

# KASSU JOINT EVALUATION 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

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## 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<sub>1</sub>

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

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

$$= 2,371,878,530 \text{ A}_1$$

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

$$\frac{3x+15+2x+2}{(x+1)(x+5)} = \frac{1}{x-2} \quad \checkmark M$$

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

$$-1 \pm \sqrt{1+16 \times 39} \quad \checkmark M_1$$

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

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

$$5x^2 + 17x - 10x + 34 = x^2 + 6x + 5 \quad \checkmark M_1$$

$$= 3 \text{ or } -3.25 \text{ A}_1$$

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

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

$$3 + 4 + 2 = 9 \text{ B}_1$$

$$x = 3$$

$$y = 4$$

$$z = 2$$

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

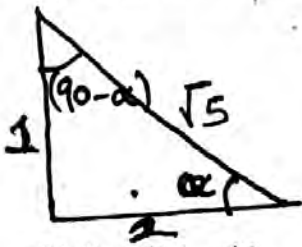
$$2^3 \times 3^4 \times 5^2$$

$$2^0 \times 3^2 \times 5^1 = 45 \quad \checkmark$$

B<sub>1</sub>

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

(a)  $\cos \alpha^\circ$  in the form of  $a\sqrt{b}$ , where  $a$  and  $b$  are rational numbers (2marks)



$$\cos \alpha = \frac{2}{\sqrt{5}} \text{ M, V}$$

$$= \frac{2\sqrt{5}}{5} \text{ V, A,}$$

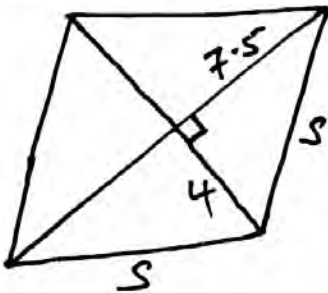
(b)  $\tan(90-\alpha)^\circ$

2marks

$$\tan(90-\alpha) = \frac{2}{1} \text{ B, V}$$

$$= 2 \text{ B,}$$

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



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

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

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

$$d = 15 \text{ cm}$$

$$7.5^2 + 4^2 = s^2$$

$$72.25 = s^2$$

$$s = 8.5 \text{ cm}$$

$$P = 4s$$

$$= 4 \times 8.5 \text{ V}$$

$$= 34 \text{ cm}$$

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

$$V = \frac{m}{\rho}$$

$$= \frac{63}{7000}$$

$$= 9000 \text{ cm}^3$$

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

$$= 180 - 120$$

$$= 60 \text{ cm}^2$$

$$V = A_{\text{CSA}} \times L$$

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

$$L = 150 \text{ cm}$$

$$= 1.5 \text{ m}$$

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

$$PR = \begin{pmatrix} 4 \\ -3 \end{pmatrix} - \begin{pmatrix} -3 \\ -1 \end{pmatrix} = \begin{pmatrix} 7 \\ -2 \end{pmatrix}$$

$$PQ = \begin{pmatrix} 0.5 \\ -2 \end{pmatrix} - \begin{pmatrix} -3 \\ -1 \end{pmatrix} = \begin{pmatrix} 3.5 \\ -1 \end{pmatrix}$$

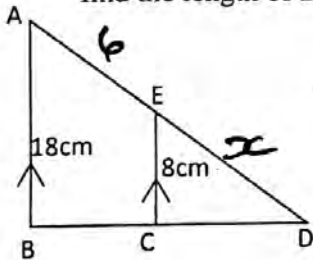
$$PQ = hPR$$

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

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

$PQ = \frac{1}{2}PR$  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

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

$$x = 4.8 \text{ cm}$$

$$18x = 48 + 8x$$

$$10x = 48$$

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

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

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

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

$$6x = 8$$

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

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

	<u>Buying (in Ksh.)</u>	<u>Selling (in Ksh.)</u>
1 Sterling Pound	145.78	146.64
1 US Dollar	110.66	110.86

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

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

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

$$180 - 117 = 63^\circ$$

$$63 \times 2 = 126^\circ \checkmark M_1$$

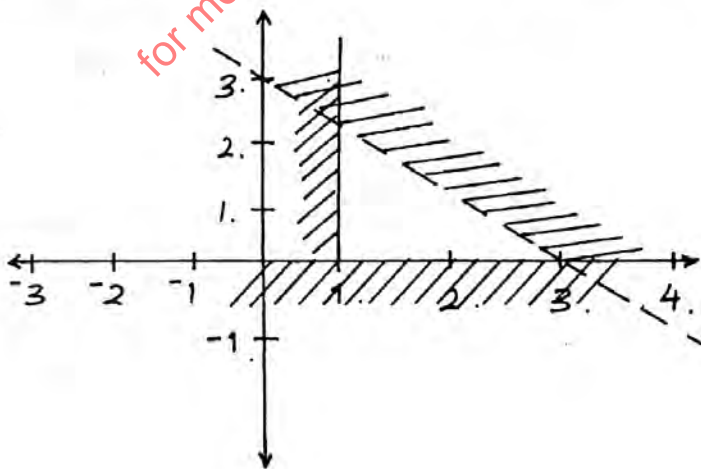
$$\frac{39(n-2)}{39} = \frac{234}{39}$$

$$n-2 = 6$$

$$126 + 39(n-2) = 360 \checkmark M_1$$

$$n = \underline{\underline{8 \text{ sides}}} \checkmark A_1$$

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



$$\begin{aligned} x > 0 & \checkmark B_1 \\ y > 0 & \checkmark B_1 \\ y + x < 3 & \checkmark B_1 \end{aligned}$$

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)

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

$$A : B = 3 : 1 \quad A_1$$

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

$$5A = 15B \quad \checkmark M_1$$

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

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

~~Midpoint~~ Midpoint;  $\left(\frac{2 + (-4)}{2}, \frac{-3 + 7}{2}\right)$   $y = mx + c$   
 $= (-1, 2) \quad \checkmark M_1$   $-3 = \frac{3}{5}(2) + c$

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

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

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

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

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

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)

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

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

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

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

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

$$x = 48$$

$$\text{Remainder} = 8571 \frac{3}{7} \quad \checkmark$$

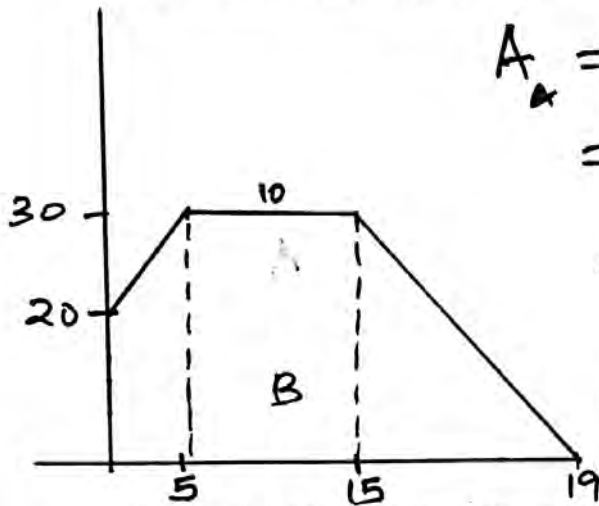
After new 2500 refugees

$$48 - 35 = \underline{\underline{13 \text{ days}}} \quad \checkmark$$

**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)



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

$$= 60 + 125 + 300$$

$$= 485 \text{ m}$$

Area = Distance AOM ✓

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

$$R_s = 72 - 56$$

$$= 16 \text{ km/h}$$

$$T = 54 \text{ s}$$

$$D = S \times T$$

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

$$16 \times 5 \times 3 = 240 \text{ m}$$

$$T_1 = 100 \text{ m}$$

$$T_2 = 240 - 100$$

$$= 140 \text{ m}$$

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)

$$R_s = 56 + 72$$

$$= 128 \text{ km/h}$$

$$D = 240 \text{ m}$$

$$t = \frac{D}{R_s}$$

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

$$= 6.75 \text{ seconds}$$

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

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

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

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

(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)

$$300x + 4y = 12,000$$

$$2x + 3y = 8500$$

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

$$2x + 3y = 8500$$

$$3x + 4y = 12,000$$

$$\begin{pmatrix} x \\ y \end{pmatrix} = \text{Inv} \begin{pmatrix} 8500 \\ 12000 \end{pmatrix}$$

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

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

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

$$x = 2000$$

$$y = 1500$$

(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)

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

$$= 22,500$$

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

$$= 0.05 \times 100$$

$$= \underline{\underline{5\%}}$$



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

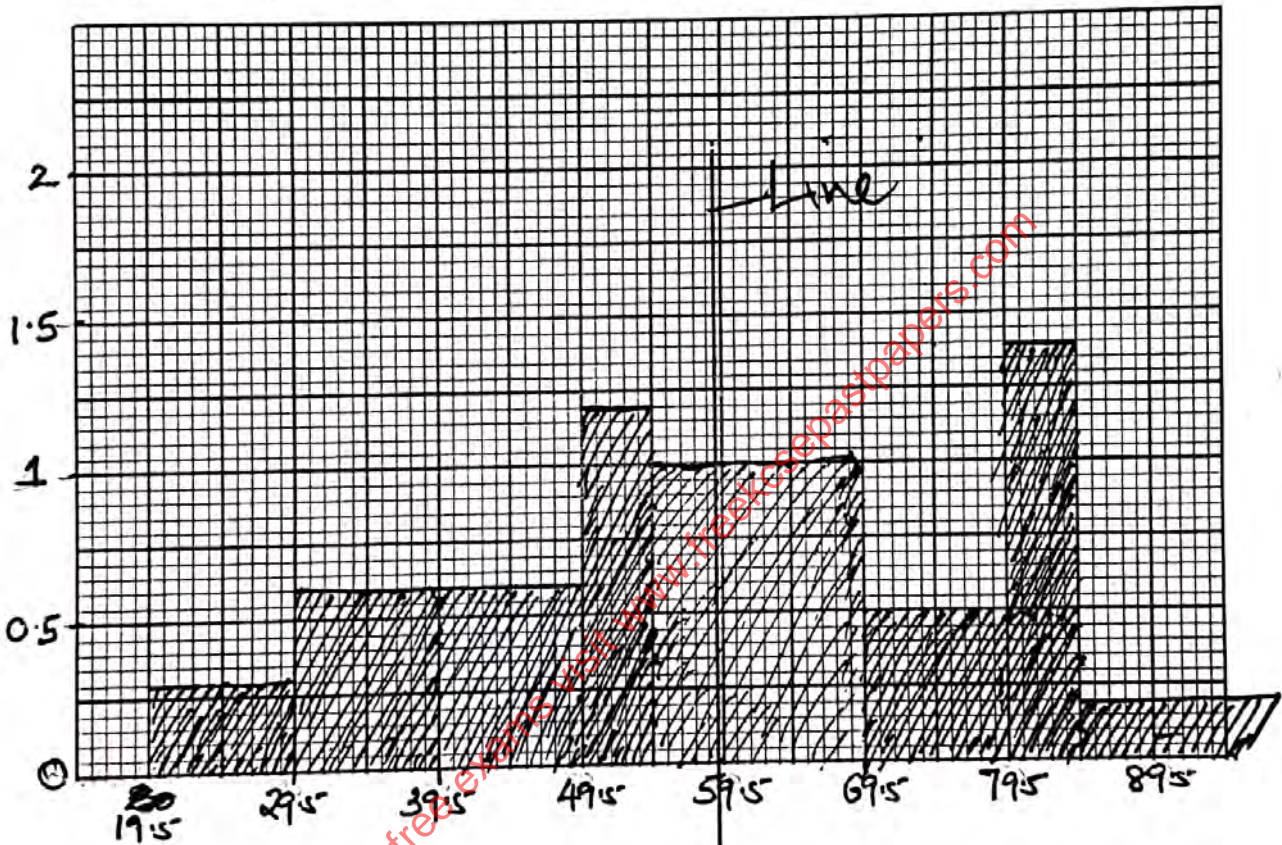
Marks	20-29	30-49	50-54	55-69	70-79	80-84	85-99
No of Students	3	12	6	15	5	7	3
f.d	0.3	0.6	1.2	1	0.5	1.4	0.2

(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

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

$$54.5 + 4.5$$

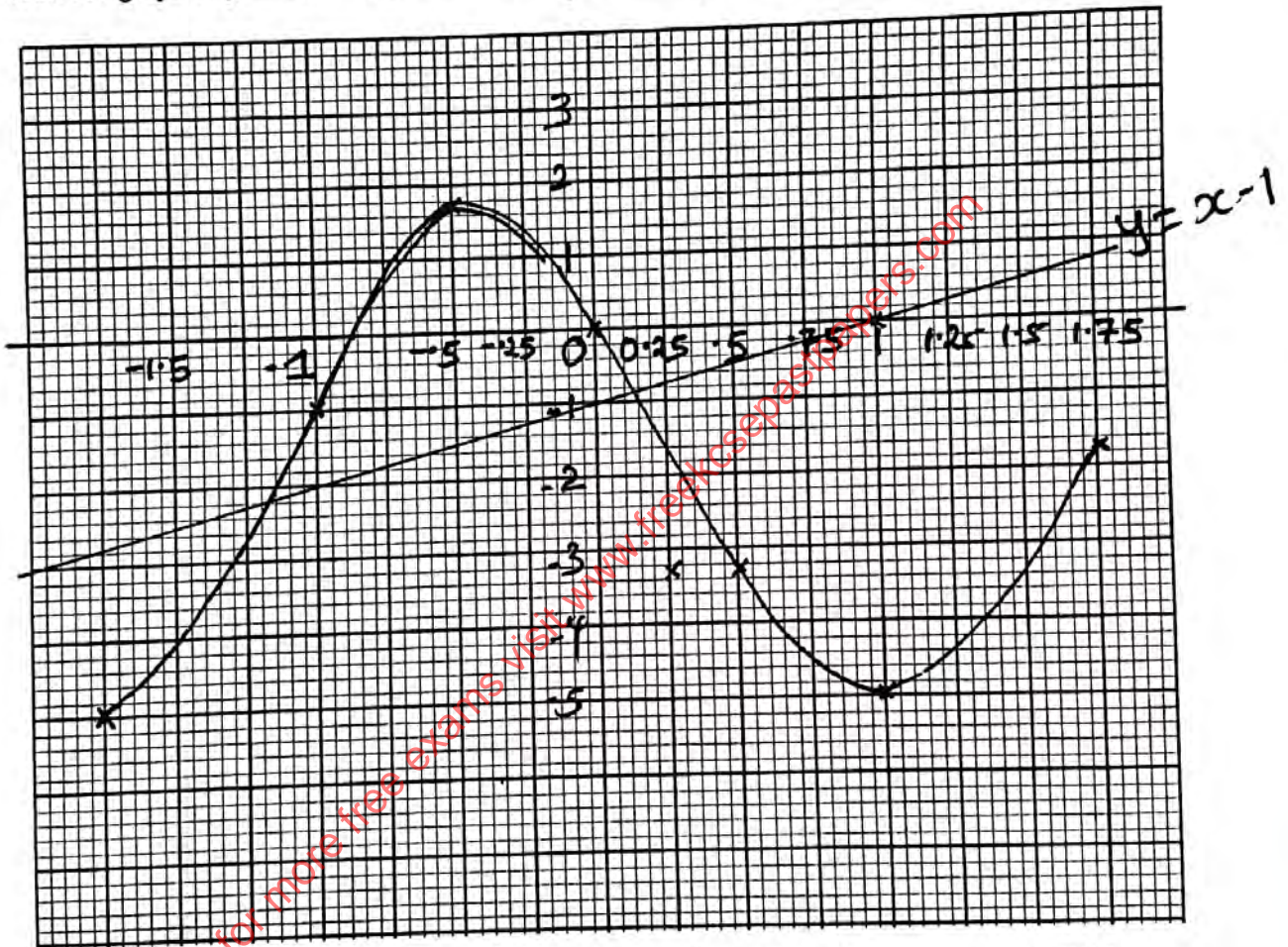
$$= \underline{\underline{59}} \checkmark$$

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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  $-1.3$  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

$$-4x^3 + 3x^2 + 7x - 1 = 0$$

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

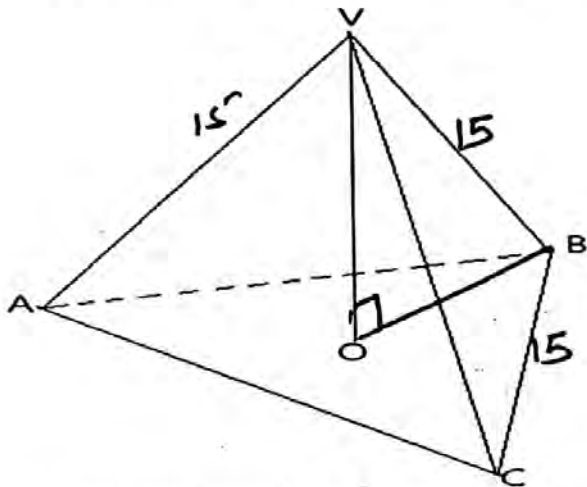
$$y = -1 + x$$

$$y = x - 1$$

(2marks)

KASSU JOINT EVALUATION TEST  $x = 0.175$  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)

$$\frac{2}{3} (\sqrt{15^2 - 7.5^2}) = BO = \sqrt{225 - 75} = VO = 12.2 \text{ cm}$$

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

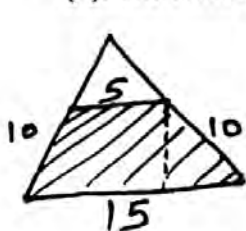
(i). The volume of the frustum. (4 marks)

$$V_T = \frac{1}{3} \times \frac{1}{2} \times 15^2 \sin 60 \times 12.2 = 396.206$$

$$V_{ST} = \frac{1}{27} \times 396.206 = 14.67$$

$$V_f = 396.206 - 14.67 = 381.53$$

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



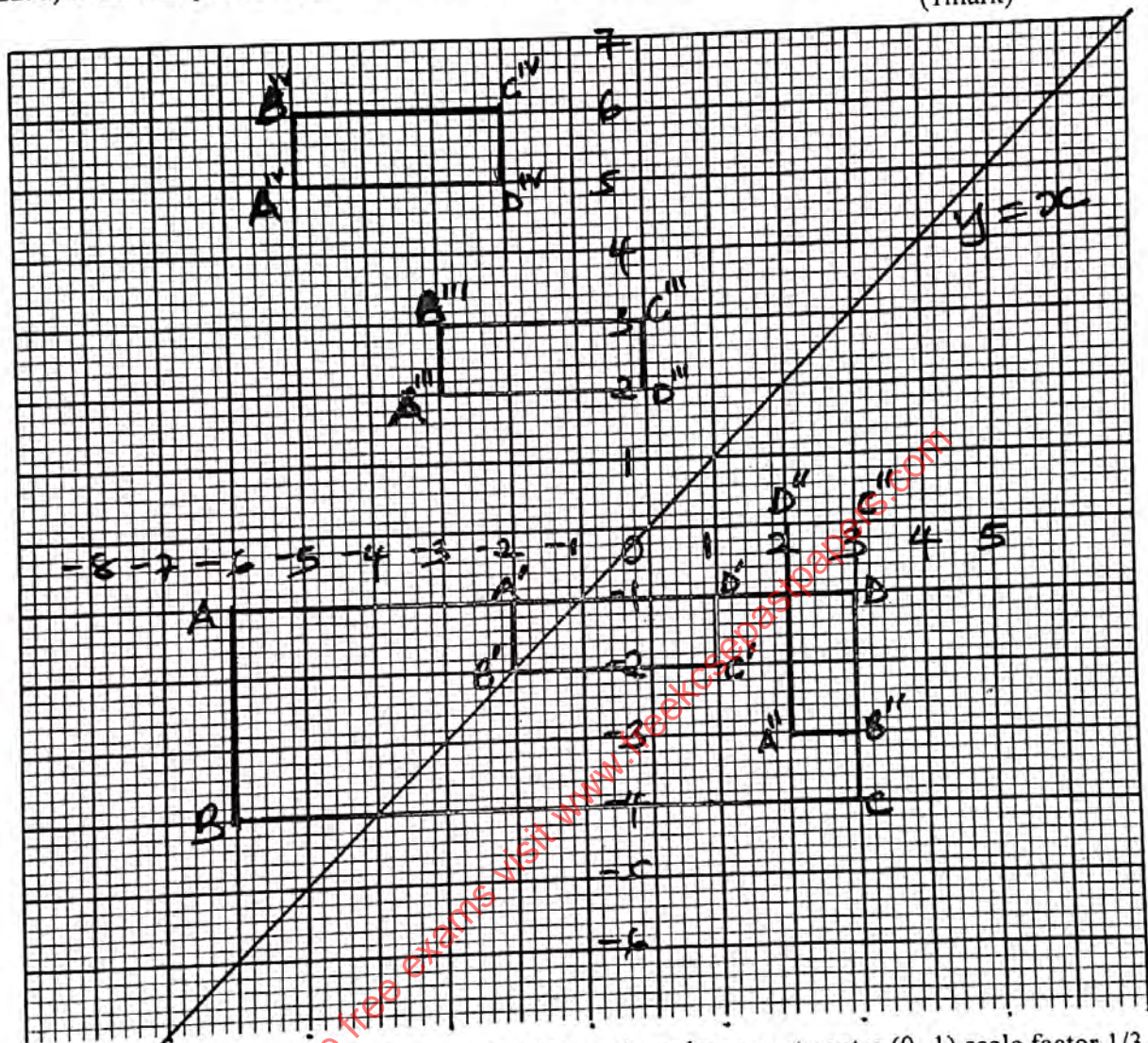
$$\left[ \frac{1}{2} (5+15) \cdot 8.660 \right] \cdot 3$$

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

$$= 368.1 \text{ cm}^2$$

Acc. 383.016 ✓✓

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)

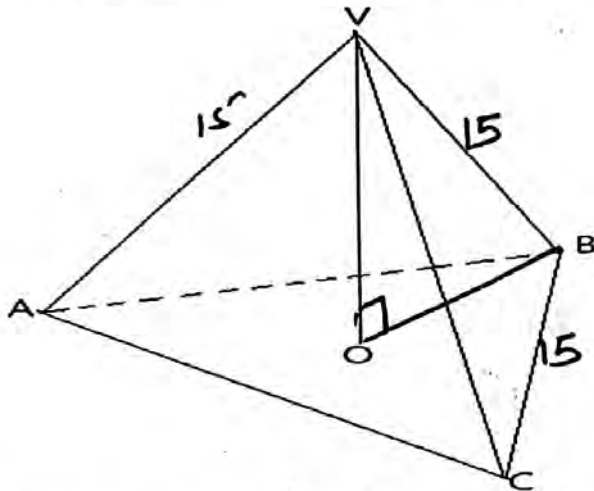
(c) Draw A''B''C''D'' the image of A'B'C'D' under rotation of +90° about (1,0). (2marks)

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

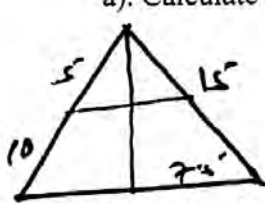
(e) Draw A''''B''''C''''D'''' the image of A'''B'''C'''D''' under translation  $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$  and write down its coordinates (3marks)

A''''(-5,5)  
 B''''(-5,6)  
 C''''(-2,6)  
 D''''(-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)



$$\frac{2}{3} \left( \sqrt{15^2 - 7.5^2} \right) = BO \quad \left| \begin{array}{l} 15^2 - 8.66^2 \\ \sqrt{225 - 75} = VO \end{array} \right.$$

$$= 8.66$$

$$= \underline{\underline{12.2 \text{ cm}}}$$

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

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

$$V_T = \frac{1}{3} \times \frac{1}{2} \times 15^2 \sin 60 \times 12.2 \quad \left| \quad V_{ST} = \frac{1}{27} \times 396.206 \right.$$

$$= \cancel{13.654} \quad \left| \quad = 14.67 \right.$$

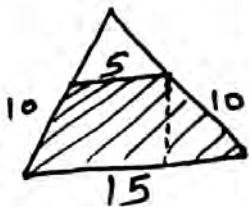
$$396.206$$

$$V_{SF} = 27:1$$

$$V_F = 396.206 - 14.67$$

$$= \underline{\underline{381.53}}$$

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



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

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

$$= \underline{\underline{368.1 \text{ cm}^2}}$$

$$\text{Acc. } \underline{\underline{383.016 \checkmark \checkmark}}$$

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

$$-5x = 20$$

$$x = \underline{\underline{-4}}$$

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)

$$3y - 8x = -9$$

$$7y - 5x = 20$$

$$- 21y - 56x = -63$$

$$21y - 15x = 60$$

$$\hline -41x = -123$$

$$x = 3$$

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

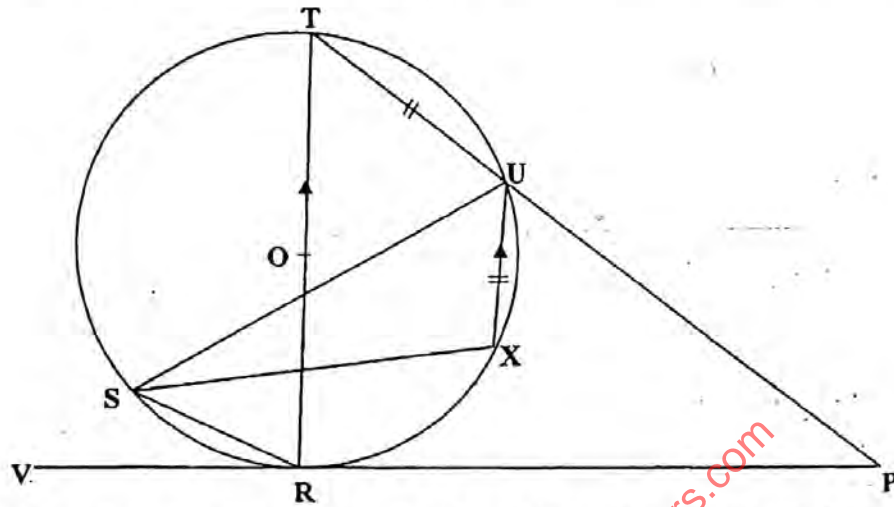
$$3y = -9 + 24$$

$$y = 5$$

$$\underline{\underline{(3, 5)}}$$

KASSU JOINT EVALUATION TEST

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  $\angle SUR = 25^\circ$ ,  $\angle URP = 60^\circ$ ,  $TU = UX$  and that  $UX$  is parallel to the diameter; giving reasons calculate;

a)  $\angle TOU$

(2 marks)

$60^\circ$  - Sum of interior angles add to  $180^\circ$

b)  $\angle XUP$

(2 marks)

$60^\circ$  - Vertically opposite angles are equal

c)  $\angle STR$

(2 marks)

$25^\circ$  - Same chord subtends equal angles at the circumference.

d) Reflex  $\angle SXU$

(2 marks)

$95^\circ$  - Opposite interior angles of a cyclic quadrilateral are equal.

e)  $\angle RPU$

(2 marks)

$30^\circ$  - Angles of a triangle add to  $180^\circ$