

NAME _____
SCHOOL _____

INDEX NO. _____
SIGNATURE _____
DATE _____

121/1
MATHEMATICS ALT A
PAPER 1
2019
TIME: 2½ HOURS

INSTRUCTIONS TO CANDIDATES

1. Write your name and index number in the spaces provided above.
2. Sign and write the date of examination in the spaces provided above.
3. This paper consists of **TWO** sections. **Section I** and **Section II**.
4. Answer **ALL** the questions in **section I** and only **FIVE** questions from **Section II**.
5. All answers and working must be written on the question paper in the space provided below each question.
6. Show all the steps in your calculations, giving your answers at each stage in the spaces below each question.
7. Marks may be given for correct working even if the answer is wrong.
8. Non-programmable silent calculators and KNEC mathematical tables may be used except where stated otherwise.
9. This paper consists of **16** printed papers.
10. Candidates should check the question paper to ascertain that all the pages are printed as indicated 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	
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SECTION I (50 MARKS)

Answer ALL questions in this section

1. Evaluate.

(3 marks)

$$\frac{[28 - (-18)]}{-2} - \frac{[15 - (-2)(-6)]}{3}$$

2. The cost of 5 skirts and 3 blouses is sh. 1750. Mutua bought three skirts and one of the blouses for sh. 850. Find the cost of each item.

(3 marks)

3. A point T is at the intersection of the lines $x - y = 0$ and $3x + y = 12$. Line Q which is parallel to line $2y - 5x - 8 = 0$ passes through point T. Find the equation of line Q.

(4 marks)

4. Solve the inequalities and illustrate your solution on a number line.

$$3x + 4 < 25 \leq 6x - 7$$

5. Use tables of reciprocals to find the value of x given that:

(3 marks)

$$\frac{1}{x} = \frac{1}{0.27} - \frac{1}{4.6}$$

6. Last year, Mulatya was four times as old as her son, Dennis; in four years' time the sum of their ages will be 53. Determine their present ages.

(3 marks)

7. Solve the equation.

$$64^x - 121 = 7 - 4^{3x}$$

8. A test tube is made up of hemispherical bottom and a cylindrical stem, both of internal radius 0.7cm. Calculate the capacity of the test tube, given that its height is 12cm. (3 marks)

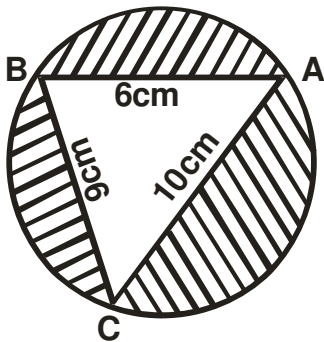
9. A bus travelling at an average speed of 63km/h left the station at 8.15 am. A car left the same station at 9.00am and caught up with the bus at 10.45 am. Find the average speed of the car. (3 marks)

10. Form a quadratic equation in t whose roots are -4 and 7 .

11. The figure below (not drawn to scale) shows a triangle ABC inscribed in a circle.

$AB = 6\text{cm}$, $BC = 9\text{cm}$ and $AC = 10\text{cm}$. Calculate the area of the shaded region.

(3 marks)



12. A salesman gets a commission of 2.4% on sales upto sh. 100,000. He gets an additional commission of 1.5% on sales above this. Calculate the commission he gets on sales worth sh. 280,000 (3 marks)

13. Given that the equation of the normal to the curve $y = x^2 + 3x + 5$ at point C is $5y + x = 46$, find the coordinates of C. (3 marks)

14. Water and milk are mixed such that the ratio of the volume of water to that of milk are 4:1. Taking the density of water as 1g/cm^3 and that of milk as 1.2g/cm^3 , find the mass in grams of 2.5 litres of the mixture. (3 marks)

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15. Every week the number of absentees in a school was recorded. This was done for 39 weeks.

The observations were tabulated as shown below.

No. of absentees	0 - 3	4 - 7	8 - 11	12 - 15	16 - 19	20 - 23
No. of weeks	6	9	8	11	3	2

Estimate the median absentee rate per week in the school.

(3 marks)

16. Solve without using tables or calculator.

(4 marks)

$$\frac{\sin 480^\circ - \tan 225^\circ}{\tan 45^\circ - \cos(-330^\circ)}$$

SECTION II (50 MARKS)

Answer ANY FIVE questions in the section.

17. The capacity of two similar rectangular tanks is 1,000,000 litres and 512,000 litres respectively.

a) Determine the length of the larger tank if the smaller one is 240cm long. (4 marks)

b) Calculate the surface area of the smaller tank if the larger tank's surface area is 1875m^2 . (3 marks)

c) Estimate the mass of the smaller tank if the mass of the larger one is 800kg. (3 marks)

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18. A school S is 1820 metres from a post office P on a bearing 068° . A house X is 1160m from the post office on a bearing of 198° . House Y is 1650 metres from the school on a bearing of 142° . House Z is 2020 metres from the school on a bearing of 286° .
- a) Using a scale of 1cm to represent 200 metres, make a scale drawing of the position of the post office, school and the houses X, Y and Z. (6 marks)

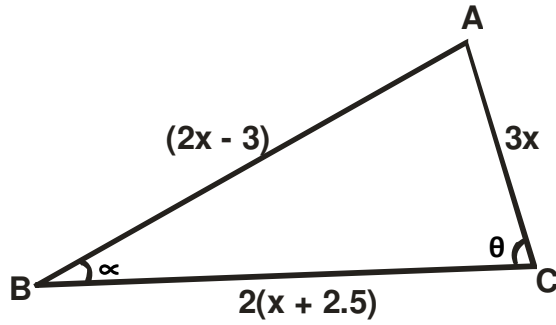
b) How far is the house Y from X? (2 marks)

c) What is the bearing of X from Y? (2 marks)

19. Use a ruler and a compass only for all constructions in this section.

- a) Construct a triangle XYZ in which $XY=6\text{cm}$ $YZ=5\text{cm}$ and $\angle XYZ=120^\circ$ (2 marks)
- b) Measure XZ and angle YXZ . (2 marks)
- c) Construct the perpendicular bisector of XZ and let it meet XZ at M . (1 mark)
- d) Locate a point W on the opposite side of XZ as Y and that $XW=ZW$ and $YW=9\text{cm}$ and hence complete triangle XZW . (2 marks)
- e) Measure WM and hence calculate the area of triangle WXZ . (3 marks)

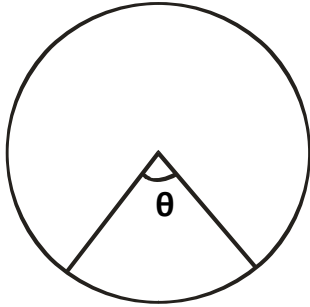
20. Triangle ABC below has an area of 30cm^2 . In the triangle, $\angle ABC = \alpha$, $\angle ACB = \theta$ and $\sin \alpha - \cos \theta = 0$. Sides $AB = (2x-3)$ cm, $AC = 3x$ cm and $BC = 2(x + 2.5)$ cm.



From the triangle, find;

- a) The value of x (3 marks)
- b) The perimeter of the triangle (2 marks)
- c) The perpendicular height from A to base BC (2 marks)
- d) The size of angles θ and α (3 marks)

21. A cone is made by cutting off a sector as shown below from a circle and gluing the straight edges of the sector.



The cone formed has a slant height of 14cm and a circular base of perimeter 11 cm. (take $\pi = \frac{22}{7}$)

- a) Calculate the value of θ (2 marks)
- b) The radius of the cones circular base (2 marks)
- c) The height of the cone (3 marks)
- d) The cone is cut uniformly on a horizontal plane 1cm below the apex. Calculate the slant height of the frustum so formed correct to 2 decimal places. (3 marks)

22. A Kenyan business woman wants to pay a company she owes US\$ 100, 000 in the United States of America. The woman can either pay through her account in Kenya or her account in the United Kingdom.

a) If the exchange rate is;

1 US dollar = 28.74 Kenya shillings

1 Sterling pound = 1.79 US Dollars

1 Sterling pound = 50.80 Kenya shillings

Which method is cheaper and by how much? Give your answer in Kenya shillings. (4 marks)

b) Three years ago, Joseph was three times older than Agnes. In two years' time the sum of their ages will be 74. Determine their present ages. (3 marks)

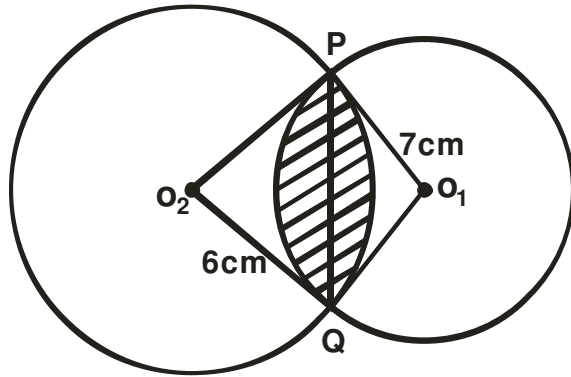
c) Use mathematical tables to evaluate;

$$\sqrt[3]{\frac{45.3 \times 0.00697}{0.534}}$$

(3 marks)

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23. Two circles, with centres O_1 and O_2 have radii 7 cm and 6cm respectively. The two circles intersect at P and Q, the length of common chord PQ is 10cm.



Calculate the area of the shaded region in the above diagram to four significant figures. (10 marks)

24. A certain number of people agreed to contribute equally to buy books worth sh. 12000 for a school library. Five people pulled out so that others agreed to contribute an extra sh. 100 each. Their contributions enabled them to buy books worth sh. 2000 more than they originally expected.

a) If the original number of people was X , write down.

i) An expression of how much each was originally to contribute . (1 mark)

ii) Two distinct expressions of how much each contributed after the five pulled out. (2 marks)

b) Calculate the value of x . (3 marks)

c) Calculate how much each person was expected to contribute originally. (2 marks)

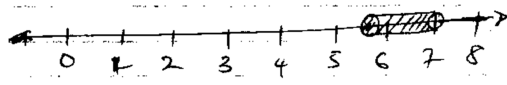
d) Calculate,

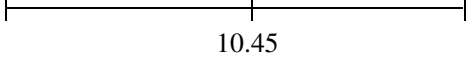
i) The number of people who actually made the contribution and how much per person. (1 mark)

ii) The ratio of the supposed original contribution to new contribution. (1 mark)


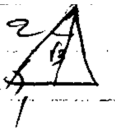
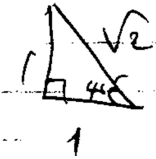
MARKING SCHEME

	MAIN SCHEME	MARKS	COMMENTS
1	$\frac{28+18}{-2} - \frac{15-(2 \times 6)}{3}$ $= \frac{46}{-2} - \frac{(15-12)}{3}$ $-23 - 1 = -24$	M1 M1 A1	
		03	
2	<p>Let x = skirts and y = blouses</p> $5x + 3y = 1750$ $39x + y = 850$ $5x + 3y = 1750$ $\underline{9x + 8y = 2250}$ $-4x = -500$ $x = 125$ $375 + y = 850$ $y = 475$ $x = 125$	M1 M1 A1	
		03	
3	$x = y \text{ and } y = 12 - 3x$ $y = y \equiv 12 - 3x = x$ $12 = 4x$ $x = 3$ $x = 3$ $9 + y = 12$ $y = 3$ <p>T(3, 3)</p> $2y - 5x = 8$ $2y = 8 + 5x$ $y = 4 + \frac{5}{2}x$ $M_1 = \frac{5}{2}$ $\text{Eq} = \frac{y-3}{x-3} = \frac{5}{2}$ $2y - 6 = 5x - 15$ $2y = 5x - 15 + 6$ $2y = 5x - 9$ $2y - 5x = -9$	M1 M1 M1 A1	For T coordinates For gradient Formation of the equation
		04	
4	$3x + 4 < 25 \leq 6x - 7$ <p>i) $3x < 25 - 4$</p> $3x < 21$ $x < 7$ <p>ii) $25 \leq 6x - 7$</p> $32 \leq 6x$	M1	Separating the inequality into small

	$\frac{32}{6} \leq x$ $= 5\frac{1}{6}$ $5\frac{1}{6} \leq x < 7$ 	M1	
		A1	Representation on a line
		03	
5	$\frac{1}{x} = \frac{1}{0.27} - \frac{1}{4.6}$ $\frac{1}{x} = 1(10^1 \times 0.3704) - 1(0.2174)$ $\frac{1}{x} = 3.704 - 0.2174$ $\frac{1}{x} = 3.4866$ $1 = 3.4866x$ $\frac{1}{3.4866} = x$ $x = 0.2868$	M1	
		M1	
		A1	
		03	
6	<p>Let Mulatya's present age = x Last year, Mulatya's age x - 1 Dennis' age was 4(x - 1)</p> <p>In 4 years time, their respective ages will be; (x - 1) + 4 and 4(x - 1) + 4 (x - 1) + 4 + [4(x - 1) + 4] = 53 x + 3 + 4x - 4 + 4 = 53 5x + 3 = 53 5x = 53 - 3 5x = 50 x = 10</p>	B1	For expression of Dennis age
		M1	For expression of total age after 4 years and equation to 53
		A1	
		03	
7	$64^x - 121 = 7 - 4^{3x}$ $4^{3x} - 121 = 7 - 4^{3x}$ $4^{3x} + 4^{3x} = 128$ $4^{3x} + 4^{3x} = 2 \times 4^3$ $2 \times 4^{3x} = 2 \times 4^3$ <p>Buses are</p> $3x = 3$ $x = 1$	B1	For rearranging
		M1	For expression as power of 4
		A1	
		03	

8	<p>Volume of sphere $\frac{4}{3}\pi r^3$</p> <p>Capacity of hemisphere bottom</p> $\frac{1}{2} \times \frac{4}{3} \times \frac{22}{7} \times 0.7^3$ $= 0.7187 \text{ cm}^3$ <p>Volume of cylinder = $\pi r^2 l$</p> <p>Height of cylindrical part</p> $12 - 0.7 = 11.3$ <p>Capacity of cylindrical part</p> $\frac{22}{7} \times 0.7^2 \times 11.3$ $= 17.402 \text{ cm}^3$ <p>Total capacity = $0.7187 + 17.402$</p> $= 18.1207 \text{ cm}^3$	M1 M1 A1	
		03	
9	<p>900 Car 63km/hr Bus 8.15 am</p>  <p>Distance covered by bus</p> $63 \times (10.45 - 8.15)$ $63 \times 2\frac{1}{2} = 157.5 \text{ km}$ <p>Speed = $\frac{157.5}{1\frac{1}{4}} = 157.5$</p> $157.5 \times \frac{4}{7} = 90 \text{ km/hr}$	M1 M1 A1	
		03	
10	<p>Let the variable be x</p> $\therefore x = -4 \text{ or } x = 7$ $x + 4 = 0 \text{ or } x - 7 = 0$ $(x + 4)(x - 7) = 0$ $x^2 - 7x + 4x + 28 = 0$ $x^2 - 3x + 28 = 0$	M1 M1 A1	For formation of roots Combining the factors or roots
		03	
11	$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} = D$ $9^2 = 6^2 + 10^2 - 2 \cos A$ $81 = 36 + 100 - 2 \times 10 \times 6 \cos A$ $81 = 136 - 120 \cos A$ $-136 + 81 = -120 \cos A$ $-55 = -120 \cos A$ $\frac{-55}{-120} = \cos A$ $\cos A = 0.4583$ $A = 62.72$ $\therefore \frac{9}{\sin 62.72^\circ} = 2R$ $\frac{9}{0.8888} = 2R$ $9 = 1.7776R$ $R = 5.06 \text{ cm}$	M1	Size of any angle

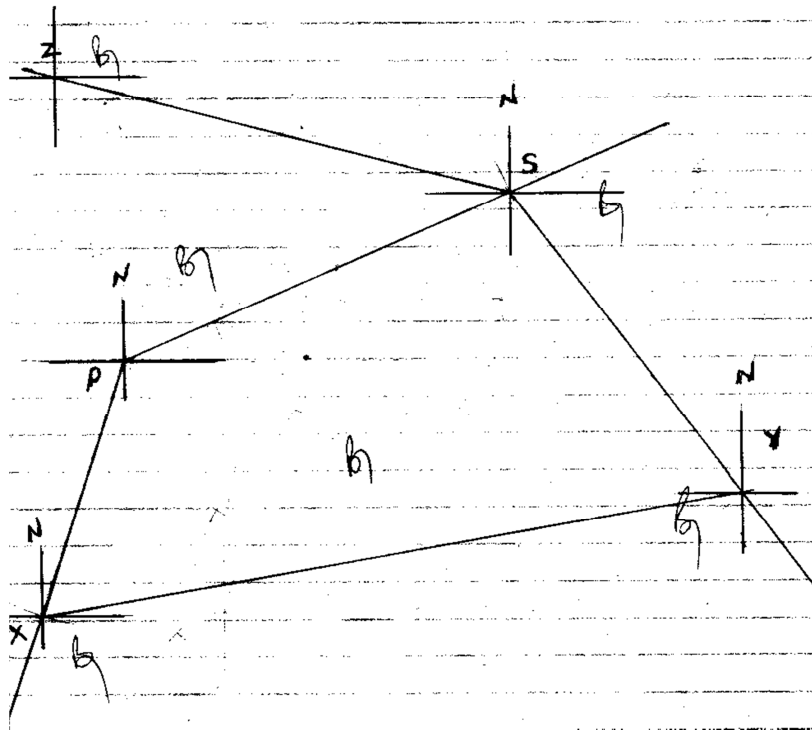
	<p>Area of cord</p> πr^2 $3.142 \times 5.06^2 = 80.4461\text{m}^2$ <p>Area of Δ</p> $\frac{1}{2} \times 63 \times 10 \sin 62.72$ $= 26.66\text{cm}^2$ <p>Area of shaded region</p> $80.45 - 26.66 = 53.79\text{cm}^2$	M1 A1	
		03	
12	<p>% commission = 2.4% sales upto 100,000 Additional comm = 1.5% on sales above this (i.e 100,000)</p> $\frac{2.4}{100} \times 100,000 = 2400$ $\frac{3.9}{100} \times 180,000 = \underline{7020} +$ $= 9420$	M1 M1 A1	
		03	
13	<p>Gradient function</p> $y = x^2 + 3x + 5$ $\frac{dy}{dx} = 2x + 3$ <p>Point C eqn = $5y + x = 46$</p> $y = \frac{4.6}{5} - \frac{x}{5}$ <p>gradient = $-\frac{1}{5}$</p> <p>gradient of tangent $MM_1 = -\frac{1}{5} \times M_2 = -1$</p> $M_2 = -1 \times -5$ $M_2 = 5$ $\therefore 2x + 3 = 5$ $2x = 2$ $x = 1$ $C = 1 + 3 + 5$ $= 9$ <p>C = (1, 9) C (1, 9)</p>	M1 M1 A1	
		03	
14	<p>Volume ratio 4 : 1 – water to milk Density of water 1gm/cm^2 Density of milk = 1.2 g/cm^3 Mixture = 2.5 litres Volume of water $\frac{4}{5} \times 2.5 = 2.0\text{ litres}$ Volume of milk $\frac{1}{5} \times 2.5 = 0.5\text{ litre}$ Mass of water = 2.0×1000 $= 2000 \times 18$ $= 2000\text{ grams}$ Mass of milk</p>	M1	

	$0.5 \times 1000 \text{ cm} \times 1.2 \text{ g/cm}$ $= 600 \text{ gm}$ Total = (2000 + 600) gram $= 2600 \text{ gram}$	M1 A1																						
		03																						
15	<table border="1"> <thead> <tr> <th></th> <th>f</th> <th>cf</th> </tr> </thead> <tbody> <tr> <td>0 – 3.5</td> <td>6</td> <td>6</td> </tr> <tr> <td>3.5 – 7.5</td> <td>9</td> <td>15</td> </tr> <tr> <td>7.5 – 11.5</td> <td>8</td> <td>23</td> </tr> <tr> <td>11.5 – 15.5</td> <td>11</td> <td>34</td> </tr> <tr> <td>15.5 – 19.5</td> <td>3</td> <td>37</td> </tr> <tr> <td>19.5 – 23.5</td> <td>2</td> <td>39</td> </tr> </tbody> </table> $7.5 + \frac{(\frac{39}{2} - 15)^2}{8}$ $7.5 + \frac{14.5 \times 3}{8}$ $7.5 + 1.6875$ $= 9.1875$		f	cf	0 – 3.5	6	6	3.5 – 7.5	9	15	7.5 – 11.5	8	23	11.5 – 15.5	11	34	15.5 – 19.5	3	37	19.5 – 23.5	2	39	M1 M1 A1	
	f	cf																						
0 – 3.5	6	6																						
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15.5 – 19.5	3	37																						
19.5 – 23.5	2	39																						
		03																						
16	 $\sin 480 - \sin 120^\circ - \sin 60^\circ$ $\tan 225 - \tan(225 - 180)$ $\tan 45^\circ$ $\tan 45^\circ$ $\cos(330) = \cos 30^\circ$ $\frac{\sin 60 \tan 45}{\tan 45 - \cos 30}$  $\sin 60 = \frac{\sqrt{3}}{2}$ $\cos 30 = \frac{1}{2}$ $\tan 45 = 1$  $\frac{\frac{\sqrt{3}}{2} - 1}{1 - \frac{\sqrt{3}}{2}}$ $= \frac{\sqrt{3} - 2}{2}$ $= \frac{\sqrt{3} - 2}{2} \dots \dots \dots (i)$ $1 - \frac{\sqrt{3}}{2} = \frac{2 - \sqrt{3}}{2} \dots \dots \dots (ii)$ $\frac{(\frac{\sqrt{3}-2}{2-\sqrt{3}}) \frac{2+\sqrt{3}}{2+\sqrt{3}}}{\frac{2+\sqrt{3}}{2+\sqrt{3}}} = \frac{2\sqrt{3}+3-4-2\sqrt{3}}{2-3}$																							
17	a) Volume of the tanks																							

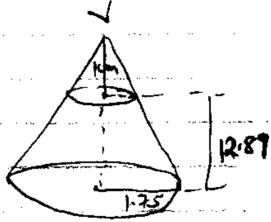
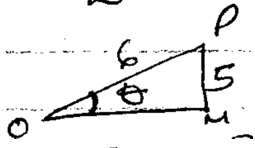
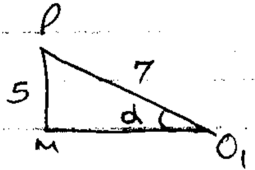
	<p>Larger 1000,000 litres Smaller 512000 litres</p> <p>Volume scale factor $\frac{512000}{1000000} = \frac{64}{1000}$</p> <p>Linear scale factor $\frac{\sqrt[3]{64}}{125} = \frac{4}{5}$</p> <p>Length of the larger tank $4 \div 5 = \frac{4}{5} = \frac{240}{x}$</p> <p>$240 \div x$ $\frac{4}{5} \times \frac{240}{x} = 4x = 240 \times 5$ $x = 300\text{cm}$</p> <p>b) Surface area of smaller tank Larger tanks surface area = 1875 cm^2 From s. factor $\left(\frac{4}{5}\right)^2 = \frac{16}{25}$ $\frac{16}{25} = \frac{x}{1875}$ $25x = 16 \times 1875$ $X = 1,200 \text{ m}^2$</p> <p>c) Volume scale factor from linear scale factor $4 : 5$ $\left(\frac{4}{5}\right)^3 = \frac{64}{125}$ $V. = \frac{64}{125} \times 800$ $= 409.6 \text{ kg}$</p>	<p>A1</p> <p>M1 M1 A1</p> <p>B1 M1 A1</p>	
		10	

18. a)

scale 1cm rep 200m



	<p>b) Distance of Y from X 15.3×200 $= 3060 \text{ metres} \pm 5\text{m}$</p> <p>c) bearing of house x from y $180^\circ + 82^\circ$ $= 262^\circ \pm 1^\circ$</p>	<p>B1 B1 B1 B1</p>	
		10	
19	<p>a) Radius of circle 14cm Circular base 11cm $\frac{\theta}{360} \times 2 \times \frac{22}{7} \times 14 = 11$ $\frac{88\theta}{360} = 11$ $\theta = 45^\circ$</p> <p>b) $\frac{22}{7} \times 2 \times \alpha = 11$ $44\alpha = 77$ $\alpha = \frac{77}{44}$ $\alpha = 1.75 \text{ cm}$</p> <p>c) Height of cone</p>	<p>M1 A1 M1 A1</p>	<p>Identifying size 14cm as the radius and 11 as the circumference</p>

	$1.75^2 + h^2 = 14^2$ $3.0625 + b^2 = 196$ $196 - 3.0625 = 192.9375$ $h^2 = 192.9375$ $h = 13.89 \text{ cm}$  $\perp : 13.89 = x : 14$ $\frac{1}{13.89} = \frac{x}{14}$ $14 = 13.89x$ $= x$ $\frac{14}{13.89} = x$ $x = 1.01 \text{ cm}$ $14 - 1.01 = 12.99 \text{ cm}$	M1 M1 A1 M1 M1 A1	
		10	
20	<p>PQ = 10 $R_1 = 7$ $R_2 = 6$ i)</p>  $\sin \theta = \frac{5}{6} = 0.8333$ $\theta = \sin^{-1} 0.8333 = 56.44^\circ$ $\angle PO_2Q = 56.44 \times 2$ $= 112.88^\circ$ <p>ii)</p>  $\sin \alpha = \frac{5}{7} = 0.7143$ $\sin^{-1}(0.7143) = 45.59^\circ$ $P_1OQ = 45.59^\circ \times 2$ $= 91.18^\circ$ <p>iii) Area of sector</p> <p>a) $O_2PQ = \frac{112.88}{360} \times \frac{22}{7} \times 6 \times 6$</p>	M1 M1 M1	

	<p>b) $PO_1Q = \frac{91.18}{360} \times 3.142 \times 7^2$ $= 38.99 \text{cm}^2$</p> <p>Area of Δs</p> <p>i) $\frac{1}{2} \times 6 \times 6 \sin 112.88$ $= 16.58 \text{cm}^2$</p> <p>ii) $\frac{1}{2} \times 7 \times 7 \sin 91.18$ $= 24.49 \text{cm}^2$</p> <p>Area of segments</p> <p>a) $35.48 - 16.58 = 18.9 \text{cm}^2$</p> <p>b) $38.99 \text{cm}^2 - 24.49 \text{cm}^2$ $= 14.5 \text{cm}^2$</p> <p>Area of shaded region $= 18.9 + 14.5 = 33.4 \text{cm}^2$</p>	<p>M1</p> <p>A1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>M1</p> <p>A1</p>	
		10	
21	<p>a) i) $\frac{12000}{x}$</p> <p>ii) a) $\frac{14000}{x-5}$</p> <p>b) $\frac{12000}{x-5} + 100$</p> <p>b) $\frac{14000}{x-5} - \frac{12000}{x-5} = 100$ $\frac{x(14000) - (x-5)(12000)}{x(x-5)} = 100$ $14000x - 12000x + 60000 = 100x^2 - 500x$ $2000x + 60000 = 100x^2 - 500x$ $100x^2 - 2500x - 60000 = 0$ $x^2 - 25x - 600 = 0$ $x = \frac{25 \pm \sqrt{25^2 - 4 \times 1 \times -600}}{2}$ $= \frac{25 \pm \sqrt{625 + 2400}}{2}$ $= \frac{25 \pm 55}{2}$ $x = \frac{80}{2} = 40$ or $x = -15$</p> <p>c) $\frac{1200}{40} = 30$</p> <p>d) No of people $40 - 5 = 35$ Contribution = $\frac{14000}{35}$ $= 400.00$</p>	<p>B1</p> <p>B1</p> <p>B1</p> <p>M1</p> <p>M1</p> <p>A1</p> <p>B1</p> <p>A1</p> <p>M1</p>	

	3 : 4	A1	
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