm and the distance from O_1 to the common chord AB along O_1O_2 is x cm.



Calculate:

- a) The distance x cm to 3 decimal places. (3 marks)

$$\begin{aligned}\frac{1}{2} AB &= \sqrt{3.5^2 - x^2} \\ \frac{1}{2} AB &= \sqrt{4.2^2 - (6-x)^2} \\ \Rightarrow 4.2^2 - (6-x)^2 &= 3.5^2 - x^2 \quad \checkmark M_1 \\ 12x &= 36 + 3.5^2 - 4.2^2 \quad \checkmark M_1 \\ x &= 2.551 \text{ cm} \quad \checkmark A_1\end{aligned}$$

- b) The size of $\angle AO_1B$ and $\angle AO_2B$ (to the nearest degree). (3 marks)

$$\begin{aligned}\cos \angle AO_1B &= \frac{2.551 \times 2}{3.5} \quad \checkmark M_1 & \cos \angle AO_2B &= \frac{3.449 \times 2}{4.2} \quad \checkmark M_1 \\ \angle AO_1B &= 86^\circ \quad \checkmark A_1 & &= 70^\circ \quad \checkmark A_1\end{aligned}$$

- c) The area of quadrilateral O_1AO_2B , correct to 2 decimal place (2 marks)

$$\begin{aligned}\text{Area of } O_1AO_2B &= \frac{1}{2} \times 3.5^2 \sin 86^\circ + \frac{1}{2} \times 4.2^2 \sin 70^\circ \quad \checkmark M_1 \\ &= 14.40 \text{ cm}^2 \quad \checkmark A_1\end{aligned}$$

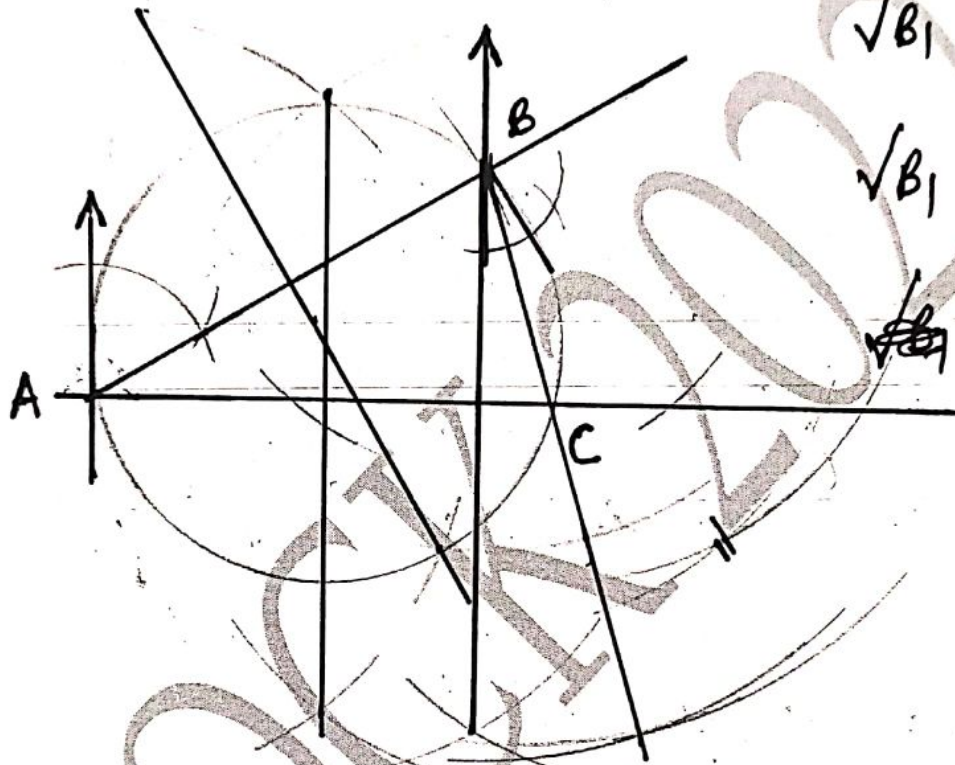
- d) The shaded area correct to two significant figures. (Take $\pi = 3.142$). (2 marks)

$$\begin{aligned}\text{Area of the shaded region} &= 14.40 - \frac{86^\circ}{360^\circ} \times 3.142 \times 3.5^2 \quad \checkmark M_1 \\ &= 5.8 \text{ cm}^2 \quad \checkmark A_1\end{aligned}$$

20. Three towns A, B and C are such that B is 120km on a bearing of 060° from A. C lies directly East of A on a bearing 165° from B. Using a scale of 1cm to represent 20km, a pair of compass and a ruler only, determine:

a) the relative positions of A, B and C.

(3 marks)



✓ B, correct scale used.
 ✓ B, B correct located from A
 ✓ B, C correct located from A and B

b) drop a perpendicular from B to meet AC at M hence measure BM.

(2 marks)

c) $3 \pm 0.1 \text{ cm}$ ✓ B, $60 \pm 2 \text{ km}$ ✓ B, construct a circle passing through the vertices A, B and C then calculate the area covered in the circle.

$$\text{Radius} = 3.2 \pm 1$$

(2 marks)

✓ B, Constructing of the circumcircle

$$A = \frac{22}{7} \times 64^2$$

$$= 12873.142857142 \text{ km}^2 \text{ ✓ B,}$$

d) Determine the amount of money used in ploughing the land inside the circle but outside triangle ABC at a rate of Kshs. 5000 per hectare.

(3 marks)

$$\text{Area outside } \triangle ABC = 12873.142857142 - \frac{1}{2} \times 120 \times 60 \text{ ✓ M,}$$

$$= 9273.142857142 \text{ km}^2$$

$$\text{Money spent} = 9273.142857142 \times 10^6 \times 5000 \text{ ✓ M,}$$

$$= 4,636,571,429 / = \text{✓ A,}$$

21. A solid is partly a cone and partly an hemisphere of radius 7cm. The slanting length of the cone is 25cm. Determine;

(2 marks)

a) the height of the solid.

$$h = 7 + \sqrt{25^2 - 7^2} \quad \sqrt{M_1}$$

$$= 31 \text{ cm} \quad \sqrt{A_1}$$

b) the volume of the solid

(3 marks)

$$V = \frac{1}{3} \times \frac{22}{7} \times 7^2 \times 24 + \frac{2}{3} \times \frac{22}{7} \times 7^3 \quad \sqrt{M_1}$$

$$= 1950 \frac{2}{3} \text{ cm}^3 \quad \sqrt{A_1}$$

c) the surface area of the solid.

(3 marks)

$$S.A = 2 \times \frac{22}{7} \times 7^2 + \frac{22}{7} \times 7 \times 25 \quad \sqrt{M_1}$$

$$= 858 \text{ cm}^2 \quad \sqrt{A_1}$$

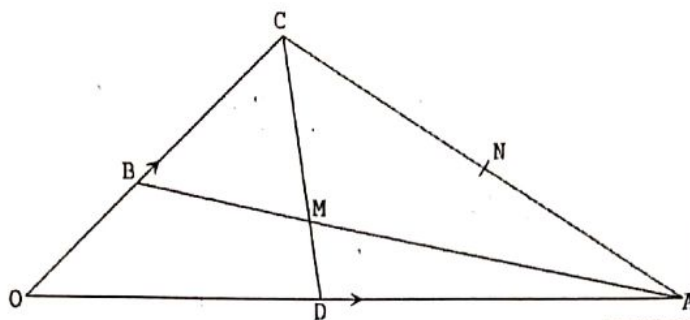
d) the mass of the solid if its density is 12.5g/cm³.

(2 marks)

$$m = 12.5 \times 1950 \frac{2}{3} \quad \sqrt{M_1}$$

$$= 24383 \frac{1}{3} \text{ g} \quad \sqrt{A_1}$$

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



- a) Given that $\vec{OD} = \frac{1}{3}\vec{OA}$ and $\vec{AN} = \frac{1}{2}\vec{AC}$, \vec{CD} and \vec{AB} meet at M. Determine in terms of a and b .

i) $\vec{AB} = \vec{AO} + \vec{OB}$ (1 mark)

$$= -a + b \quad \sqrt{B_1}$$

ii) $\vec{CD} = -3b + \frac{1}{3}a$ (1 mark)

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

$$\vec{CM} = k(-3b + \frac{1}{3}a)$$

$$\vec{AM} = h(-a + b) \quad \sqrt{B_1}$$

$$\vec{AM} = \vec{AC} + \vec{CM}$$

$$= -a + 3b + k(-3b + \frac{1}{3}a)$$

$$= (-1 + \frac{1}{3}k)a + (3-3k)b \quad \sqrt{B_1}$$

$$h(-a + b) = (-1 + \frac{1}{3}k)a + (3-3k)b \quad \sqrt{A_1}$$

Comparing the coefficients

$$-h = -1 + \frac{1}{3}k$$

$$h = 3 - 3k$$

$$\Rightarrow -(3-3k) = -1 + \frac{1}{3}k \quad \sqrt{M_1}$$

$$k = \frac{3}{4}$$

$$h = 3 - 3 \times \frac{3}{4} \quad \sqrt{A_1}$$

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

for both marks

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

$$\vec{OM} = 3b + \frac{3}{4}(-3b + \frac{1}{3}a)$$

$$= \frac{3}{4}b + \frac{1}{4}a \quad \sqrt{B_1}$$

$$\vec{MN} = (\frac{1}{2}a - \frac{3}{4}a) + (\frac{3}{4}b - \frac{3}{4}b)$$

$$\vec{MN} = \frac{3}{4}b + \frac{1}{4}a \quad \sqrt{B_1}$$

$$\vec{OM} = t \vec{MN} \text{ where } t \text{ is scalar}$$

$$\vec{OM} = \vec{MN} \text{ hence } \vec{OM} \parallel \vec{MN}$$

Since OM is parallel to MN

and they share a common pt M
then points O, M and N are
collinear $\sqrt{B_1}$

23. The displacement of a particle is given as $s = t^3 - 6t^2 + 9t + 50$ metres.

Determine;

(2 marks)

a) The displacement of the particle when $t = 2$ seconds.

$$\begin{aligned} s(2) &= 2^3 - 6(2)^2 + 9(2) + 50 \sqrt{M} \\ &= 52 \text{ m } \sqrt{A} \end{aligned}$$

b) the velocity of the particle when $t = 4$

(2 marks)

$$\begin{aligned} v &= 3t^2 - 12t + 9 \sqrt{M} \\ v(4) &= 3(4)^2 - 12(4) + 9 \\ &= 9 \text{ m s}^{-1} \sqrt{A} \end{aligned}$$

c) the acceleration of the particle when $t = 5$.

(2 marks)

$$\begin{aligned} a &= 6t - 12 \sqrt{M} \\ a(5) &= 6 \times 5 - 12 \\ &= 18 \text{ m s}^{-2} \sqrt{A} \end{aligned}$$

d) the time when the particle is at rest.

(2 marks)

$$\begin{aligned} \text{At rest } v &= 0 \\ 3t^2 - 12t + 9 &= 0 \sqrt{M} \\ t &= \frac{12 \pm \sqrt{144 - 27 \times 4}}{6} \sqrt{A} \\ t &= 1 \text{ s or } 3 \text{ s} \end{aligned}$$

e) the displacement during the 3rd second.

(2 marks)

$$\begin{aligned} s_{3\text{rd}} &= s_3 - s_2 \\ &= [3^3 - 6(3)^2 + 9 \times 3 + 50] - [2^3 - 6(2)^2 + 9 \times 2 + 50] \sqrt{M} \\ &= -2 \text{ m } \sqrt{A} \end{aligned}$$

24. The height of a number of students was recorded in the table below. Each measurement is given to the nearest cm.

Height(cm)	Mid-point x	Frequency f	fx
138-142	140	3	420
143-147	145	8	1160
148-152	150	12	1800
153-157	155	20	3100
158-162	160	30	4800
163-167	165	14	2310
168-173	170	7	1190
173-177	175	4	700
178-182	180	2	360
		$\sum f = 100$	$\sum fx = 15840$

$\checkmark B_1$ All correct midpoints

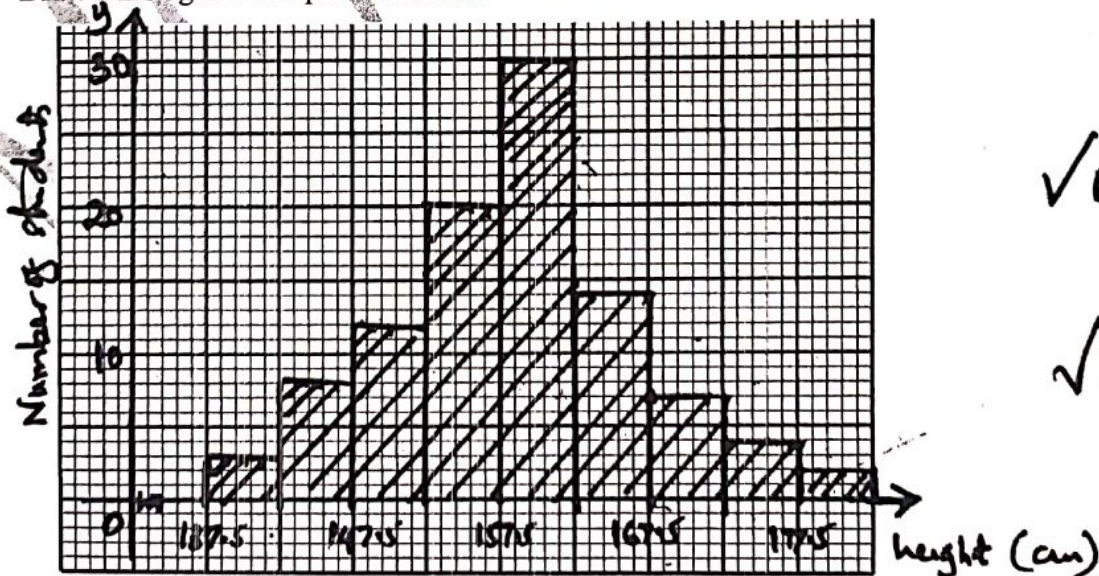
$\checkmark B_1$

$\checkmark B_1$

- a) Complete the table. (3 marks)
- b) Use the completed table to calculate the mean height of the students. (2 marks)

$$\bar{x} = \frac{15840}{100} \checkmark M_1 \quad \bar{x} = 158.4 \text{ cm} \checkmark A_1$$

- c) Draw a histogram to represent the information. (2 marks)



$\checkmark B_1$ First 4 bars correctly drawn

$\checkmark B_1$ Last 5 bars correctly drawn

d) Use the histogram above to estimate the median height.

(3 marks)

class	Area	Cumulative Area
138 - 142	15	15
143 - 147	40	55
148 - 152	60	115
153 - 157	100	215
158 - 162	150	365
163 - 167	70	435
168 - 172	35	470
173 - 177	20	490
178 - 182	10	500

$$\frac{1}{2} CA = 250$$

Median class 158 - 162

$$30x = 250 - 215 \sqrt{B_1}$$

$$x = 1\frac{1}{6}$$

$$\text{Median} = 157.5 + 1\frac{1}{6} = 158\frac{2}{3} \sqrt{A_1}$$

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