NAME: ....M/S.................................. Index Number: ....

School.. Adm no..............................

Date................................

MATHEMATICS ALTA

121/1

Paper 1

Time: 2 ½ hours

BUNAMFAN CLUSTER EXAMINATION 2021

Kenya Certificate of Secondary Education

INSTRUCTIONS TO CANDIDATES

(a) Write your **name** and **index number** in the spaces provided above.
(b) This paper consists of **TWO sections**: **Section I** and **Section II.**
(c) Answer **ALL** the questions in **Section I** and **only five questions** from **Section II.**
(d) All answers and workings must be written on the question paper in the spaces provided below each question.
(e) Show all the steps in your calculations, giving your answers at each stage in the spaces 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 indicted and that no questions are missing.

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 A (50 MARKS)

1. Evaluate, (3 marks)

$$\frac{-12 \div (-3) \times 4 - (-15)}{-5 \times 6 \div 2 + (-5)}$$

$N = 4 \times 4 + 15 = 31$ ✓B1

$D = -15 - 5 = -20$ ✓B1

$\frac{31}{-20} = -1\frac{11}{20}$ ✓B1

$= -1.55$

2. A trader sold an article at 15% discount to a customer who paid sh.510 for it. What was the marked price of the article? (2 marks)

$\frac{100}{85} \times 510$ ✓M1

$= 600$ ✓A1

3. Two similar cubes have masses of 512g and 125g. The base area of the larger cube is $64cm^2$. Find the base area of the smaller cube. (3 marks)

$V.S.F = \frac{512}{125} \rightarrow L.S.F = \sqrt[3]{\frac{512}{125}} = 8/5 = 1\frac{3}{5}$ ✓B1

$A.S.F = \frac{64}{25}$ ✓B1

$\frac{25}{64} \times 64 = 25cm^2$ ✓B1

4. Simplify,

(3 marks)

$$\frac{16m^2 - 9n^2}{4m^2 - mn - 3n^2}$$

$N = (4m-3n)(4m+3n)$ ✓ M1

$D: 4m^2 - 4mn + 3mn - 3n^2$

$= 4m(m-n) + 3n(m-n)$

$= (4m+3n)(m-n)$ ✓ M1

$$\frac{(4m-3n)(4m+3n)}{(4m+3n)(m-n)} = \frac{4m-3n}{m-n}$$ ✓ A1

5. The ratio of john's earnings to muse's earnings is 5:3. If john's earnings increase by 12%, his new figure becomes sh. 5 600. Find the corresponding percentage change in muse's earnings if the sum of their new earnings is sh.9 600. (4 marks)

$\frac{100}{112} \times 5600 = 5000$ ✓ M1

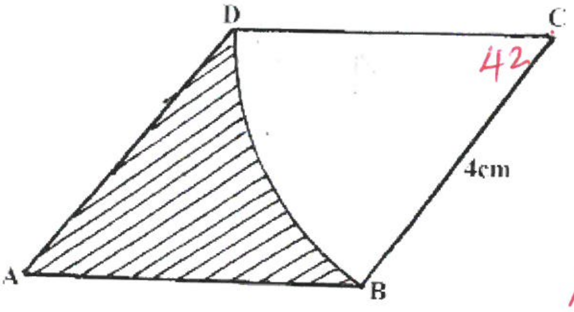
John $= 5000$

Musa $= \frac{3}{5} \times 5000 = 3000$ ✓ M1

$9600 - 5600 = 4000$ ✓ M1

$\frac{4000-3000}{3000} \times 100 = 33\frac{1}{3}\%$ ✓ A1

6. The figure below is a rhombus ABCD of sides 4cm. BD is an arc of circle centre C. Given that $\angle ABC = 138^0$. Find the area of shaded region. (3 marks)



Area of rhombus

$= \left(\frac{1}{2} \times 4^2 \sin 42\right) + \frac{1}{2} \times 4^2 \sin 42$

$= 10.71$ ✓ B1

Area of sector $= \frac{42}{360} \times \frac{22}{7} \times 4^2$

$= 6.146$ ✓ B1

Shaded Area $= 10.71 - 6.146$

$= 4.564$ ✓ B1

7. A shopkeeper sells two- types of pangas type x and type y. Twelve x pangas and five type y pangas cost Kshs 1260, while nine type x pangas and fifteen type y pangas cost 1620. Mugala bought eighteen type y pangas. How much did he pay for them? (3 marks)

$12x+5y=1260$ ✓ B1
$9x+15y=1620$

$36x+15y=3780$
$9x+15y=1620$ −

$27x=2160$

$x=80$ ✓ B1

$9(80)+15y=1620$
$15y=900$
$y=60$

✓ B1
$18\times 60 = 1080/=$

8. During a certain month, the exchange rates in a bank were as follows;

	Buying (Ksh.)	Selling (Ksh.)
1 US \$	91.65	91.80
1 Euro	103.75	103.93

A tourist left Kenya to the United States with Ksh.1 000,000.On the airport he exchanged all the money to dollars and spent 190 dollars on air ticket. While in US he spent 4500 dollars for upkeep and proceeded to Europe. While in Europe he spent a total of 2000 Euros. How many Euros did he remain with? (3marks)

M1 ✓ $\frac{1,000,000}{91.80} = 10,893.25\$$ ✓ A1
$-\ 190.00$
$10,703.25$
$4,500.00$
$6,203.25$

$\frac{6203.25\$ \times 91.65}{103.93}$

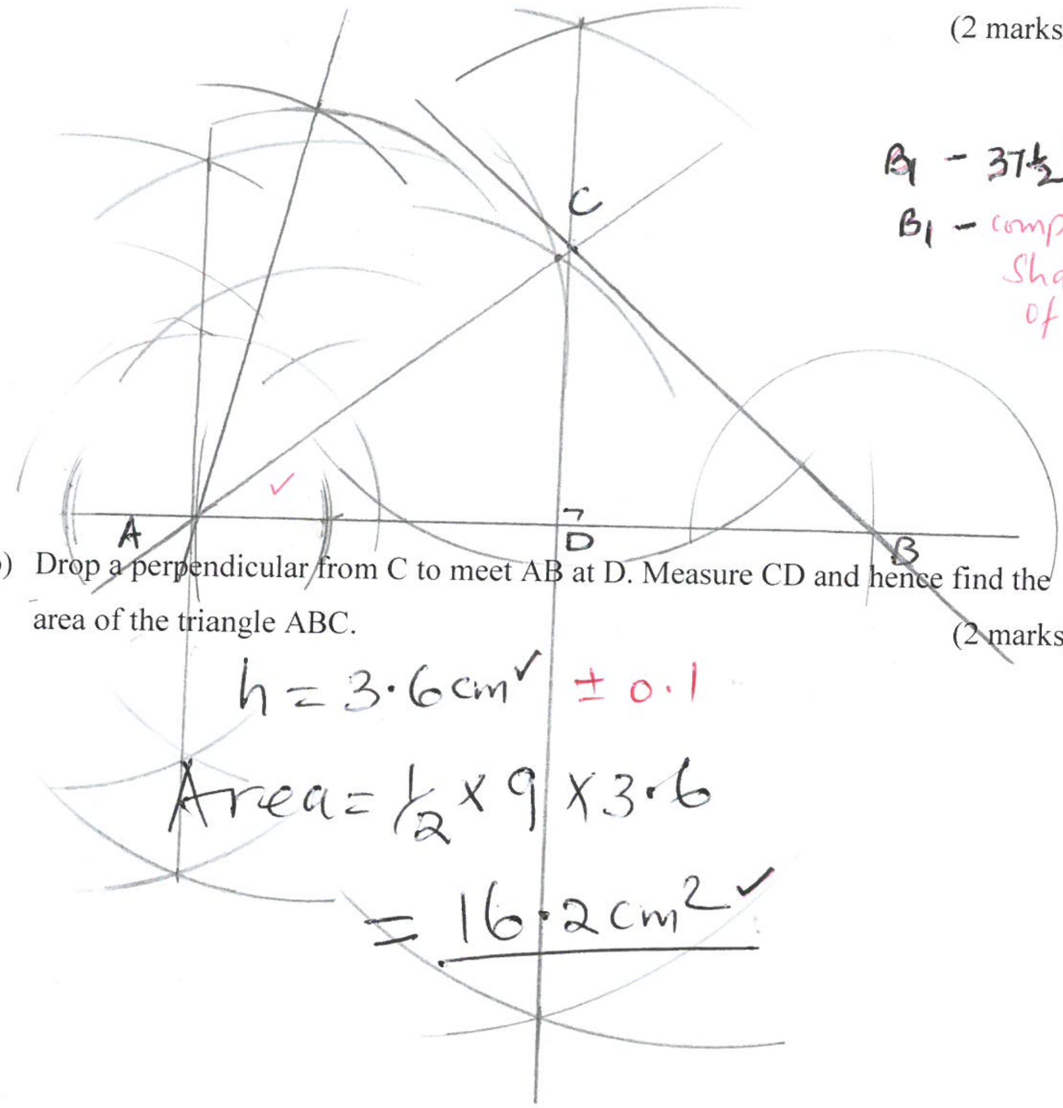
$= 5470.30€$
2000.00
3470.30

$= 3,470.30€$ ✓ B1

9. Using a ruler and a pair of compasses only,

a) Construct a triangle ABC in which AB = 9cm, AC = 6cm and angle BAC = $37\frac{1}{2}^0$

(2 marks)



B_1 - $37\frac{1}{2}°$

B_1 - complete shape of triangle

b) Drop a perpendicular from C to meet AB at D. Measure CD and hence find the area of the triangle ABC.

(2 marks)

$h = 3.6\text{cm}$ ✓ ± 0.1

$\text{Area} = \frac{1}{2} \times 9 \times 3.6$

$= \underline{16.2\text{cm}^2}$ ✓

10. Given that log 3 = 0.4771 and log 5 = 0.6990, without using logarithm tables or a calculator, evaluate log 0.135.

(3 marks)

$0.135 = \frac{135}{1000} = \frac{3^3 \times 5}{1000}$ ✓ M1

$\log 0.135 = 3\log 3 + \log 5 - \log 1000$

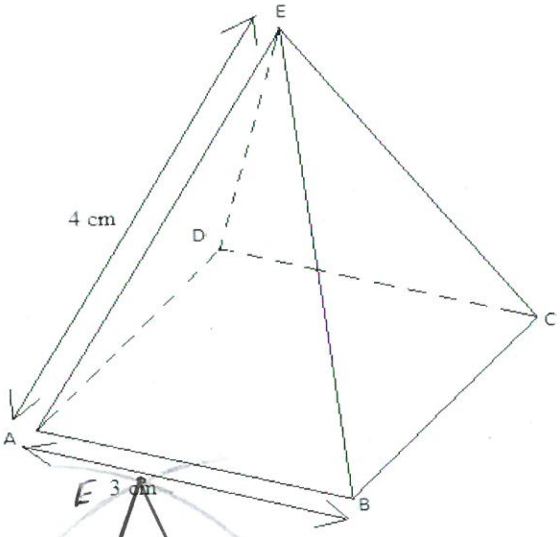
$= 3(0.4771) + 0.6990 - 3$ ✓ M1

$= 2.1303 - 3.0000$

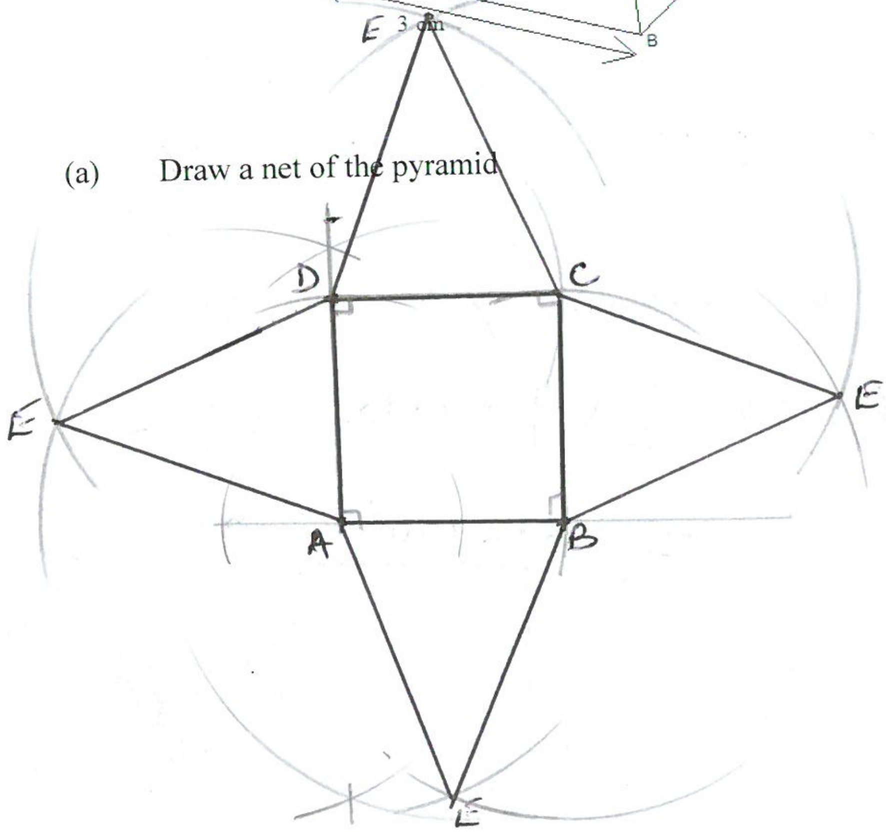
$\bar{1}.1303$

$= \underline{\bar{1}.1303}$ ✓ A1

11. The diagram below represents a right pyramid on a square base of side 3 cm. The slant height of the pyramid is 4 cm.



(a) Draw a net of the pyramid (3 marks)



$B_1 \to$ square base

$B_1 \to$ 2 triangular faces

$B_1 \to$ 2 triangular faces

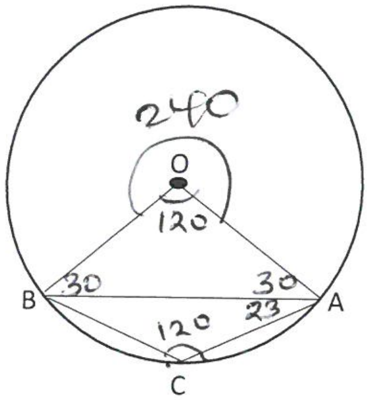
12. A translation maps a point (1, 2) onto (-2, 2). What would be the coordinates of the object whose image is (-3, -3) under the same translation? (3 marks)

Vector $\begin{pmatrix} -2 \\ 2 \end{pmatrix} - \begin{pmatrix} 1 \\ 2 \end{pmatrix} = \begin{pmatrix} -3 \\ 0 \end{pmatrix}$ M1

$\begin{pmatrix} x \\ y \end{pmatrix} + \begin{pmatrix} -3 \\ 0 \end{pmatrix} = \begin{pmatrix} -3 \\ -3 \end{pmatrix}$ ✓ M1

$\begin{pmatrix} x \\ y \end{pmatrix} = \begin{pmatrix} 0 \\ -3 \end{pmatrix}$ $(x, y) = (0, -3)$ ✓ A1

13. In the figure below, O is the centre of the circle. Angle OAB = 30^0 and angle CAB = 23^0. Find angle ABC. (3 marks)



$\angle BAC = 120^0$ ✓ B1

$\angle ABC = 180 - (120 + 23)$ ✓ M1

$= 37^0$ ✓ A1

14. The line which joins the point A (3,k) and B(-2,5) is parallel to the line whose equation is $\frac{5}{7}y + \frac{2}{7}x = 1$ find the value of k. (3 marks)

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

$y = -\frac{2}{7} \times \frac{7}{5}x + \frac{7}{5}$ ✓ M1

$y = -\frac{2}{5}x + 1.4$

$\frac{5-k}{-2-3} = -\frac{2}{5}$ ✓ M1 $\rightarrow \frac{5-k}{-5} = -\frac{2}{5}$

$\frac{5(5-k)}{5} = \frac{10}{5}$

$5 - k = 2$

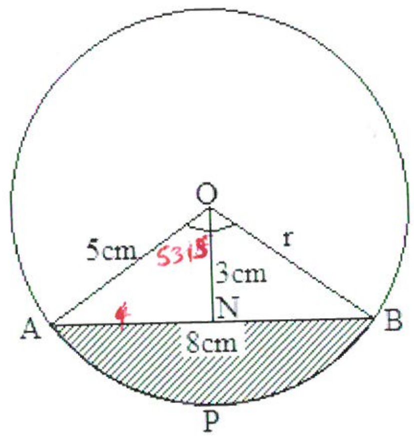
$k = 3$. A1

15. A segment is a region of a circle bounded by a chord and an arc.

$\cos 53.15 = 3/r$

$r = 3/\cos 53.15$

$= 5cm$.



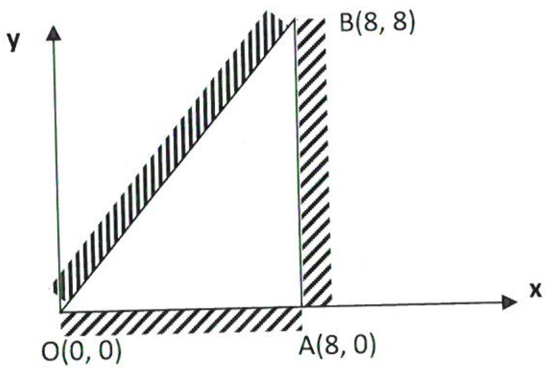
In the figure above the shaded region is a segment of the circle with Centre O and radius r. AB=8 cm, ON = 3 cm, Angle AOB =106.3 ^{0}. Find the area of the shaded part. (3 marks)

Area of sector $= \frac{106.3}{360} \times 3.142 \times 5^2 = 23.19$ ✓B1

Area of triangle $= \frac{1}{2} \times 8 \times 3 = 12$ ✓B1

Segment $= 23.19 - 12 = \underline{11.19 \text{ cm}^2}$ ✓B1

16. The vertices of the unshaded region in the figure below are O(0, 0) , B(8, 8) and A (8, 0). Write down the inequalities which satisfy the unshaded region. (3 marks)



$x \leq 8$ ✓B1

$y \geq 0$ ✓B1

$y \leq x$ ✓B1

SECION B (50MKS)

17. A straight line L1 has a gradient -1/2 and passes through point P (-1,3). Another line L2 passes through the points Q (1,-3) and R(4,5). find ,

a) The equation of L_1. (2 marks)

$\frac{y+3}{x+1} = -\frac{1}{2}$ M1

$2y+6 = -x-1$

$2y = -x-7$

$y = -\frac{1}{2}x - 3\frac{1}{2}$ A1

b) The gradient of L_2. (1 mark)

$\frac{5+3}{4-1} = \frac{8}{3}$ B1

$\frac{y+3}{x-1} = \frac{8}{3}$

c) The equation of L_2. (2 marks)

$\frac{y+3}{x-1} = \frac{8}{3}$ M1

$3y = 8x - 17$

$y = 2\frac{2}{3}x - 5\frac{2}{3}$ A1

d) The equation of a line passing through a point S (0,5) and is perpendicular to L_2. (3 marks)

$m_2 = -\frac{3}{8}$ B1

$\frac{y-5}{x} = \frac{-3}{8}$ M1

$8y - 40 = -3x$

$8y + 3x = 40$

$y = \frac{-3}{8}x + 5$ A1

e) The equation of a line through R parallel to L1. (2 marks)

$\frac{y-5}{x-4} = -\frac{1}{2}$ M1

$2y - 10 = 4 - x$

$2y + x = 14$

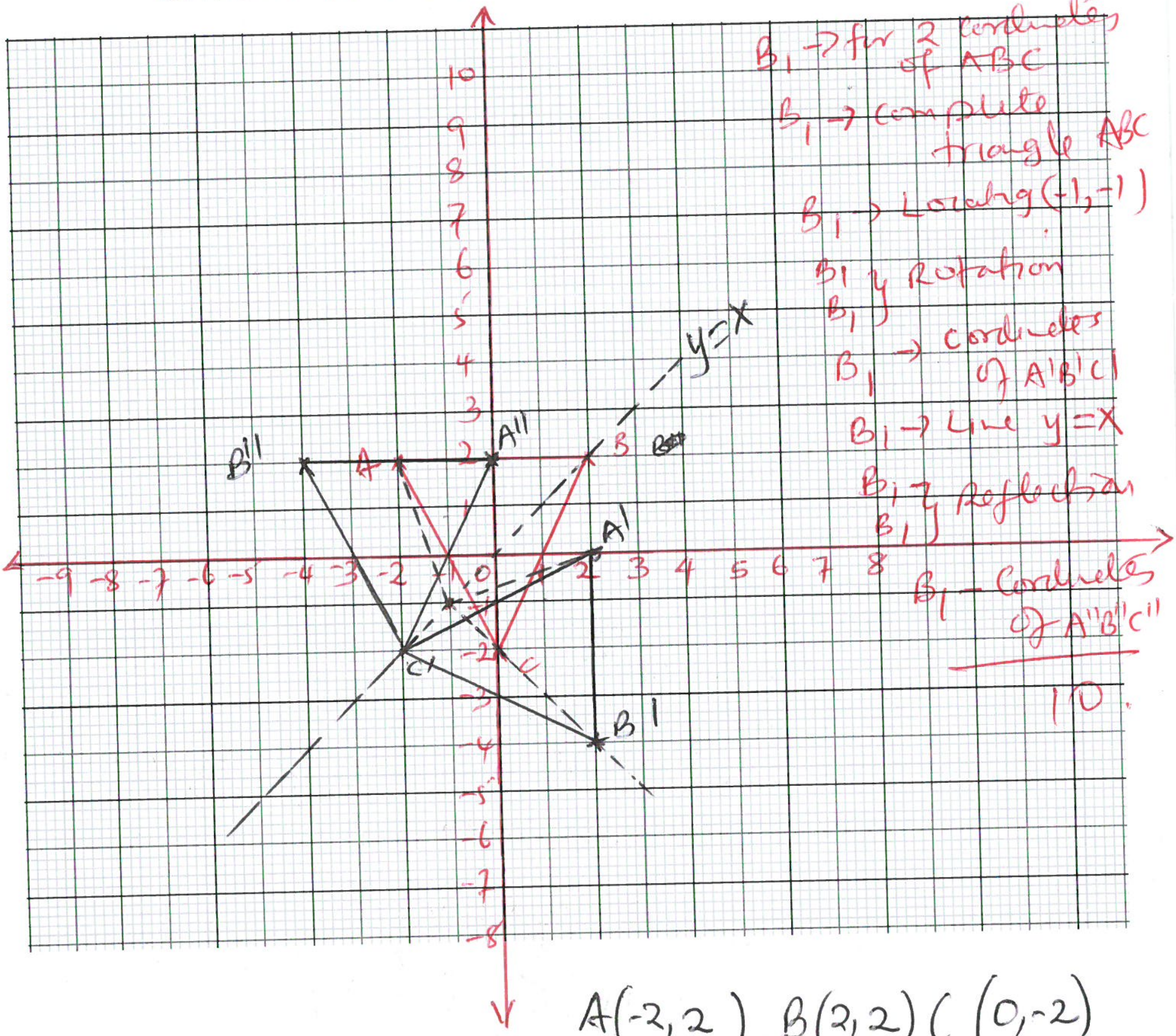
or $y = -\frac{1}{2}x + 7$ A1

18. A(-2,2), B(2,2) and C(0,-2) are coordinates of vertices of a triangle ABC;

a) On the grid provided draw triangle ABC (2 marks)

b) A'B'C' are the images of ABC under a rotation 90^0 clockwise turn about (-1,-1). Find the coordinates of A'B'C' on the same grid. (4 marks)

c) ABC is reflected on the line y= x to form an image A''B''C''. Find the image and the coordinates of A''B''C''. (4 marks)

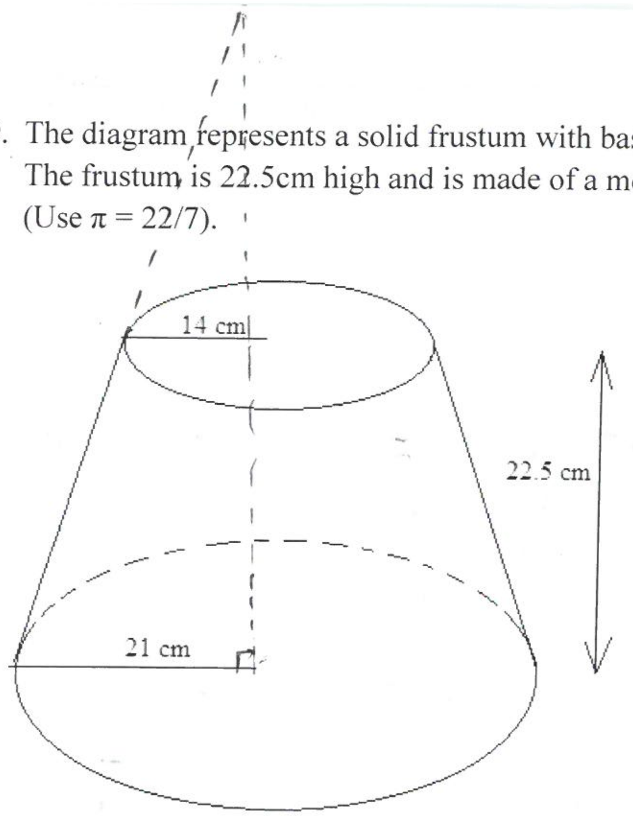


A(-2,2) B(2,2) C(0,-2)

A'(2,0) B'(2,-4) C'(-2,-2)

A''(0,2) B''(-4,2) C''(-2,-2)

19. The diagram represents a solid frustum with base radius 21cm and top radius 14cm. The frustum is 22.5cm high and is made of a metal whose density is 3g/cm3 . (Use $\pi = 22/7$).



$$\frac{h+22.5}{h} = \frac{21}{14} = \frac{3}{2}$$

$$2(h+22.5) = 3h$$

$$2h+45 = 3h$$

$$h = 45cm$$ B1

Calculate;

a) The volume of the metal in the frustum. (5 marks)

$$\tfrac{1}{3} \times \tfrac{22}{7} \times 21^2 \times 67.5 = 31,185$$ B1

$$\tfrac{1}{3} \times \tfrac{22}{7} \times 14^2 \times 45 = 9240$$ B1

M1

$$31,185 - 9240 = 21,945cm^3$$ A1

b) The mass of the frustum in kg. (2 marks)

M1

$$m = v\rho = (21,945 \times 3)g = 65,835g.$$

$$= 65.835Kg$$ A1

c) The frustum is melted down and recast into a solid cube. In the process 20% of the metal is lost. Calculate to 2 decimal places the length of each side of the cube. (3 marks)

$$\tfrac{80}{100} \times 21945 = L^3 = 17,556$$ B1

M1

$$L = \sqrt[3]{17,556}$$

$$= 25.99$$ A1

20. The height of 36 students in a class was recorded to the nearest centimetres as follows.

~~148~~	~~159~~	~~163~~	~~158~~	~~166~~	~~155~~	~~155~~	~~179~~	~~158~~	~~155~~	~~171~~	~~172~~
~~156~~	~~161~~	~~160~~	~~165~~	~~157~~	~~165~~	~~175~~	~~173~~	~~172~~	~~178~~	~~159~~	~~168~~
~~160~~	~~167~~	~~147~~	~~168~~	~~172~~	~~157~~	~~165~~	~~154~~	~~170~~	~~157~~	~~162~~	~~173~~

(a) Make a grouped frequency distribution table with 145.5 as lower class limit and class width of 5. (3 marks)

B1 B1 B1

class	Tally	f	x	xf	
146-150	//	2	148	296	
151-155	////	4	153	612	
156-160	//////////	10	158	1580	
161-165	//////	6	163	976	
166-170	/////	5	168	840	
171-175	///////	7	173	1211	
176-180	//	2	178	356	

B1

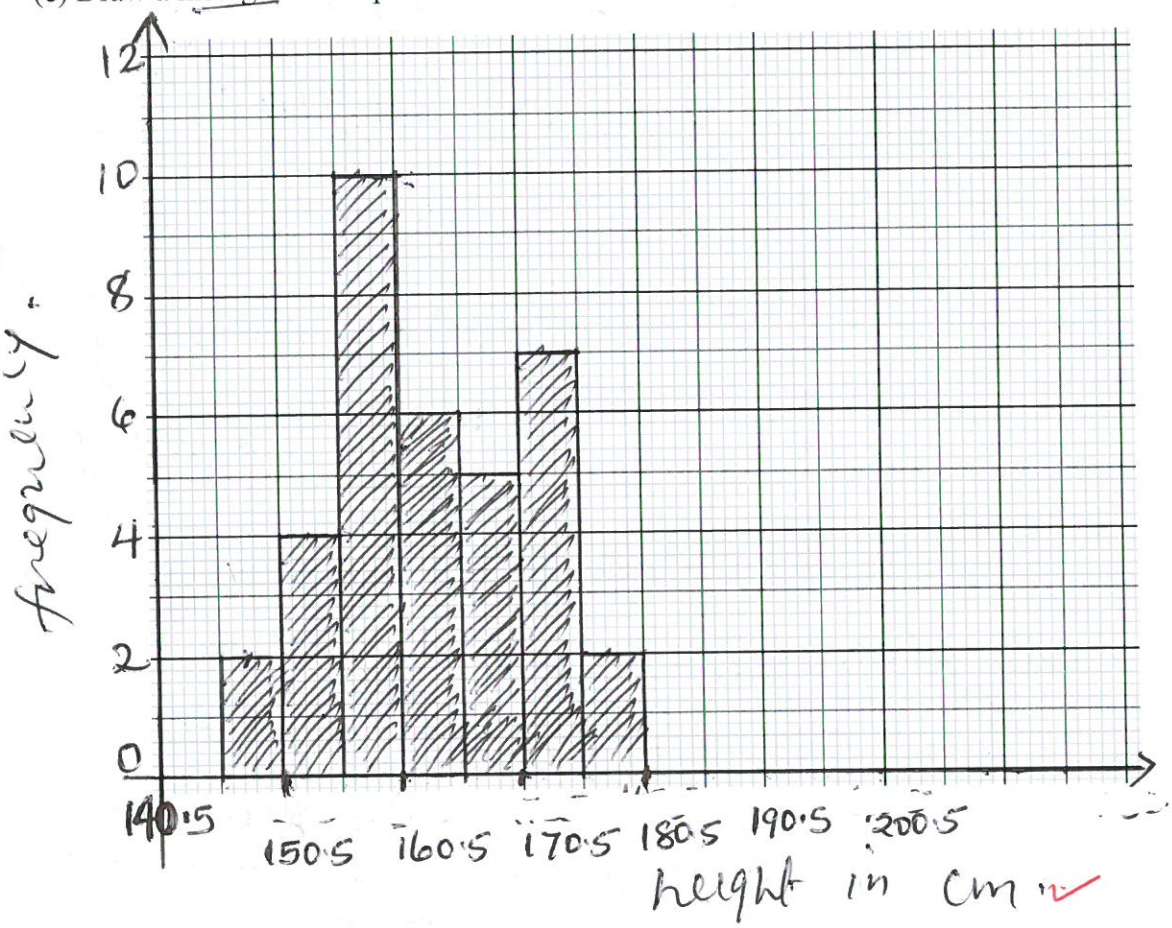
$\Sigma xf = 5871$

(b) Calculate the mean height of the students (3 marks)

$$\bar{X} = \frac{5871}{36} \text{ M1 } = 163.08$$

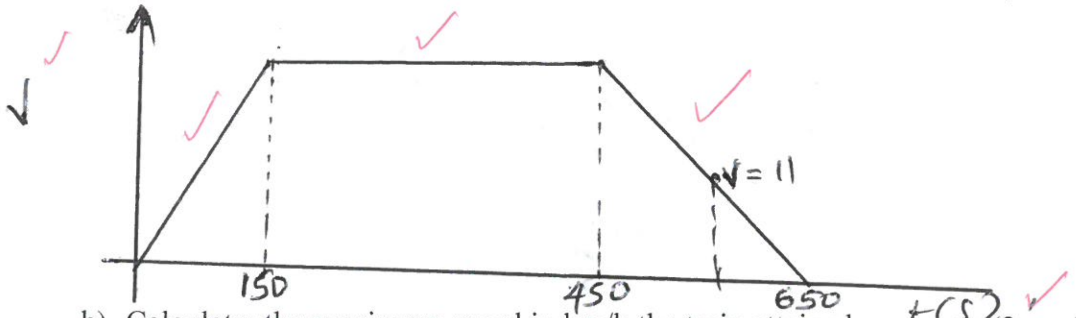
$$= \underline{163.1} \text{ A1}$$

(c) Draw a histogram to represent the above information on the grid provided . (4 marks)



21. A train travelling between two stations starts from rest and accelerates uniformly for 150 seconds. It then travels at a constant speed for 300 seconds and finally decelerates uniformly for 200 seconds to rest. Given that the distance between the two stations is 10450m,

a) Sketch the speed time graph for the train. (3 marks)



b) Calculate; the maximum speed in km/h the train attained. (3 marks)

$\frac{1}{2}(650+300)V = 10450$ M1

$950V = 20900$ M1

$V = 22 m/s$ A1 $= 79.2 km/h$

c) Acceleration (2 marks)

$\frac{22-0}{150} = {}^{11}/_{75}$ M1 A1

$= 0.1467 m/s^2$

d) Distance the train travelled during the last 100 seconds (2 marks)

Av velocity = 11 m/s² B1

$\frac{1}{2} \times 100 \times 11 = 550 m$ A1

$\frac{0+22}{2} = 11$

$\frac{11+0}{2} = 5.5 m/s$

$5.5 \times 100 = 550 m$

22. Given that $4p - 3q = \begin{pmatrix} 10 \\ 5 \end{pmatrix}$ and $p + 2q = \begin{pmatrix} -14 \\ 15 \end{pmatrix}$ find

a) (i) $\underset{\sim}{p}$ *and* $\underset{\sim}{q}$ (3 marks)

$4p - 3q = \begin{pmatrix} 10 \\ 15 \end{pmatrix}$

$4p + 8q = \begin{pmatrix} -56 \\ 60 \end{pmatrix}$ –

M1

$4p - 3q = \begin{pmatrix} 10 \\ 5 \end{pmatrix}$

$11q = \begin{pmatrix} -66 \\ 55 \end{pmatrix}$

$\underset{\sim}{q} = \begin{pmatrix} -6 \\ 5 \end{pmatrix}$ A1

$\underset{\sim}{p} = \begin{pmatrix} -2 \\ 5 \end{pmatrix}$ B1

(ii) $|p + 2q|$ (3 marks)

$\sqrt{(-14)^2 + (15)^2}$ M1 $= \sqrt{421}$ M1

$= 20.52$ A1

(b) Show that A (1, -1), B (3, 5) and C (5, 11) are collinear. (4 marks)

$\vec{AB} = \begin{pmatrix} 3 \\ 5 \end{pmatrix} - \begin{pmatrix} 1 \\ -1 \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$

$\vec{BC} = \begin{pmatrix} 5 \\ 11 \end{pmatrix} - \begin{pmatrix} 3 \\ 5 \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$ } B1

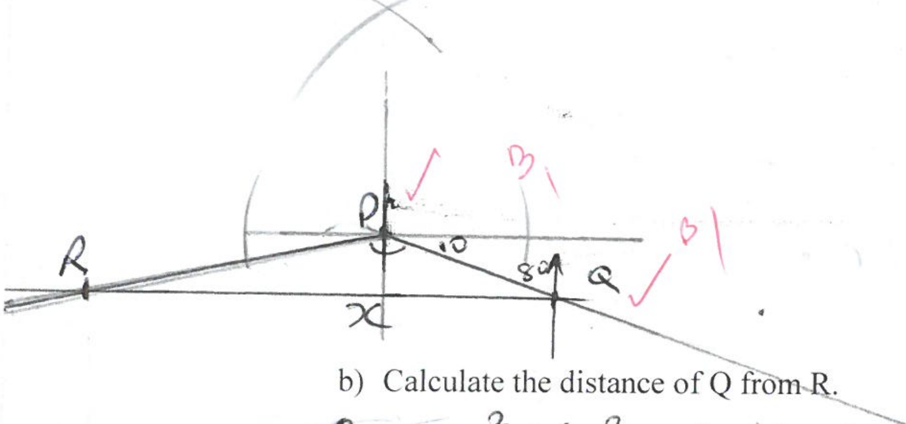
$\vec{AB} = \vec{BC}$ ✓ B1 hence parallel,

pt B ✓ B1 is common

$\therefore$ A, B, C are collinear ✓ B1

23. From town P, a town Q is 60km away on a bearing South 80° east. A third town R is 100km from P on the bearing South 40° west. A cyclist travelling at 20km/h leaves P for Q. He stays at Q for one hour and then continues to R. He stays at R for 1½ hrs. and then returns directly to P.

a) Sketch the positions of towns PQR . (2 marks)



b) Calculate the distance of Q from R. (3 marks)

$x^2 = 100^2 + 60^2 - 2(60)(100)\cos 160$ M1

$= 13600 - -11,276$

$= 24,876$

$x = \sqrt{24,876}$ M1

$= 157.7\text{km}$ A1

c) Calculate the bearing of R from Q. (3 marks)

$\frac{157.5}{\sin 160} = \frac{100}{\sin Q}$

$\sin Q = \frac{100 \sin 160}{157.5}$ M1

$= 12.54°$

$80 + 12.5 = 92.5$

$360 - 92.5$ M1

$= 267.5°$ A1

d) What is the time taken for the whole round trip? (2 marks)

$60 + 157.7 + 100 = 317.7$

$\frac{317.7}{20} = 15.885\text{hrs} = 15\text{hrs } 53\text{min}$ B1

15hr 33min +
2 30

18hr 03min B1

24. A particle moves in a straight line so that t seconds after passing affixed point in the line, its velocity v m/s is given by $v = \frac{1}{2}t^2 - 3t + 7$.

a) The velocity after 8s, (3 marks)

$V = \frac{1}{2}(8)^2 - 3(8) + 7$

$= 32 - 24 + 7$

$= 15 m/s.$

b) The acceleration when t = 0 (2 marks)

$a = t - 3$

$= -3 m/s^2$

c) The minimum velocity (2 marks)

$t - 3 = 0$

$t = 3.$

$V = \frac{1}{2}(3)^2 - 3(3) + 7$

$= 2.5 m/s.$

d) The distance travelled in the first two seconds of motion, (3 marks)

$S = \int v\,dt = \int \frac{1}{2}t^2 - 3t + 7$

$= \frac{1}{6}t^3 - \frac{3}{2}t^2 + 7t \Big|_0^2$

$= \left(\frac{8}{6} - 6 + 14\right) - 0$

$= 9\frac{1}{3} m$