



MARANDA HIGH SCHOOL PRE-MOCK

121/2

MATHEMATICS

Paper 2

ALT A

Apr. 2023 - 2 1/2 hours

Name: Marking Scheme Admission Number:

Candidate's Signature: Stream: Date:

Instructions to Candidates

- (a) Write your name and admission number in the spaces provided above.
- (b) Sign and write the date of examination in the spaces provided.
- (c) This paper consists of two sections; Section I and Section II.
- (d) Answer all questions in Section I and only five questions from Section II.
- (e) Show all the steps in your calculations, giving the answer 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 scientific mathematical tables may be used, except where stated otherwise.
- (h) This paper consists of 16 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



Turn Over

2

SECTION I (50 marks)

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

1. State the Amplitude, the Period and the Phase angle of the function:

$$y = \frac{4}{3} \sin\left(\frac{1}{2}x + 15\right)^\circ$$

(3 marks)

$$a = \frac{4}{3} \quad \checkmark \quad B_1$$

$$P = 720 \quad \checkmark \quad B_1$$

$$\text{Phase Angle} = 15^\circ \quad \checkmark \quad B_1$$

2. Three quantities P, Q and r are such that P varies directly as Q and inversely as the fifth root of r. When P = 1.5, Q = 9 and r = 32. Determine the equation connecting P, Q and r. (3 marks)

$$P = k \frac{Q}{\sqrt[5]{r}}$$

$$k = \frac{3}{2} \times \frac{2}{9}$$

$$= \frac{1}{3} \quad \checkmark \quad M_1$$

$$P = \frac{Q}{3\sqrt[5]{r}} \quad \checkmark \quad M_1$$

$$\frac{3}{2} = \frac{9k}{2} \quad \checkmark \quad M_1$$

$$P = \frac{1}{3} \frac{Q}{\sqrt[5]{r}}$$

3. Omollo intends to buy a plot of land which cost Ksh. 1450000. He borrows the money from a financial institution that charges an interest rate of r% per annum compounded quarterly. Calculate the compound interest r% p.a if he paid back a sum of Ksh. 1836817 in two years. (3 marks)

$$1836817 = 1,450,000 \left(1 + \frac{r}{100} \times \frac{1}{4}\right)^8 \quad \checkmark \quad M_1$$

$$r = 12\% \quad \checkmark \quad A_1$$

$$\sqrt[8]{\frac{1836817}{1,450,000}} = \sqrt[8]{\left(1 + \frac{r}{400}\right)^8}$$

$$1.0300 = 1 + \frac{r}{400} \quad \checkmark \quad M_1$$

$$0.03 = \frac{r}{400}$$

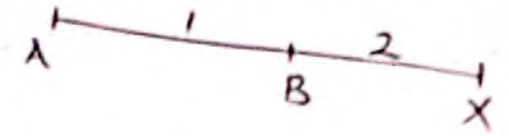
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4. Given that O is the origin, $OA = 3i - 2j - 4k$ and $OB = 1i + 5j + 2k$. If a point X divides AB externally in the ratio 3 : -2 find AX in terms of the unit vector (3 marks)



$$AX = \begin{pmatrix} -3 \\ 2 \\ 4 \end{pmatrix} + \begin{pmatrix} -6 \\ 4 \\ 8 \end{pmatrix} + \begin{pmatrix} 12 \\ 15 \\ -6 \end{pmatrix} \checkmark$$

$$AX = \begin{pmatrix} 3 \\ 2 \\ 6 \end{pmatrix}$$

$$AX = 3i + 2j + 6k \checkmark$$

$$AX = AO + OX$$

$$-\begin{pmatrix} 3 \\ -2 \\ -4 \end{pmatrix} + \frac{-2}{1} \begin{pmatrix} 3 \\ -2 \\ -4 \end{pmatrix} + \frac{3}{1} \begin{pmatrix} 4 \\ 5 \\ -2 \end{pmatrix} \checkmark$$

5. Without using calculators or mathematical tables, express in surd form and simplify (3 marks)

$$\frac{\sqrt{52}}{2 - \cos 750^\circ}$$

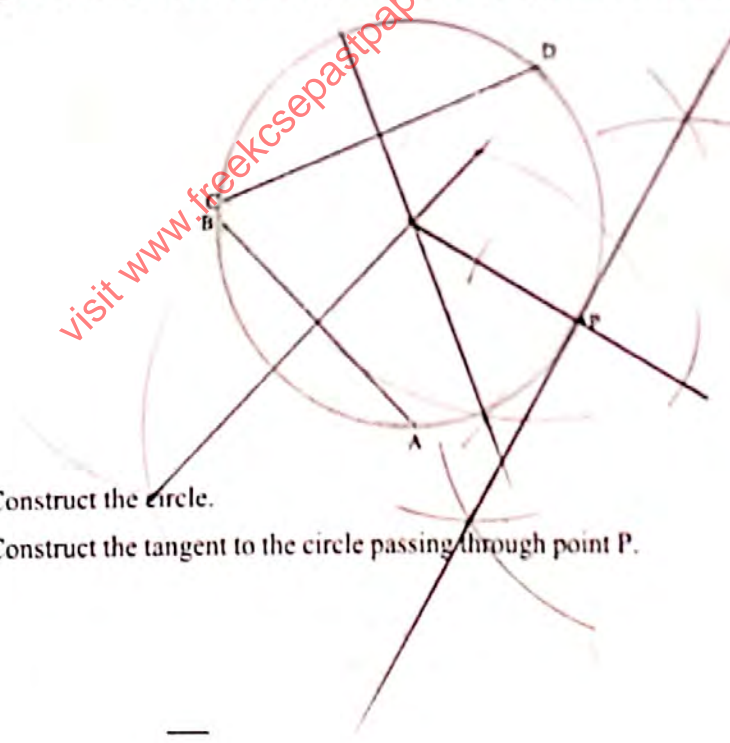
$$\frac{\sqrt{52}}{2 - \frac{\sqrt{3}}{2}}$$

$$\frac{2\sqrt{52}(4 + \sqrt{3})}{(4 - \sqrt{3})(4 + \sqrt{3})} \checkmark B_1$$

$$\frac{8\sqrt{52} + 2\sqrt{156}}{16 - 3}$$

$$\frac{16\sqrt{13} + 4\sqrt{39}}{13} \checkmark A_1$$

6. In the diagram below, AB and CD are chords of a circle. A point P is on the circumference of the circle



(a) Construct the circle.

(b) Construct the tangent to the circle passing through point P.

B₁ for L bisector of AB
 B₁ for L bisector of CD
 B₁ for correct circle drawn

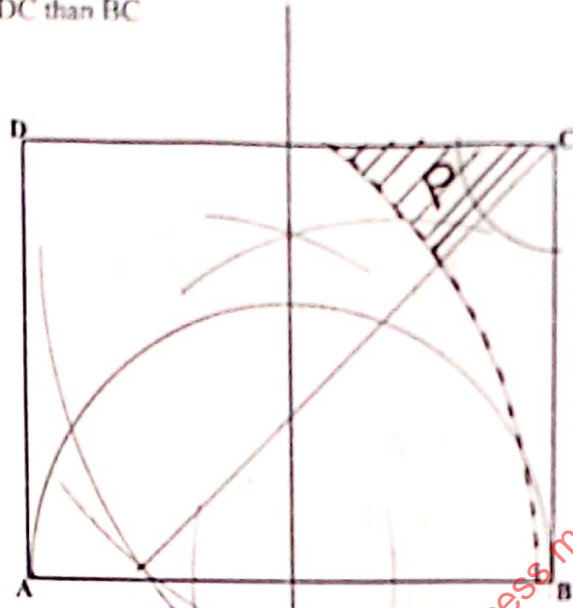
(3 marks)

(1 mark)

B₁ Correct tangent drawn at P.

7. Given the rectangle ABCD below, locate and shade a region within the rectangle in which a variable point P must lie given that P satisfies the following conditions:

- (i) $AP \geq BP$
- (ii) $\angle APB \leq 90^\circ$
- (iii) P is closer to DC than BC
- (iv) $AP > 7 \text{ cm}$



(4 marks)

- B_1 L bisector of AB
- B_1 for the arc from A to B
- B_1 Angle bisect of $\angle BCD$
- B_1 for an arc 7cm from A (dotted)

8. Use binomial expansion to simplify

$$|\sqrt{3} + 5|^4 + |\sqrt{3} - 5|^4$$

(3 marks)

$$(\sqrt{3} + \sqrt{5})^4$$

1	4	6	4	1
$(\sqrt{3})^4$	$(\sqrt{3})^3$	$(\sqrt{3})^2$	$(\sqrt{3})$	$(\sqrt{3})^0$
$(5)^0$	5^1	5^2	5^3	5^4

$$9 + 60\sqrt{3} + 450 + 500\sqrt{3} + 625$$

$$(9 + 60\sqrt{3} + 450 + 500\sqrt{3} + 625) -$$

$$(9 - 60\sqrt{3} + 450 - 500\sqrt{3} + 625) \checkmark M_1$$

$$(1084 + 560\sqrt{3}) -$$

$$(1084 - 560\sqrt{3}) \checkmark M_1$$

$$1,120\sqrt{3} \checkmark A_1$$

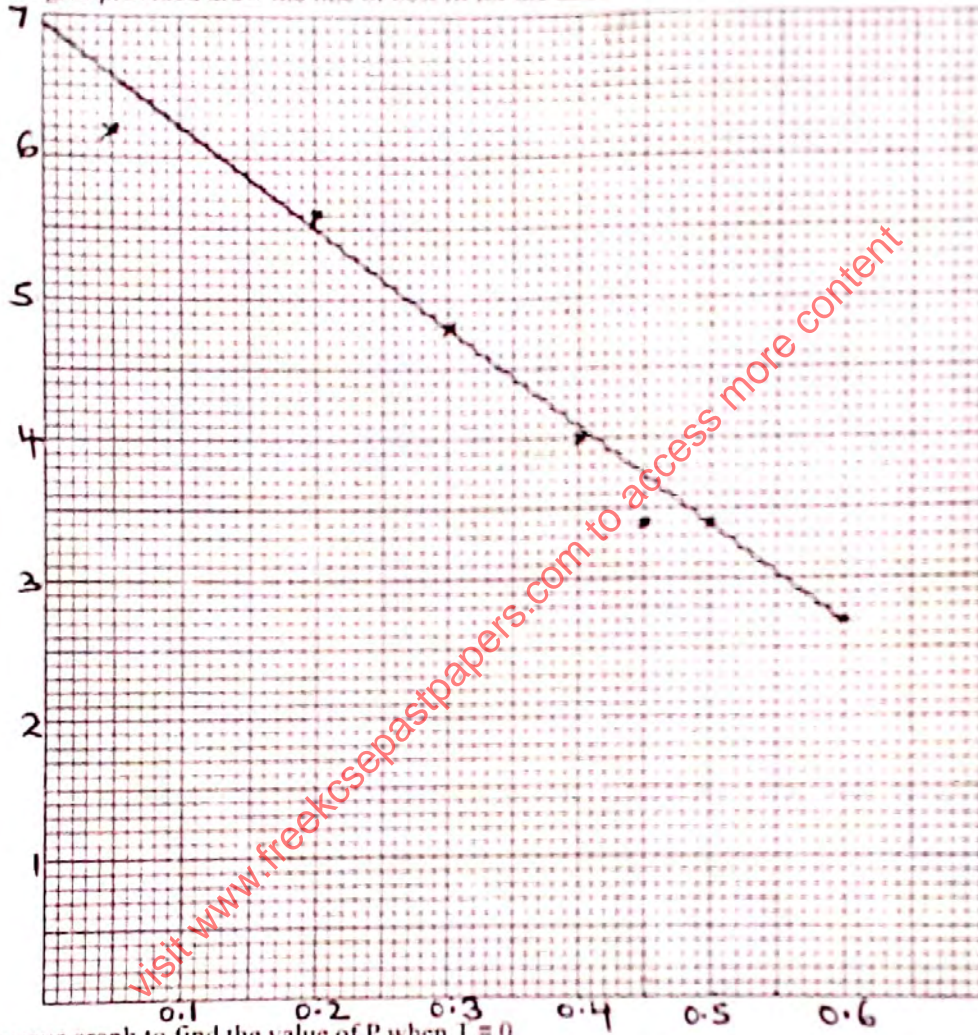
9. The table below represents a relationship between two variables P and T, connected by the equation,

$P = aT + b$ where a and b are constants.

T	0.1	0.2	0.3	0.4	0.5	0.6
P	6.2	5.6	4.8	4.0	3.4	2.7

On the grid provided draw the line of best fit for the data

(3 marks)



S₁
P₁
L₁

Use your graph to find the value of P when T = 0

(1 mark)

$P = 6.9$

B₁

10. Solve without using mathematical tables or calculator

$4 \sin^2(2x + 10) = 3$ for $0 \leq x \leq 180$

(3 marks)

$\sin^2(2x + 10) = \frac{3}{4}$

$2x = 50, 110, 230, 290$

$\sin(2x + 10) = \pm \frac{\sqrt{3}}{2} \checkmark M_1$

$x = 25^\circ, 55^\circ, 115^\circ, 145^\circ \checkmark A_1$

$2x + 10 = 60, 120, 240, 300 \checkmark M_1$
a

11. Nine students scored some marks in a random assessment test whose deviations from the mean were: 5, -2, 2, 1, z, -3, -2, -4, 0. Given that, the mean of the scores is 11. Find z and the quartile deviation. (4 marks)

$d = (x - \bar{x}) : 5 - 2 + 2 + 1 + z - 3 - 2 - 4 + 0 = 0$
 $z = -3 \checkmark$

B₁

B₁

x : 18, 11, 15, 14, 10, 10, 11, 9, 13 $\checkmark \checkmark$

$Q_1 = \frac{11 + 15}{2} = 13$

$Q_1 = 10$

Quartile Deviat = $\frac{14.5 - 10}{2} \checkmark M_1$

= 2.25 $\checkmark A_1$

$Q_3 = \frac{14 + 15}{2} = 14.5$

$Q_3 = 14.5$

12. At Maranda High School, Magway House can accommodate only 144 students, both junior and senior students. The number of junior students must be at least 90 while the number of seniors must be less than a third of the total capacity. Taking x to represent number of the junior students and y to represent the number of seniors, write down all the inequalities representing this information. (3 marks)

(i) $x + y \leq 144 \checkmark$

B₁

(ii) $x \geq 90 \checkmark$

B₁

(iii) $y < 48 \checkmark$

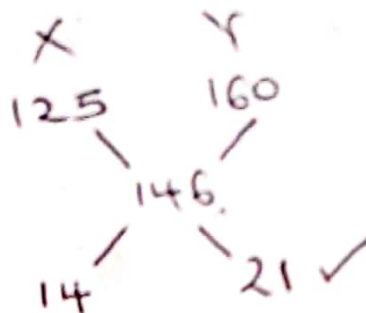
B₁

7

13. A coffee blender mixes two types of coffee, X which costs Ksh. 125 and Y which costs Ksh. 160. She sells the mixture at Ksh. 182.5 thereby making a profit of 25%. Find the ratio X:Y at which she mixed the two types of coffee. (3 marks)

$$BP = \frac{100}{125} \times 182.5$$

$$= 146 \checkmark$$



2:3 ✓
M1
M1
A1

14. Truncate 3645986 correct to 3 significant figures. Hence calculate the percentage error arising from the truncation. (2 marks)

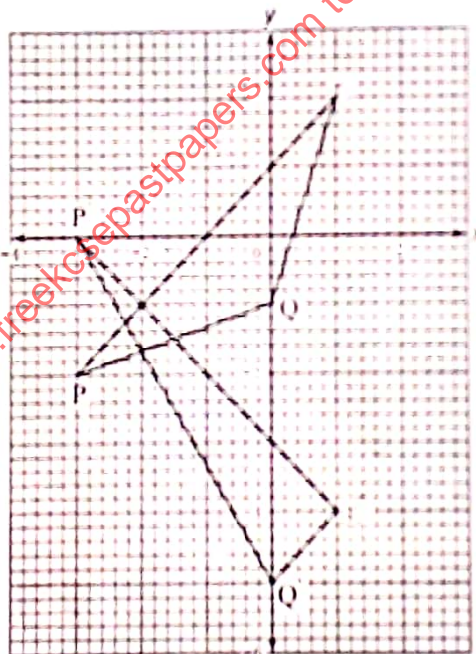
Truncated Value 3640000

$$\% \text{ Error} = \frac{3645986 - 3640000}{3645986} \times 100\%$$

$$\frac{5986}{3645986} \times 100\% \checkmark$$

0.164180553% ✓

15. On the grid below, triangle P'Q'R' is the image of triangle PQR under a certain transformation. Describe the transformation. (2 marks)



A shear, with the line $x = -2$ invariant and point $P(-3, -2)$ mapped onto $P'(-3, 0)$ ✓
 or A shear, with line $x = -2$ invariant and shear factor -2 ✓

16. Find the radius and the co-ordinates of the centre of the circle whose equation is

(3 marks)

$$\frac{1}{2}x^2 + \frac{1}{2}y^2 = 3x - 5y - 9$$

$$x^2 + y^2 = 6x - 10y - 18$$

Centre

$$2a = 6$$

$$a = 3$$

$$2b = -10$$

$$b = -5$$

Centre is (3, -5) ✓

$$\text{Radius: } r = \sqrt{3^2 + (-5)^2 + 18}$$

$$6.379 \text{ or } 2\sqrt{13}$$

M₁A₁B₁

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SECTION II (50 marks)

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

17. (a) A fair tetrahedron with faces marked 1, 2, 3 and 4 and a fair die are tossed together and the difference of the faces showing up recorded. By taking x and y to represent faces on the tetrahedron and die respectively,

- (i) Draw a possibility space to show the possible outcomes. (2 marks)

$x \backslash y$	1	2	3	4	5	6
1	0	-1	-2	-3	-4	-5
2	1	0	-1	-2	-3	-4
3	2	1	0	-1	-2	-3
4	3	2	1	0	-1	-2

B₂

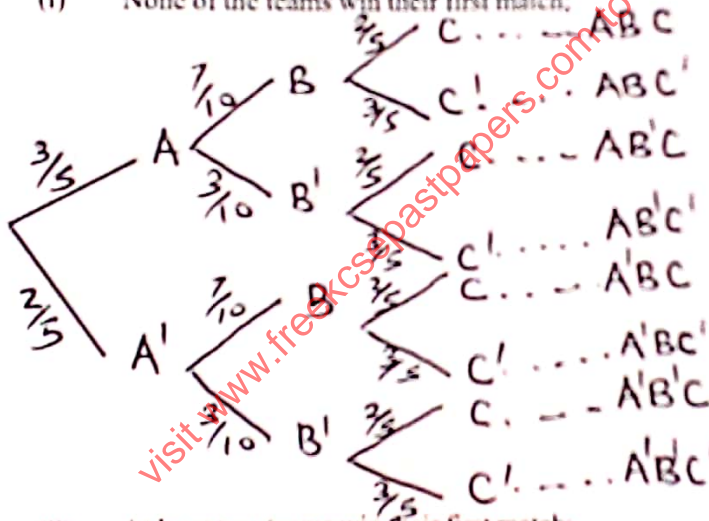
- (ii) Find the probability that $|x - y| \geq 3$. (1 mark)

$\frac{7}{24}$ ✓

B₁

- (b) The probabilities of three football teams A, B and C winning their first match in CFAFA championships are $\frac{3}{5}$, $\frac{7}{10}$ and $\frac{2}{5}$ respectively. Using a tree diagram, find the probability that

- (i) None of the teams win their first match. (2 marks)



$P(\text{None wins}) = (\frac{2}{5} \times \frac{3}{10} \times \frac{3}{5}) \checkmark$

$\frac{9}{125} \checkmark$
or
0.072

- (ii) At least two teams win their first match. (3 marks)

$P(ABC \cup ABC' \cup A'BC) = (\frac{3}{5} \times \frac{7}{10} \times \frac{2}{5}) + (\frac{3}{5} \times \frac{7}{10} \times \frac{3}{5}) + (\frac{3}{5} \times \frac{3}{10} \times \frac{2}{5}) + (\frac{3}{5} \times \frac{7}{10} \times \frac{2}{5}) \checkmark$

All correct prob added

- (iii) At most one team wins its first match. (2 marks)

$P(A'B'C' \cup A'BC' \cup A'BC' \cup A'BC) = (\frac{2}{5} \times \frac{3}{10} \times \frac{3}{5}) + (\frac{2}{5} \times \frac{3}{10} \times \frac{2}{5}) + (\frac{2}{5} \times \frac{7}{10} \times \frac{3}{5}) + (\frac{2}{5} \times \frac{7}{10} \times \frac{2}{5}) \checkmark$
 $\frac{99}{250} \checkmark$ or 0.396

$\frac{151}{250} \checkmark$ (2 marks) A₁

18. The income tax rates in a certain year are as shown below

Monthly Income (in Ksh)	Tax rate in each shilling (%)
0 - 10164	10
10165 - 19740	15
19741 - 29316	20
29317 - 38892	25
38893 and above	30

Mwenda pays Ksh 8234 as P A Y E per month. He has a monthly house allowance of Ksh 10500 and is entitled to a personal relief of Ksh 1162 per month. Determine

a). (i) his gross tax per month;

(2 marks)

$$8234 + 1162 = \text{Sh. } 9396$$

M₁ M₁

(ii) his monthly taxable income;

(4 marks)

$$1^{\text{st}} = 10164 \times 0.1 = \text{sh. } 1016.4$$

$$2^{\text{nd}} = 9576 \times 0.15 = \text{sh. } 1436.4$$

$$3^{\text{rd}} = 9576 \times 0.2 = \text{sh. } 1915.2$$

$$4^{\text{th}} = 9576 \times 0.25 = \text{sh. } 2394$$

$$5^{\text{th}} = 20 \times 0.3 = \text{sh. } 6386$$

$$20 = \frac{2634}{0.3}$$

$$= 8780$$

$$\text{Taxable income} = 1016.4 + 3(9576) + 8780 = \text{sh. } 47672$$

(iii) his basic salary per month

(2 marks)

$$47672 - 10,500 = \text{sh. } 37172$$

$$\text{sh. } 37172$$

M₁

A₁

b). If the second tax bracket was expanded by 25% Calculate his new P.A.Y.E

(2 marks)

$$\frac{125}{100} \times 9576 = 11970$$

$$1016.4 + (11970 \times 0.15) + 1915.2 + 2394 + (6386 \times 0.3)$$

$$\text{sh. } 9036.9$$

M₁
A₁

19. The table below shows distribution of marks scored by 80 students in a Mathematics test

Marks	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100
Frequency (f)	3	5	5	9	11	15	14	8	6	4
X	5.5	15.5	25.5	35.5	45.5	55.5	65.5	75.5	85.5	95.5
d	-50	-40	-30	-20	-10	0	10	20	30	40
fd	-150	-200	-150	-180	-110	0	140	160	180	160
d ²	2500	1600	900	400	100	0	100	400	900	1600
fd ²	7500	8000	4500	3600	1100	0	1400	3200	5400	6400
C.f	3	8	13	22	33	48	62	70	76	80

$\Sigma = -150$
 $\Sigma = 41,100$

- a). Using an assumed mean of 55.5 calculate
i). mean mark

$$\bar{X} = 55.5 + \left(\frac{-150}{80} \right)$$

~~53.67~~ 53.625 ✓

(3 marks)
B₁ for all
f.d.
M₁
A₁

- ii) the standard deviation;

$$S.D = \sqrt{\frac{41,100}{80} + \left(\frac{-150}{80} \right)^2}$$

~~19.15~~ ~~19.04~~ 19.15 ✓

(3 marks)
B₁ for all
fd²
M₁
A₁
(2 mark)

- b). Find the number of students who scored 73% and above

$$73 = 70.5 + \left(\frac{n-62}{8} \right) 10 \quad n = 63$$

$$20 = 10n - 620 \quad 18 \text{ students } \checkmark$$

- c) if each students was added 5 marks determine the new mean and the standard deviation

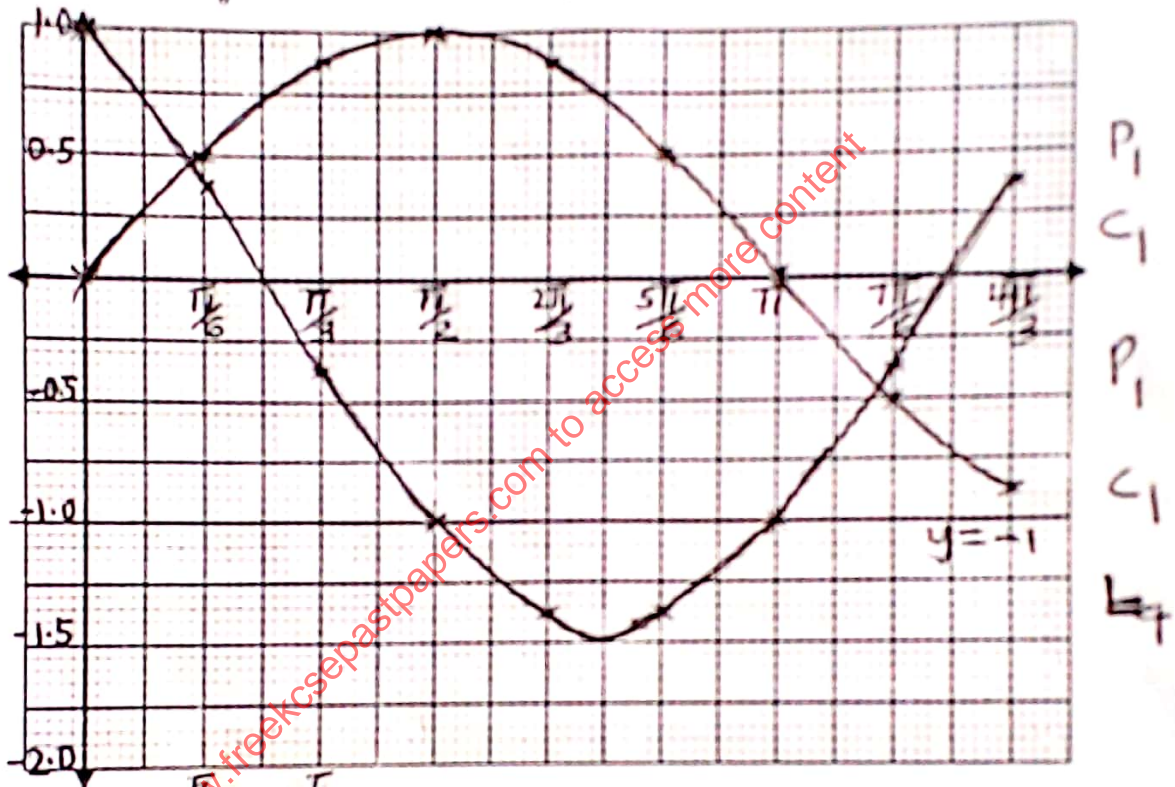
New mean = 58.625 ✓
S.D = 19.15 ✓

(2marks)
B₁
B₁

20. (a) Complete the table below for the equation $y = \sin x$ and $y = \cos x - \sin x$ correct to 2 decimal places (2 marks)

x°	0°	$\frac{1\pi^\circ}{6}$	$\frac{1\pi^\circ}{3}$	$\frac{1\pi^\circ}{2}$	$\frac{2\pi^\circ}{3}$	$\frac{5\pi^\circ}{6}$	π°	$\frac{7\pi^\circ}{6}$	$\frac{8\pi^\circ}{6}$
$y = \sin x$	0.00	0.50	0.87	1.00	0.87	0.50	0.00	-0.50	-0.87
$y = \cos x - \sin x$	1.00	0.37	-0.37	-1	-1.37	-1.37	-1.00	-0.37	0.37

(b) On the graph provided, draw a graph of $y = \sin x$ and $y = \cos x - \sin x$ for $0^\circ \leq x \leq \frac{8\pi^\circ}{6}$. Use 2 cm to represent $\frac{1\pi^\circ}{6}$ on the x-axis and 4 cm to represent 1 unit on the y-axis (4 marks)



(c) Use the graph in (b) above to:

(i) solve the equation $\cos x = 2 \sin x$ (2 marks)

$$x_1 = 27^\circ \pm 1.5^\circ \quad \frac{3\pi}{20} \pm 0.026 \quad B_1$$

$$x_2 = 207^\circ \pm 1.5^\circ \quad \frac{69\pi}{60} \pm 0.026 \quad B_1$$

(ii) find the range of x for which $\cos x - \sin x \leq -1$ (2 marks)

$$y = -1$$

$$\frac{\pi}{2} \leq x \leq \pi \quad \frac{\pi}{2} \leq x \leq \pi \quad B_1 \text{ for } 90^\circ \leq 180^\circ$$

21. The positions of two points A and B are, A(40°N, 121°W) and B(40°N, 59°E)

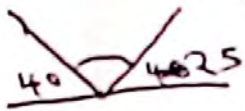
a. Calculate the distance between A and B along a circle of latitude in nautical miles (3 marks)

$$\begin{aligned}
 s &= 60 \times \cos \theta \\
 &= 60 \times 180 \cos 140^\circ \\
 &= 8273.28 \text{ nm} \checkmark
 \end{aligned}$$

B₁ for 180°
M₁
A₁

b. Another point C is on (25°N, 59°E) An aircraft leaves A at 8.30 am on Sunday and flies to C through the North Pole at a speed of 200 knots

i) Calculate the distance from A to C in nautical miles.



$\theta = 115$

$$\begin{aligned}
 &60 \times 115 \checkmark \\
 &6900 \text{ nm} \checkmark
 \end{aligned}$$

(3 marks)

B₁ for 115°
M₁
A₁

Follow Through

ii) Determine the local time at C when the aircraft left A.

(2 marks)

$$\begin{array}{r}
 8.30 \\
 12.00 + \\
 \hline
 20.30
 \end{array}$$

8.30 p.m. ✓ same day

iii) Determine the time and day the aircraft will arrive at C.

(2 marks)

$$\frac{6900}{200} = 24.5 \text{ hrs} \checkmark$$

34 hrs 30 min

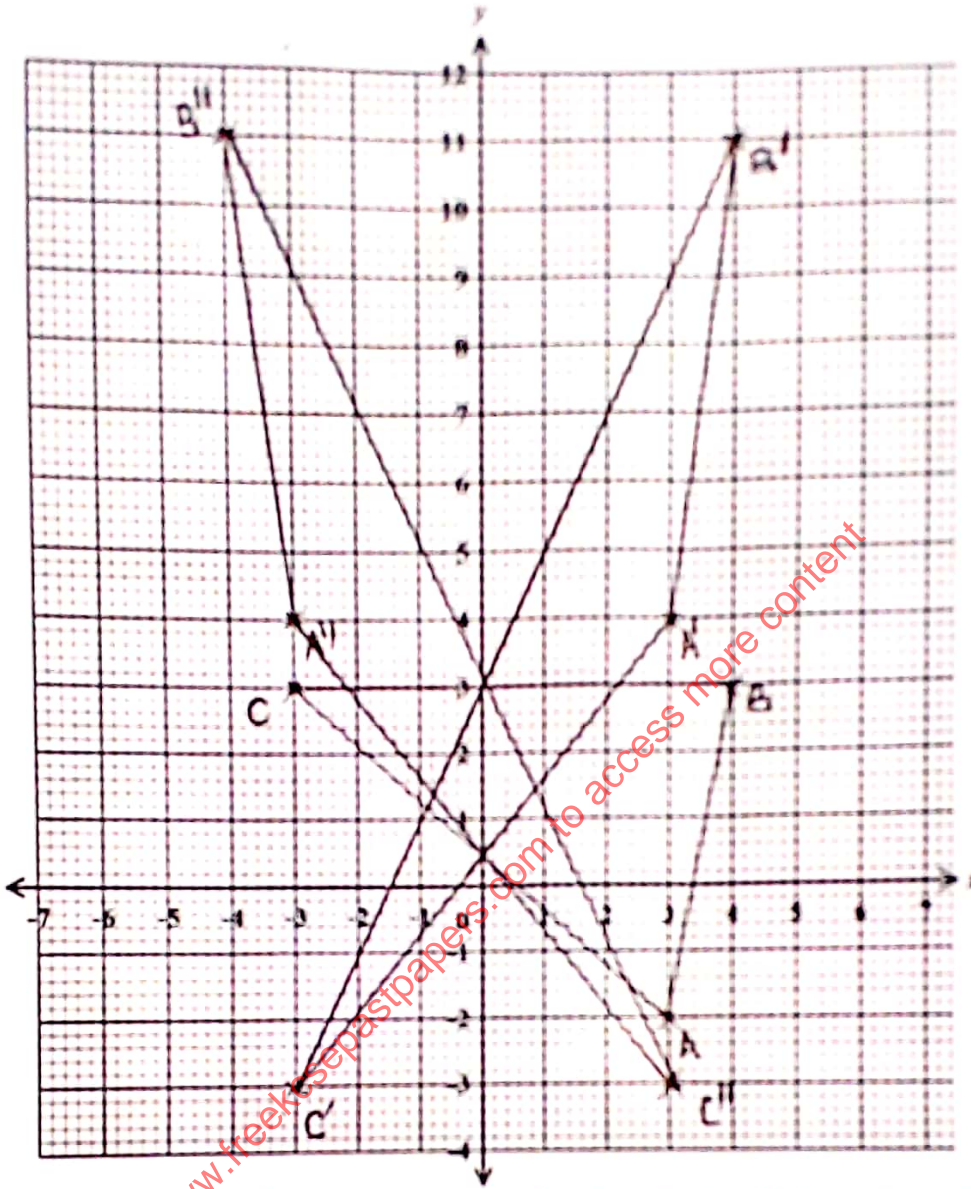
B₁
B₁

$$\begin{array}{r}
 2400 \\
 2030 \\
 \hline
 3.30
 \end{array}$$

$$\begin{array}{r}
 10.30 \\
 3.30 \\
 \hline
 7.00
 \end{array}$$

Tuesday 7.00 a.m. ✓ Tied

22. Triangle ABC has vertices A(3, -2) B(4, 3) and C(-3, 3). On the grid provided below, draw triangle A'B'C'.



(a) Point A is mapped on to A'(3, 4) by a shear y-axis invariant. On the grid above, draw triangle A'B'C' under the shear. (2 marks)

B₁ for correct pts.
B and C plotted B.
B₁ complete triangle A'B'C'

(b) Determine the matrix representing the shear (2 marks)

Shear factor = $\frac{6}{3}$
 $= 2$ ✓

Matrix $\begin{pmatrix} 1 & 0 \\ 2 & 1 \end{pmatrix}$ ✓

~~A₁~~ B₁
Follow through B₁

(c) Triangle $A'B'C'$ is mapped onto triangle $A''B''C''$ by the transformation matrix $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$

(i) State the coordinates of triangle $A''B''C''$

(2 marks)

$$\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 3 & 4 & -3 \\ 4 & 11 & -3 \end{pmatrix} = \begin{pmatrix} -3 & -4 & 3 \\ 4 & 11 & -3 \end{pmatrix} \quad \checkmark \quad \text{M1}$$

$$A''(-3, 4) \quad B''(-4, 11) \quad C''(3, -3) \quad \checkmark \quad \text{A1}$$

(ii) Draw triangle $A''B''C''$

(1 mark)

(d) Find a single matrix that maps triangle $A''B''C''$ onto triangle $A'B'C$ (2 marks)

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

Inverse matrix

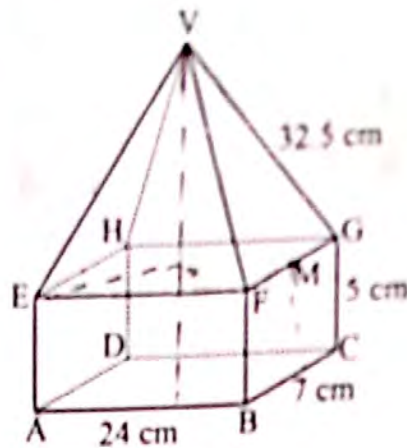
$$-1 \begin{pmatrix} 1 & 0 \\ -2 & -1 \end{pmatrix} \quad \checkmark \quad \text{M1}$$

$$\begin{pmatrix} -1 & 0 \\ 2 & 1 \end{pmatrix} \quad \checkmark \quad \text{A1}$$

Follow Through

16

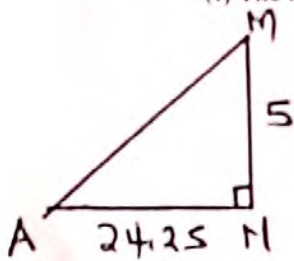
23. The figure below represents a model of a cottage with a rectangular base. $AB = 24$ cm, $BC = 7$ cm, $CG = 5$ cm and $VG = 32.5$ cm. M is the mid-point of FG .



- (a) Calculate correct to 2 decimal places,

- (i) The length AM .

(2 marks)



$$\sqrt{24^2 + 3.5^2}$$

$$24.25$$

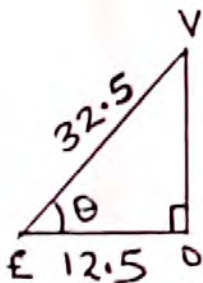
$$AM = \sqrt{5^2 + 24.25^2}$$

$$25.05 \text{ cm} \checkmark$$

M₁
A₁

- (iii) The angle between line EV and AC .

(2 marks)



$$AC = \sqrt{7^2 + 24^2} = EG$$

$$= 25$$

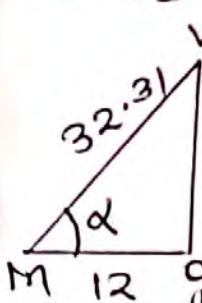
$$\theta = \cos^{-1}\left(\frac{12.5}{32.5}\right) \checkmark$$

$$\theta = 67.38^\circ \checkmark$$

M₁
A₁

- (iv) The angle between planes VGF and EHG .

(3 marks)



$$VM = \sqrt{32.5^2 - 3.5^2}$$

$$= 32.31 \text{ cm} \checkmark$$

$$\alpha = \cos^{-1}\left(\frac{12}{32.31}\right) \checkmark$$

$$\alpha = 68.20^\circ \checkmark$$

B₁
M₁
A₁

- (b) Calculate the volume of the model.

(3 marks)

$$VO = \sqrt{32.31^2 - 12^2}$$

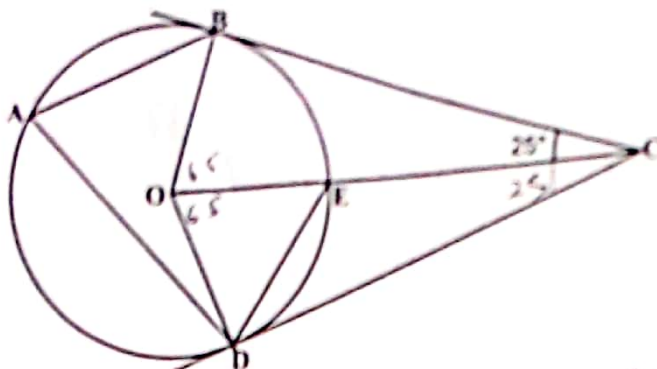
$$= 29.999 \checkmark$$

$$\text{Volume} = (24 \times 7 \times 5) + \left(\frac{1}{3} \times 24 \times 7 \times 29.999\right) \checkmark$$

$$2519.94 \text{ cm}^3 \checkmark$$

B₁
M₁

24. In the figure below, O is the centre of the circle. BC and DC are tangents to the circle. $\angle BCO = 25^\circ$. OEC is a straight line.



Find the value of the following angles, stating the reason in each case:

(i) $\angle BOC$

$180 - (90 + 25)$ or $(90 - 25)$

65° ✓ Angle sum of interior angles in a triangle

(2 marks)

B₁
B₁

(ii) $\angle OED$

$\angle EDC = (65/2)$
 $= 32.5$

Chord DE subtend 32.5° at Circum. equals $\angle EDC = 32.5^\circ$

$\angle OED = 180 - (25 + 32.5)$
 122.5°

(2 marks)

B₁

(iii) $\angle CDE$

$CDE = 65/2$
 $= 32.5^\circ$ ✓

Angle btw a chord and Tangent equal angle subtended by chord on alternate segments

(2 marks)

B₁

B₁

(iv) $\angle BED$

$360 - (2 \times 122.5)$
 115° ✓

Angles at a point add up to 360° ✓

(2 marks)

B₁

B₁

(v) Reflex $\angle DAE$

$360 - (65/2)$
 327.5° ✓

Angle subtended by chord OE at Circum. is half angle at Centre. ✓

B₁

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