

Candidate Name	Centre Number	Candidate Number
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GCSE LINKED PAIR PILOT

4361/02

APPLICATIONS OF MATHEMATICS

UNIT 1: APPLICATIONS 1

HIGHER TIER

A.M. TUESDAY, 21 June 2011

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 π as 3.14 or use the π 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.

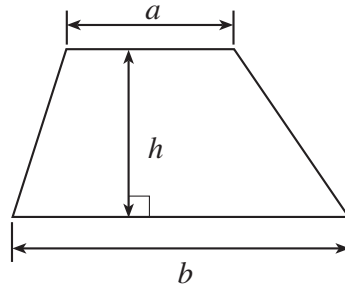
The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question 7.

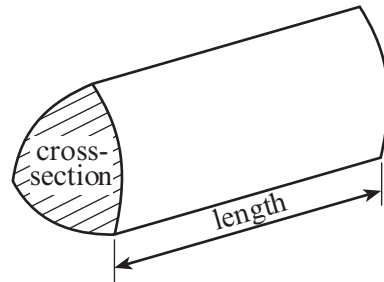
For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1	7	
2	5	
3	6	
4	4	
5	8	
6	5	
7	8	
8	6	
9	4	
10	10	
11	10	
12	10	
13	7	
14	10	
TOTAL MARK		

Formula List

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

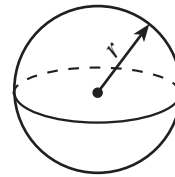


$$\text{Volume of prism} = \text{area of cross-section} \times \text{length}$$



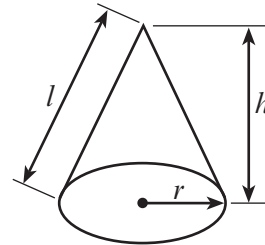
$$\text{Volume of sphere} = \frac{4}{3} \pi r^3$$

$$\text{Surface area of sphere} = 4\pi r^2$$



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

$$\text{Curved surface area of cone} = \pi r l$$

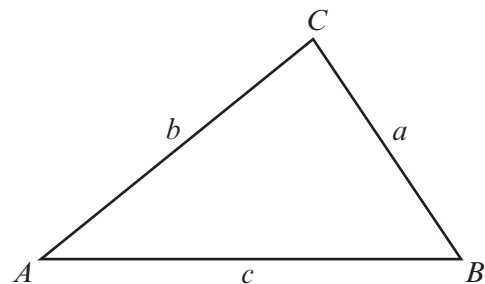


In any triangle ABC

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

$$\text{Cosine rule} \quad a^2 = b^2 + c^2 - 2bc \cos A$$

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



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. Simon has two fair dice in his pocket, one blue dice and one red dice.

The two dice are thrown and the two outcomes are added together to obtain the total score. The table below shows how all the possible outcomes together with the total scores are recorded.

		Blue dice					
		1	2	3	4	5	6
Red dice	1	2	3			6	7
	2	3	4			7	8
	3	4	5			8	9
	4	5	6			9	10
	5	6	7			10	11
	6	7	8			11	12

- (a) Complete the table above.

[1]

- (b) Write down the probability of throwing

- (i) a 3 on both dice,

..... [1]

- (ii) a 2 on the red dice and a 4 on the blue dice,

..... [1]

- (iii) a total score of 6.

..... [1]

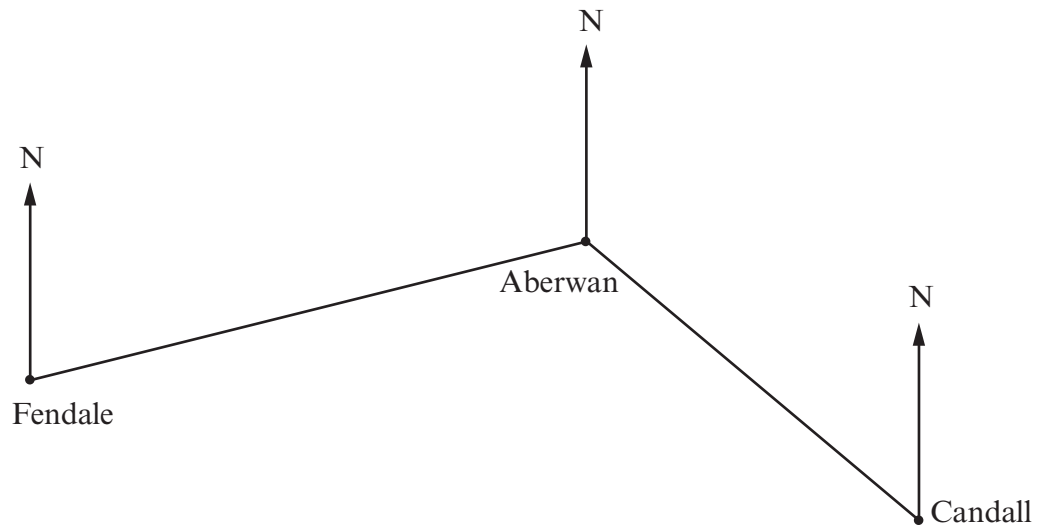
- (c) Which of the total scores are least likely to occur when the two dice are thrown?

..... [2]

- (d) Simon selects one of the dice at random from his pocket.
What is the probability that it is the red dice?

..... [1]

2. The diagram shows three places Fendale, Aberwan and Candall in the positions that they would appear on a map drawn to scale.



(a) Find the bearing of

(i) Aberwan from Fendale,

..... [2]

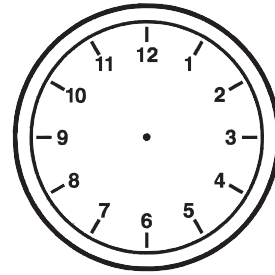
(ii) Fendale from Aberwan.

..... [1]

(b) Find the bearing of Aberwan from Candall.

..... [2]

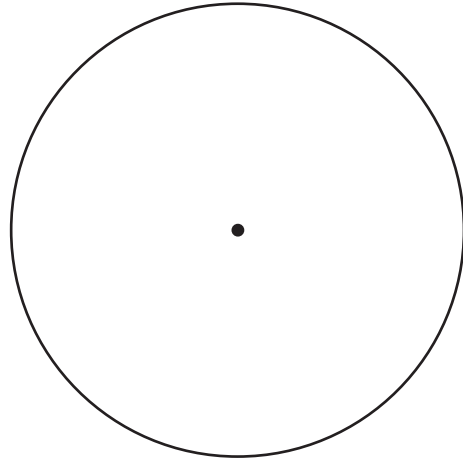
3. (a) A clockface is to be designed using a single dot in place of each number.



Use the circle opposite to mark accurately the positions of the 12 dots on the clockface.

The centre of the clock has been marked for you.

You **must** show **all** your lines joining the centre of the clock to the dots.



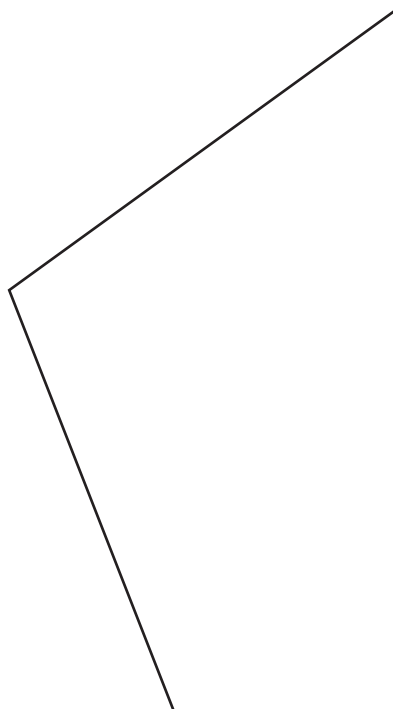
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[3]

- (b) Use a pair of compasses and a ruler to bisect the obtuse angle shown below. You **must** show **all** of your construction marks on the diagram.



[3]

4.



Diagram not drawn to scale

A ribbon is tied around **all** the sides of a box as shown in the diagram.
 The ribbon is placed across **each** face of the box and always meets the edges of the box at right angles.
 The bow is tied on top of the box, as shown.

- (a) Calculate the total length of ribbon required to decorate a box with length 8.5 cm, width 4.6 cm and height 2.2 cm. The bow is made using 18 cm of ribbon.

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[2]

- (b) A different box is to be decorated with ribbon in the same way.
 The bow is made using 18 cm of ribbon.
 The box has length l cm, width w cm and height h cm.
 Write down an expression for the total length of ribbon needed to decorate this box.

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[2]

5. Miriam is working on a spreadsheet. She has been asked to work with a number of formulae, but soon realises that some of the formulae are the same.

Here is the list of formulae given to Miriam:

Formula **A** $y = 3(a + b) - b$

Formula **B** $y = a(a + 1) + b$

Formula **C** $y = 5a - b - 2a + 3b$

Formula **D** $y = 2b(a + 1) + a(3 - 2b)$

- (a) Simplify each of the above formulae.

Formula **A** $y = 3(a + b) - b$

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Formula **B** $y = a(a + 1) + b$

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Formula **C** $y = 5a - b - 2a + 3b$

.....

Formula **D** $y = 2b(a + 1) + a(3 - 2b)$

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[7]

- (b) Which of the formulae are identical?

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[1]

6. Davina is entering a kite flying competition.
To enter the competition, Davina's kite must meet all the requirements below.

- The diagonals of the kite are perpendicular.
- The shorter diagonal must be 25 cm.
- The longer diagonal must be 48 cm.
- The shorter diagonal of the kite must cut the longer diagonal in the ratio 3:5.

Using a scale of 1:5, construct a scale drawing of Davina's kite for the competition.
You **must** show **all** your working.

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[5]

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7. You will be assessed on the quality of your written communication in this question.

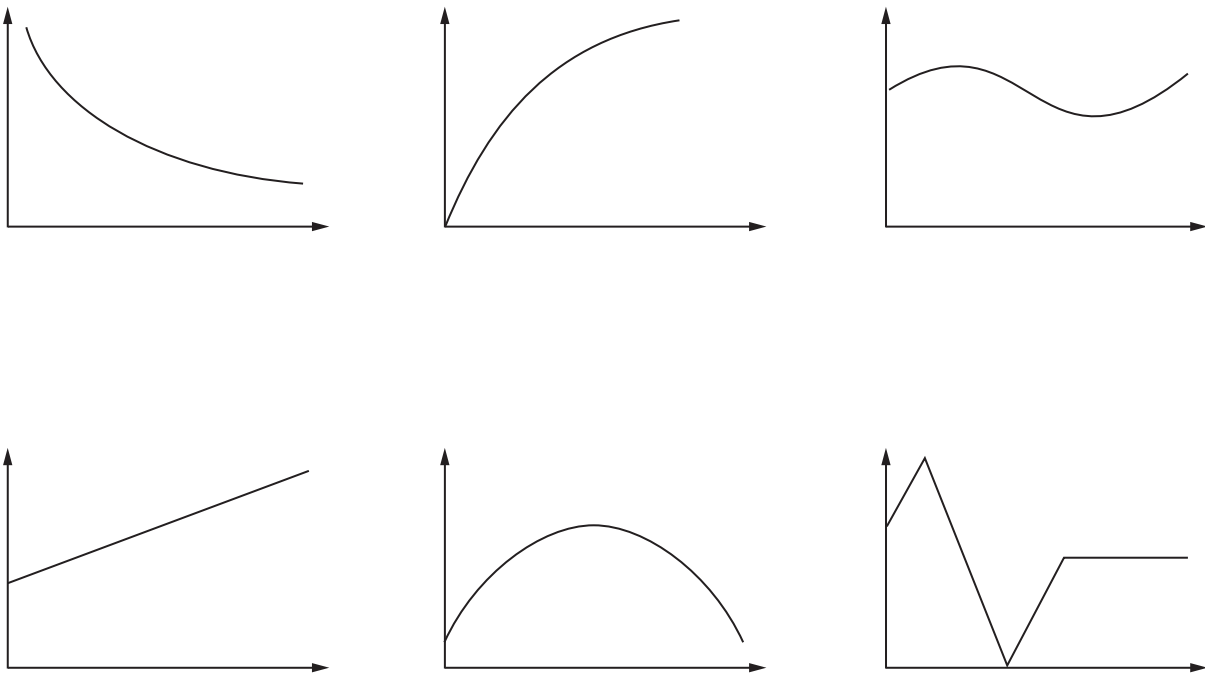
Michelle has cut out two headlines and a number of graphs from newspapers. She has cut off the labels and scales from the graphs so that she is left with simple sketches of the original graphs.

Each headline originally had a matching graph.

Headlines

- More ice creams are sold in the summer than in the winter in South Wales.
- Vast increase in sales of bicycles in the South East of England.

Michelle's sketches of the graphs



On the opposite page, for **each** of the headlines

- select an appropriate sketch from above and draw it in the box opposite,
- label the axes,
- explain why the graph matches the headline.

- More ice creams are sold in the summer than in the winter in South Wales.

Graph



Explanation

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- Vast increase in sales of bicycles in the South East of England.

Graph



Explanation

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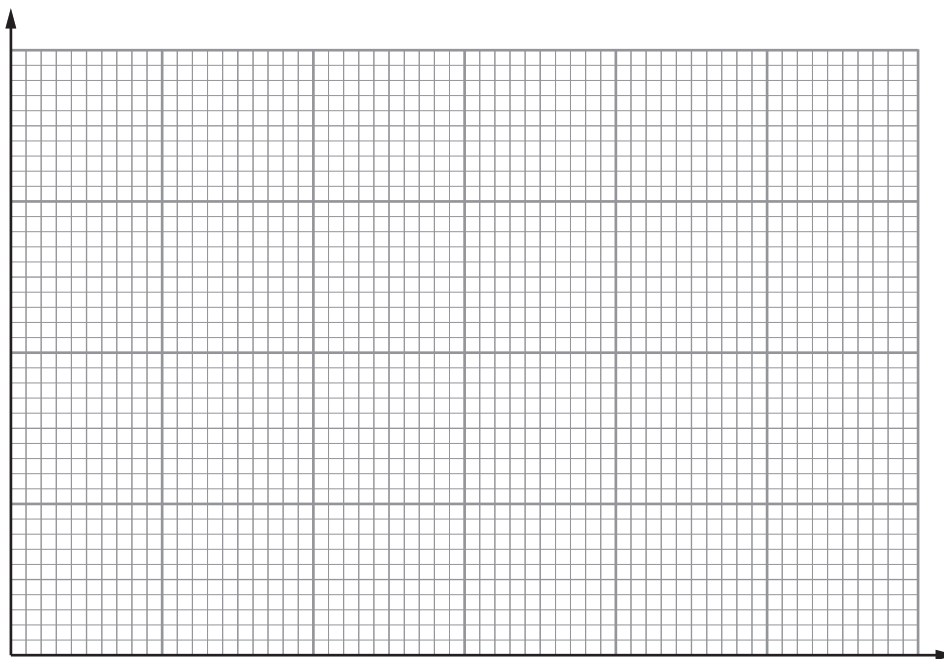
8. The cost of advertising on a radio station is given by the following formula.

$$\text{Cost in } \pounds = \pounds 500 + \pounds 20 \times \text{Advert airtime in minutes}$$

(a) Use the graph paper below to show the cost of advertising for up to and including 10 minutes of airtime.

[3]

Cost, in £s



Advert airtime, in minutes

(b) (i) Calculate the cost of an advertisement with an airtime of $4\frac{1}{2}$ minutes.

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[1]

(ii) The small print on the contract has been changed to say that all part minutes are now to be charged as a whole minute. Explain why a straight line drawn between the points plotted would not now be appropriate.

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[2]

9. £22 600 is the cost, per metre, of building a new motorway.
Calculate the cost of building a new 85 km motorway.
Give your answer, in standard form, correct to 2 significant figures.

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[4]

10. (a) The thickness of each of 100 books in a library is measured. A summary of the measurements is given in the table below.

Thickness, t in mm	Frequency
$0 \leq t < 10$	2
$10 \leq t < 20$	20
$20 \leq t < 30$	44
$30 \leq t < 40$	28
$40 \leq t < 50$	6

- (i) Calculate an estimate for the mean thickness of a library book.

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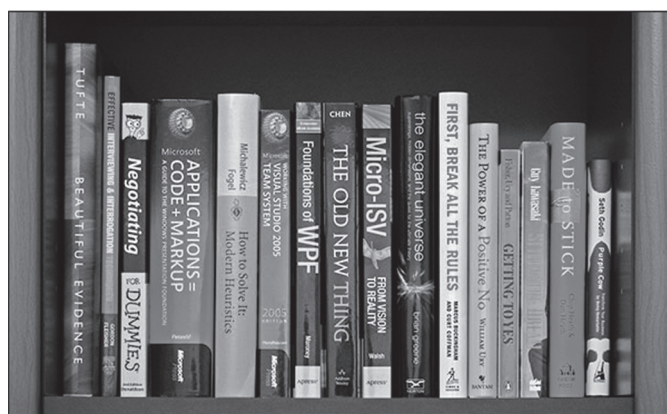
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[4]

- (ii)



A bookshelf of length 10 000 mm is bought for the library. Books are arranged on the shelf as shown in the picture. How many books might you expect to be able to store on the shelf? Show **all** your working.

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[2]

(b) Over a twelve week period the number of books borrowed from the library each week was recorded.

Week	1	2	3	4	5	6	7	8	9	10	11	12
Number of books	460	146	345	680	935	320	734	140	452	648	780	446

(i) Calculate the 10-point moving average and complete the table below.

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10 week period ending:	Week 10	Week 11	Week 12
10-point moving average:			

[3]

(ii) Explain why considering a moving average is worthwhile in reviewing the number of books borrowed.

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[1]

11. The table gives a grouped frequency distribution for the lengths, each measured to the nearest millimetre, of 80 earthworms.

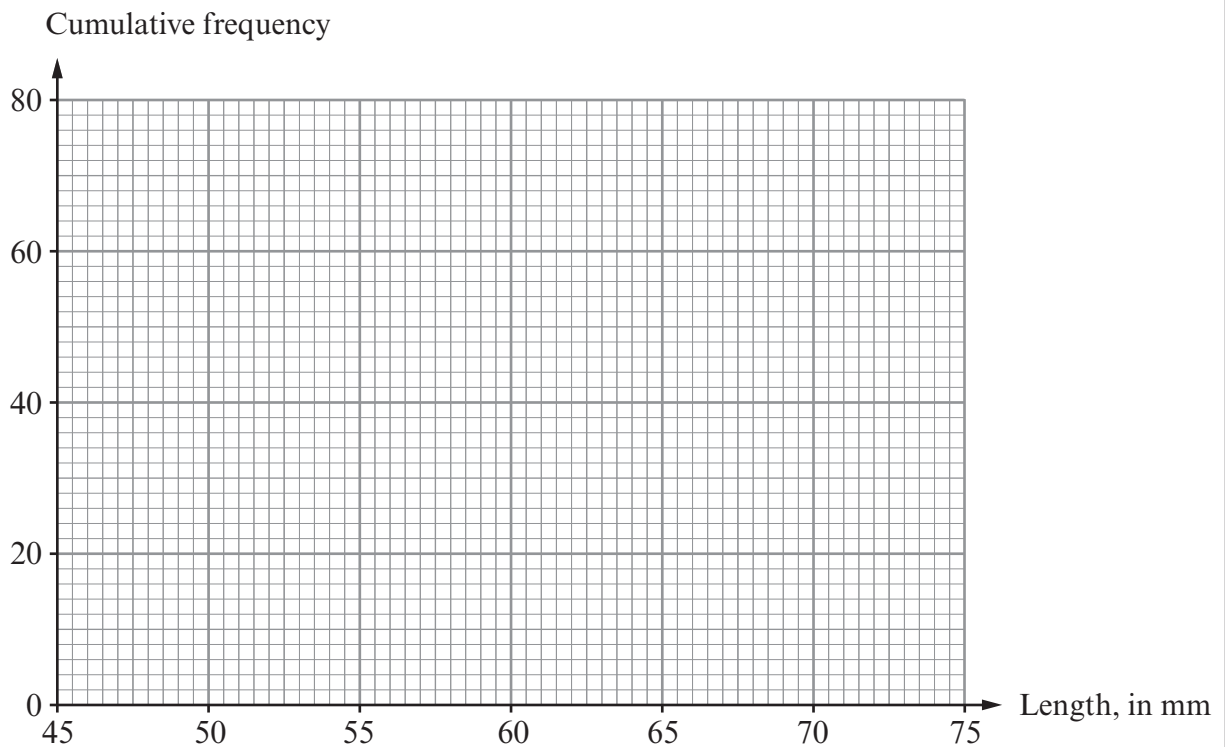
Length, to the nearest mm	47-53	54-60	61-67	68-74
Number of earthworms	10	18	40	12

- (a) Complete the following cumulative frequency table.

Length, mm	< 46.5	< 53.5	< 60.5	< 67.5	< 74.5
Cumulative frequency	0	10			

[1]

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



[2]

- (c) Use your cumulative frequency diagram to find an estimate for the median and the interquartile range.
You **must** show your working.

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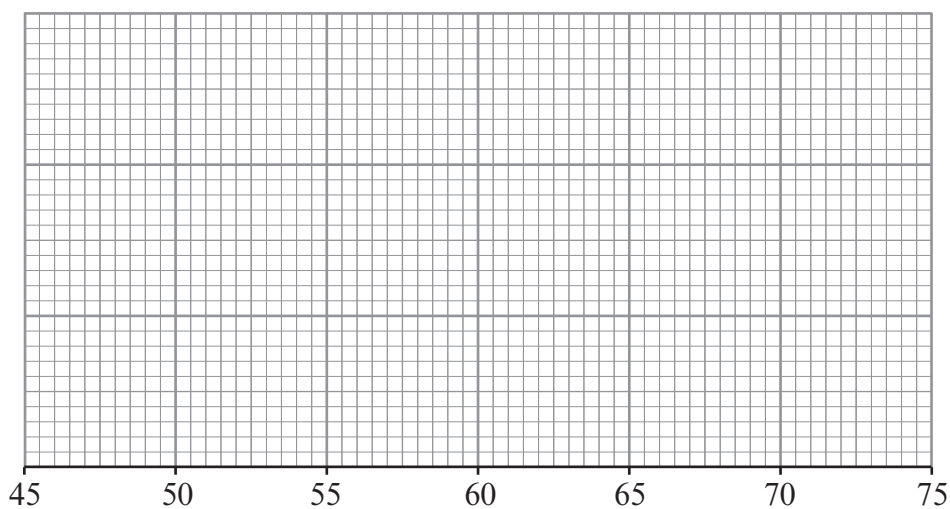
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Median Interquartile range

[3]

- (d) Draw a box and whisker diagram to illustrate this information.



[4]

12. The Body Mass Indicator (BMI) is a formula that is sometimes used as an indicator of relative body fat.

A Belgian statistician developed the formula in the nineteenth century.

Imperial BMI Formula

$$\text{BMI} = \frac{W \times 703}{H^2}$$

W = weight in pounds

H = height in inches

1 foot = 12 inches

1 stone = 14 pounds

In America, the Department of Health have in the past used the BMI to give a Weight Status as follows:

BMI	Weight Status
Below 18.5	Underweight
18.5 to 24.9	Normal
25 to 29.9	Overweight
30 and above	Obese

- (a) Joel is 5 foot 4 inches tall and weighs 12 stone 3 pounds.
Find Joel's Weight Status.
You **must** show **all** your calculations.

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Weight Status

(b) Construct a version of the BMI formula so that it is possible to use values for weights in stone (s) and pounds (p) and for heights in feet (f) and inches (i) without any prior calculations.

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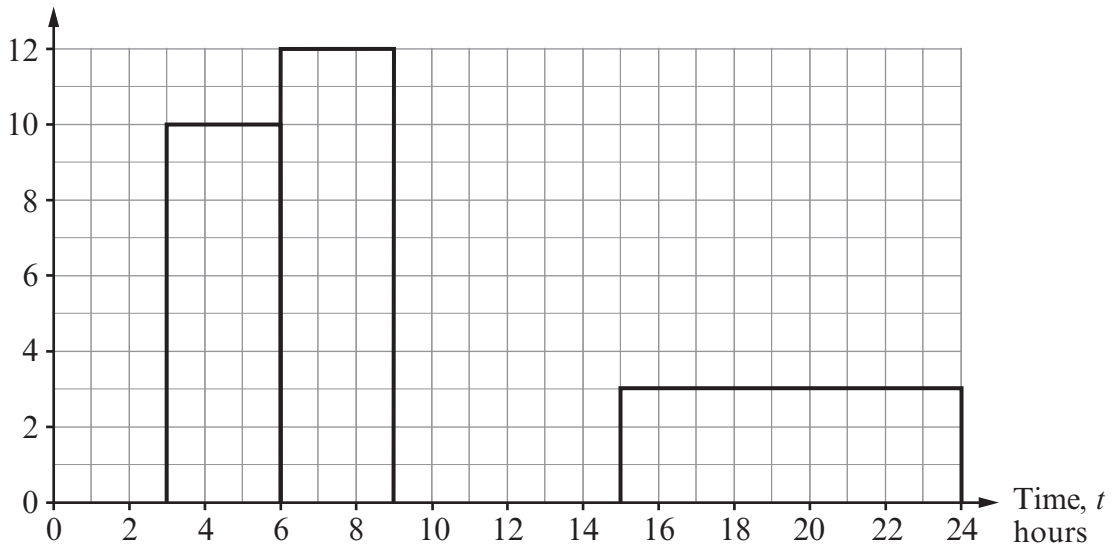
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[4]

13. The histogram and frequency table show some information about the time each person, from a group of people, spent using the Internet during one day in August.

Time, t hours	Number of people
$0 < t \leq 3$	24
$3 < t \leq 6$
$6 < t \leq 9$	36
$9 < t \leq 15$	30
$15 < t \leq 24$

Frequency density



- (a) Complete the frequency table and the histogram shown above.

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[4]

- (b) There are 72 people who spent less than x hours using the Internet.
Calculate an estimate for x .

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[3]

- 14.** As the sea comes in and out we have low tide and high tide.
 At low tide, the depth of water in a harbour is 3 metres and at high tide the depth is 15 metres.
 The tide takes approximately 6 hours to come in to high tide, and approximately 6 hours to go out to low tide.
 Starting at low tide, $\frac{1}{12}$ of the tidal range comes in during the first hour, a further $\frac{1}{6}$ comes in during the second hour, a further $\frac{1}{4}$ during the third hour, a further $\frac{1}{4}$ during the fourth hour, a further $\frac{1}{6}$ during the fifth hour, and finally a further $\frac{1}{12}$ comes in during the sixth hour.
 The pattern for the tide going out is the same in reverse.

(a) Draw a graph to show the approximate heights of the tides over **24 hours**. [6]

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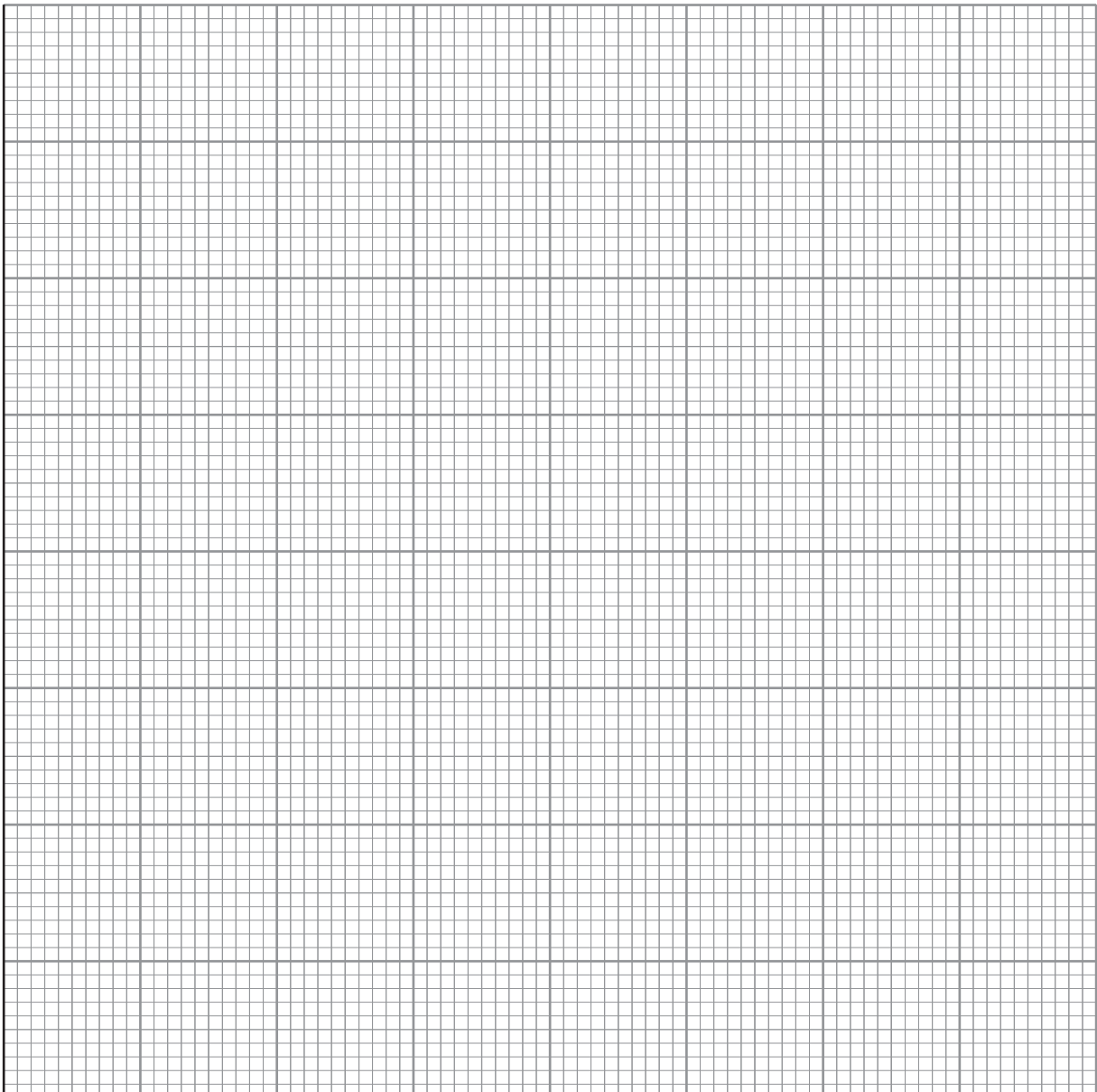
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(b) Estimate the height of the tide $4\frac{1}{2}$ hours after low tide.

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[2]

(c) State the period of your graph and state how you know this.

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[2]