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**ORERO – AGORO SARE MATHS JOINT EXAMINATION**  
Kenya Certificate of Secondary Education

121/1

Paper 1



**MATHEMATICS**



**ALT. A**

**August. 2022 – 2<sup>1</sup>/<sub>2</sub> hours**

Name: ..... MARKING GUIDE ..... Index Number: .....

Student's Signature: ..... School : ..... Class:.....

**Instructions to candidates**

- (i) Write your name, Index number and class in the spaces provided above.
- (ii) Sign and write the date of examination in the spaces provided above.
- (iii) This paper consists of **two** sections: **Section I** and **Section II**.
- (iv) Answer **all** the questions in **Section I** and **only five** questions from **Section II**.
- (v) **Show all the steps in your calculations, giving your answers at each stage in the spaces provided below each question.**
- (vi) Marks may be given for correct working even if the answer is wrong.
- (vii) **Non – programmable** silent electronic calculators and KNEC Mathematical tables may be used, except where stated otherwise.
- (viii) This paper consists of 15 printed pages. **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- (ix) **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**

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Kenya Certificate of Secondary Education, 2022

121/1

350  
222

**SECTION I (50 MARKS)**

**Answer ALL the questions in this section**

1. Without using a calculator or mathematical tables, evaluate:

$$\frac{8+2+12 \times 9 - 4 \times 6}{56 \div 7 \times 2}$$

$$\frac{4 + 108 - 24}{8 \times 2} \checkmark$$

$$= \frac{88}{16} = \frac{22}{4} \checkmark$$

$$= 5\frac{1}{2} \text{ or } 5.5 \checkmark$$

(3 marks)

M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>

2. Solve the following simultaneous inequalities and show your solution on a number line.

$$\frac{x-3}{3} \leq 1$$
~~$$3x+1 \leq 17$$~~

$$-3x+1 \leq 16 \quad -5 \leq x \leq 6$$

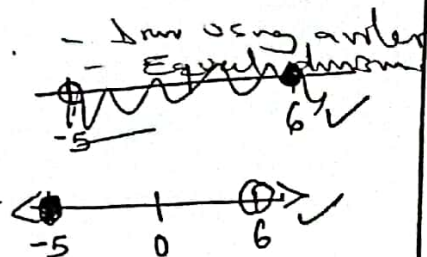
$$x-3 < 1 \times 3$$

$$x < 6 \checkmark$$

$$-3x+1 \leq 16$$

$$-3x \leq 15$$

$$x \geq -5 \checkmark$$



(3 marks)

03

B<sub>1</sub>  
B<sub>1</sub>  
B<sub>1</sub>

3. Solve for x in the equation;  $2^{x-3} \times 8^{2x+2} = 128$

$$2^{x-3} \times 2^{3x^2+6} = 2^7 \checkmark$$

$$2^{3x^2+x+3} = 2^7$$

$$3x^2+x+3=7$$

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

$$x = \frac{-\pm\sqrt{49}}{6} \checkmark$$

$$= -\frac{\pm 7}{6} \quad 2$$

$$x = -1\frac{1}{3} \text{ or } 1 \checkmark$$

(3 marks)

03

M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>

03

4. The position vectors of A and B are  $5i + 4j - 6k$  and  $2i - 2j$  respectively. A point Y divides AB in the ratio 2: -5. Find the coordinates of Y. (3 marks)

$$AY:YB$$

$$2: -5$$

$$\vec{OY} = \frac{-5}{-3} \begin{pmatrix} 5 \\ 4 \\ -6 \end{pmatrix} + \frac{2}{-3} \begin{pmatrix} 2 \\ -2 \\ 0 \end{pmatrix}$$

$$= \begin{pmatrix} 7 \\ 8 \\ 10 \end{pmatrix} \quad \text{Y } (7, 8, 10)$$

5. Use factor method to evaluate the expression below leaving your answer as a product of its prime factors in power form. (3 marks)

$$\sqrt{5184 \times 49}$$

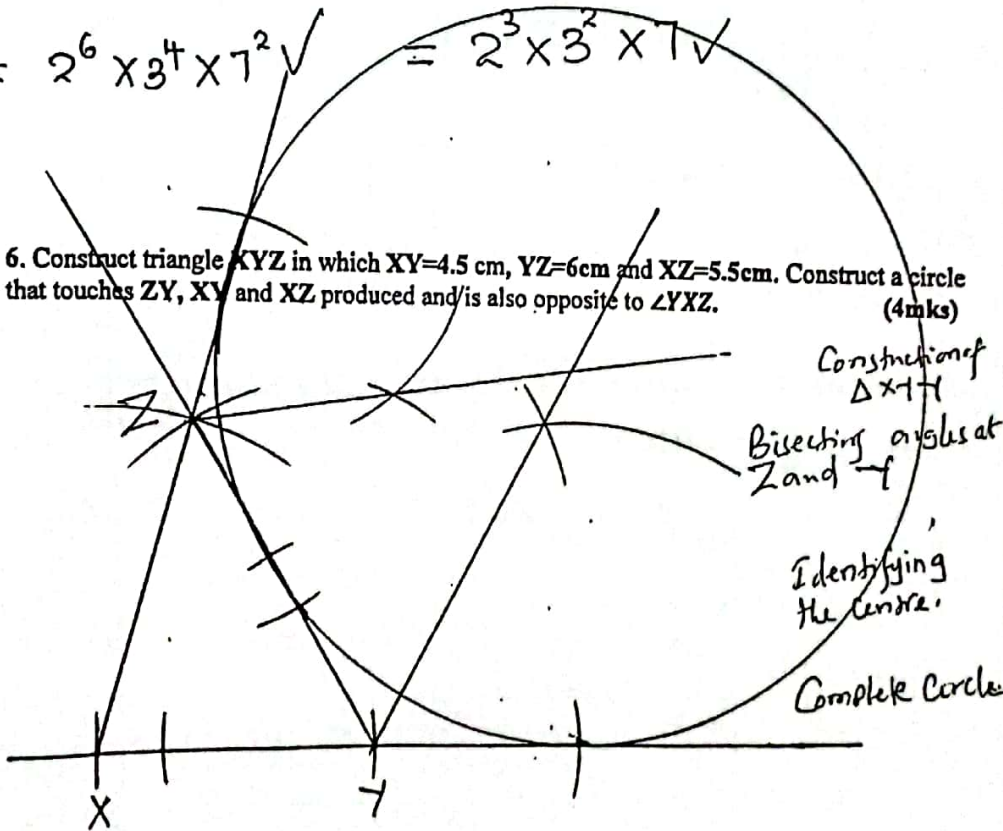
$$\sqrt{2^6 \times 3^4 \times 7^2}$$

$$= 5184 \times 49$$

$$= 2^6 \times 3^4 \times 7^2$$

$$= 2^3 \times 3^2 \times 7$$

6. Construct triangle XYZ in which XY=4.5 cm, YZ=6cm and XZ=5.5cm. Construct a circle that touches ZY, XY and XZ produced and is also opposite to  $\angle YXZ$ . (4 marks)



M <sub>1</sub>
M <sub>1</sub>
A <sub>1</sub>
03
M <sub>1</sub>
M <sub>1</sub>
A <sub>1</sub>
03
B <sub>1</sub>
B <sub>1</sub>
B <sub>1</sub>
B <sub>1</sub>
04



7. Two similar solids whose densities are each  $1\text{g/cm}^3$  are such that the first has a height of  $5\text{cm}$  and a volume of  $120\text{cm}^3$ . The second has mass of  $3240\text{g}$ . Find the height of the second solid. (3 marks)

$$V_2 = \frac{m}{d}$$

$$= \frac{3240}{1}$$

$$= 3240\text{cm}^3 \checkmark$$

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

$$\text{Height} = 15\text{cm} \checkmark$$

$$\text{V.S.F} = 3240:120$$

$$= 27:1$$

$$\text{L.S.F} = 3:1 \checkmark$$

8. The matrices P and Q are such that  $P = \begin{pmatrix} 5 & x \\ 4 & 1 \end{pmatrix}$  and  $Q = \begin{pmatrix} 0 & 1 \\ 2 & 6 \end{pmatrix}$ . Given that the Determinant of  $PQ = 46$ , find the value of x. (3 marks)

$$\begin{pmatrix} 5 & x \\ 4 & 1 \end{pmatrix} \begin{pmatrix} 0 & 1 \\ 2 & 6 \end{pmatrix}$$

$$\begin{pmatrix} 2x & 5+6x \\ 2 & 10 \end{pmatrix} \checkmark$$

$$20x - 10 - 12x = 46 \checkmark$$

$$8x = 56$$

$$x = 7 \checkmark$$

9. Find the equation of the normal to the curve  $y = x^3 - 2x^2 + 3x - 1$  at the point  $(2, 5)$ . (3 marks)

$$\frac{dy}{dx} = 3x^2 - 4x + 3 \text{ at } (2, 5) \checkmark$$

$$= 3(2)^2 - (4 \times 2) + 3$$

$$= 7$$

$$M_1 \times M_2 = -1$$

$$M_2 = -\frac{1}{7}$$

$$\frac{y-5}{x-2} = -\frac{1}{7} \checkmark$$

$$y = -\frac{1}{7}x + \frac{52}{7} \checkmark$$

M<sub>1</sub>

B<sub>1</sub>

A<sub>1</sub>

03

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

03

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

03

10. Given that  $\log_a x = 0.6024$  and  $\log_a y = 0.7785$ . Without using mathematical tables or calculators, evaluate the exact value of  $\log_a \left(\frac{\sqrt{x}}{y^{\frac{1}{3}}}\right)$ . (3 marks)

$$\begin{aligned} \log_a \left(\frac{x^{\frac{1}{2}}}{y^{\frac{1}{3}}}\right) &= \frac{1}{2} \log_a x - \frac{1}{3} \log_a y \\ &= \frac{1}{2} (0.6024) - \frac{1}{3} (0.7785) \checkmark \\ &= 0.3012 - 0.2595 \\ &= 0.0417 \checkmark \end{aligned}$$

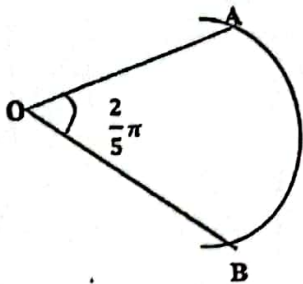
M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

03

11. The figure below shows the sector of a circle. If the area of the sector is  $61.6 \text{ cm}^2$ , calculate the length of the arc AB.  $\angle AOB = \frac{2}{5}\pi^c$ . (Take  $\pi = \frac{22}{7}$ ). (3 marks)



$$\frac{\frac{2}{5}\pi^c}{2\pi^c} \times \frac{22}{7} \times r^2 = 61.6$$

$$r^2 = 61.6 \times \frac{7}{22} \times \frac{5}{1}$$

$$= 98$$

$$r = 9.899 \text{ cm}$$

$$AB = \frac{1}{5} \times 2 \times \frac{22}{7} \times 9.899 \checkmark$$

$$= 12.44 \text{ cm} \checkmark$$

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

03

12. A tourist came into Kenya and exchanged 550 US Dollars into Kenya shillings at the rates shown below.

Buying	Selling
83.5	85.2

He spent KSh. 35,000 after which he converted the remaining balance to US dollars. How much US dollars did he get back to the nearest dollar? (3 marks)

$$550 \times 83.5 = 45,925 \checkmark$$

$$45,925 - 35,000 = 10,925$$

$$\frac{10,925}{85.2} \checkmark$$

$$= \$128. \checkmark$$

C.A.O.

13. In a regular polygon each exterior angle is  $90^\circ$  less than each interior angle. Calculate the number of sides of the polygon hence give its name. (3 marks)

Let exterior angle be  $x$

$$x + x + 90 = 180$$

$$2x = 90$$

$$x = 45 \checkmark$$

No. of sides  $\frac{360}{45} = 8$

8 sides.  $\checkmark$

Octagon.  $\checkmark$

14. Simplify

$$\frac{6x^2 + 5xy + y^2}{4x^2 - y^2}$$

$$\frac{6x^2 + 3xy + 2x + y^2}{(2x+y)(2x-y)} \checkmark$$

$$\frac{3x(2x+y) + y(2x+y)}{(2x+y)(2x-y)} \checkmark$$

$$\frac{(3x+y)(2x+y)}{(2x+y)(2x-y)} \checkmark$$

$$\frac{3x+y}{2x-y} \checkmark$$

6

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

03

B<sub>1</sub>

B<sub>1</sub>

B<sub>1</sub>

03

(4 marks)

M<sub>1</sub>

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

04



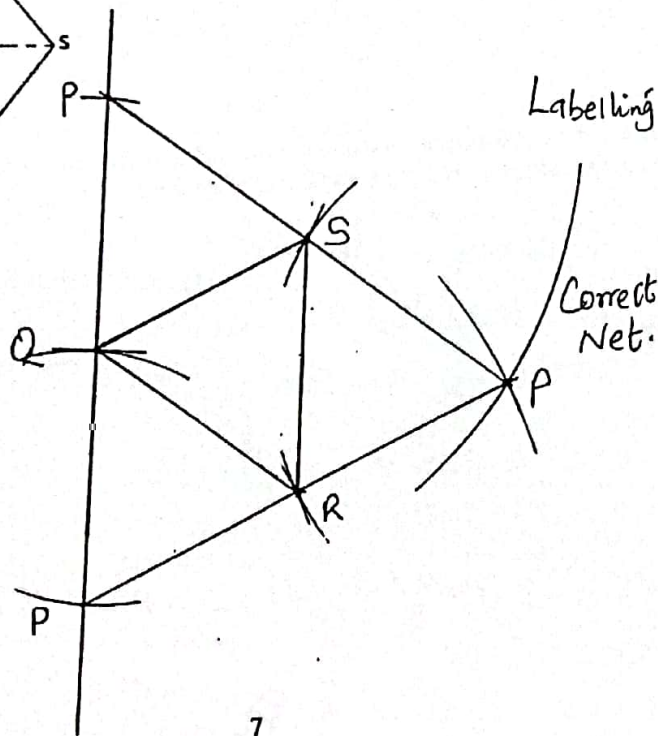
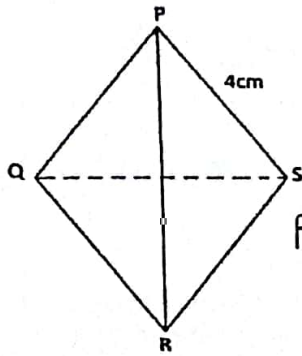
15. The length of a rectangle has increased in the ratio 3 : 2 and the width reduced in the ratio 4 : 5. If the original length and width were 18 cm and 15 cm respectively. Find the ratio of change in its area. (3 marks)

Original Area =  $18 \times 15 = 270$  ✓  
 New Area =  $(\frac{3}{2} \times 18) \times (\frac{4}{5} \times 15) = 324$  ✓

New : Original  
 324 : 270 ✓  
 6 : 5 ✓

B  
B  
B  
03

16. The figure PQRS below is a regular tetrahedron of side 4cm. Draw its net. (3 marks)



Arcs showing Points. B  
 Labelling B  
 Correct Net. B

03

**SECTION II (50mks)**

Answer only FIVE questions in this section.

17. Mr. Kamau a businessman packs juice collar in a cylindrical tins of radius 10cm and height of 20cm. The tins are then packed into rectangular containers each measuring 80cm long, 80cm wide and 100cm high

a) Determine the maximum number of tins that can be packed into one container.

$$\frac{80}{20} \times \frac{80}{20} \times \frac{100}{20} \checkmark$$
$$= 80 \text{ tins.} \checkmark$$

(2mks)

M<sub>1</sub>

A<sub>1</sub>

b) An empty tin and empty container weighs 630g and 400g respectively. The juice caller packed in a tin weighs 700g. a Nissan which carry a maximum of 3634kg is used to transport the juice. Determine the maximum number of container the Nissan can carry

$$= (630g \times 80) + (400g) + (700g \times 80) \checkmark$$

(4mks)

M<sub>1</sub>

$$= 50,400 + 400 + 56,000 \checkmark$$

M<sub>1</sub>

$$= 106.8 \text{ kg} \checkmark$$

$$\text{Number of Containers } \frac{3634}{106.8} = 34 \checkmark$$

A<sub>1</sub>

B<sub>1</sub>

c) The businessman delivered a Nissan full of containers of juice to a retailer for sh. 5000 each container. The retailer later sells each tin at sh 90. Calculate the percentage profit made by the retailer

$$5000 \times 34 \checkmark = 170,000$$

(4mks)

M<sub>1</sub>

$$90 \times 80 \times 34 \checkmark = 244,800$$

M<sub>1</sub>

$$\text{Profit} = 74,800$$

M<sub>1</sub>

$$\frac{74,800}{170,000} \times 100 \checkmark$$

A<sub>1</sub>

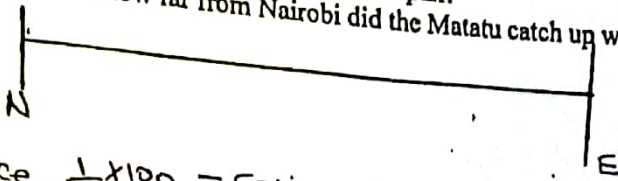
$$44\% \checkmark$$

10



18. A bus and a Matatu left Nairobi for Eldoret a distance of 340km at 7.00am. The Bus travelled at 100km/h while the Matatu travelled at 120km/h. After 30 minutes, the Matatu had a puncture which took 30 minutes to repair.

a) Find how far from Nairobi did the Matatu catch up with the Bus.



(5marks)

M<sub>1</sub>  
M<sub>1</sub>  
M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>

$$\text{Distance } \frac{1}{2} \times 100 = 50 \text{ km.}$$

$$50 - 10 \sqrt{=} = 40 \text{ km}$$

$$\text{R.S} = (120 - 100) \left( \frac{40}{20} \right) \sqrt{=} = 2 \text{ hrs}$$

$$\text{Distance } (2 \times 120) = 240 + 60 \sqrt{=}$$

$$\therefore 300 \text{ km. } \sqrt{=}$$

b) At what time of the day did the Matatu catch up with the Bus?

(2marks)

$$\begin{array}{r} 7.00 \text{ am.} \\ + 3.00 \sqrt{=} \\ \hline 10.00 \text{ am. } \sqrt{=} \end{array}$$

M<sub>1</sub>  
A<sub>1</sub>

c) At what time did the Bus reach Eldoret?

(3marks)

$$\left( \frac{340}{100} \right) = 3 \left( \frac{4}{10} \times 60 \right)$$

$$3 \text{ hrs } 24 \text{ mins } \sqrt{=}$$

$$\begin{array}{r} 7.00 \text{ am} \\ + 3.24 \sqrt{=} \\ \hline 10:24 \text{ am. } \sqrt{=} \end{array}$$

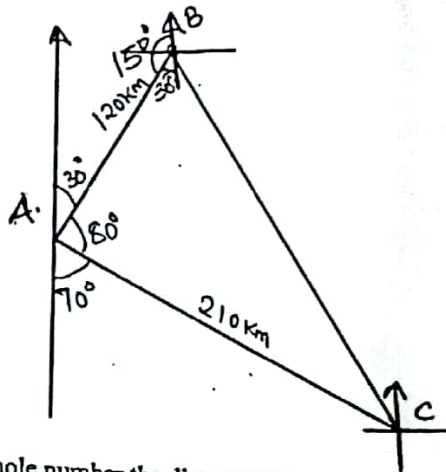
9

M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>  
10

19. Three towns are situated in such a way that town B is 120km on a bearing of  $030^\circ$  from town A. Town C is 210km on a bearing of  $110^\circ$  from town A.

(a) Draw a sketch diagram showing the positions of the three towns.

(3 marks)



B FOR B

B FOR C

B Complete Sketch

(b) Calculate to the nearest whole number the distance BC.

(3 marks)

$$a^2 = 120^2 + 210^2 - 2 \times 120 \times 210 \cos 80^\circ \checkmark \checkmark$$

$$a = \sqrt{49748.13}$$

$$a = 223 \text{ km. } \checkmark$$

C. A. O

(c) Find the bearing of C from B by calculation.

(4 marks)

$$\cos B = \frac{120^2 + 223^2 - 210}{2 \times 120 \times 223} \checkmark$$

$$B = \cos^{-1} 0.3742$$

$$= 68.03 \checkmark$$

$$\text{Bearing of C from B} = 360 - (150 + 68.03) \checkmark$$

$$= 141.97$$

OR

$$S 38.03^\circ E \checkmark$$

10

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

M<sub>1</sub>

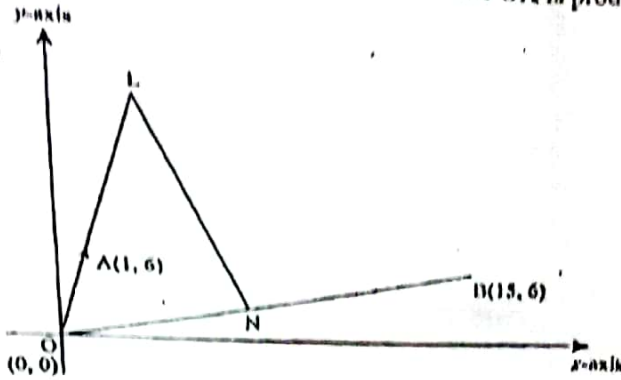
A<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

10

20. In the diagram below, the coordinates of points A and B are (1, 6) and (15, 6) respectively. Point N is on OB and that  $3ON = 2OB$ . Line OA is produced to L such that  $OL = 3OA$ .



a) Find vector LN

$$\begin{aligned} \vec{LN} &= \vec{LO} + \vec{ON} \\ &= -3\begin{pmatrix} 1 \\ 6 \end{pmatrix} + \frac{2}{3}\begin{pmatrix} 15 \\ 6 \end{pmatrix} \\ &= \begin{pmatrix} -3 \\ -18 \end{pmatrix} + \begin{pmatrix} 10 \\ 4 \end{pmatrix} \\ \vec{LN} &= \begin{pmatrix} 7 \\ -14 \end{pmatrix} \end{aligned}$$

(3 marks)

b) Given that a point M is on LN such that  $LM:MN = 3:4$  find the coordinate of M

$$\begin{aligned} \vec{OM} &= \vec{OL} + \vec{LM} \\ &= \begin{pmatrix} 3 \\ 18 \end{pmatrix} + \frac{3}{7}\begin{pmatrix} 7 \\ -14 \end{pmatrix} = \begin{pmatrix} 3 \\ 18 \end{pmatrix} + \begin{pmatrix} 3 \\ -6 \end{pmatrix} = \begin{pmatrix} 6 \\ 12 \end{pmatrix} \\ M &= (6, 12) \end{aligned}$$

(3 marks)

c) If line OM is produced to T such that  $OM:MT = 6:1$

i) Find the position vector of T

$$\frac{7}{6}\begin{pmatrix} 6 \\ 12 \end{pmatrix} = \begin{pmatrix} 7 \\ 14 \end{pmatrix}$$

(1 mark)

ii) Show that points L, T and B are collinear.

(3 marks)

$$\begin{aligned} \vec{LT} &= \vec{T} - \vec{L} \\ &= \begin{pmatrix} 7 \\ 14 \end{pmatrix} - \begin{pmatrix} 3 \\ 18 \end{pmatrix} = \begin{pmatrix} 4 \\ -4 \end{pmatrix} \\ \vec{LB} &= \vec{B} - \vec{L} \\ &= \begin{pmatrix} 15 \\ 6 \end{pmatrix} - \begin{pmatrix} 1 \\ 6 \end{pmatrix} = \begin{pmatrix} 14 \\ 0 \end{pmatrix} \\ \vec{LB} &= \begin{pmatrix} 12 \\ -12 \end{pmatrix} \end{aligned}$$

Since  $3\vec{LT} = \vec{LB}$  and point L is common hence points L, T, B are collinear.

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

M<sub>1</sub>

M<sub>1</sub>

A<sub>1</sub>

B<sub>1</sub>

M<sub>1</sub>

~~A<sub>1</sub>~~

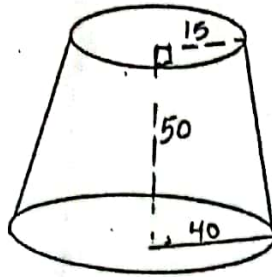
A<sub>1</sub>

B<sub>1</sub>

10



21. The diagram below represents a bucket that has been placed upside down. The radius of the top surface is 15cm and that of the bottom is 40cm. The vertical height of the bucket is 50cm. (Use  $\pi = 3.142$ )



Calculate to the nearest whole number, the

(a) Volume of the bucket.

$$\begin{aligned} \text{L.S.F} &= 15:40 \\ &= 3:8 \\ H &= \frac{8}{5} \times 50 = 80 \text{ cm} \checkmark \\ \text{Vol. of original cone} \\ &= \frac{1}{3} \times 3.142 \times 40^2 \times 80 \\ &= 134058.67 \end{aligned}$$

$$\begin{aligned} \text{V.S.F} &= 27:512 \\ V &= \frac{485 \times 134058.67}{512} \checkmark \quad (3 \text{ marks}) \\ &= 126989 \text{ cm}^3 \checkmark \\ &\text{C.A.O} \end{aligned}$$

(b) If the bucket is filled with molten substance used to make it and allowed to solidify. If the mass of the solid frustum is 90kg. Calculate the density of the frustum in  $\text{kg/m}^3$ . (2 marks)

$$\begin{aligned} &\frac{90}{126,989} \times 10^6 \checkmark \\ &= 709 \checkmark \quad \text{C.A.O} \end{aligned}$$

(c) Calculate the curved surface area of the frustum. (3 marks)

$$\begin{aligned} \text{A.S.F} &= 9:64 \checkmark \\ L &= \sqrt{80^2 + 40^2} = 89.4427 \\ \text{Area of Curved Part of original Cone} &= 3.142 \times 40 \times 89.4427 \checkmark \\ &= 11241.16 \\ \text{Area of Curved Part of frustum} &= \frac{55}{64} \times 11241.16 \checkmark \\ &= 96600 \text{ cm}^2 \text{ C.A.O} \end{aligned}$$

(d) If a cockroach moves around the base of the bucket then rose up straight and went round the top side and back to the base. Calculate the distance it covered. (2 marks)

$$\begin{aligned} &(3.142 \times 80) + (3.142 \times 30) + 2 \left( \frac{5}{8} \times 89.4427 \right) \checkmark \\ &= 457 \text{ cm} \checkmark \end{aligned}$$





23. (a) A straight line L1, whose equation is  $3y - 2x = -2$  meets the x-axis at P. Determine the coordinates of P. (2marks)

$$y = 0$$

$$-2x = -2$$

$$x = 1$$

$$P(1, 0)$$

b) A second line L2 is perpendicular to L1 at P. Find the equation of L2 in the form  $y = mx + c$  where m and c are constants. (3marks)

$$3y = 2x - 2$$

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

$$\text{Grad} = -\frac{3}{2}$$

$$\frac{y}{x-1} = -\frac{3}{2}$$

$$2y = -3(x-1)$$

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

c) A third line L3, passes through  $(-4, 1)$  and is parallel to L1. Find:  
i) The equation of L3 in the form  $y = mx + c$  where m and c are constants. (2marks)

$$\frac{y-1}{x+4} = \frac{2}{3}$$

$$y = \frac{2}{3}x + \frac{11}{3}$$

ii) The coordinate of point Q at which L3 intersect L2. (3marks)

$$-\frac{3x}{2} + \frac{3}{2} = \frac{2x}{3} + \frac{11}{3}$$

$$-9x + 9 = 4x + 22$$

$$-13x = 13$$

$$x = -\frac{13}{13} = -1$$

$$y = 3$$

$$(-1, 3)$$



24.  $S = 8t + 3t^2 - \frac{2}{3}t^3$ , where,  $t$ , is time in seconds. Find

(a) The time when the particle is momentarily at rest.

(3 marks)

$$\frac{ds}{dt} = 8 + 6t - 2t^2$$
$$= -2t^2 + 6t + 8 = 0 \checkmark$$
$$t = \frac{-6 \pm \sqrt{100}}{-4} = \frac{-6 \pm 10}{-4}$$
$$t = 4 \checkmark$$

M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>

(b) The displacement when it comes to rest momentarily.

(3 marks)

$$S = 8(4) + 3(4)^2 - \frac{2}{3}(4)^3 \checkmark \checkmark$$
$$= 37\frac{1}{3} \checkmark$$

M<sub>1</sub>  
M<sub>1</sub>  
A<sub>1</sub>

(c) Calculate the initial acceleration.

(2 marks)

$$a = -4t + 6$$
$$= -4(0) + 6 \checkmark$$
$$= 6 \text{ m/s}^2 \checkmark$$

M<sub>1</sub>  
A<sub>1</sub>

(d) Calculate the maximum velocity attained.

(2 marks)

$$-4t + 6 = 0$$
$$t = 1.5$$
$$v = -2(1.5)^2 + 6(1.5) + 8 \checkmark$$
$$= 12.5 \text{ m/s} \checkmark$$

M<sub>1</sub>  
A<sub>1</sub>

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