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**GENERAL CERTIFICATE OF SECONDARY EDUCATION  
MATHEMATICS SYLLABUS A**

**J512/04**

Paper 4 (Higher Tier)

Candidates answer on the question paper

**OCR supplied materials:**  
None

**Other materials required:**

- Electronic calculator
- Geometrical instruments
- Tracing paper (optional)

**Friday 14 January 2011  
Morning**

**Duration: 2 hours**



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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**INSTRUCTIONS TO CANDIDATES**

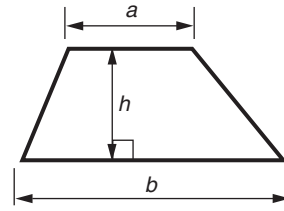
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Show your working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Answer **all** the questions.
- Do **not** write in the bar codes.

**INFORMATION FOR CANDIDATES**

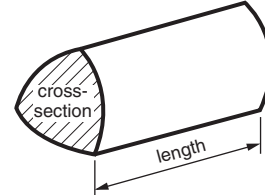
- The number of marks is given in brackets [ ] at the end of each question or part question.
- You are expected to use an electronic calculator for this paper.
- Use the  $\pi$  button on your calculator or take  $\pi$  to be 3.142 unless the question says otherwise.
- The total number of marks for this paper is **100**.
- This document consists of **24** pages. Any blank pages are indicated.

## Formulae Sheet: Higher Tier

**Area of trapezium** =  $\frac{1}{2}(a + b)h$



**Volume of prism** = (area of cross-section)  $\times$  length

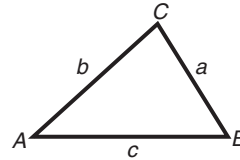


**In any triangle ABC**

**Sine rule**  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

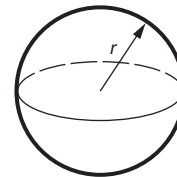
**Cosine rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

**Area of triangle** =  $\frac{1}{2}ab \sin C$



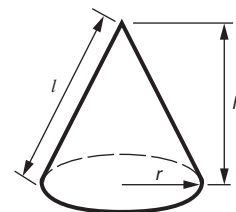
**Volume of sphere** =  $\frac{4}{3}\pi r^3$

**Surface area of sphere** =  $4\pi r^2$



**Volume of cone** =  $\frac{1}{3}\pi r^2 h$

**Curved surface area of cone** =  $\pi r l$



**The Quadratic Equation**

The solutions of  $ax^2 + bx + c = 0$ ,  
where  $a \neq 0$ , are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

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1 Calculate.

(a)  $\frac{3.6 \times 4.7}{5.1 - 3.6}$

.....  
 (a) \_\_\_\_\_ [2]

(b)  $\frac{2}{3.6 + 1.7}$

Give your answer correct to 2 decimal places.

.....  
 (b) \_\_\_\_\_ [2]

2 Jonah bought two sizes of helium balloons for a party.  
 He bought  $x$  small balloons at £2 each and 3 large balloons at £5 each.  
 The total cost was £43.

(a) Write down an equation to show this information.

.....  
 .....  
 (a) \_\_\_\_\_ [2]

(b) Solve the equation to find the number of small balloons that Jonah bought.

.....  
 .....  
 .....  
 (b) \_\_\_\_\_ [2]

- 3 A bag contains 1 yellow counter and 3 blue counters.

How many yellow counters must be added to the bag to double the probability of randomly choosing a yellow counter? Show how you found your answer.

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[3]



5 In the year 2000 the average price of a house in the United Kingdom was £81 600.

(a) By 2005 the average price of a house had increased by 93%.

Find the average price of a house in 2005.

.....  
.....  
.....  
.....

(a) £ \_\_\_\_\_ [3]

(b) In 1995 the average price of a house was £50 900.

Find the percentage increase in the average price of a house from 1995 to 2000.

.....  
.....  
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(b) \_\_\_\_\_ % [3]

- 6 (a) Solve this inequality.

$$4x - 1 < 20$$

.....

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.....

(a) \_\_\_\_\_ [2]

- (b) You are given also that  $x > 0$  and that  $x$  is a whole number.

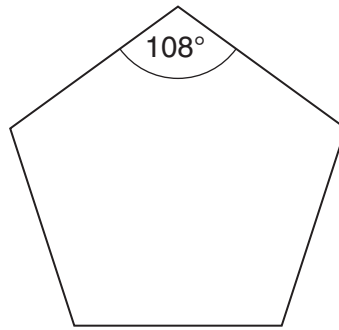
Write down all the possible values of  $x$ .

.....

.....

(b) \_\_\_\_\_ [1]

7 Here is a regular pentagon.



(a) Show that each interior angle is  $108^\circ$ .

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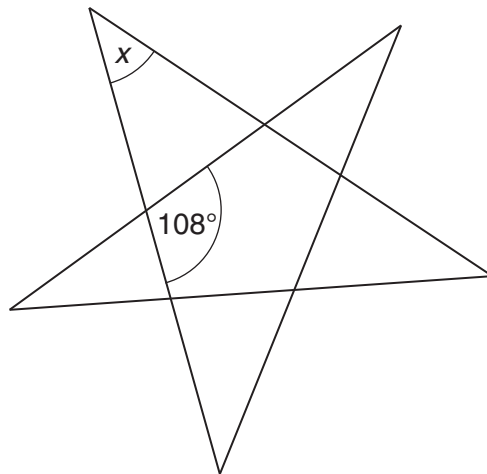
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[2]

(b) The sides of a regular pentagon are extended to make this shape.



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Calculate the size of angle  $x$ .

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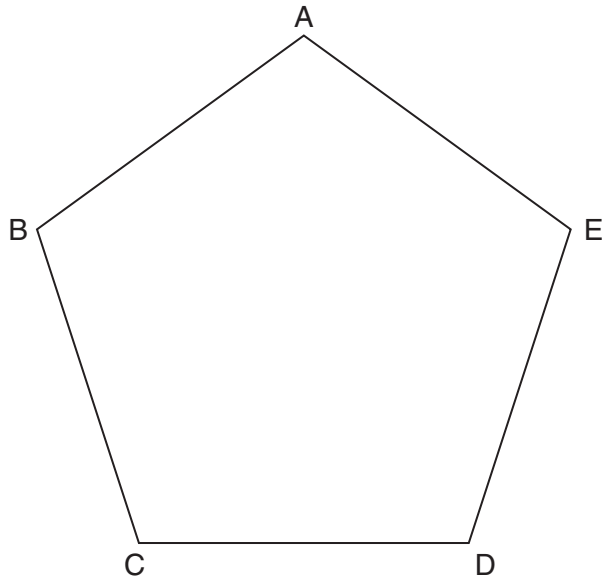
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(b) \_\_\_\_\_  $^\circ$  [3]



(c) Here is another regular pentagon.

Using ruler and compasses, construct the bisector of angle C.  
You must leave in your construction lines.



[2]

8 Use trial and improvement to solve this equation.

$$x^3 - 2x = 7$$

Give your answer to 1 decimal place.  
Show all your trials and their outcomes.

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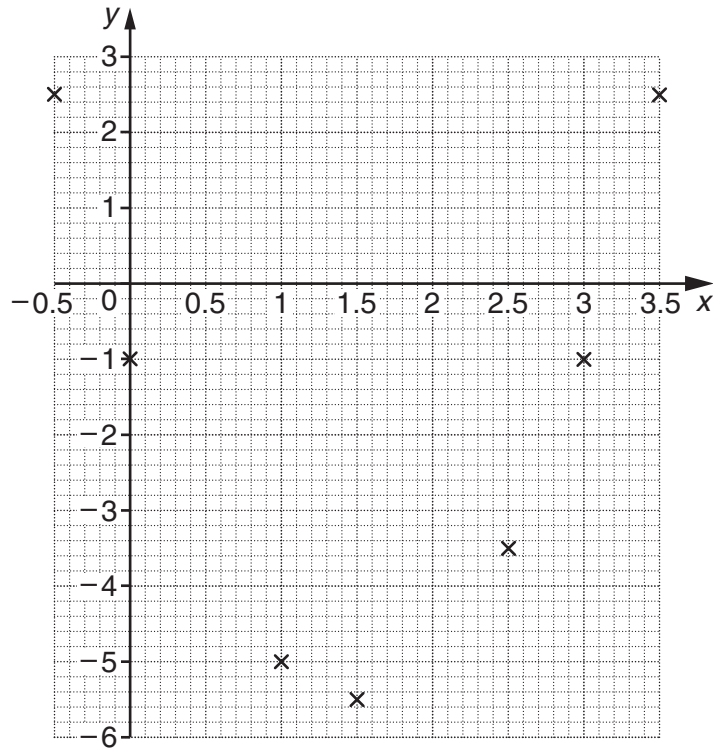
\_\_\_\_\_ [4]

9 (a) Complete this table for  $y = 2x^2 - 6x - 1$ .

$x$	-0.5	0	0.5	1	1.5	2	2.5	3	3.5
$y$	2.5	-1		-5	-5.5		-3.5	-1	2.5

[1]

(b) Draw the graph of  $y = 2x^2 - 6x - 1$  for  $-0.5 \leq x \leq 3.5$ .



[2]

(c) On the grid, draw the line  $y = 2x - 5$ .

.....  
 ..... [3]

(d) Use your graphs to solve  $2x^2 - 6x - 1 = 2x - 5$ .

.....  
 (d) \_\_\_\_\_ [2]

(e) Show that  $2x^2 - 6x - 1 = 2x - 5$  can be simplified to  $x^2 - 4x + 2 = 0$ .

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[1]

(f) Solve  $x^2 - 4x + 2 = 0$ , giving your answers correct to 3 decimal places.

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(f) \_\_\_\_\_ [3]

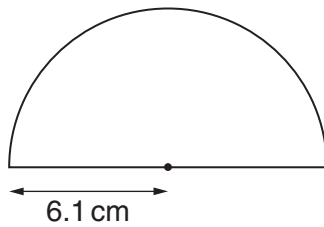
10 (a) The circumference of a circle is 25.8 cm.

Calculate the radius of the circle.  
Give your answer to an appropriate degree of accuracy.

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 .....  
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(a) \_\_\_\_\_ cm [3]

(b) A semi-circle has radius 6.1 cm.



Calculate the area of the semi-circle.

.....  
 .....  
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(b) \_\_\_\_\_ cm<sup>2</sup> [2]



13 (a) Factorise completely.

(i)  $x^2 - 36$

.....

(a)(i) \_\_\_\_\_ [1]

(ii)  $8x^2 + 12xy$

.....

.....

(ii) \_\_\_\_\_ [2]

(b) Rearrange this formula to make  $c$  the subject.

$$E = mc^2$$

.....

.....

.....

.....

(b) \_\_\_\_\_ [2]

14 (a) Write each of these numbers in standard form.

(i) 320 000

.....

(a)(i) \_\_\_\_\_ [1]

(ii)  $\frac{1}{40}$

.....

(ii) \_\_\_\_\_ [1]

(b) Multiply  $3.6 \times 10^7$  by  $7.5 \times 10^{12}$ .  
Give your answer in standard form.

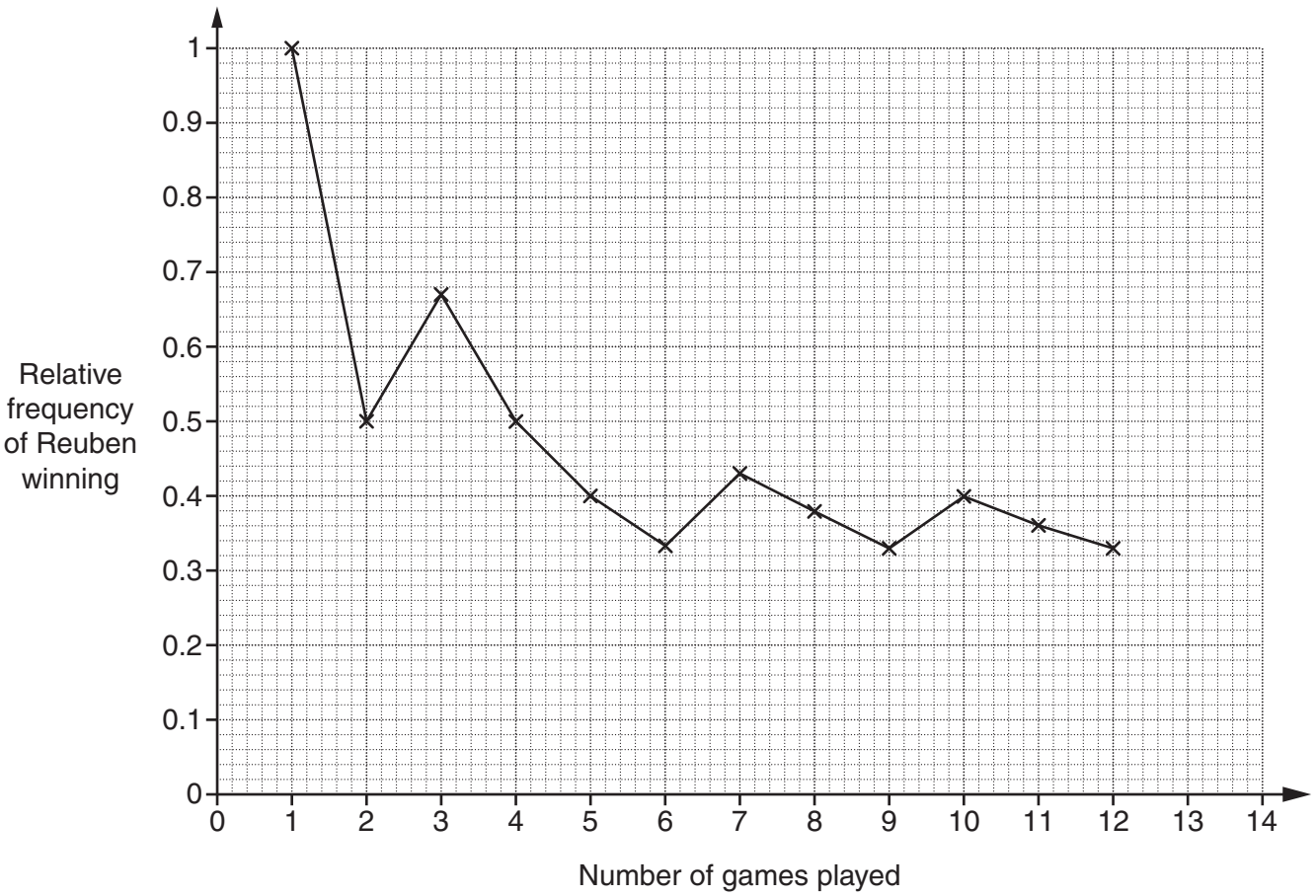
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(b) \_\_\_\_\_ [2]

- 15 Reuben plays a game on his computer 12 times.  
The graph shows the relative frequency of Reuben winning the game after each of the first 12 games.



- (a) (i) Reuben won the first game, but lost the second.

How can you tell this from the graph?

\_\_\_\_\_

\_\_\_\_\_ [1]

- (ii) Did Reuben win or lose the third game?  
Did Reuben win or lose the fourth game?

.....

.....

Third game \_\_\_\_\_ Fourth game \_\_\_\_\_ [1]



(b) Reuben is going to play the game for a 13th time.

Use the graph to estimate the probability that Reuben will win the 13th game.

.....  
.....

(b) \_\_\_\_\_ [1]

(c) Reuben played the game a 13th and a 14th time and won each of these two games.

Add the relative frequencies for these two games to the graph.

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..... [3]

16 The weights of two candles are measured as 258g and 143g both correct to the nearest gram.

(a) What is the minimum possible total weight of both candles?

.....

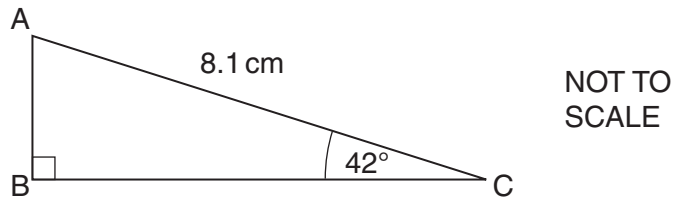
(a) \_\_\_\_\_ g [1]

(b) What is the maximum possible difference in weight between the two candles?

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.....

(b) \_\_\_\_\_ g [2]

17 (a) Calculate AB.



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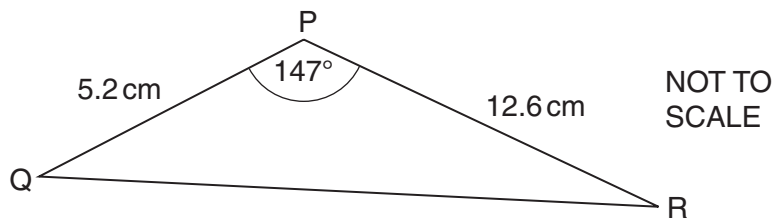
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(a) \_\_\_\_\_ cm [3]

(b) Calculate QR.



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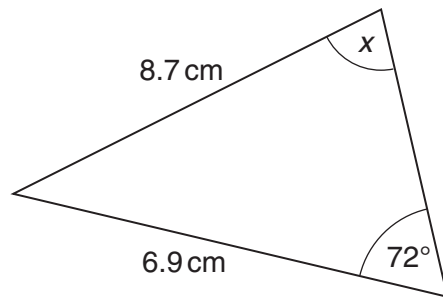
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(b) \_\_\_\_\_ cm [3]

(c) Calculate angle  $x$ .



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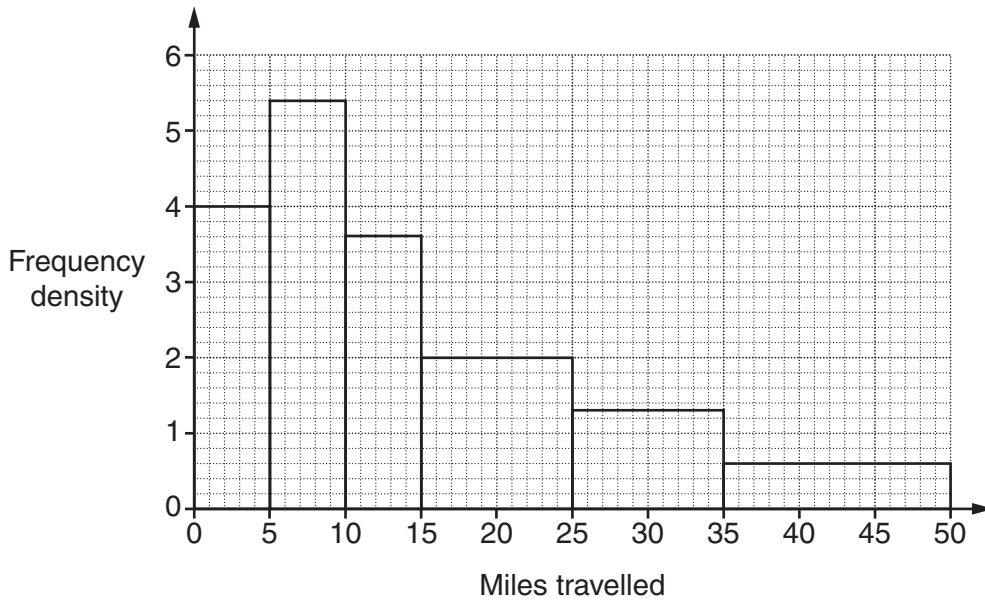
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(c) \_\_\_\_\_  $^\circ$  [3]

- 18 (a) The histogram summarises the distances in miles travelled to work each day by a group of city workers.



Work out an estimate of the number of these city workers who travelled more than 20 miles to work each day.

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(a) \_\_\_\_\_ [3]

(b) The table shows the number of unemployed people in a city.

Age (years)	Number unemployed
16 – 19	34 800
20 – 24	19 300
25 – 34	8 600
35 – 49	7 500
50 +	4 200

(i) What further information is needed in order to draw a histogram for these data?

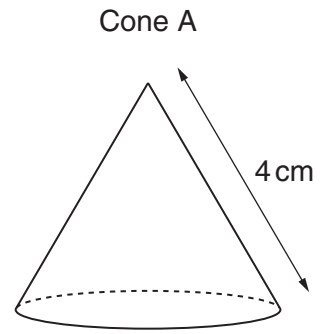
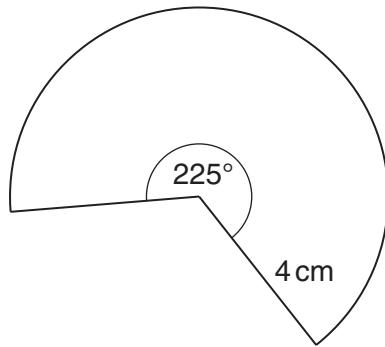
\_\_\_\_\_ [1]

(ii) Suggest a suitable value for the missing information and give a reason why you chose this value.

\_\_\_\_\_  
\_\_\_\_\_ [1]

19 The diagram shows the net of cone A.

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(a) (i) Show that the radius of the base of cone A is  $2.5\text{ cm}$ .

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[2]

(ii) Calculate the volume of cone A.

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(a)(ii) \_\_\_\_\_  $\text{cm}^3$  [4]

(b) Cone B is made from a mathematically similar net. This net is an enlargement of the original net, with length scale factor 3.

Complete the following.

.....

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(b) Volume of cone A : Volume of cone B = 1 : \_\_\_\_\_ [1]

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