M1S 1

KASSU JET

Kenya Certificate of Secondary Education

MOCK EXAMINATIONS 2024

121/2 Mathematics Alt A Paper 2

June 2024 Time: 2½ Hours

Name: ..... Adm No: .....

Class: .....Candidate's Signature: ..... Date: 24TH June, 2024

School.....Index number..... Time: 8.00 am-10.30 am

Instructions to Candidates

(a) Write your name, admission number class and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
*(c) This paper consists of **two** sections; **Section I** and **Section II.***
*(d) Answer **all** the questions in **Section I** and any **five** questions from **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 calculators and KNEC 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) Answer all 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 (50 MARKS)

1. Without using mathematical tables or calculators simplify $\frac{\sin 60^0 \cos 45^0 - \tan 45^0}{\cos 30^0 \sin 45^0 + \cos 60^0}$ leaving your answer in the surd form (3 marks)

$$\frac{\left[\frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{2}}\right] - 1}{\left[\frac{\sqrt{3}}{2} \times \frac{1}{\sqrt{2}}\right] + \frac{1}{2}} \quad \checkmark 1$$

$$= \frac{\sqrt{3} - 2\sqrt{2}(\sqrt{3} - \sqrt{2})}{\sqrt{3} + \sqrt{2}(\sqrt{3} - \sqrt{2})} \quad \checkmark 1$$

$$= \frac{3 - \sqrt{6} - 2\sqrt{6} + 4}{3 - 2}$$

$$= 7 - 3\sqrt{6} \quad \checkmark 1$$

(3)

Accept Any other Correct Method A.A.O.C.M

2. A cone has a radius of 21.36 cm with exact height of 35.7 cm. Calculate the percentage error in the volume of the cone correct to 3 decimal places. $\left(\text{Take } \pi = \frac{22}{7}\right)$ (3 marks)

Actual volume $= \frac{1}{3} \times \frac{22}{7} \times (21.36)^2 \times 35.7$

$= 17,063.73504$

maximum volume $= \frac{1}{3} \times \frac{22}{7} \times [21.365]^2 \times 35.7$

$= 17,071.72462$

minimum volume $= \frac{1}{3} \times \frac{22}{7} \times (21.355)^2 \times 35.7$

$= 17,055.74734$

Absolute error $= \frac{17,071.72462 - 17,055.74734}{2}$

$= 7.98864 \text{ cm}^3$ $\checkmark 1$

Percentage Error $= \frac{7.98864}{17,063.73504} \times 100\ \%$ $\checkmark 1$

$= 0.046816\ \%$

$= 0.047\ \%$ $\checkmark 1$

(3)

3. Solve the following quadratic equation by completing the square $2x^2 = 1.5 - 7x$ to 2 significant figures (3 marks)

$2x^2 + 7x = 1.5$

$x^2 + 3.5 + c = 0.75 + c$

$c = \left(\frac{3.5}{2}\right)^2 = (1.75)^2$ $\checkmark 1$

$x^2 + 3.5 + (1.75)^2 = 0.75 + (1.75)^2$

$(x + 1.75)^2 = 0.75 + 3.0625$

$(x + 1.75)^2 = 3.8125$

$x + 1.75 = \pm\sqrt{3.8125}$

$x + 1.75 = \pm 1.953$ $\checkmark 1$

$x = 1.953 - 1.75 = 0.203$

$x = -1.953 - 1.75 = -3.703$

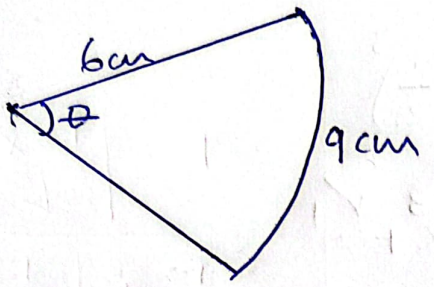
$x = 0.20$ or -3.7 $\checkmark 1$ For Both answers.

(3)

09

4. An arc of a circle of radius 6cm is 9cm long, calculate

a) Angle subtended by the arc at the center of the circle in radians (2 marks)



$\frac{\theta}{360} \times 2 \times 6 \times \pi = 9$

$\frac{\theta}{30}\pi = 9$

$\theta = \frac{270}{\pi}$ ✓1

If $180^\circ = \pi^c$

$\frac{270}{\pi}$

$\frac{1.5}{\frac{270}{\pi}} \times \pi^c \times \frac{1}{180} = 1.5^c$ ✓1

ALTERNATIVELY:

$r\theta = 9 \Rightarrow 6\theta = 9$ ✓1

$\theta = \frac{9}{6} = 1.5^c$ ✓1

(2)

b) Area of the sector made by the angle and the arc to 2 decimal places (2 marks)

$\text{Area} = \frac{270}{360} \times \pi \times 6^2$ ✓1

$= 27.00\ cm^2$ ✓1

ALTERNATIVELY

$\text{Area} = \frac{1}{2} r^2 \theta$

$= \frac{1}{2} \times 6 \times 6 \times 1.5$ ✓1

$= 27.00\ cm^2$ ✓1

Accept $27.01\ cm^2$

(2)

5. The average of the first and fourth terms of a Geometrical Progression (G.P) is 185. Given that the first term is 27, find the common ratio. (3 marks)

$\frac{a + ar^3}{2} = 185$

$a + ar^3 = 370$ ✓1

$27 + 27r^3 = 370$

$27r^3 = 370 - 27$

$\frac{27r^3}{27} = \frac{343}{27}$

$r^3 = \frac{343}{27}$ ✓1

$r = \sqrt[3]{\frac{343}{27}} = \frac{7}{3}$

$= 2\frac{1}{3}$ ✓1

Reject $\frac{7}{3}$

(3)

6. Given that the coefficient of x^3 in the expansion $\left(a+\frac{x}{2}\right)^4$ is 1

a) Find the value of a (2 marks)

$a^4\left(\frac{x}{2}\right)^0 + a^3\left(\frac{x}{2}\right)^1 + a^2\left(\frac{x}{2}\right)^2 + a^1\left(\frac{x}{2}\right)^3$

1 4 6 4

$= a^4 + 2a^3x + \frac{3}{2}a^2x^2 + \frac{1}{2}ax^3 + \ldots$ ✓1

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

$a = 2$ ✓1

3

b) Hence write down the first four terms of $\left(a+\frac{x}{2}\right)^4$ (1 mark)

$(2)^4 + 2(2)^3x + \frac{3}{2}(2)^2x^2 + \frac{1}{2}(2)x^3$

$= 16 + 16x + 6x^2 + x^3$ ✓1

4

7. Given that $\mathbf{OP} = 5i+3j-2k$ and $\mathbf{OQ} = 2i+5j$, find the coordinates of N which divides PQ externally in the ratio 3:2 (3 marks)

$m+n = 3+-2 = 1$

$-\frac{2}{1}\begin{bmatrix}5\\3\\-2\end{bmatrix} + \frac{3}{1}\begin{bmatrix}2\\5\\0\end{bmatrix}$ ✓

$= \begin{bmatrix}-10\\-6\\4\end{bmatrix} + \begin{bmatrix}6\\15\\0\end{bmatrix}$

$= \begin{bmatrix}-4\\9\\4\end{bmatrix}$ ✓

$N(-4, 9, 4)$ ✓

3

06

8. An object whose area is 10 cm^2 is mapped onto an image whose area is 40 cm^2 by a transformation B. Given that the matrix of transformation $B = \begin{pmatrix} 2x+2 & x \\ 1 & 1 \end{pmatrix}$, find the image of a point A (-2, 4). (3 marks)

Determinant $= \frac{40}{4} = 4$

$(2x+2)1 - (x)1 = 4$

$2x + 2 - x = 4$

$x = 4 - 2$ ✓1

$x = 2$

$B = \begin{bmatrix} 6 & 2 \\ 1 & 1 \end{bmatrix}$

MOI

$\begin{bmatrix} 6 & 2 \\ 1 & 1 \end{bmatrix}\begin{bmatrix} -2 \\ 4 \end{bmatrix} = \begin{bmatrix} -4 \\ 2 \end{bmatrix}$ ✓1

$A'(-4, 2)$ ✓1 (3)

9. The scores obtained by four students in a class are given as 22,28, p and 24. If the sum of the squares is 2520. Calculate the standard deviation of the scores, leave your answer to 4 significant figures. (3 marks)

$\frac{22^2 + 28^2 + p^2 + 24^2}{1} = 2520$

$1844 + p^2 = 2520$

$p^2 = 676$

$p = \sqrt{676} = 26$ ✓1

x	$d = x - (25)$	d^2
22	-3	9
28	3	9
26	1	1 ✓1
24	-1	1
		$\Sigma d^2 = 20$

Standard deviation $= \sqrt{\frac{20}{4}} = 2.236$ ✓1 (3)

10. Three quantities P, Q and R are such that P varies as the square of Q and inversely as the square root of R. Given that $P = 20$ when $Q = 5$ and $R = 9$. Find the percentage change in P when Q is increased by 16% and R is decreased by 36%, correct to 2 decimal places (3 marks)

$P_0 = \frac{KQ^2}{\sqrt{R}} \Rightarrow 20 = \frac{25K}{3} \Rightarrow K = 2.4$

$P_n = \frac{K(1.16Q)^2}{8\sqrt{R}}$ ✓1

$P_n = \frac{1.3456}{8} = 0.1682$

Percentage change ✓1

$= \frac{0.1682 - 1}{1} \times 100\%$

Decrease by 83.18 % ✓1 (3)

11. The cash price of a fridge is Sh. 40 000. Ann bought the fridge on hire purchase by paying a deposit of Sh. 7 500 and 14 monthly installment of Sh. 2 875 each. Calculate the monthly rate of interest she was charged. Give your answer to 2 decimal places. (3 marks)

Amount = $2875 \times 14 = Sh.\ 40250$

P = C.P − Down payement

$40,000 - 7500$

$= Sh.\ 32500$ ✓1

$A = P\left(1 + \frac{r}{100}\right)^n$

$40,250 = 32500\left(1 + \frac{r}{100}\right)^{14}$

$\sqrt[14]{1.023846} = 1 + \frac{r}{100}$ ✓1

$1 + \frac{r}{100} = 1.0154$

$\frac{r}{100} = 0.0154 \times 100\%$

$r = 1.54\%$ ✓1 (3)

12. Solve the equation: $\log_3(x^2+x) - \log_3(x^2-x) = 1$ (3 marks)

$\log \frac{x^2+x}{x^2-x} = \log 3$

$\frac{x^2+x}{x^2-x} = 3$ ✓1

$x^2 + x = 3x^2 - 3x$

$2x^2 - 4x = 0$

$2x(x-2) = 0$ ✓1

$x = 0$ or $x = 2$

NA

$\therefore x = 2$ ✓1 (3)

13. Brian and Rop working together can mark examination scripts in 2 hours and 24 minutes. When marking alone, Rop takes 1hour 36 minutes more to do the same work. How long does it take Brian to mark the scripts alone? (3 marks)

Brian and Rop in 1hr $= \frac{5}{12}$

Let Brian take x hr

Rop $= \left(x + 1\frac{3}{5}\right)$

$\frac{1}{x} + \frac{1}{x+\frac{8}{5}} = \frac{5}{12}$ ✓1

$12x + \frac{96}{5} + 12x = 5x^2 + 8x$

$5x^2 - 16x - \frac{96}{5} = 0$

$25x^2 - 80x - 96 = 0$ ✓1

$x = \frac{80 \pm \sqrt{6400 - 9600}}{50}$

$x = 4hrs\ 7 minutes.$ ✓1 (3)

09

14. Make p the subject of the equation: $E + x = x + \left(\frac{p^2 - 3u}{y - 3xp^2}\right)^{\frac{1}{2}}$ (3 marks)

$$E = x + \sqrt{\frac{p^2 - 3u}{y - 3xp^2}} - x$$

$$E = \left[\frac{p^2 - 3u}{y - 3xp^2}\right]^{\frac{1}{2}}$$

$$E^2 = \frac{p^2 - 3u}{y - 3xp^2} \quad \checkmark_1$$

$$E^2y - 3xp^2E^2 = p^2 - 3u$$

$$E^2y + 3u = p^2 + 3xp^2E^2$$

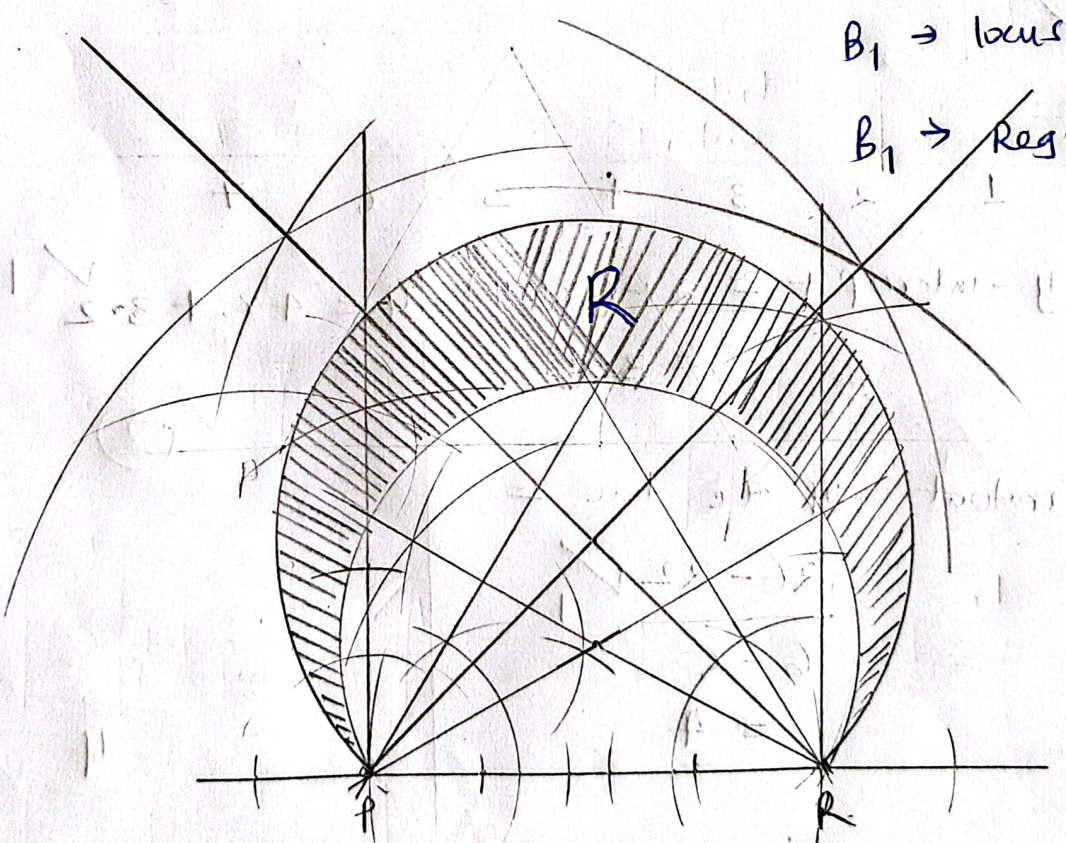
$$p^2(1 + 3xE^2) = E^2y + 3u$$

$$p^2 = \frac{E^2y + 3u}{1 + 3xE^2} \quad \checkmark_1$$

$$p = \pm\sqrt{\frac{E^2y + 3u}{1 + 3xE^2}} \quad \checkmark_1$$

3

15. Using a ruler and a pair of compass only, shade and label the region R on the upper side of line PR = 6 cm such that $45^0 \leq PRQ \leq 60^0$ (3 marks)



$B_1 \rightarrow$ locus 45°

$B_1 \rightarrow$ locus 60°

$B_1 \rightarrow$ Region R.

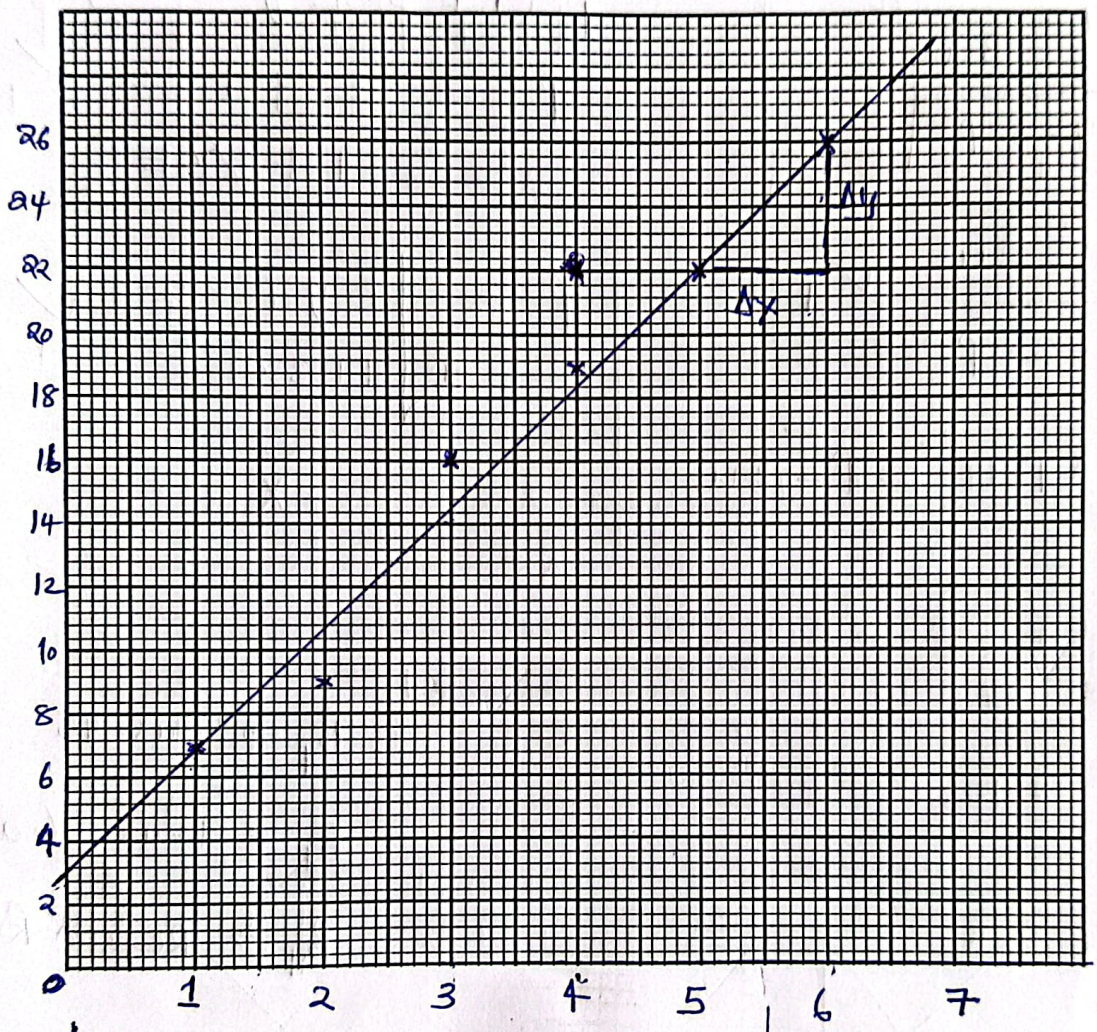
3

6

16. The table below represents a relationship between two variables x and y.

X	1	2	3	4	5	6
Y	7	9	16	17	22	26

On the grid below, draw a line of best fit to represent the information provided in the table hence find the equation connecting the variables x and y in the form $y = mx + c$ (4marks)



P1

L1

2

y - intercept = $2 + (3 \times 0.4)$

$= 3.2$

Gradient of the line = $\frac{26 - 22}{6 - 5}$ ✓1

$= 4$

$y = 4x + 3.2$ ✓1

(2)

4

SECTION II (50 MARKS)

17. An organization has up to 40 hectares of land available for planting beans and rice. The labour cost for planting rice is Kshs. 900 per hectare while for beans is Kshs. 1500 per hectare. Rice takes 3 labourers per hectare while beans takes 6 labourers per hectare. At least 72 labourers are to be hired and Kshs. 45000 is available to cater for labour cost. The company hopes to make a profit of Kshs. The company hopes to make Kshs. 3500 per hectare of rice and Kshs. 4000 per hectare of beans. By letting the number of hectares of beans to be x and the number of hectares of rice to be y

a) Write the inequalities representing the above information (3 marks)

$x + y \leq 40$ ✓1

$6x + 3y \geq 72 \Rightarrow 2x + y \geq 24$ ✓1

$5x + 3y \leq 150$ ✓1

$x \geq 0,\ y \geq 0$.

(3)

b) Graph the inequalities in (a) above shading the unwanted regions (4 marks)

$x + y = 40 \Rightarrow (40, 0)\ (0, 40)$

$2x + 3y = 24$ $(12, 0)\ (0, 24)$

$5x + 3y = 150$

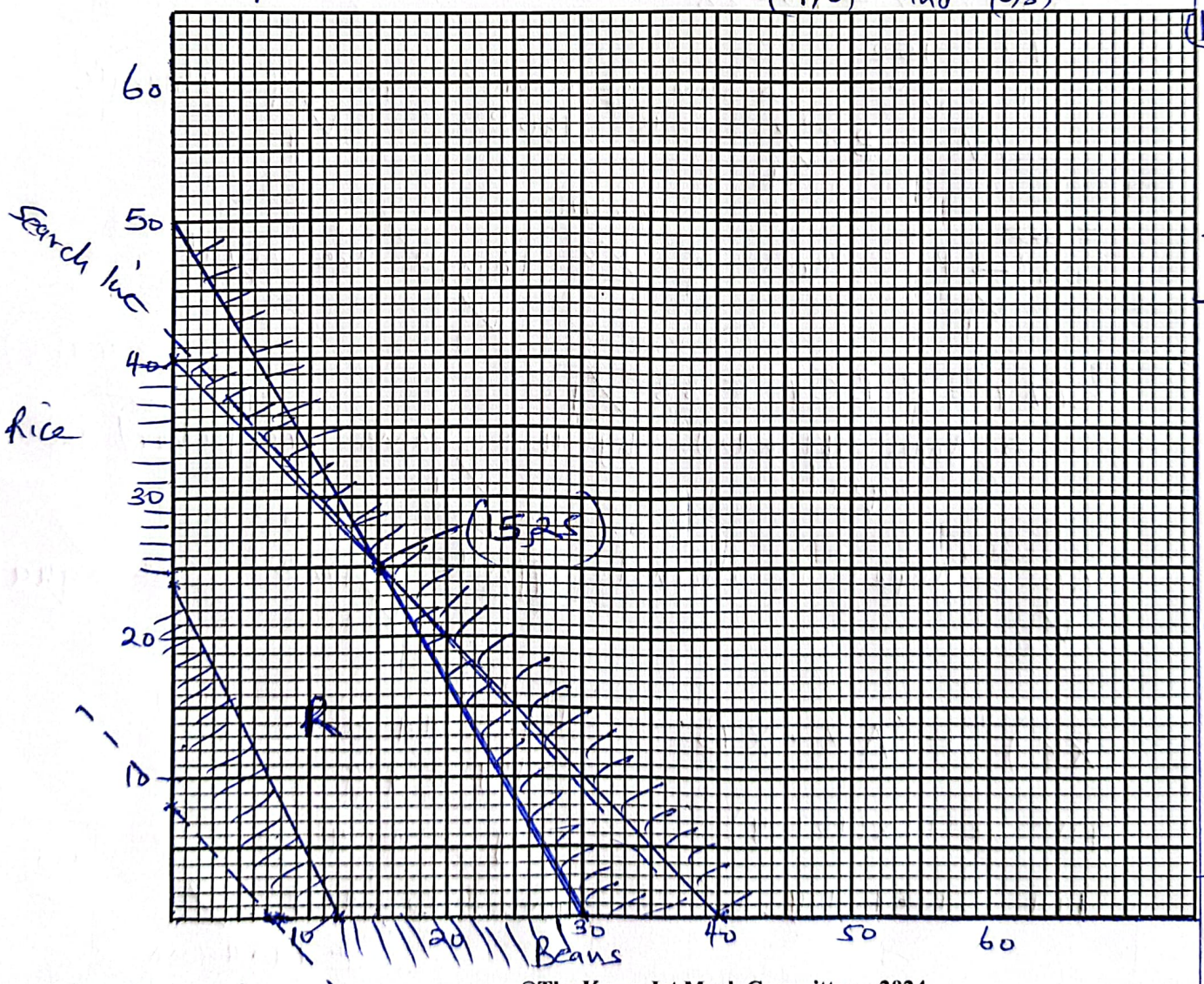
$(30, 0)\ (0, 50)$

$4000x + 3500y = 28000$

$40x + 35y = 280$

$(7, 0)$ and $(0, 8)$

c) By use of a search line determine the maximum profit (3 marks)



(b)

S_1

L_3

04

(c)

search line ✓1

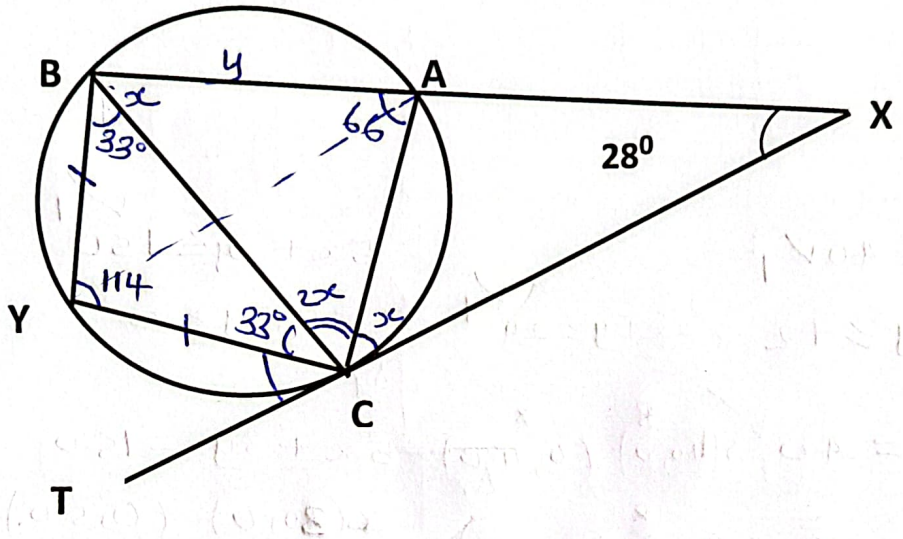
Equation for search line ✓1

Maximum profit

$= (15 \times 4000) + (25 \times 3500) =$ Sh. 147,500 ✓1

10

18. The figure below XCT is a tangent to a circle ABYC at C and Y is the midpoint of the arc BC. If $\angle BXC = 28^0$ and $\angle BCA = 2\angle ACX$. Find the size of the following angles giving the reasons



a) $\angle CBA$ (2 marks)

$x + 2x + x = 180 - 28$

$4x = 152$

$x = 38^0$ → Sum of interior angles of a triangle is 180^0. ✓1

$\angle CBA = 38^0$ ✓1

b) $\angle CBY$ (2 marks)

$= 38$

33^0 → Base angles of isosceles triangle are equal. ✓1 ✓1

c) $\angle BAY$ (2 marks)

$\angle BAY = \angle BCY = 33^0$ ✓1

→ Angles subtended by the same arc | chord are equal ✓1

d) $\angle BCT$ (2 marks)

66^0 → Angles in alternate | opposite segment are equal ✓1 ✓1

e) Given that AX = 10cm and XC = 12 cm, calculate the length of BX (2 marks)

$(XC)^2 = AX \cdot XB$

$(12)^2 = 10x(10+y)$

$144 = 100 + 10y$ ✓

$10y = 144 - 100$

$10y = 44$

$y = 4.4$

$BX = 10 + 4.4$ ✓

$= 14.4\text{cm}$

10

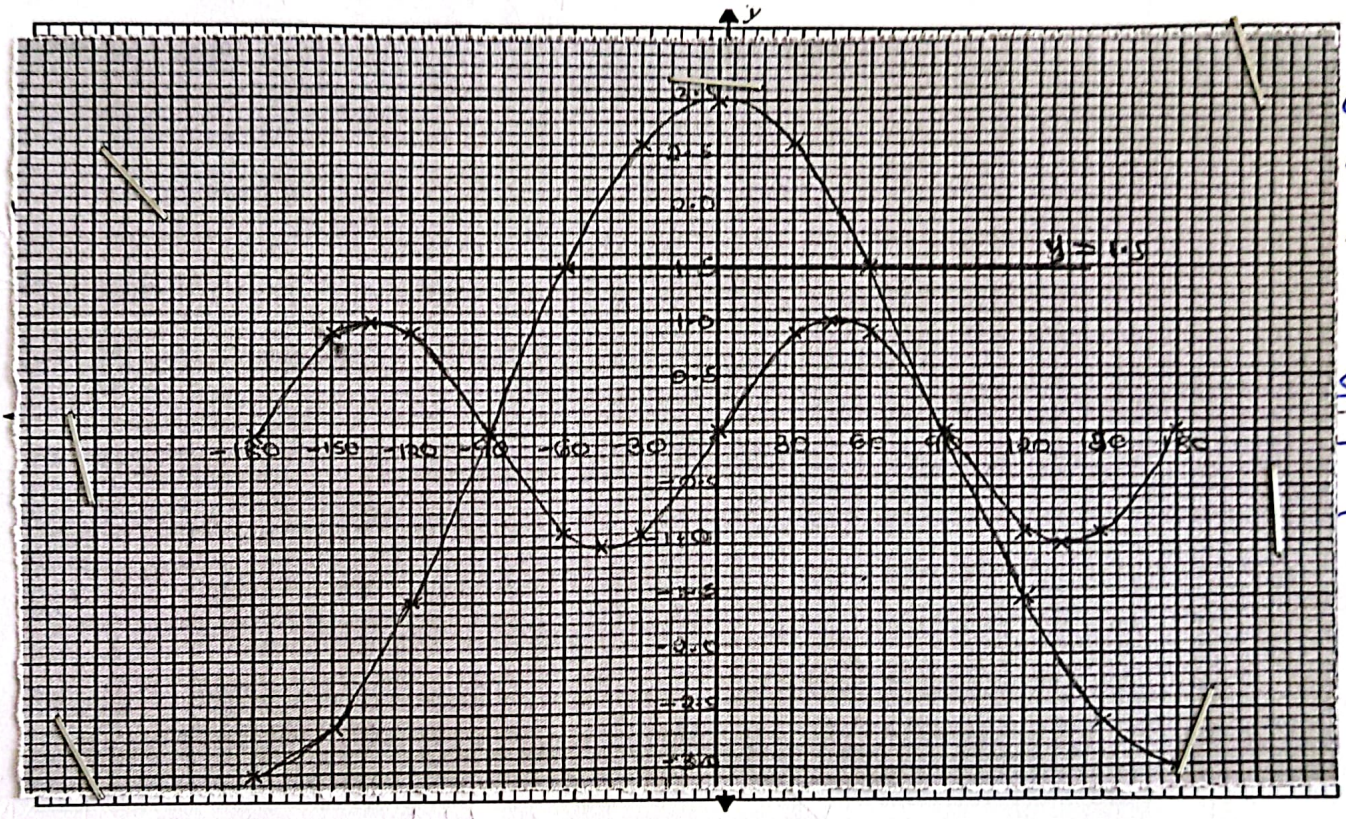
19. a) Fill in the table below giving your values correct to 2 decimal places (2 marks)

X	-180^0	-150^0	-120^0	-90^0	-60	-30	0^0	30^0	60^0	90^0	120^0	150^0	180^0
$y=3\cos x$	−3.00	−2.60	1.50	0.00	1.50	2.60	3.00	2.60	1.50	0.00	-1.5	-2.60	−3.00
$y=\sin 2x$	0.00	0.87	0.87	0.00	−0.87	−0.87	0.00	0.87	0.87	0.00	−0.87	−0.87	0.00

B_1 - More than ½ of the value correct

B_2 complet table with correct value

b) On the same axes plot the graphs of $y=3\cos x$ and $y=\sin 2x$. Use a scale of 1 cm rep 0.5 units on the vertical axis and 1cm rep 30° on the horizontal axis. (5 marks)



C_1 C_1 P_1 P_1 S_1

5

c) Use the graph in (b) above to solve the equation: $3\cos x=\sin 2x$ (2 marks)

$x = -90^0, 90^0$ ✓1 ✓1

d) Using the graphs, determine the range of values of x such that $3\cos x \geq 1.5$ (1 marks)

$-60^0 \leq x \leq 60^0$ ✓1

10

20. A teacher picked a Die from the staffroom and noticed that its faces were labeled 1, 2, 2, 3, 4, 6. He decided to be tossing the die in every evening in order to decide which activity he would partake in school. If 2 or 4 faces up, he calls students for consultation. If 3 faces up he goes to train Chess, otherwise he rests in the staffroom. If the teacher trains Chess ,the probability of leaving school late is $\frac{1}{3}$. If he organizes consultation, the probability of leaving late is $\frac{2}{5}$.

a) Calculate the probability that the teacher;

i. leaves school late (3 marks)

$[P(2) \text{ or } P(4)]\ \frac{2}{5}$ OR $[P(3)]\ \frac{1}{3}$ ✓

$\frac{1}{6}+\frac{1}{6}+\frac{1}{6} = \frac{1}{2}\times\frac{2}{5} = \frac{1}{5}$

$\frac{1}{6}\times\frac{1}{3} = \frac{1}{18}$ ✓

$\frac{1}{5}+\frac{1}{18} = \frac{23}{90}$ ✓ (3)

(2 marks)
~~(1 mark)~~

ii. organizes for consultation and arrives home in time.

$[P(2) \text{ or } P(4)]\ \frac{3}{5}$ ✓

$\left[\frac{1}{6}+\frac{1}{6}+\frac{1}{6}\right]\frac{3}{5}$

$= \frac{1}{2}\times\frac{3}{5}$

$= \frac{3}{10}$ ✓ (2)

b) In a certain batch of seeds, the chances of the plants having red, pink and white flowers are in the ratio 4: 4: 1 respectively. When 3 plants are raised, find the probability that

i. All have white flowers (2 marks)

$P(W \text{ and } P(W) \text{ and } P(W)$

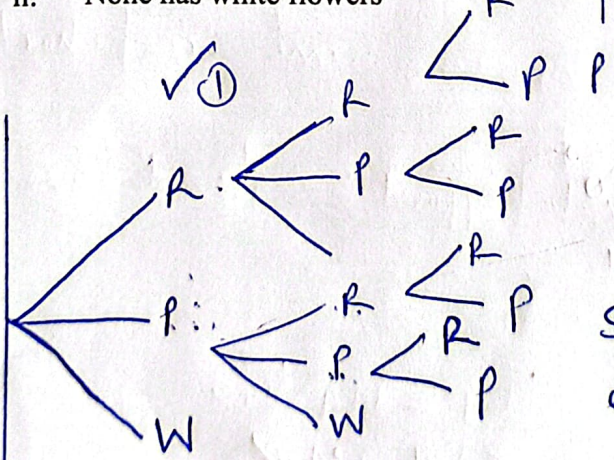
$= P(WWW)$ ✓

$= \frac{1}{9}\times\frac{1}{9}\times\frac{1}{9} = \frac{1}{729}$

$= \frac{1}{729}$ ✓ (2)

ii. None has white flowers

(3 marks)
~~(1 marks)~~



✓① $P(RRR) + P(RRP) + P(RPR) + P(PPP) + P(RRP) + P(RPP) + P(PPR) + P(PPP)$ ✓ (1)

Since pink and Red have equal chances from the ratio 4 : 4 : 1

$\therefore P(\text{none has white flowers}) = 8\left(\frac{4}{9}\right)^3$

$= \frac{512}{729}$ ✓ (2)

10

21. A plane leaves airport A $(41.5^0N, 36.4^0W)$ at 9:00am and flies due north to airport B on a latitude 53.2^0N. Taking $\pi = \frac{22}{7}$ and the radius of the earth as 6370km,

a) Calculate the distance covered by the plane to the nearest km (4 marks)

Distance $= \frac{53.2-41.5}{360} \times 2 \times \frac{22}{7} \times 6370$ ✓1

$= \frac{11.7}{360} \times 2 \times \frac{22}{7} \times 6370$ ✓1

$= 1301.3\text{km}$ ✓1

$= 1,301\text{km}$ ✓1

b) The plane stopped for 30 minutes to refuel at B then flew due east to C 2500km from B. calculate;

i) Position of C (3 marks)

$\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 6370 \cos 53.2 = 2500$

$66.62470 = 2500$ ✓1

$\theta = 37.52^\circ$

$37.52 - 36.4 = 1.12^\circ$ ✓1

C $(53.2^\circ N, 1.12^\circ E)$ ✓1

ii) The time the plane lands at C if its speed is 500km/h (3 marks)

time $= \frac{1301.3}{500} + \frac{2500}{500} = 7\text{hrs } 36\text{min}$ ✓1

$= 7\text{hrs } 36\text{ min}$

$37.52 \times 4 = \frac{150.08}{60}$

$= 2\text{hrs } 30\text{minutes}$ ✓1

0900hrs + 0736 + 0230

$= 1906\text{ hrs}$

$= 7:06$ PM ✓1

10

22. Mr. Odongo earns a basic salary of sh 45,500 and house allowance of sh 8,500 per month. Being a civil servant, he is deducted ksh 810 for National housing which is exempted from taxation. He also pays insurance premiums amounting to Sh 4500 and is entitled to an insurance relief at 15% of premiums paid, subject to a maximum of Ksh 9,000 per month. He is entitled to a monthly personal relief of sh 1408.

a) Calculate his taxable income per annum (2 marks)

Total Gross income = 45 500 + 8 500
= sh. 54000

Taxable income = 54000 − 810 ✓1
= 53,190

= 53,190 × 12 ✓1
= sh. 638, 280

b) The table below shows the tax rates during that year. Use the table to calculate his net tax (6 marks)

income in Ksh (per month)	tax rate (%)
1–11180	10
11181–21714	15
21715–32248	20
32249–42781	25
42782 and above	30

11180 × 0.1 = 1118 ✓1
10534 × 0.15 = 1580.10
10534 × 0.2 = 2106.80 ✓1
10533 × 0.25 = 2633.25
10409 × 0.3 = 3122.70 ✓1
Gross Tax = sh. 10,560.85 ✓1

Total Relief = (0.15 × 4500) + 1408
= sh. 2083 ✓1

Net tax | P.A.Y.E
= 10,560.85 − 2083
= sh. 8, 477.85 ✓1

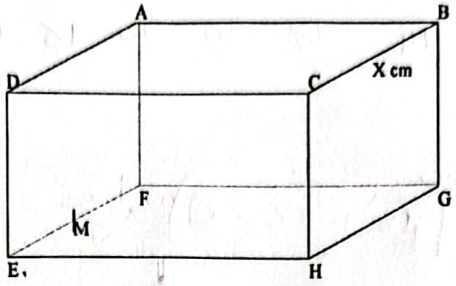
c) The following deductions are also made from his monthly income. Cooperative shares Ksh. 1200, Cooperative loan Ksh. 8500, Service charge Ksh. 575. Determine Mr. Odongo's net monthly salary (2 marks)

Total Deductions =
8477.85 + 810 + 4500 + 1200
+ 8500 + 575
= sh. 24062.85 ✓1

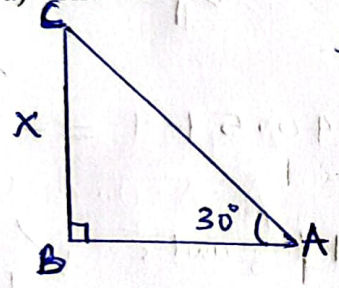
Net pay =
54000 − 24062.85
= sh 29,937.15 ✓1

10

23. The figure below shows a cuboid ABCDEFGH. AC = 52 cm, BC = x cm, $CE = 28\sqrt{3}$ *cm* and angle CAB 30^0 . M is the mid – point of line FE. Determine correct to 4 significant figures:



a) The value of x. (2 marks)

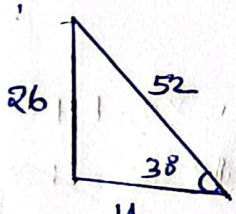


$\sin 30^\circ = \frac{x}{52}$ ✓1

$x = 52\sin 30^\circ$

$= 26.00\ cm$ ✓1

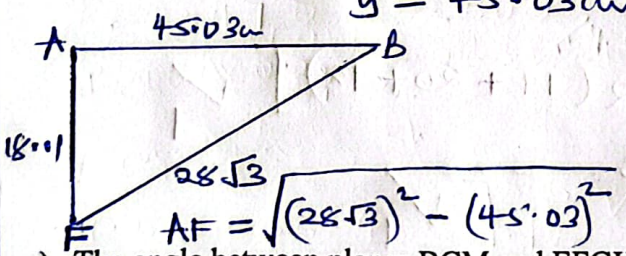
b) The angle CAE. (4 marks)



$\tan 30^\circ = \frac{26}{y}$

$y = \frac{26}{\tan 30^\circ}$ ✓1

$y = 45.03\ cm$

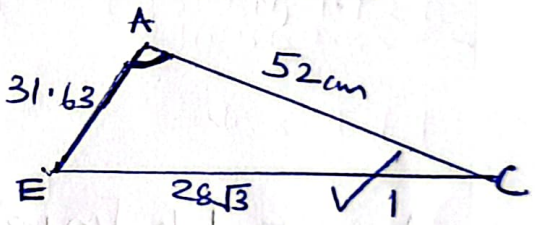


$AF = \sqrt{(28\sqrt{3})^2 - (45.03)^2}$

$AF = 18.01\ cm$ ✓1

$AE = \sqrt{(26)^2 + (18.01)^2}$

$= 31.63\ cm$

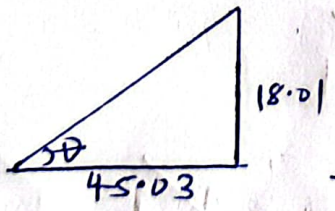


$(28\sqrt{3})^2 = 31.63^2 + 52^2 - 2\times 52\times 31.63\cos A$

$\cos A = 0.4111$

$A = 65.73^\circ$ ✓1

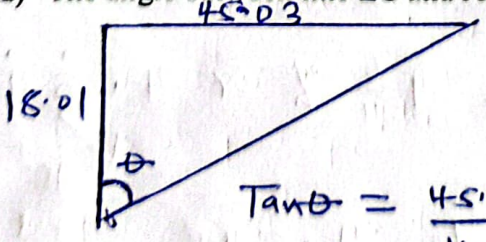
c) The angle between planes BCM and EFGH. (2 marks)



$\tan\theta = \frac{18.01}{45.03}$ ✓1

$\theta = 21.80^\circ$ ✓1

d) The angle between line EC and AF. (2 marks)



$\tan\theta = \frac{45.03}{18.01}$ ✓1

$\theta = 68.20^\circ$

$= 68.20^\circ$ ✓1

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24. a) Complete the table below for the function $y = 18 + 3x - x^2$ for $-3 \le x \le 5$ (2 marks)

x	−3	−2	−1	0	1	2	3	4	5
y	0	8	14	18	20	20	18	14	8

b) Find the actual area bounded by the curve, $y = 18 + 3x - x^2$ the lines $x = -3$, $x = 5$ and the x- axis (3 marks)

Actual area $= \int_{-3}^{5} (18 + 3x - x^2)\,dx = \left[18x + 1.5x^2 - \frac{x^3}{3}\right]_{-3}^{5}$

$= 18(5) + 1.5(5)^2 - \frac{(5)^3}{3} = 85\frac{5}{6}$ ✓1

$= 18(-3) + 1.5(-3)^2 - \frac{[-3]^3}{3} = -40.5 + 9 = -31\frac{1}{2}$ ✓1

Area $= 85\frac{5}{6} + 31\frac{1}{2} = 117\frac{1}{3}$ units^2 ✓1

c) Use the trapezoidal rule with five ordinates to estimate the area bounded by the curve, $y = 18 + 3x - x^2$ the lines $x = -3$, $x = 5$ and the x- axis (3 marks)

Area $= \frac{1}{2} h\,[(0+8) + 2(14 + 20 + 18)]$ ✓1

$h = \frac{5+3}{4} = 2$ ✓1

$\frac{1}{2} \times 2\,[8 + 104)$

$= 112$ units^2 ✓1

d) Calculate the percentage error introduced by approximation (2 marks)

Absolute error $= |117\frac{1}{3} - 112| = 5\frac{1}{3}$ ✓1

% error $= \frac{5\frac{1}{3}}{117\frac{1}{3}} \times 100\% = 4\frac{6}{11}\%$ or $4.\dot{5}4\dot{}\%$ ✓1

Reject 4.545

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