

Surname	Centre Number	Candidate Number
Other Names		0



**GCSE LINKED PAIR PILOT**

4361/02

**APPLICATIONS OF MATHEMATICS  
UNIT 1: APPLICATIONS 1  
HIGHER TIER**

A.M. MONDAY, 16 January 2012

2 hours

**ADDITIONAL MATERIALS**

A calculator will be required for this paper.

**INSTRUCTIONS TO CANDIDATES**

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** the questions in the spaces provided.

Take  $\pi$  as 3.14 or use the  $\pi$  button on your calculator.

**INFORMATION FOR CANDIDATES**

You should give details of your method of solution when appropriate.

Unless stated, diagrams are not drawn to scale.

Scale drawing solutions will not be acceptable where you are asked to calculate.

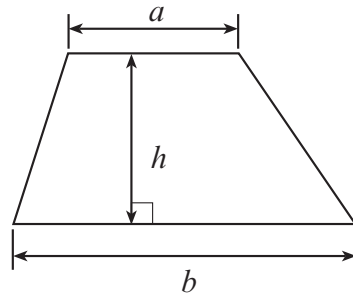
The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question 3(b).

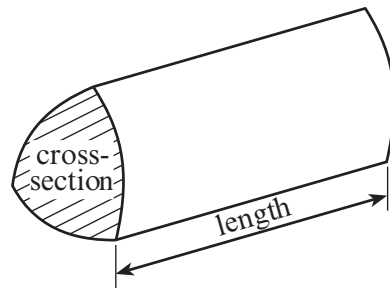
For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	8	
2	7	
3	12	
4	14	
5	10	
6	10	
7	5	
8	7	
9	7	
10	5	
11	3	
12	12	
<b>TOTAL MARK</b>		

### Formula List

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

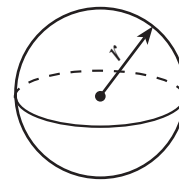


**Volume of prism** = area of cross-section  $\times$  length



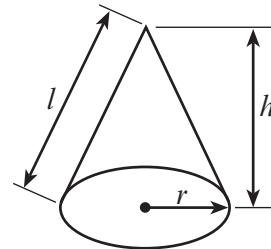
**Volume of sphere** =  $\frac{4}{3}\pi r^3$

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



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

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

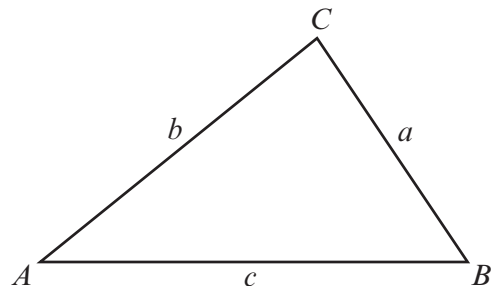


**In any triangle ABC**

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



### The Quadratic Equation

The solutions of  $ax^2 + bx + c = 0$

where  $a \neq 0$  are given by

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

1. Write down expressions for each of the following.

(a) The total cost of 10 pencils at  $g$  pence each and 5 pens at  $h$  pence each.

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[2]

(b) The mean height of the three boys listed below.

	Height in cm
Adam	$x$
Tommy	$y$
Joseph	$z$

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[2]

(c) The perimeter of a rectangle with length  $l$  cm and width  $w$  cm.

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[2]

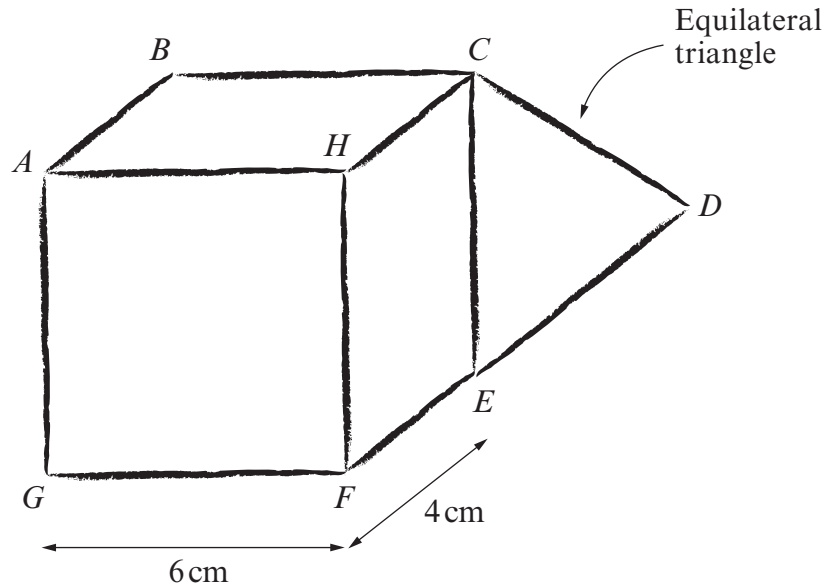
(d) The smaller share when  $£q$  is shared in the ratio 1:3.

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[2]

2. Sasha has designed a new two dimensional logo for her company.  
The logo is to be printed on all official company paper.  
A sketch of the logo is shown below.



*Diagram not drawn to scale*

The idea for the logo is based on a 2-D representation of a cube with an accurate equilateral triangle attached to one edge.

On the logo, ***DEF*** is a straight line.

To help Sasha to draw an accurate version of the logo, she needs to identify what the actual lengths and angles will be on the logo.

- (a) Write down the actual

size of  $\widehat{CED}$  on the logo ..... °

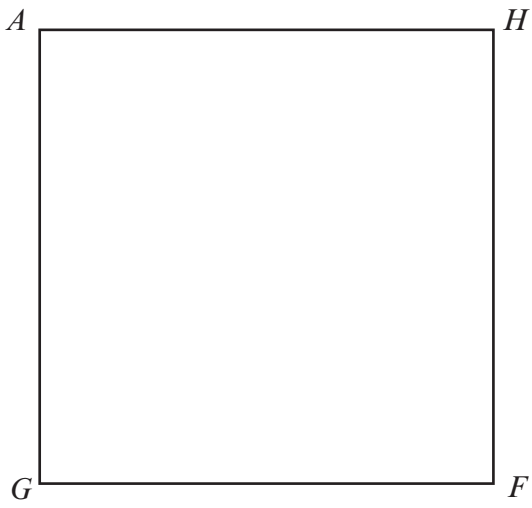
length of  $CE$  on the logo ..... cm

length of  $AB$  on the logo ..... cm.


[3]

- (b) Complete the accurate drawing of the logo on the opposite page.  
*AHFG* has been drawn for you.

[4]



3. Mr Smith needs to buy boxes for necklaces that he makes.  
There are two possible suppliers he can use, Boxes Galore or Box Clever.

	<p style="text-align: center;"><b>BOXES GALORE</b></p> <p style="text-align: center;">Order 1 to 100 boxes pay 40p for each box Need more than 100 boxes? ..... Special Offer: <b>MORE</b> than 100 boxes get <b>all boxes for just 15p each!</b></p> <p style="text-align: center;"><b>PLUS</b> standard delivery charge of £3 per order.</p>
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	<p style="text-align: center;"><b>BOX CLEVER</b></p> <p style="text-align: center;">First 1 to 50 boxes                      30p each Every extra box then just            25p each</p> <p style="text-align: center;"><b>PLUS</b> standard delivery charge of £2 per order</p>
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- (a) Mr Smith placed orders for boxes in June, July and August with Boxes Galore.  
Complete the chart below.

Month	June	July	August
Number of boxes bought	8	95	105
Company used	<b>Boxes Galore</b>	<b>Boxes Galore</b>	<b>Boxes Galore</b>
Total cost (including the delivery charge)	£	£	£

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[4]

(b) *You will be assessed on the quality of your written communication in this part of the question.*

Mr Smith notices that he has not been wise with his order from Boxes Galore.  
In September he intends to buy 96 boxes from Boxes Galore.  
What advice would you give Mr Smith?  
You must give a reason for your answer.

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(c) Use the graph paper below to show the costs for ordering up to 130 boxes from **Box Clever**.

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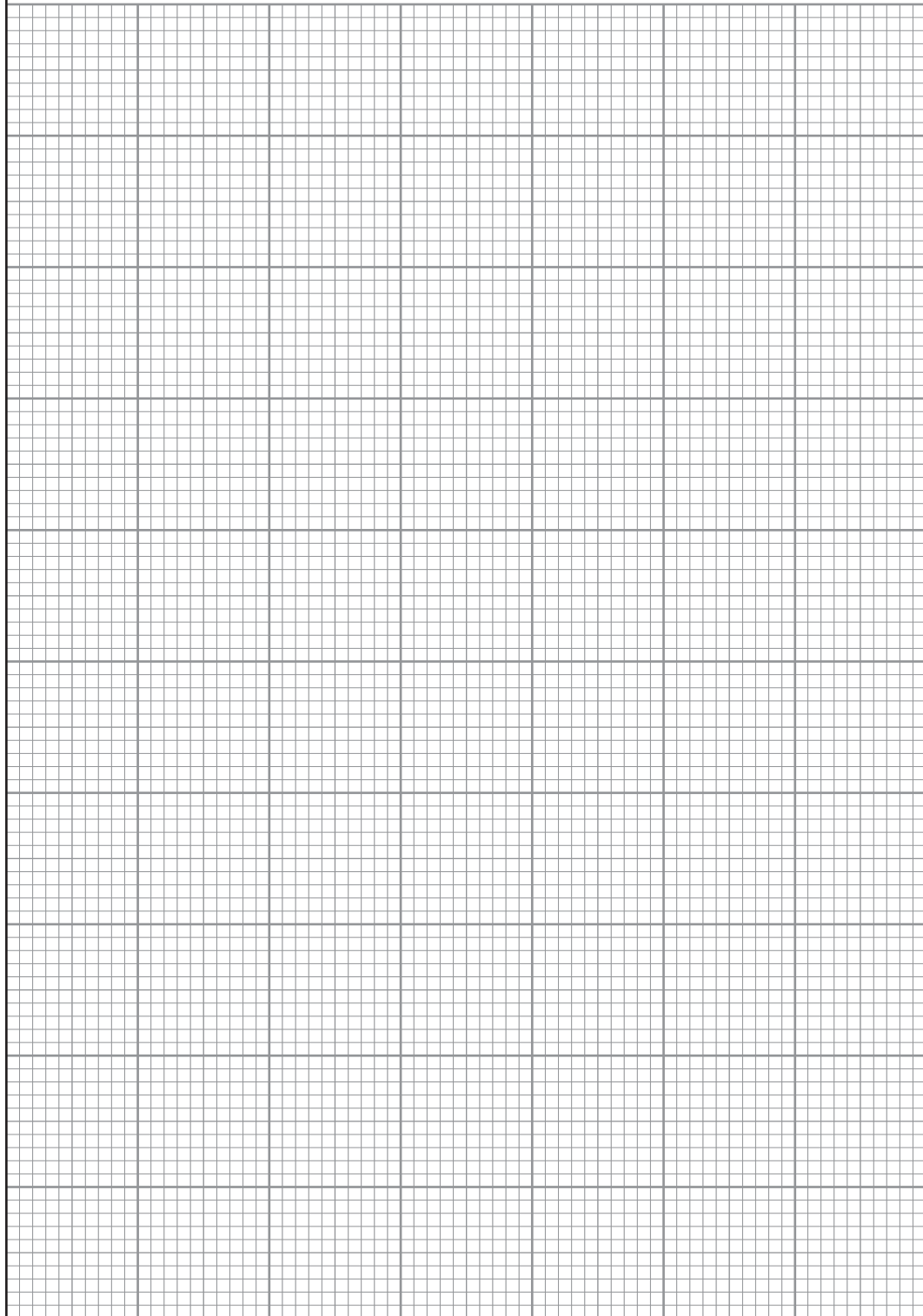
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Cost in £s,  
including  
delivery  
charge

Buying from **Box Clever**

[3]





(d) Complete the chart below to give recommendations for Mr Smith.

Number of boxes	Better company to buy from
Fewer than 8	
Between 50 and 54	
More than 110	

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[1]

4. A machine is used to pack boxes of chocolate beans.  
 To check the machine, 10 boxes of beans are selected on the hour for 10 consecutive hours.  
 There should be exactly 55 chocolate beans in each box.  
 Each hour the number of boxes containing exactly 55 chocolate beans is recorded.

Time	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00
Number of the 10 boxes with exactly 55 beans	8	7	6	9	8	10	8	6	9	9

- (a) Is a statement on the box that says

*“Contains at least 55 chocolate beans”*

always true?

You must give a reason for your answer.

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[2]

- (b) If the experiment were to be carried out again would you expect the results to be exactly the same?

You must give a reason for your answer.

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[2]

- (c) It is decided to record and plot the relative frequencies for the information shown in the previous table.

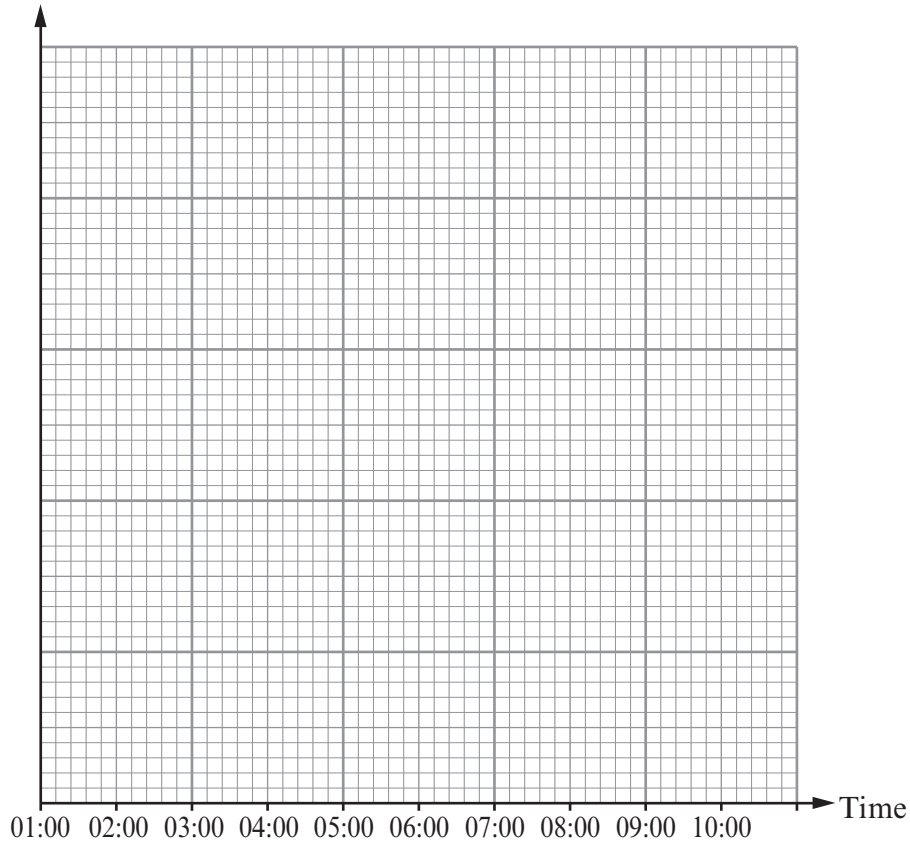
- (i) Complete the table below.

Time, by	01:00	02:00	03:00	04:00	05:00	06:00	07:00	08:00	09:00	10:00
Total number of boxes with exactly 55 beans	8	15	21							
Total number of boxes checked	10	20								
Relative frequency										

[4]

(ii) Use the graph paper below to plot the relative frequencies.

Relative frequency



[3]

(iii) Write down the best estimate for the probability that a box selected at random will contain exactly 55 chocolate beans. Give a reason for your answer.

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(iv) How would you improve on your estimate?

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[1]

5. (a) A number of people were asked how much they would be willing to pay to go on a fairground ride. The results are summarised in the table.

Amount of money, £ $x$	Number of people
$0 \leq x < 2$	24
$2 \leq x < 4$	16
$4 \leq x < 6$	42
$6 \leq x < 8$	18

- (i) Calculate an estimate for the mean amount of money.

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- (ii) Find the greatest possible value of the range.

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(b) The fairground owner recorded the number of people coming into his fairground during the different seasons.

Season	Winter 2010	Spring 2010	Summer 2010	Autumn 2010	Winter 2011	Spring 2011	Summer 2011
Number of people	234	156	316	230	326	456	324

(i) Calculate the 4-point moving averages and complete the table below.

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4-point period ending:	Autumn 2010	Winter 2011	Spring 2011	Summer 2011
4-point moving average				

[3]

(ii) The fairground owner looks at the moving average with his staff. Explain why considering the moving average is worthwhile.

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(iii) The fairground owner states “we were as busy in Summer 2011 as we were in Spring 2011”. Explain fully the mathematical error in his statement.

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[1]

6. The table gives a grouped frequency distribution of the arm lengths of 100 women each measured correct to the nearest centimetre.

Arm length, $a$ cm	156 to 158	159 to 161	162 to 164	165 to 167	168 to 170
Number of women	5	15	35	40	5

(a) Complete the following cumulative frequency table.

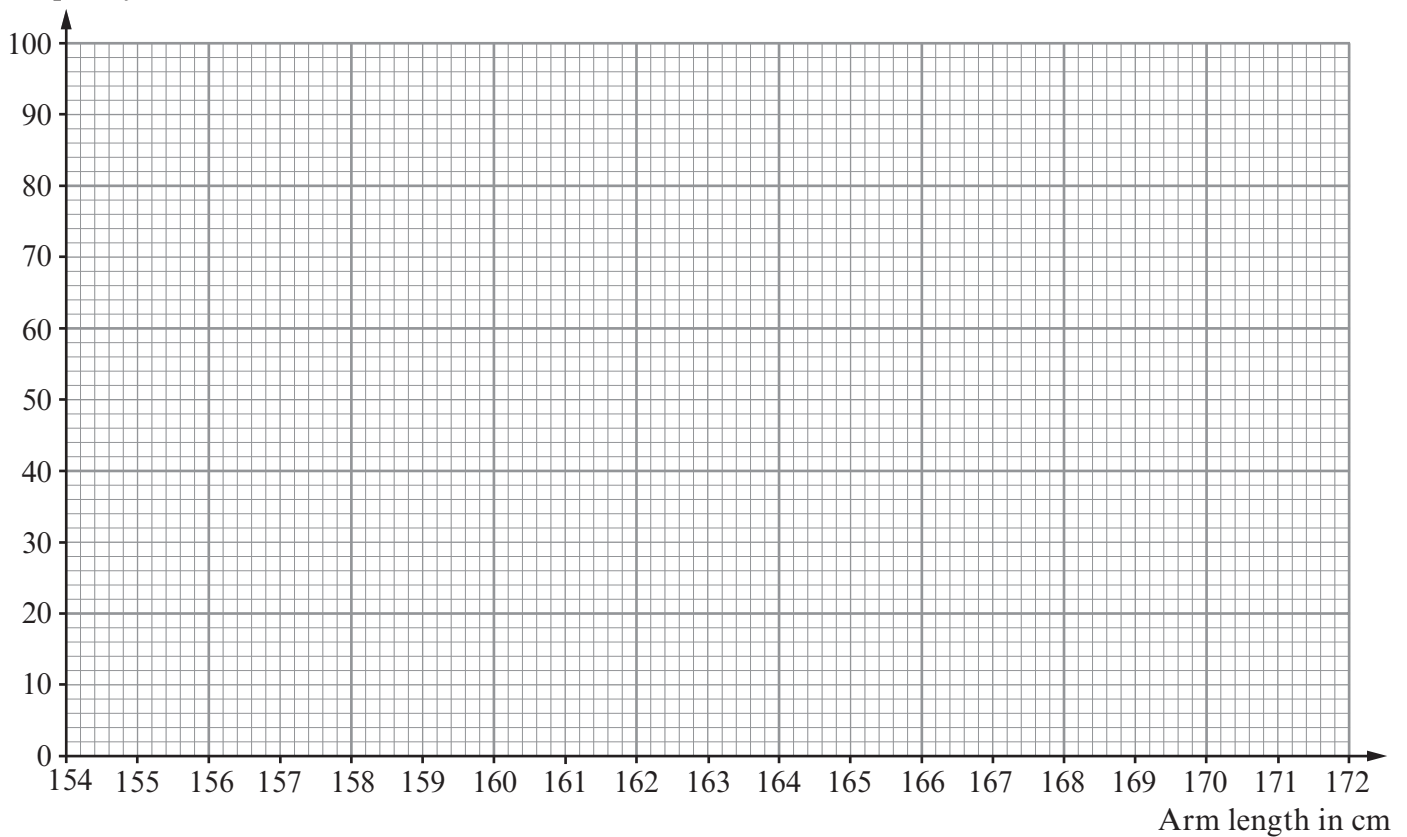
Arm length, $a$ cm	$a < 155.5$	$a < 158.5$	$a < 161.5$	$a < 164.5$	$a < 167.5$	$a < 170.5$
Cumulative frequency	0	5				

[1]

(b) On the graph paper below, draw a cumulative frequency diagram to show this information.

[2]

Cumulative frequency



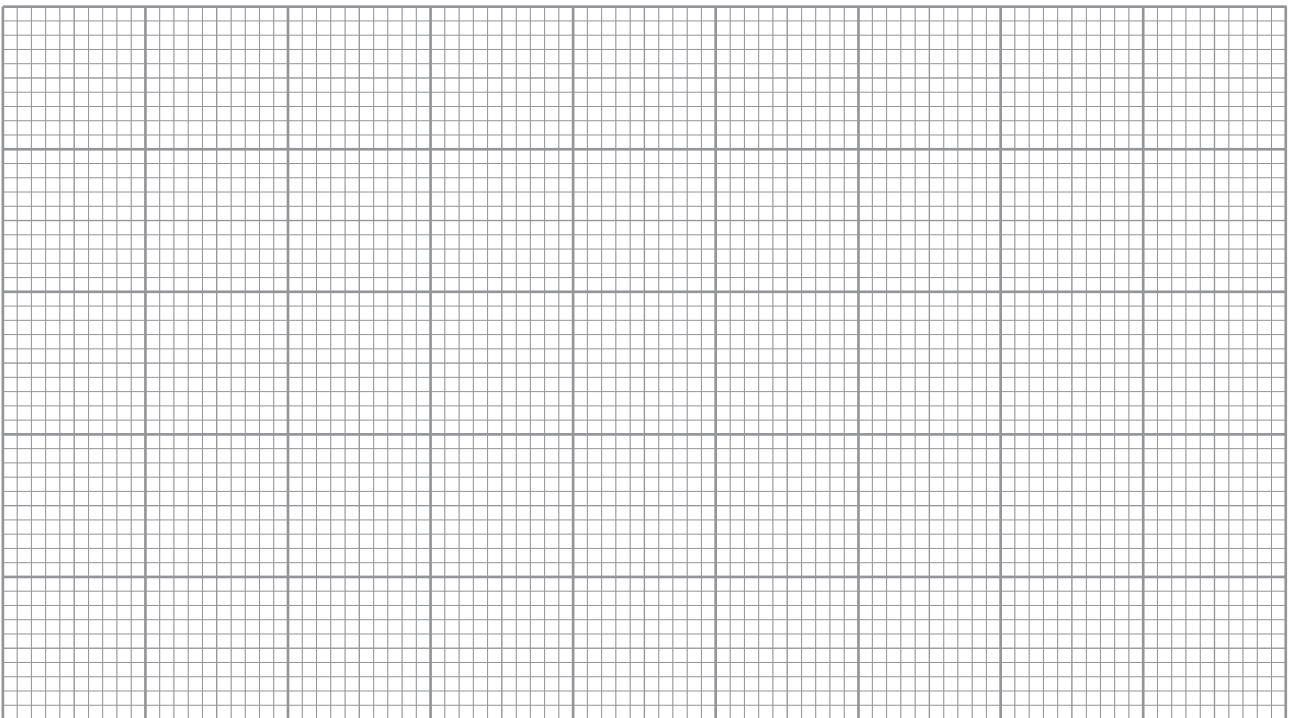
(c) Use your cumulative frequency diagram to estimate the median and the interquartile range.

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Median ..... Interquartile range .....

[3]

(d) Use the graph paper below to draw a box-and-whisker diagram to show these results.



[4]

7. A valuable statue is on display.

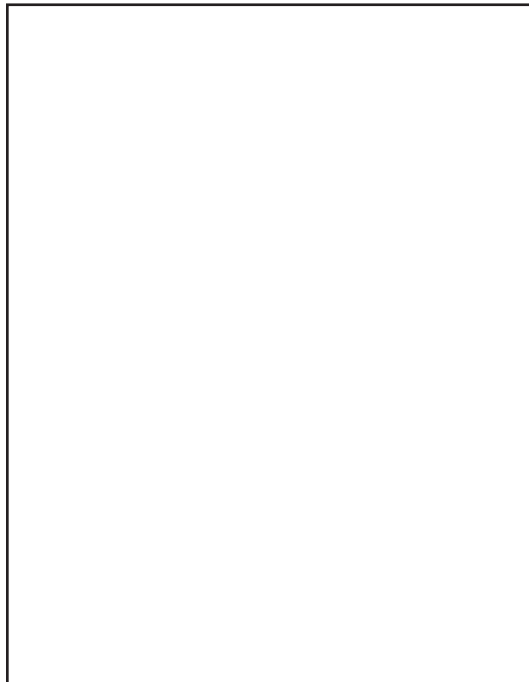
To protect the statue a glass cuboid is built around it.

A scale drawing of the plan view (bird's eye or aerial view) of the cuboid is shown below.

**Scale 1 cm : 20 cm**

A barrier is built around the cuboid so that no one can stand within 60 cm of the cuboid.

Using the given scale, draw accurately the locus of the barrier on the scale drawing shown below.



[5]





9. Lucy is a scientist. During an investigation she needs to find the points of intersection of two equations to solve a problem.  
The equations are  $y = x^2 - 6x + 8$  and  $x + y = 4$ .  
Draw graphs to solve Lucy's problem.

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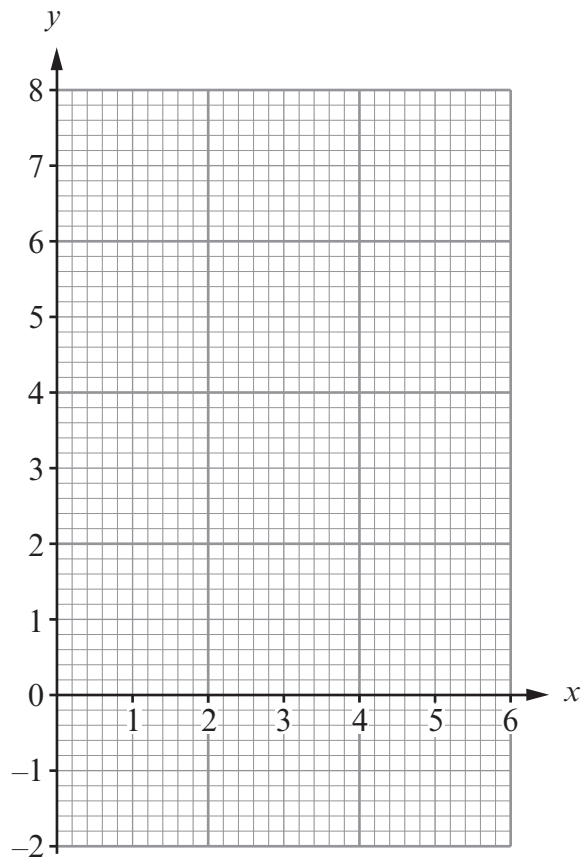
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[5]

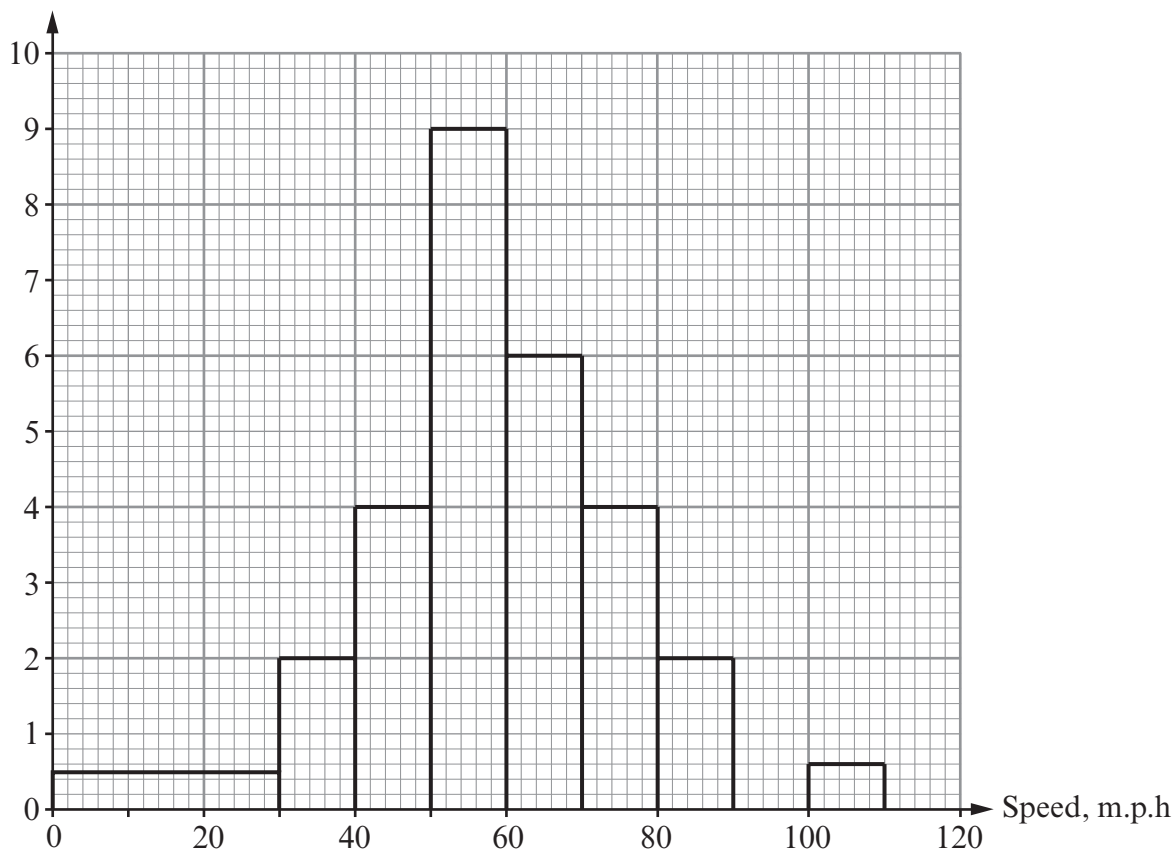
Points of intersection .....

[2]



12. The histogram below shows the speeds of motorists as they enter a tunnel between 1 a.m. and 2 a.m.

Frequency density



- (a) The speed limit on entering the tunnel is 70 m.p.h.  
How many motorists were exceeding the speed limit on entering the tunnel?

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[3]

- (b) In order to compare the speeds of motorists between 1 a.m. and 2 a.m. with other 1 hour periods, it is decided to group the data in equal intervals of width 30 m.p.h., starting at 0 m.p.h.  
Construct a histogram to display these results meeting this new requirement.

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[8]



- (c) Given that the speed limit is 70 m.p.h., which of the two histograms is the more appropriate for the display of the data? You must give a reason for your answer.

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