KASSU JOINT EVALUTION TEST (J.E.T)

Kenya certificate of secondary education (KCSE)

121/1 - MATHEMATICS - Paper 1

ALT A

June. 2022 - $2\frac{1}{2}$ hours

Name..... Marking Scheme .....class..... Adm.....

Signature.....date.....

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.*
- *You are reminded of the necessity of **orderly presentation** in your answers.*
- *The paper contains **TWO** sections: **Section I** and **Section II.***
- *Answer **ALL** the questions in **Section I** and any **five** questions from **Section II***
- *All answers and working must be written on the question paper in the spaces provided below each question.*
- ***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 electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.*

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 this section on the spaces provided*

1. An aircraft Company bought eight aircrafts for eighteen billion, nine hundred and seventy-five million, twenty-eight thousand, two hundred and forty.

(a) Write the total cost of the eight aircrafts in figures. (1mark)

18,975,028,240 B_1

(b) Calculate the cost of each aircraft. (2marks)

$\frac{18,975,028,240}{8}$ M_1

$= 2,371,878,530$ A_1

2. Solve for x in the equation $\frac{3}{x+1} + \frac{2}{x+5} = \frac{1}{x-2}$ (4mks)

$\frac{3x+15+2x+2}{(x+1)(x+5)} = \frac{1}{x-2}$ ✓ M_1

$(x-2)(5x+17) = (x+1)(x+5)$

$5x^2 + 17x - 10x + 34 = x^2 + 6x + 5$ ✓ M_1

$4x^2 + x - 39 = 0$

$\frac{-1 \pm \sqrt{1+16\times 39}}{8}$ ✓ M_1

$= 3$ or -3.25 ✓ A_1

3. (a)The number 16200 is given as $2^x \times 3^y \times 5^z$. Find the value of $x + y + z$ 2marks Both

$16200 = 2^3 \times 3^4 \times 5^2$

$x = 3$

$y = 4$

$z = 2$

$3 + 4 + 2 = 9$ B_1

(b). When another number N is multiplied by 16200, a perfect cube is obtained. Find the least value of N (2marks)

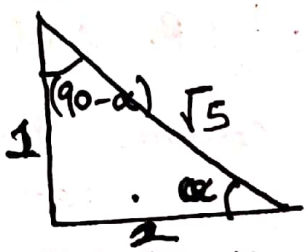
$2^3 \times 3^4 \times 5^2$

$2^0 \times 3^2 \times 5^1$ ✓ $= 45$ ✓ B_1

B_1

4. Given that $\sin \propto ° = \frac{1}{\sqrt{5}}$ where a is an acute angle find, without using Mathematical tables

(a) Cos ∝ ° in the form of $a\sqrt{b}$, where a and b are rational numbers (2marks)



$\cos \propto = \frac{2}{\sqrt{5}}$ M_1 ✓

$= \frac{2\sqrt{5}}{5}$ ✓A_1

2marks

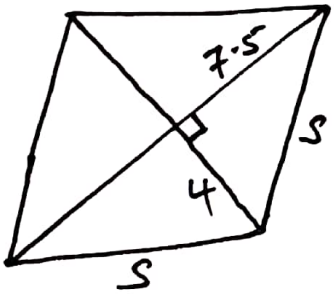
(b) $Tan\ (90-\propto)°$

$\tan(90-\propto) = \frac{2}{1}$ B_1 ✓

✓

$= 2$ B_1

5. The area of a rhombus is 60 cm^2. If the shorter diagonal is 8 cm. Find the perimeter of the rhombus. (4 marks)



$A = \frac{1}{2} D \times d$

$60 = \frac{1}{2} \times 8 \times D$

$\frac{120}{8} = D$

$D = 15cm$ ✓

$7.5^2 + 4^2 = S^2$

$72.25 = S^2$ ✓

$S = 8.5\ cm$ ✓

$P = 4S$

$= 4 \times 8.5$ ✓

$= 34cm$ ✓

6. A 63kg metal of density 7,000 kg/m^3 is moulded into a rectangular pipe with external dimensions of 12cm by 15cm and internal dimensions of 10cm by 12cm. Calculate the length of the pipe in meters. (3marks)

(2marks)

$V = m/\rho$

$= \frac{63}{7000}$

$= 9000cm^3$ ✓

$A_{CSA} = (12 \times 15) - (10 \times 12)$

$= 180 - 120$

$= 60\ cm^2$

$V = A_{CSA} \times L$

$\frac{60 \times L}{60} = \frac{9000}{60}$

$L = 150\ cm$

$= 1.5m$

7. The position vectors of the points P, Q and R are $\begin{pmatrix}-3\\-1\end{pmatrix}, \begin{pmatrix}\frac{1}{2}\\-2\end{pmatrix}$ *and* $\begin{pmatrix}4\\-3\end{pmatrix}$ respectively. Show that P, Q and R are collinear (3marks)

$PR = \begin{pmatrix}4\\-3\end{pmatrix} - \begin{pmatrix}-3\\-1\end{pmatrix}$

$= \begin{pmatrix}7\\-2\end{pmatrix}$

$PQ = \begin{pmatrix}0.5\\-2\end{pmatrix} - \begin{bmatrix}-3\\-1\end{bmatrix}$

$= \begin{pmatrix}3.5\\-1\end{pmatrix}$

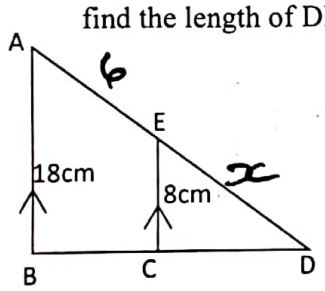
$PQ = hPR$

$\begin{bmatrix}3.5\\-1\end{bmatrix} = h\begin{bmatrix}7\\-2\end{bmatrix}$

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

$PQ = \frac{1}{2}PR$ and P is common Pt Hence Collinear

8. In the triangle ABD, BA is parallel, to CE, given that BA= 18cm, CE = 8cm and AE = 6cm, find the length of DE (3marks)



Let DE be x

$\frac{18}{8} = \frac{6+x}{x}$

$18x = 48 + 8x$

$10x = 48$

$x = 4.8\ cm.$

9. Given the equation $\frac{9^{4x}}{3^{2x}} = \frac{1}{9^{-4}}$, solve for x to its simplest form. (3 marks)

$[3^2]^{4x} \div 3^{2x} = 1 \div [3^2]^{-4}$

$3^{8x-2x} = 3^{0-(-8)}$

$6x = 8$

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

$x = 1\frac{1}{3}.$

10. A Kenyan company received M US Dollars. The money was converted into Kenyan shillings in a bank which buys and sells foreign currencies.

	Buying (in Ksh.)	Selling (in Ksh.)
1Sterling Pound	145.78	146.64
` US Dollar	110.66	110.86

If the company received Ksh. 15,132, 000, calculate the amount M, received in US Dollars. (2marks)

$\frac{15,132,000}{110.66}$ M_1 ✓ = 136,743.1773 US $ ✓A_1

11. Two interior angles of an irregular n sided polygon is 117 each. The remaining exterior angles are 39^0 each. Calculate the number of sides of the polygon (3marks)

$180 - 117 = 63°$.

$63 \times 2 = 126°$ ✓M_1

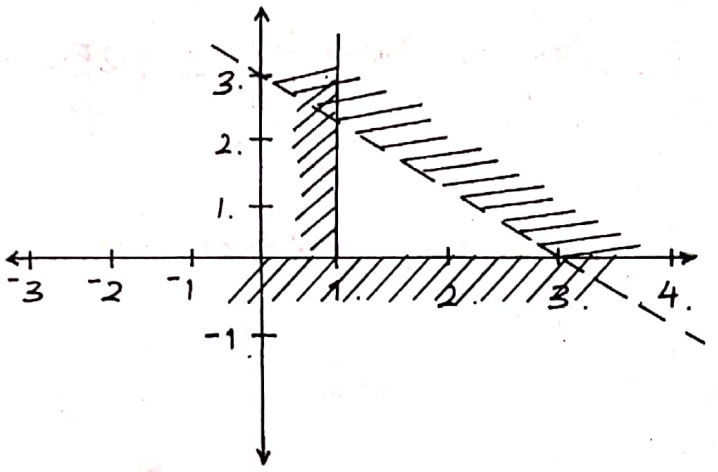
$126 + 39(n-2) = 360$ ✓M_1

$\frac{39}{39}(n-2) = \frac{234}{39}$

$n - 2 = 6$

$n = 8$ sides. ✓A_1

12. Determine the inequalities that represent and satisfies the unshaded region (3marks)



$x \geq 1$ ✓B_1

$y \geq 0$ ✓B_1

$y + x < 3$ ✓B_1

14. There are two grades of rice, grade A and Grade B. Grade A costs Sh 80 per Kg while Grade B costs Sh 60 per Kg. In what ratio must the two be mixed in order to produce a blend costing Sh 75 per Kg. (3marks)

$\frac{80A+60B}{A+B} = 75$ $\checkmark M_1$

$80A - 75A = 75B - 60B$

$5A = 15B$ $\checkmark m_1$

$\frac{A}{B} = \frac{15}{5} = \frac{3}{1}$

$A:B = 3:1$ A_1

15. One of the three vertices of triangle ABC is A (2,-3). Point A is mapped onto A^1 (-4, 7) under a reflection on mirror line *M*. find the equation of the mirror-line *M* (3marks)

Midpoint; $\left(\frac{2-4}{2}, \frac{-3+7}{2}\right)$

$= (-1, 2)$ $\checkmark m_1$

$m_1 = \frac{7+3}{-4-2} = \frac{10}{-6}$

$m_2 = \frac{3}{5}$ $\checkmark$

$y = mx + c$

$-3 = \frac{3}{5}(2) + c$

$-3 - \frac{6}{5} = c = -\frac{21}{5}$

$5y - 3x + 21 = 0$ $\checkmark c$

$y = \frac{3}{5}x - \frac{21}{5}$

16. A camp has enough food ration to last 10,000 refugees for 35 days. After 5 days, 2500 more refugees arrived in the camp. If all are now put on a half ration, how much longer will the food last? (3 marks)

$1\,Day = \frac{10,000}{35}$

$5\,days = \frac{10,000}{35} \times 5$

$= \frac{10,000}{7}$

Remainde $= 8571\frac{3}{7}$ $\checkmark$

Afte new 2500 refugee

$1\,Day = \frac{12500}{35 \div \frac{1}{2}} = \frac{12500}{70}$ $\checkmark$

$\frac{12500}{70} x = 8571\frac{3}{7}$

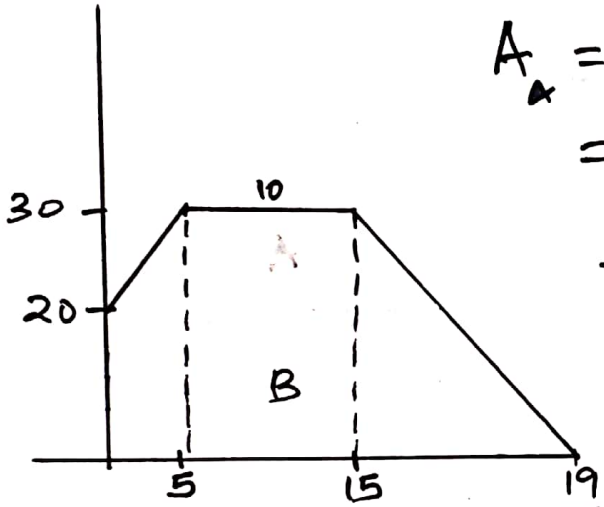
$x = 48$

$48 - 35 = 13\,days$ $\checkmark$

SECTION II (50 marks)

*Answer any **five** questions from this section on the spaces provided.*

17. a). A particle moving at 20 m/s accelerates to 30 m/s in 5 seconds then travels at this speed for 10 seconds before decelerating to rest in 4 seconds. Draw a velocity –time graph and use it to calculate the distance covered by the particle in 19 seconds. (3 marks)



$A_A = \left(\frac{1}{2} \times 4 \times 30\right) + \frac{1}{2}(30+20)5 + 10 \times 30$

$= 60 + 125 + 300$

$= 485\,m$

Area = Distance

405m ✓

b). A train 100 m long travelling at 72km/h overtakes another train travelling in the same same direction at 56km/hr and passes it completely in 54 seconds. Find the length of the second train. (4 marks)

$RS = 72 - 56$

$= 16\,km/h$

$T = 54s$

$D = SXT$

$= 16 \times \frac{5}{18} \times 54$

$16 \times 5 \times 3 = 240m$

$T_1 = 100m$

$T_2 = 240 - 100$

$= 140m$

ii). Find the time (how long) they would have taken to pass each other if they had been travelling at these speeds in opposite directions. (3 marks)

$RS = 56 + 72$

$= 128\,km/h$

$D = 240\,m$

$t = D/Rs$

$= \frac{240 \times \frac{1}{1000}}{128}$

$= 6.75$ Seconds

18. (a) Find the inverse of the matrix A , given that A is $\begin{pmatrix} 2 & 3 \\ 3 & 4 \end{pmatrix}$

$\text{Det} = 8 - 9 = -1$

$\text{Inv} = -1\begin{pmatrix} 4 & -3 \\ -3 & 2 \end{pmatrix}$

$= \begin{bmatrix} -4 & 3 \\ 3 & -2 \end{bmatrix}$

(b) Jane bought 200 bags of sugar and 300 bags of rice for a total cost of shs. 850,000. Peter bought 120 bags of rice and 90 bags of sugar for a total cost of shs. 360,000. If the price of a bag of sugar is shs. x and that of rice is shs. y.

(i) Form two equations to represent the above information. (2marks)

$3x + 4y = 12,000$

$2x + 3y = 8500$

(ii) Use matrix method to find the price of one bag of each item (3marks)

$2x + 3y = 8500$

$3x + 4y = 12,000$

$\begin{pmatrix} x \\ y \end{pmatrix} = \text{Inv}\begin{pmatrix} 8500 \\ 12500 \end{pmatrix}$

$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} -4 & 3 \\ 3 & -2 \end{pmatrix}\begin{pmatrix} 8500 \\ 12,000 \end{pmatrix}$

$x = -4(8500) + 3(12000)$

$y = 3(8500 - 2(12000)$

$x = 2000$

$y = 1500$

(c) Robert bought 225 bags of sugar and 360 bags of rice. He was given a total discount of shs. 33,300. If the discount on the price of a bag of rice was 2%, calculate the percentage discount on the price of a bag of sugar. (3marks)

$33,300 - [0.02 \text{ of } 360 \times 1500)$

$= 22,500$

$\frac{22500}{225 \times 2000} \times 100$

$= 0.05 \times 100$

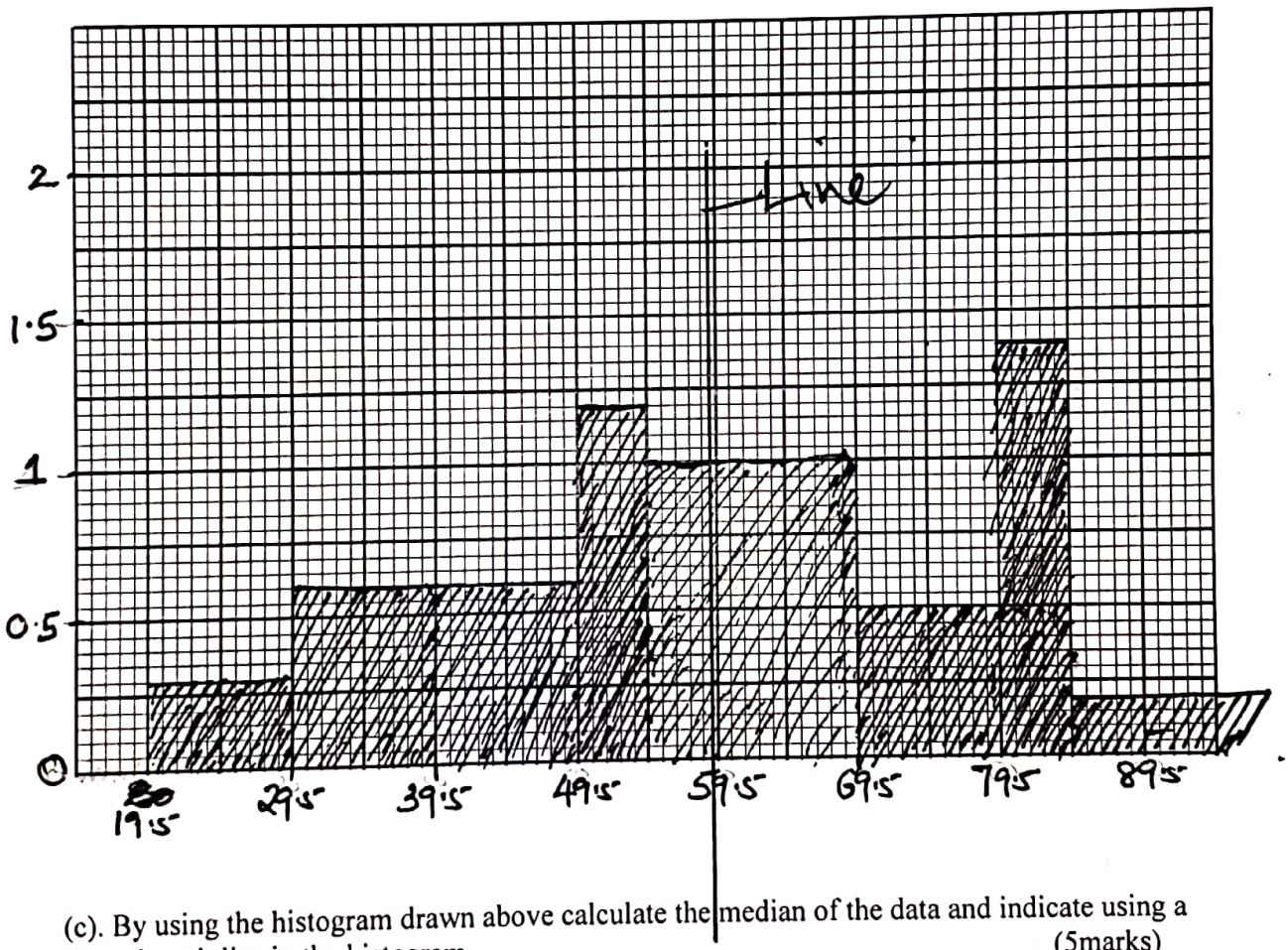
$= 5\%$

19. The table below shows scores for a form 4 class Math results in Ushindi School.

	3	15	21	36	41	48	51
Marks	20-29	30-49	50-54	55-69	70-79	80-84	85-99
No of Students	3	12	6	15	5	7	3
f.d	0·3	0·6	1·2	1	0·5	1·4	0·2

(a). Fill in the column for frequency density row on the table (2marks)

(b). Draw a histogram to represent the above data (3marks)



(c). By using the histogram drawn above calculate the median of the data and indicate using a line where it lies in the histogram. (5marks)

$\frac{51}{2} = 25.5$

Median class = 55-69

$54.5 + \left[\frac{25.5 - 21}{15}\right] 15$

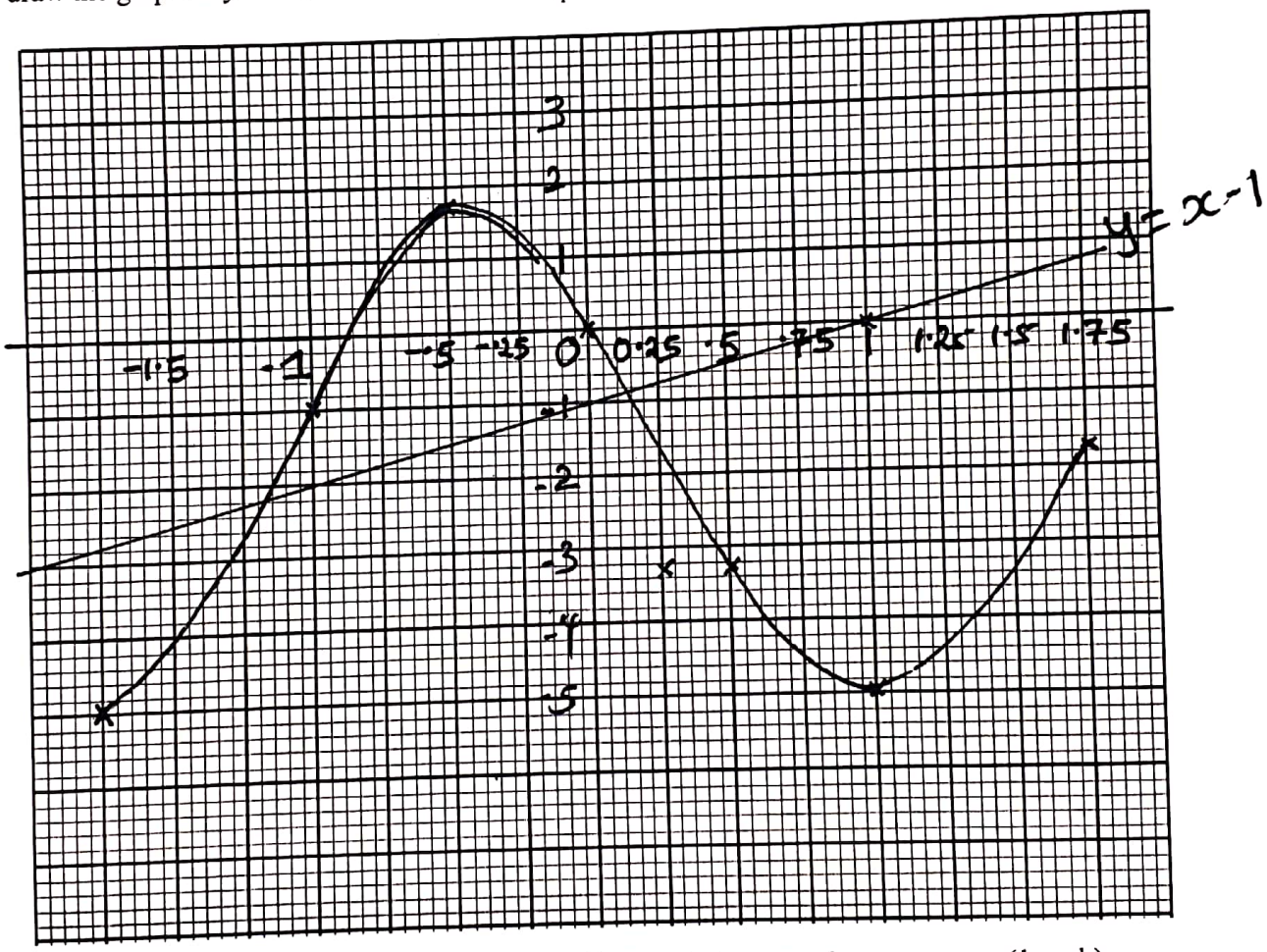
$54.5 + 4.5$

$= 59$

20. (a). Complete the table below for the equation $y = 4x^3 - 3x^2 - 6x$ 2marks

x	$-1\frac{1}{4}$	-1	$-\frac{1}{2}$	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	$1\frac{3}{4}$
y	-5	-1	$1\frac{3}{4}$	0	$-3\frac{1}{4}$	-5	$-2\frac{1}{4}$	$1\frac{3}{4}$

b. Using a scale of 4 cm to represent 1 unit on the x axis and 2cm to represent 1 unit on the y-axis draw the graph of $y = 4x^3 - 3x^2 - 6x$ for $-1\frac{1}{4} \leq x \leq 1\frac{3}{4}$ on the grid provided 3marks



c). Use your graph to find the range of values of x for which $y \leq -3$ (1mark)

0·45 to 1·55 and -1·5 to -1·75.

d). Use your graph to solve the equation $4x^3 - 3x^2 - 6x = 0$ (2marks)

0 and -0·85.

e). By drawing a suitable straight-line graph on the same axes solve the equation $-4x^3 + 3x^2 + 7x - 1 = 0$ (2marks)

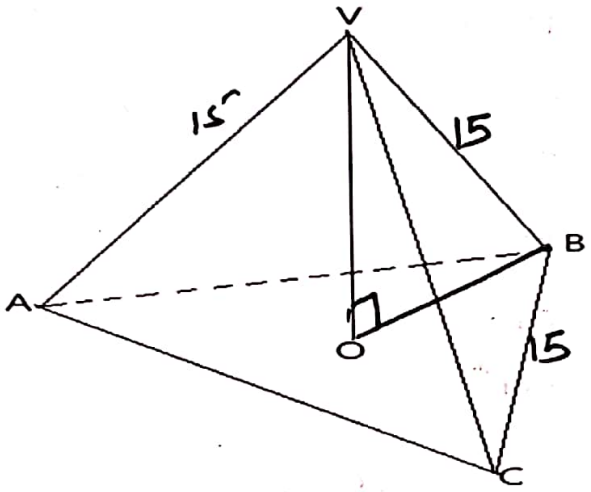
$4x^3 - 3x^2 - 6x + 0 = y$ +

$y = -1 + x$

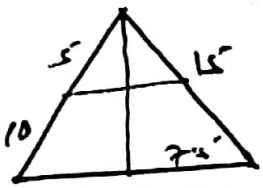
$y = x - 1$

$x = 0.175$ and 1.175

21. The figure below shows a solid regular tetrahedron of side 15 cm. Point O is center of the base ABC



a). Calculate the perpendicular height VO of the pyramid to 1 decimal place. (3 marks)



$\frac{2}{3}\left(\sqrt{15^2-7.5^2}\right)=BO$

$= 8.66$

$15^2-8.66^2$

$\sqrt{225-75}=VO$

$= 12.2\ cm$

b). The tetrahedron is cut parallel to the base ABC forming a frustrum. The slant height of the frustrum is two-thirds the slant height of the pyramid. Calculate;

(i). The volume of the frustrum. (4 marks)

$V_T = \frac{1}{3}\times\frac{1}{2}\times 15^2\sin 60\times 12.2$

$= 396.206$

$V_{sf} = 27:1$

$V_{S.T} = \frac{1}{27}\ 396.206$

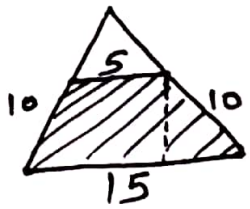
$= 14.67$

$V_f = 396.206-14.67$

$= 381.53$

(ii). The surface area of the solid frustrum (3 marks)

Acc. 383.016

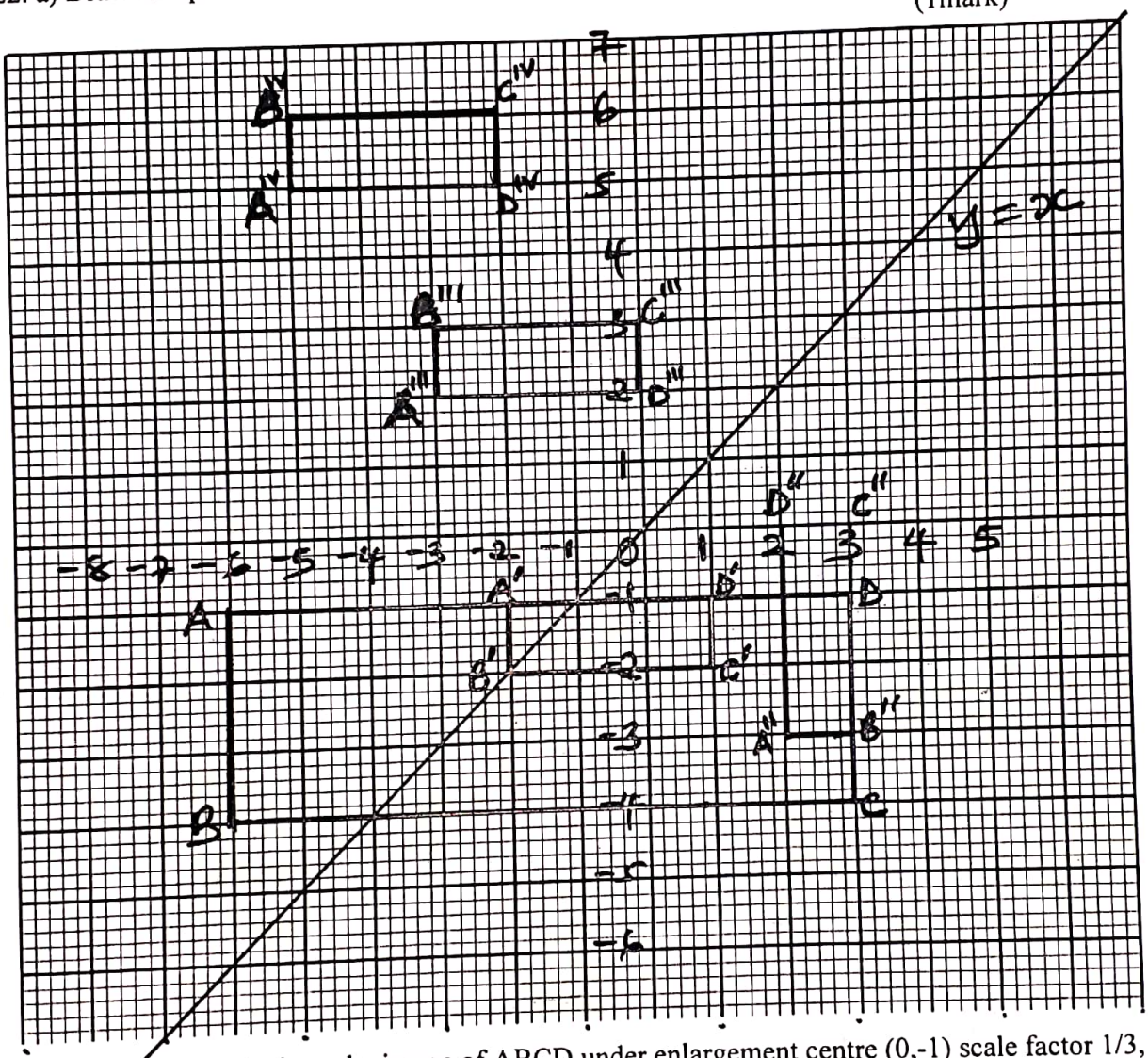


$\left[\frac{1}{2}(5+15)8.660\right]3$

$259.81+\frac{1}{2}\times 15^2\sin 60+\frac{1}{2}\times 5^2\sin 60$

$= 368.1\ cm^2$

22. a) Draw the quadrilateral with vertices at A(-6,-1) B(-6,-4) C(3,-4) and D(3,-1) (1mark)



(b) On the same grid, draw the image of ABCD under enlargement centre (0,-1) scale factor 1/3, label the image A'B'C'D'. (2marks)

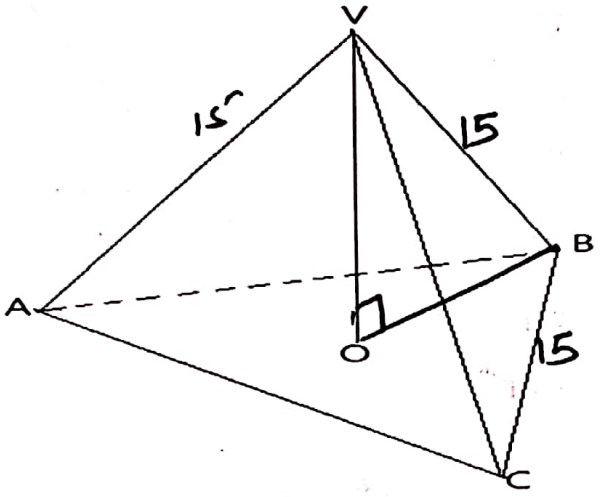
(c) Draw A''B''C''D'' the image of A'B'C'D' under rotation of +90° about (1,0). (2marks)

(d) Draw A'''B'''C'''D''' the image of A''B''C''D'' under reflection in the line $y - x = 0$ 2marks

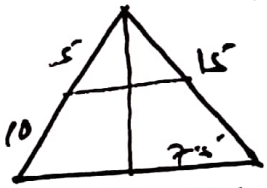
(e) Draw $A^{IV}B^{IV}C^{IV}D^{IV}$ the image of A'''B'''C'''D''' under translation $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ and write down its coordinates (3marks)

$A^{IV}(-5,5)$
$B^{IV}(-5,6)$
$C^{IV}(-2,6)$
$D^{IV}(-2,5)$.

21. The figure below shows a solid regular tetrahedron of side 15 cm. Point O is center of the base ABC



a). Calculate the perpendicular height VO of the pyramid to 1 decimal place. (3 marks)



$\frac{2}{3}\left(\sqrt{15^2-7.5^2}\right)=BO$

$= 8.66$

$15^2-8.66^2$

$\sqrt{225-75}=VO$

$= 12.2$ cm

b). The tetrahedron is cut parallel to the base ABC forming a frustrum. The slant height of the frustrum is two-thirds the slant height of the pyramid. Calculate;

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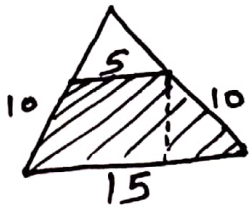
Acc. 383.016 √√



$\left[\frac{1}{2}(5+15)8.660\right]3$

$259.81 + \frac{1}{2}\times 15^2 \sin 60 + \frac{1}{2}\times 5^2 \sin 60$

$= 368.1\ cm^2$

23. (a). The equation of a line L_1 is $7y - 5x - 20 = 0$ · Find the x-intercept of the equation (1mark)

$-5x = 20$

$x = -4$

b). Another line L_2 is perpendicular to L_1 and passes through (-5, 3). Find the equation of L_2. (3marks)

$m_1 = \frac{5}{7}$

$m_2 = -\frac{7}{5}$ $(-5, 3)$

$3 = -\frac{7}{5}(-5) + c$

$-4 = c$

$y = -\frac{7}{5}x - 4$

c). L_3 passes through (0,-3) and parallel to the line L_4 whose equation is $3y - 8x = 3$ find the equation of L_3. (3marks)

$m_1 = \frac{8}{3}$

$m_2 = \frac{8}{3}$ $(0, -3)$

$-3 = \frac{8}{3}(0) + c$

$-3 = c$

$y = \frac{8}{3}x - 3$.

d). Calculate the coordinates of point of intersection between the lines L_1 and L_3. (3marks)

$3y - 8x = -9$

$7y - 5x = 20$

$21y - 56x = -63$

$21y - 15x = 60$

$-41x = -123$

$x = 3$

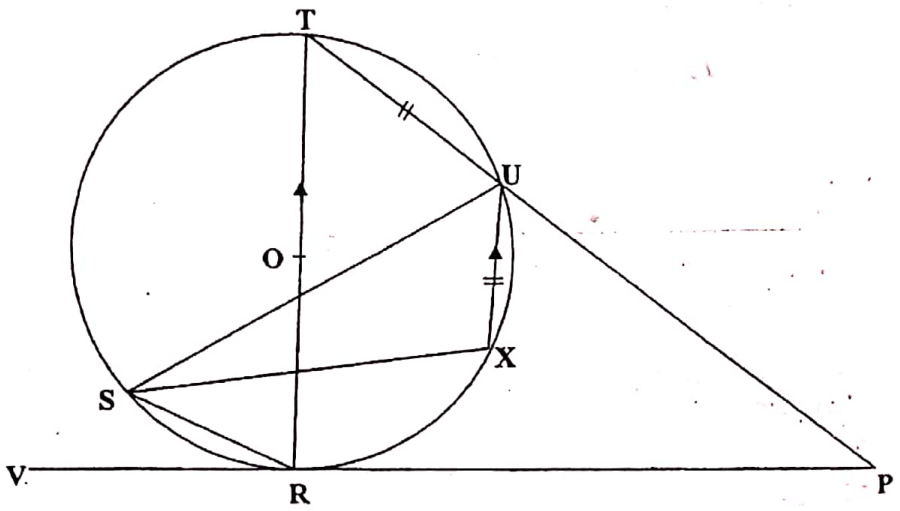
$3y - 8(3) = -9$

$3y = -9 + 24$

$y = 5$.

$(3, 5)$

24. In the figure below, O is the center of the circle TOR is the diameter and PRV is tangent to the circle at R.



Given that <SUR = 25^0, <URP = 60^0, TU = UX and that UX is parallel to the diameter; giving reasons calculate;

a) <TOU (2 marks)

60° - Sum of interior angles add to 180°

b) <XUP (2 marks)

60° - Vertically opposite angles are equal

c) <STR (2 marks)

25° - Same chord subtends equal angles at the circumference.

d) Reflex <SXU (2 marks)

95° - Opposite interior angles of a cyclic quadrilateral are equal.

e). <RPU (2marks)

30° - Angles of a triangle add to 180°