



UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS  
International General Certificate of Secondary Education

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**MATHEMATICS (US)**

**0444/41**

Paper 4 (Extended)

**May/June 2013**

**2 hours 30 minutes**

Candidates answer on the Question Paper.

Additional Materials:      Geometrical instruments  
   Electronic calculator

**READ THESE INSTRUCTIONS FIRST**

Write your Center number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use a pencil for any diagrams or graphs.

Do not use staples, paper clips, highlighters, glue or correction fluid.

**DO NOT WRITE IN ANY BARCODES.**

Answer **all** questions.

If work is needed for any question it must be shown in the space provided.

Electronic calculators should be used.

If the degree of accuracy is not specified in the question, and if the answer is not exact, give the answer to three significant digits.

Give answers in degrees to one decimal place.

For  $\pi$ , use either your calculator value or 3.142.

The number of points is given in parentheses [ ] at the end of each question or part question.

The total of the points for this paper is 130.

**Write your calculator model in the box below.**

This document consists of **20** printed pages.



## Formula List

For the equation  $ax^2 + bx + c = 0$   $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Lateral surface area,  $A$ , of cylinder of radius  $r$ , height  $h$ .  $A = 2\pi rh$

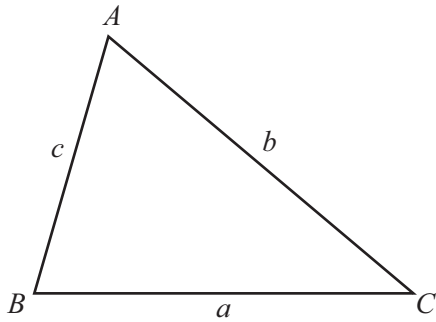
Lateral surface area,  $A$ , of cone of radius  $r$ , sloping edge  $l$ .  $A = \pi rl$

Surface area,  $A$ , of sphere of radius  $r$ .  $A = 4\pi r^2$

Volume,  $V$ , of pyramid, base area  $A$ , height  $h$ .  $V = \frac{1}{3}Ah$

Volume,  $V$ , of cone of radius  $r$ , height  $h$ .  $V = \frac{1}{3}\pi r^2 h$

Volume,  $V$ , of sphere of radius  $r$ .  $V = \frac{4}{3}\pi r^3$

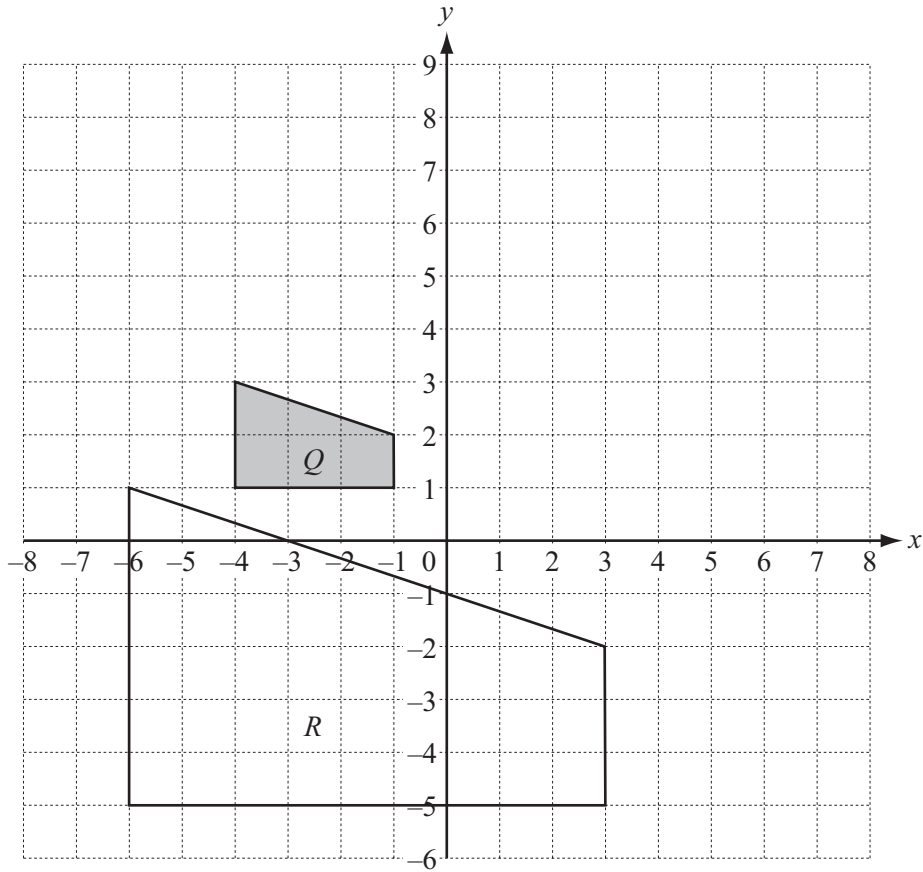


$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$

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

$$\text{Area} = \frac{1}{2}bc \sin A$$

1



(a) Describe fully the **single** transformation that maps shape *Q* onto shape *R*.

Answer(a) ..... [3]

(b) (i) Draw the image when shape *Q* is translated by the vector  $\begin{pmatrix} 5 \\ 4 \end{pmatrix}$ . [2]

(ii) Draw the image when shape *Q* is reflected in the line  $x = 2$ . [2]

(iii) Draw the image when shape *Q* is rotated by  $180^\circ$  about the point  $(-4, 3)$ . [2]

2 (a) One day, Maria took 27 minutes to walk 1.8 km to school.  
She left home at 07:48.

(i) Write down the time Maria arrived at school.

Answer(a)(i) ..... [1]

(ii) Show that Maria's average walking speed was 4 km/h.

Answer(a)(ii)

[2]

(b) Another day, Maria cycled the 1.8 km to school at an average speed of 15 km/h.

(i) Calculate the percentage **increase** that 15 km/h is on Maria's walking speed of 4 km/h.

Answer(b)(i) ..... % [3]

(ii) Calculate the percentage **decrease** that Maria's cycling time is on her walking time of 27 minutes.

Answer(b)(ii) ..... % [3]

- (iii) After school, Maria cycled to her friend's home.  
This took 9 minutes, which was 36% of the time Maria takes to walk to her friend's home.

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Calculate the time Maria takes to walk to her friend's home.

*Answer(b)(iii)* ..... min [2]

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3

$$f(x) = 3 - x - x^2 \qquad g(x) = 3^x$$

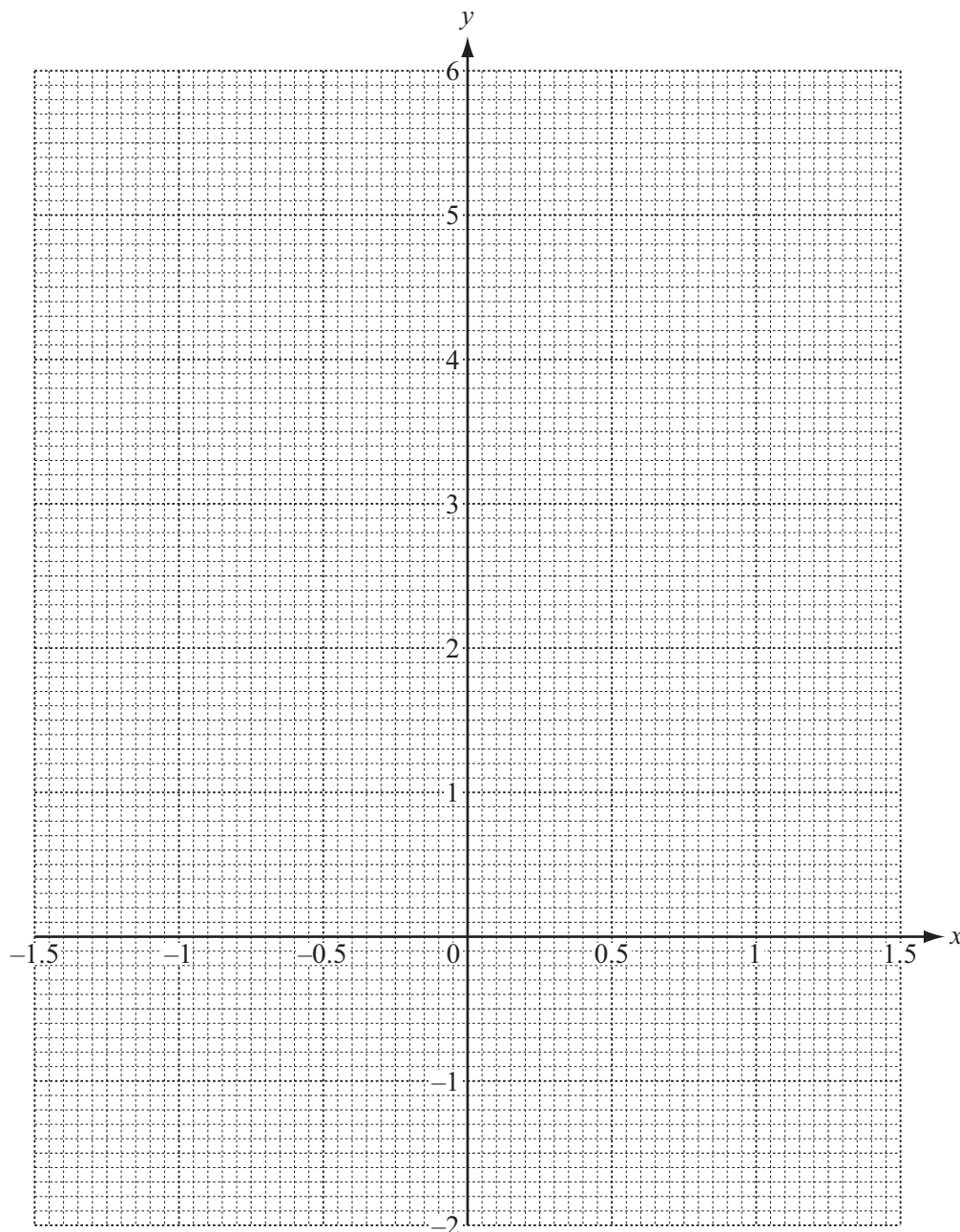
(a) Complete the tables of values for  $f(x)$  and  $g(x)$ .

$x$	-1.5	-1	-0.5	0	0.5	1	1.5
$f(x)$	2.25	3	3.25		2.25	1	-0.75

$x$	-1.5	-1	-0.5	0	0.5	1	1.5
$g(x)$	0.19		0.58		1.73	3	5.20

[3]

(b) On the grid, draw the graphs of  $y = f(x)$  and  $y = g(x)$  for  $-1.5 \leq x \leq 1.5$ .



[6]

(c) For  $-1.5 \leq x \leq 1.5$ , use your graphs to solve

(i)  $f(x) = 0$ ,

*Answer(c)(i)*  $x = \dots\dots\dots$  [1]

(ii)  $g(x) = 4$ ,

*Answer(c)(ii)*  $x = \dots\dots\dots$  [1]

(iii)  $f(x) = g(x)$ .

*Answer(c)(iii)*  $x = \dots\dots\dots$  [1]

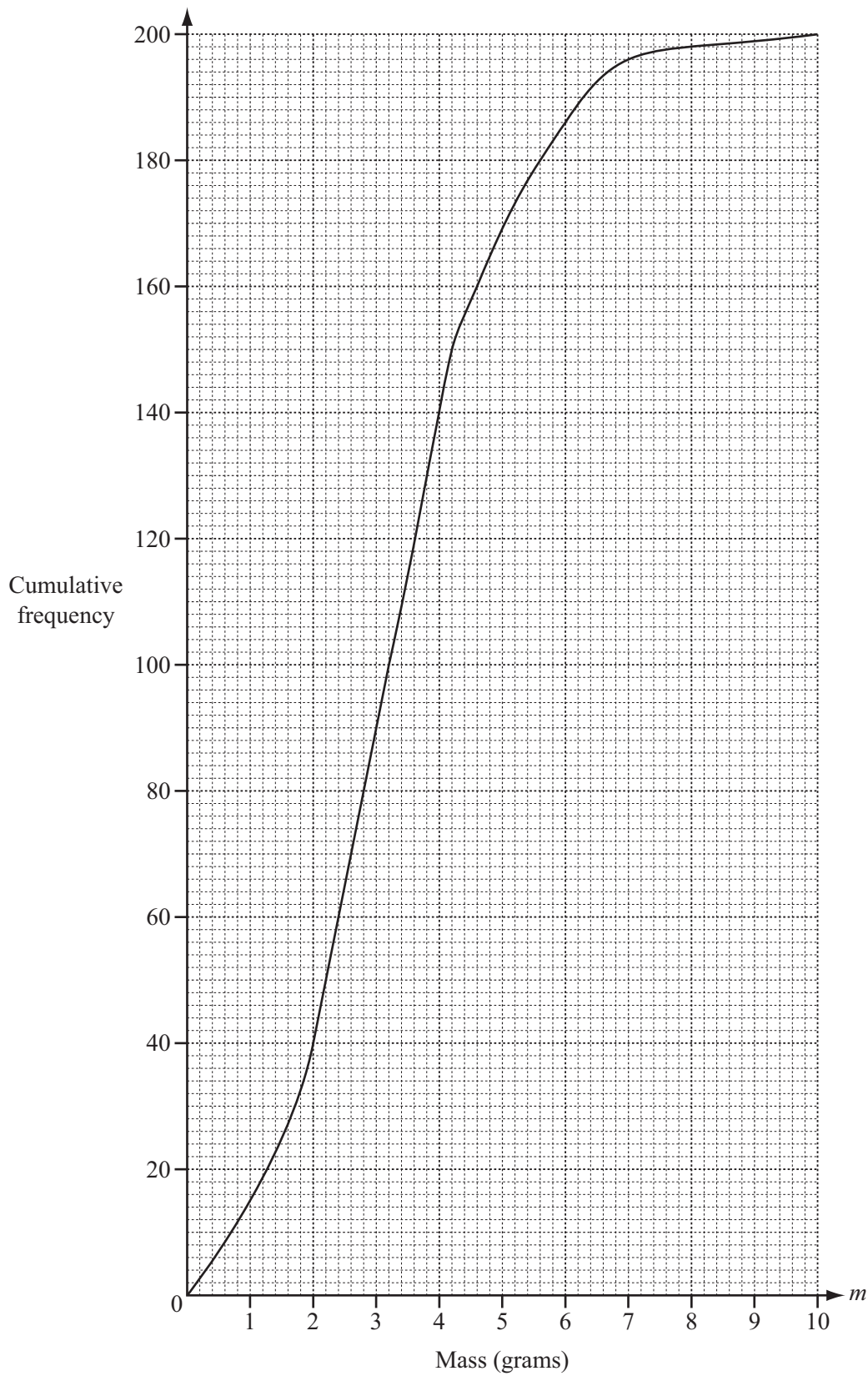
(d) By drawing a suitable tangent, find an estimate of the slope of the graph of  $y = f(x)$  when  $x = 0.5$ .

*Answer(d)*  $\dots\dots\dots$  [3]

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- 4 200 students estimate the mass ( $m$  grams) of a coin.  
The cumulative frequency diagram shows the results.

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Use*





(a) Find

(i) the median,

Answer(a)(i) ..... g [1]

(ii) the upper quartile,

Answer(a)(ii) ..... g [1]

(iii) the 80th percentile,

Answer(a)(iii) ..... g [1]

(iv) the number of students whose estimate is 7 g or less.

Answer(a)(iv) ..... [1]

(b) (i) Use the cumulative frequency diagram to complete the frequency table.

Mass ( $m$ grams)	$0 < m \leq 2$	$2 < m \leq 4$	$4 < m \leq 6$	$6 < m \leq 8$	$8 < m \leq 10$
Frequency	40				2

[2]

(ii) A student is chosen at random.

The probability that the student estimates that the mass is greater than  $M$  grams is 0.3.

Find the value of  $M$ .

Answer(b)(ii)  $M =$  ..... [2]

5

Height ( $h$ cm)	$150 < h \leq 160$	$160 < h \leq 165$	$165 < h \leq 180$	$180 < h \leq 190$
Frequency	5	9	18	10

The table shows information about the heights of a group of 42 students.

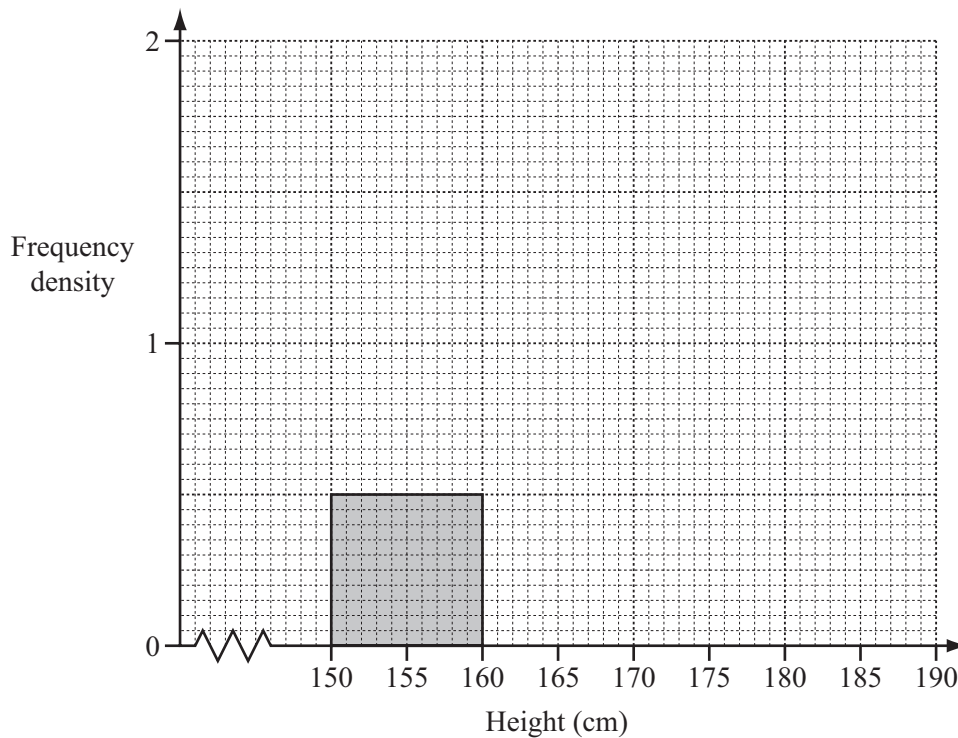
- (a) Calculate an estimate of the mean height of the students.  
Show your working.

Answer(a) ..... cm [4]

- (b) Write down the interval which contains the lower quartile.

Answer(b) ..... [1]

- (c) Complete the histogram to show the information in the table.  
One column has already been drawn for you.



[4]

6 A bag contains 7 white beads and 5 red beads.

- (a) The mass of a red bead is 2.5 grams more than the mass of a white bead.  
The total mass of all the 12 beads is 114.5 grams.

Find the mass of a white bead and the mass of a red bead.

*Answer(a)* White ..... g

Red ..... g [5]

- (b) Two beads are taken out of the bag at random, without replacement.

Find the probability that

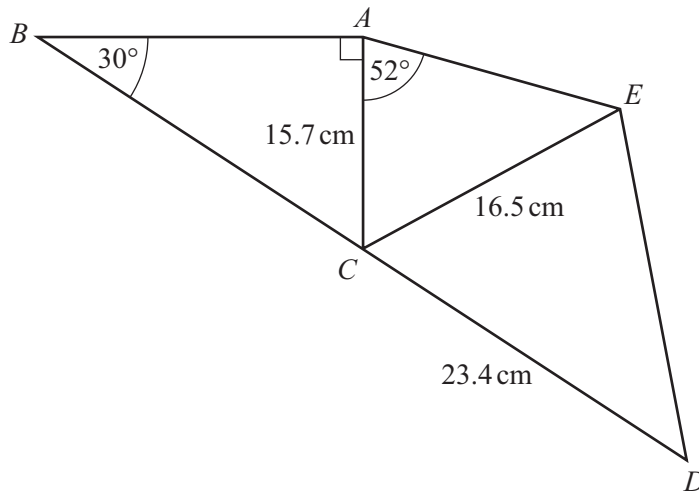
- (i) they are both white,

*Answer(b)(i)* ..... [2]

- (ii) one is white and one is red.

*Answer(b)(ii)* ..... [3]

7

NOT TO  
SCALE

In the diagram,  $BCD$  is a straight line and  $ABDE$  is a quadrilateral.  
 Angle  $BAC = 90^\circ$ , angle  $ABC = 30^\circ$  and angle  $CAE = 52^\circ$ .  
 $AC = 15.7$  cm,  $CE = 16.5$  cm and  $CD = 23.4$  cm.

(a) Calculate  $BC$ .

Answer(a)  $BC = \dots\dots\dots$  cm [3]

(b) Use the sine rule to calculate angle  $AEC$ .  
 Show that it rounds to  $48.57^\circ$ , correct to 2 decimal places.

Answer(b)

[3]

- (c) (i) Show that angle  $ECD = 40.6^\circ$ , correct to 1 decimal place.

*Answer(c)(i)*

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[2]

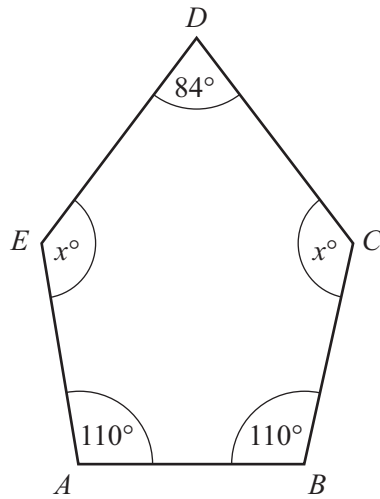
- (ii) Calculate  $DE$ .

*Answer(c)(ii) DE = ..... cm [4]*

- (d) Calculate the area of the quadrilateral  $ABDE$ .

*Answer(d) ..... cm<sup>2</sup> [4]*

8 (a)



NOT TO  
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In the pentagon  $ABCDE$ , angle  $EAB = \text{angle } ABC = 110^\circ$  and angle  $CDE = 84^\circ$ .  
Angle  $BCD = \text{angle } DEA = x^\circ$ .

(i) Calculate the value of  $x$ .

Answer(a)(i)  $x = \dots\dots\dots$  [2]

(ii)  $BC = CD$ .  
Calculate angle  $CBD$ .

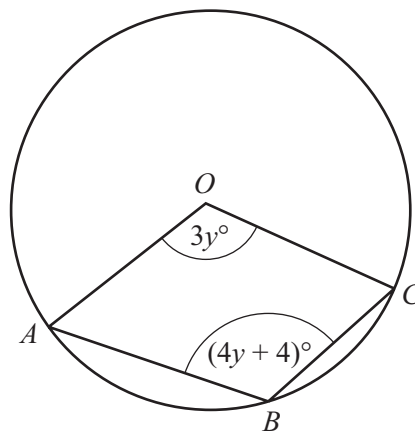
Answer(a)(ii) Angle  $CBD = \dots\dots\dots$  [1]

(iii) This pentagon also has one line of symmetry.  
Calculate angle  $ADB$ .

Answer(a)(iii) Angle  $ADB = \dots\dots\dots$  [1]

(b)  $A, B$  and  $C$  lie on a circle center  $O$ .  
Angle  $AOC = 3y^\circ$  and angle  $ABC = (4y + 4)^\circ$ .

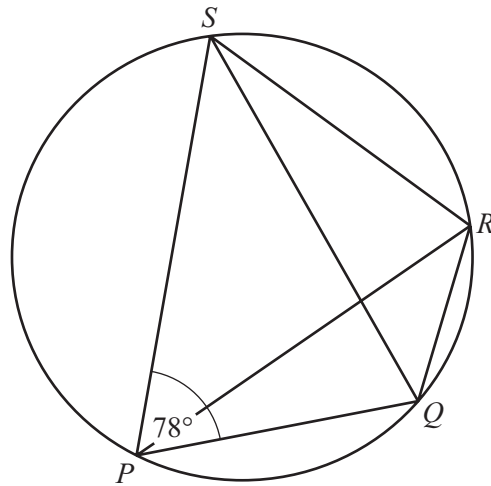
Find the value of  $y$ .



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Answer(b)  $y = \dots\dots\dots$  [4]

(c)



NOT TO  
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In the cyclic quadrilateral  $PQRS$ , angle  $SPQ = 78^\circ$ .

(i) Write down the geometric reason why angle  $QRS = 102^\circ$ .

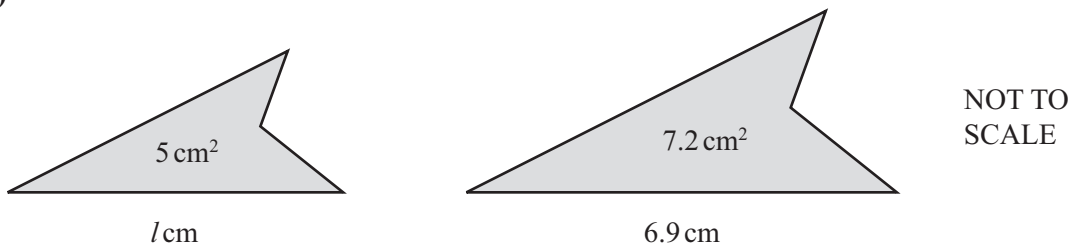
Answer(c)(i) ..... [1]

(ii) Angle  $PRQ$  : Angle  $PRS = 1 : 2$ .

Calculate angle  $PQS$ .

Answer(c)(ii) Angle  $PQS =$  ..... [3]

(d)



The diagram shows two similar figures.  
The areas of the figures are  $5 \text{ cm}^2$  and  $7.2 \text{ cm}^2$ .  
The lengths of the bases are  $l \text{ cm}$  and  $6.9 \text{ cm}$ .

Calculate the value of  $l$ .

Answer(d)  $l =$  ..... [3]

9

$f(x) = x^2 + x - 3$

$g(x) = 2x + 7$

$h(x) = 2^x$

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- (a) Solve the equation  $f(x) = 0$ .  
Show all your working and give your answers correct to 2 decimal places.

Answer(a)  $x = \dots\dots\dots$  or  $x = \dots\dots\dots$  [4]

(b)  $f(g(x)) = px^2 + qx + r$

Find the values of  $p$ ,  $q$  and  $r$ .

Answer(b)  $p = \dots\dots\dots$

$q = \dots\dots\dots$

$r = \dots\dots\dots$  [3]



(c) Find  $g^{-1}(x)$ .

Answer(c)  $g^{-1}(x) = \dots\dots\dots$  [2]

(d) Find  $x$  when  $h(x) = 0.25$ .

Answer(d)  $x = \dots\dots\dots$  [1]

(e) Find  $h(h(h(3)))$ .

Give your answer in scientific notation, correct to 4 significant figures.

Answer(e)  $\dots\dots\dots$  [4]

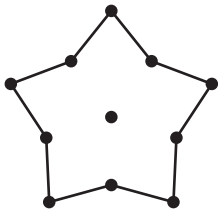
(f) The graph of  $y = h(x)$  is mapped onto the graph of  $y = 2^{x+1}$ .  
There are two possible **single** transformations which produce this mapping.

One is a translation by the vector  $\begin{pmatrix} -1 \\ 0 \end{pmatrix}$ .

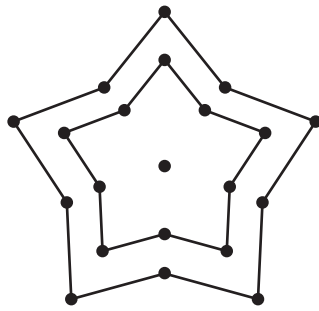
Describe fully the other **single** transformation.

Answer(f)  $\dots\dots\dots$  [3]

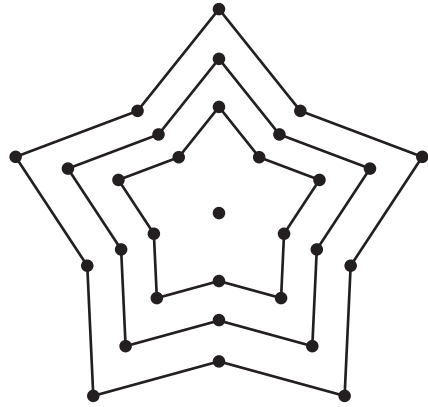
10



Star 1



Star 2



Star 3

The diagrams show stars made of lines and dots.

(a) Complete the table for Star 5, Star 7 and Star  $n$ .

	Star 1	Star 2	Star 3	Star 4	Star 5		Star 7		Star $n$
Number of lines	10	20	30	40					
Number of dots	11	21	31	41					

[4]

(b) The sums of the number of dots in two consecutive stars are shown in the table.

Star 1 and Star 2	Star 2 and Star 3	Star 3 and Star 4
32	52	72

Find the sum of the number of dots in

(i) Star 10 and Star 11,

Answer(b)(i) ..... [1]

(ii) Star  $n$  and Star  $(n + 1)$ ,

Answer(b)(ii) ..... [1]

(iii) Star  $(n + 7)$  and Star  $(n + 8)$ .

Answer(b)(iii) ..... [1]

(c) The **total number of dots** in the first  $n$  stars is given by the expression  $5n^2 + 6n$ .

(i) Show that this expression is correct when  $n = 3$ .

*Answer(c)(i)*

[2]

(ii) Find the total number of dots in the first 10 stars.

*Answer(c)(ii)* ..... [1]

(d) The total number of dots in the first  $n$  stars is  $5n^2 + 6n$ .  
The number of dots in the  $(n + 1)$ th star is  $10(n + 1) + 1$ .

Add these two expressions to show that the total number of dots in the first  $(n + 1)$  stars is

$$5(n + 1)^2 + 6(n + 1).$$

You must show each step of your working.

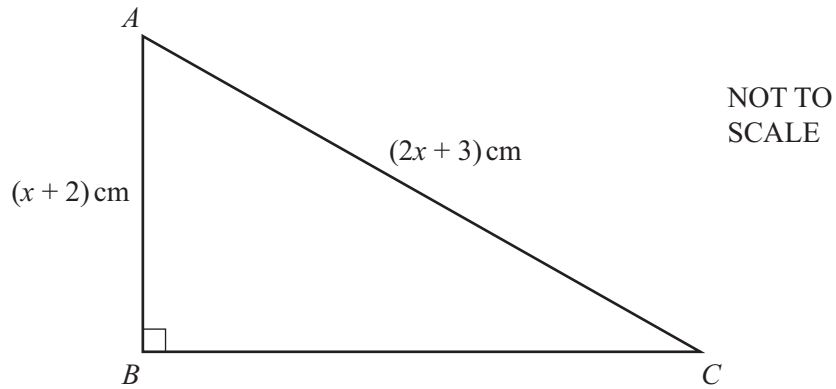
*Answer(d)*

[4]

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Question 11 is printed on the next page.

11



In triangle  $ABC$ ,  $AB = (x + 2)$  cm and  $AC = (2x + 3)$  cm.

$$\sin ACB = \frac{9}{16}$$

Find the length of  $BC$ .

*Answer*  $BC = \dots\dots\dots$  cm [6]

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