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. FRIDAY, 14 June 2013

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.

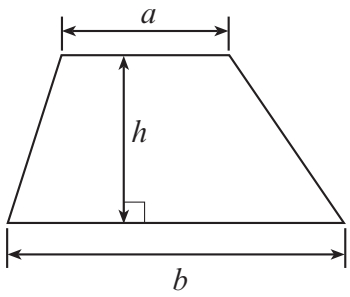
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question 7*(c)*(ii).

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

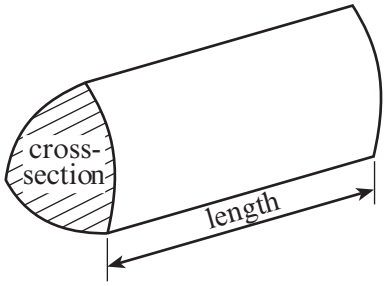
4361
020001

Formula List

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

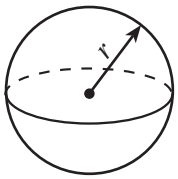


Volume of prism = area of cross-section × length



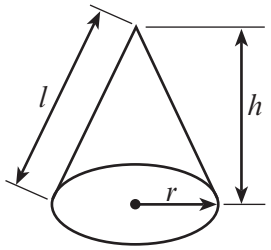
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

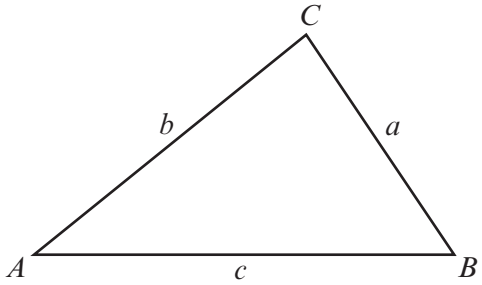


In any triangle ABC

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

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

Examiner only

1. Huw has designed a new clothes hook.

He has made a rough sketch as shown below.

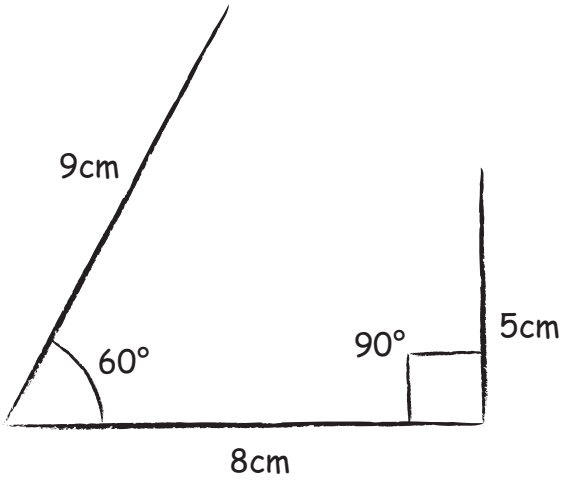


Diagram not drawn to scale

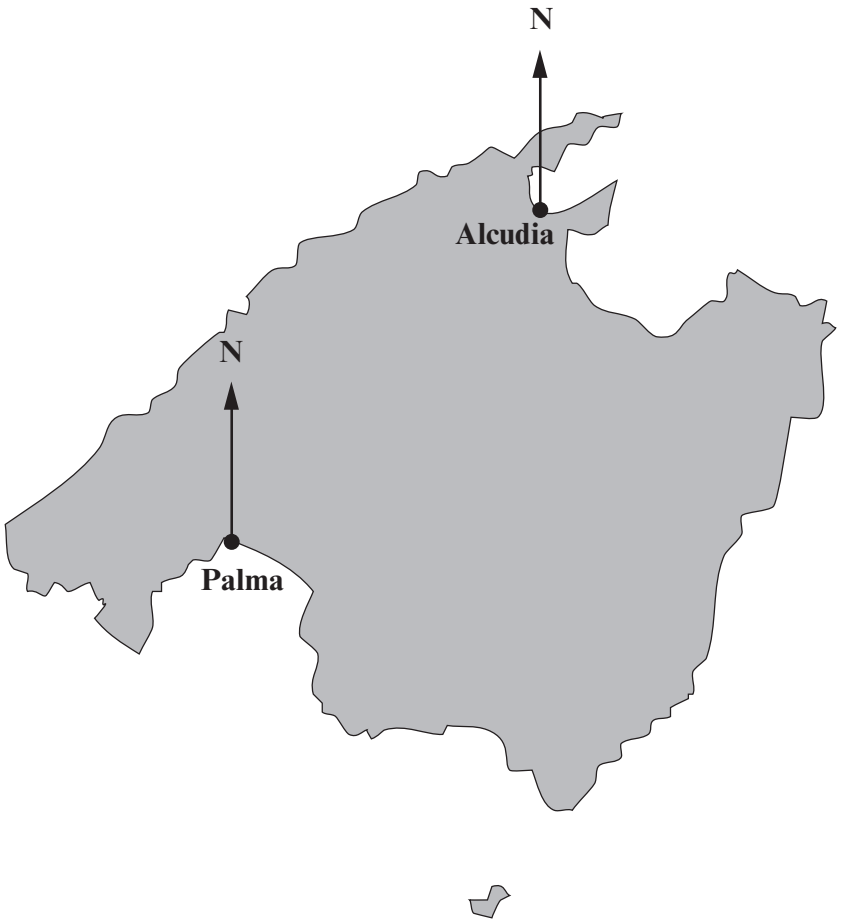
Use a pair of compasses and a ruler only to construct an accurate drawing of Huw's design. You **must** show all your construction lines.

[5]

4361 020003

Examiner only

2. The map below shows the island of Majorca.



(a) Find the bearing of Palma from Alcudia. ..... ° [1]

(b) Arta is another place on the island of Majorca.
Arta is on a bearing of 073° from Palma and on a bearing of 130° from Alcudia.
Indicate where Arta is on the above map of Majorca. [3]

(c) The distance between Alcudia and Palma is 54 km.

Write down the scale of the map in the form 1 cm: ..... m

.....

.....

.....

.....

1 cm: ..... m

[3]

Examiner only

(d) A new runway site is being planned for a different island.
A diagram of the plan for the runway site is shown below.

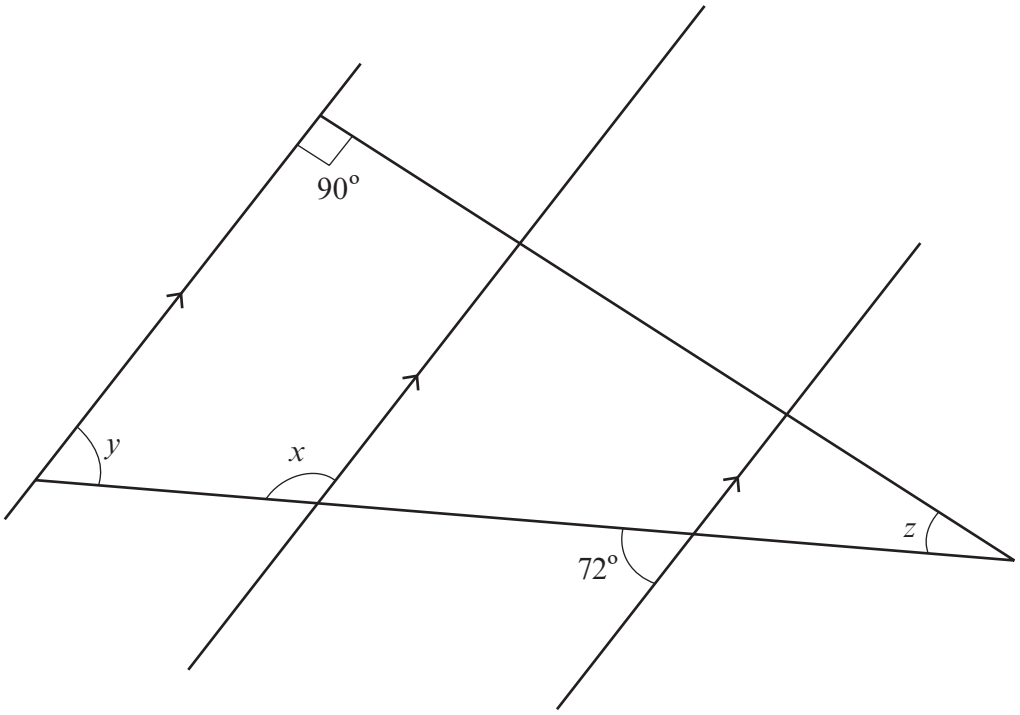


Diagram not drawn to scale

Find the size of the angles x, y and z.

.....

.....

.....

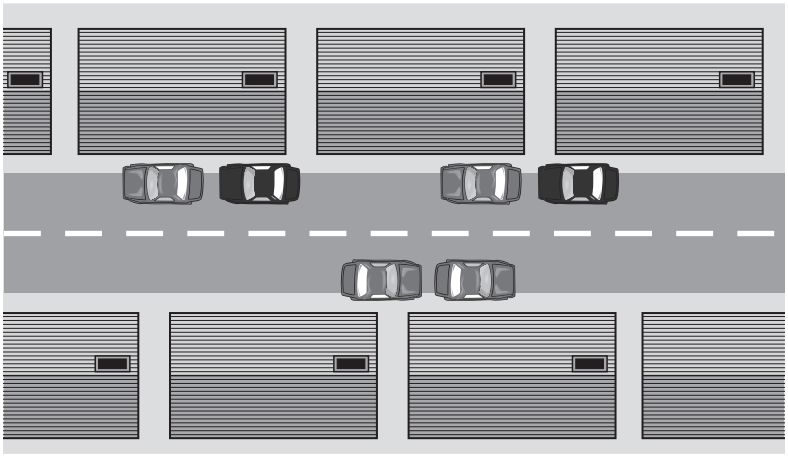
.....

x = ... ° y = ... ° z = ... °

[4]

Examiner only

3. *(a)* The diagram shows an aerial view of some cars parked in a street in Spain. The scale of the map is not shown.



Using the cars as a guide, complete the following statement.

1 cm represents approximately ..... **metres**

[1]

Examiner only

(b) A different aerial view shows a tree with its branches spreading 2 metres in all directions from the tree trunk.
The tree has many branches and many, many leaves.
Using a scale of 1 cm to represent 0·5 metres, show how this tree would look from an aerial view. [2]

Tree trunk

Examiner only

4. In an experiment, the weight added to the end of a vertical spring is gradually increased.

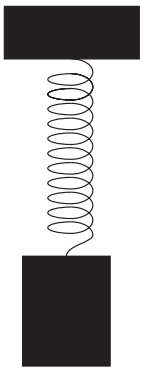
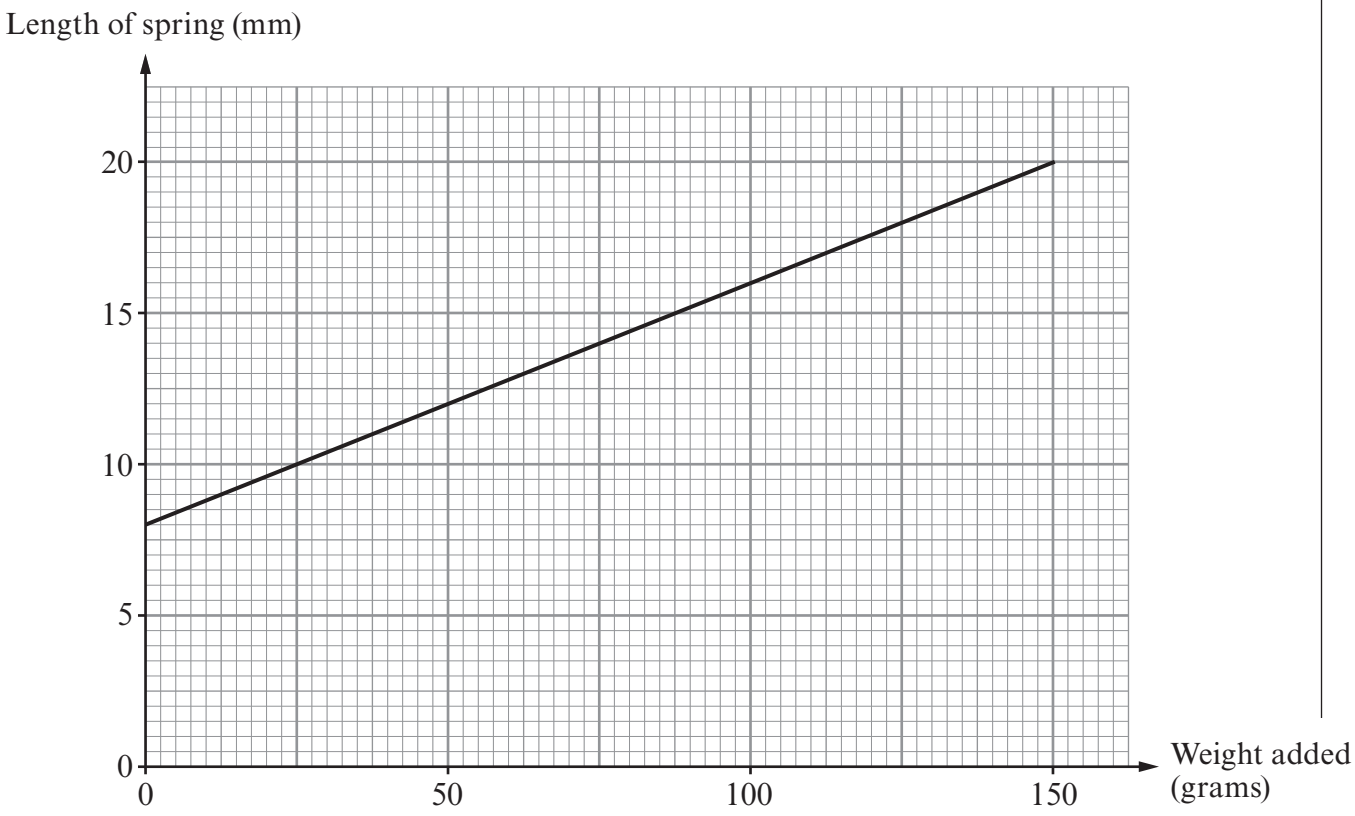


Diagram not drawn to scale

At the end of the experiment, a computer produced the graph shown below.



(a) Write down the length of the spring without any weight added.

.....

[2]

Examiner only

(b) (i) Calculate the gradient of the straight line drawn on the graph.

.....

.....

.....

.....

[2]

(ii) Explain what the gradient of this graph tells you in relation to the experiment.

.....

.....

.....

[2]

(c) The straight line stops before the right-hand edge of the graph paper.
Why do you think this might be?

.....

.....

[1]

(d) In a similar experiment, weights of up to 100 g are added to the end of a different spring. The following data is recorded.

Weight added, W (grams)	0	100
Length of spring, L (mm)	35	235

Using the data given above, complete the formula to give the length of the spring, L mm, for different weights added, W g.

.....

.....

.....

.....

.....

.....

$L =$ ..... $W +$ .....

[3]

4361
020009

Examiner only

5. *Dees Print*, a graphic design company, finds that they use 2 yellow, 8 red and 20 black cartridges each week. So, *Dees Print* always orders yellow, red and black cartridges in the ratio 2 : 8 : 20 respectively.

(a) *Dees Print* orders 210 cartridges in total.
How many cartridges of each of the colours yellow, red and black are there in this order?

.....

.....

.....

.....

.....

.....

Number of yellow cartridges .....

Number of red cartridges .....

Number of black cartridges .....

[3]

(b) In another order, x yellow cartridges are ordered, along with the corresponding number of red and black cartridges.
T is the total number of cartridges in the order.
Write down a formula for T in terms of x.
Give your answer in its simplest form.

.....

.....

.....

.....

.....

[3]

Examiner only

(c) A new cupboard is bought to store cartridges.
It can hold a total of P cartridges.
When the cupboard is full, the number of yellow, red and black cartridges stored will always be in the ratio 2 : 8 : 20 respectively.

Write down an expression, in terms of P, for the number of **red** cartridges this cupboard can hold.

.....

.....

.....

.....

.....

[2]

Turn over.

Examiner only

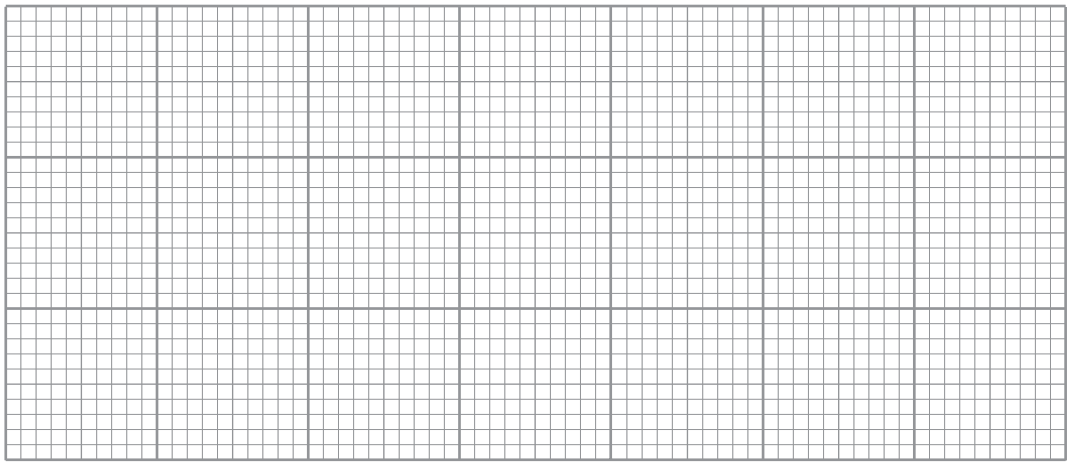
6. Iona needs to give a presentation to her work team.
Her boss has asked her to include a box-and-whisker plot in her presentation.
Iona works in a sales team, selling new telephone systems to large companies.
She had been given some sales data by her boss, as shown below.

Cheapest system sold	£30
Most expensive system sold	£140
Median price of systems sold	£60
Lower quartile price of a system	£50
Upper quartile price of a system	£100

On the graph paper below, draw a box-and-whisker plot using the data that Iona has been given.

.....

.....



[4]

BLANK PAGE

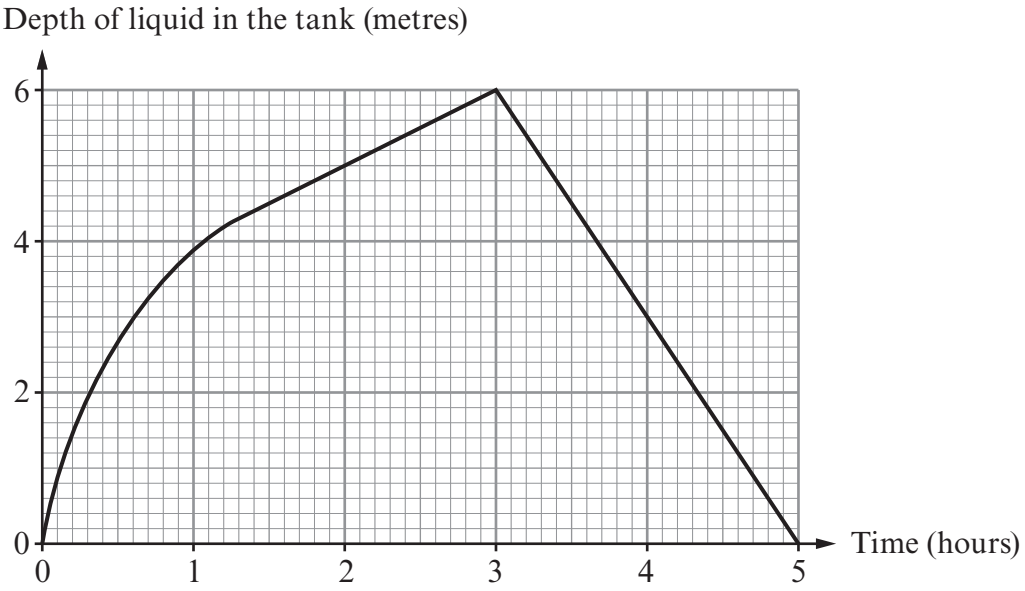
Examiner only

7. A chemical factory makes a liquid that is used in the production of a waterproof fabric. A cylindrical tank is used to collect the liquid made in the factory.

The moment the tank is full, it starts to empty the liquid into a tanker in readiness for delivery to a company which makes the waterproof fabric.

This process is continuous during the week, but the production stops at weekends for maintenance.

The graph shows the process of the tank being filled and emptied into the tanker.



(a) What is the depth of the liquid in the tank $2\frac{1}{2}$ hours into the process?

..... metres

[1]

(b) How long, in minutes, does it take to half fill the cylindrical tank?

.....

.....

.....

.....

[2]

Examiner only

(c) The tank is left empty over the weekend.
The continuous process starts each Monday at 07:00 by filling the tank.
This process of filling and emptying the tank continues until shutdown on Friday.

(i) Explain what is happening at 20:00 on Monday, giving the depth of the liquid in the tank.

.....

.....

.....

.....

.....

[3]

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

The process has to shut down with the tank empty as soon after, but not before, 19:00 on a Friday. At what time should the process shut down on a Friday?
You must show all your working.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

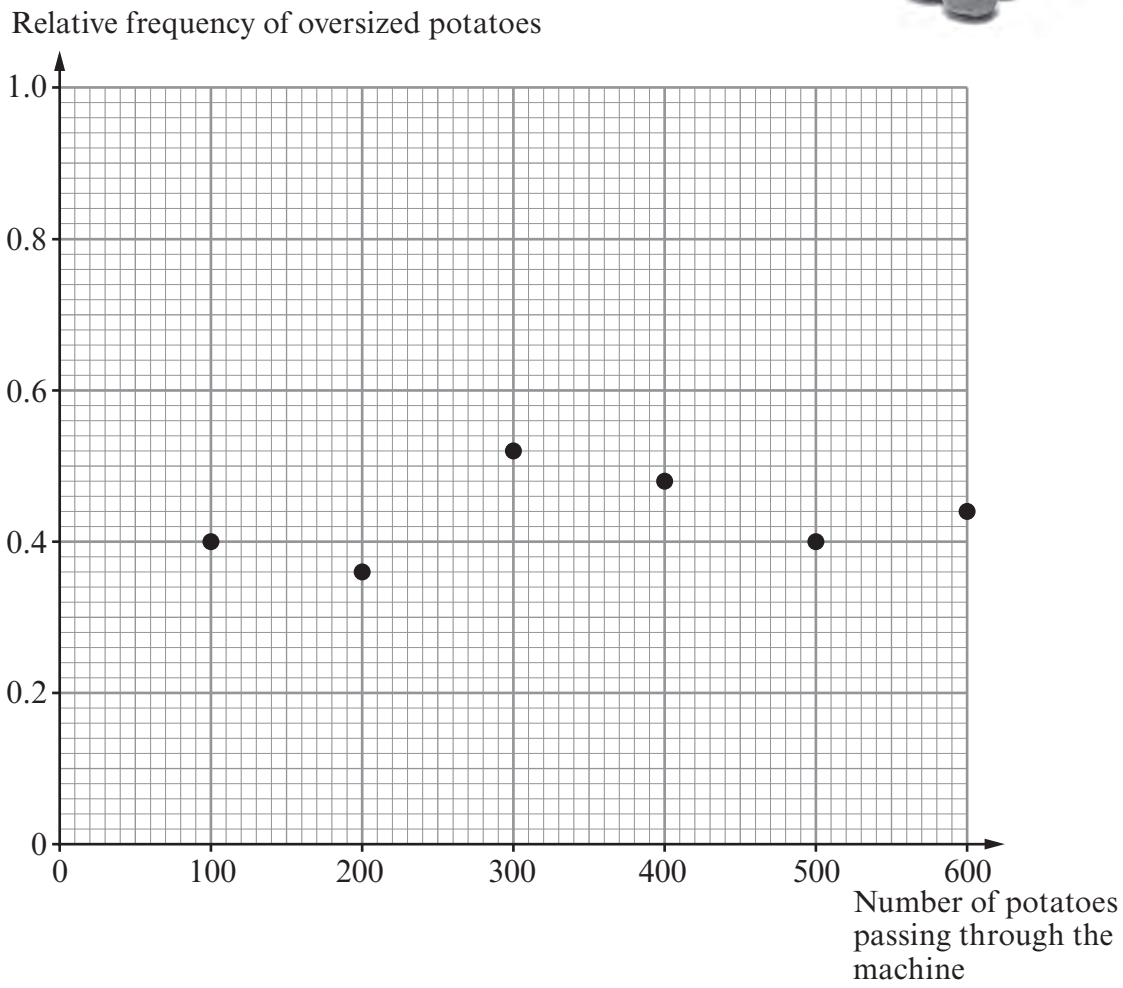
.....

.....

[6]

Examiner only

8. A potato producer uses a machine to sort his potatoes.
The potato producer carried out a survey to investigate the probability of oversized potatoes passing through his sorting machine.
The relative frequency of oversized potatoes passing through the machine was calculated after a total of 100, 200, 300, 400, 500 and 600 potatoes.
The results are plotted on the graph below.



(a) Write down the best estimate for the probability that one of these potatoes, selected at random, will be oversized.
You must give a reason for your answer.

.....

.....

.....

.....

.....

.....

[2]

Examiner only

(b) A trader offers to buy oversized potatoes at 15p each.
How much would the potato producer receive if he decided to sell, to the trader, all the oversized potatoes in the first 100 potatoes sorted by the machine?

.....

.....

.....

.....

[3]

(c) The potato producer decides not to sell his potatoes to the trader.
He sells 900 potatoes to a market stall holder.
The potato producer sells these potatoes for £4.50 per 100 potatoes.
He has agreed with the market stall holder that he will give a 2p refund per oversized potato discovered.
What would your best estimate be for the amount you would expect the potato producer to make from this transaction?

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

[6]

Examiner only

9.

Some data is found on two different websites, **www.sciencenow.com** and **www.planetalong.uk** about some of the planets.
The data found varies slightly between the two websites.

www.sciencenow.com		
Planet	**Radius, km**	**Mass, kg**
Mercury	2439	$3{\cdot}30 \times 10^{23}$
Venus	6052	$4{\cdot}87 \times 10^{24}$
Earth	6378	$5{\cdot}98 \times 10^{24}$
Mars	3397	$6{\cdot}42 \times 10^{23}$
Jupiter	71 492	$1{\cdot}90 \times 10^{27}$

www.planetalong.uk		
Planet	**Radius, km**	**Mass, kg**
Mercury	2439	$3{\cdot}3 \times 10^{23}$
Venus	6052	$4{\cdot}9 \times 10^{24}$
Earth	6378	$6{\cdot}0 \times 10^{24}$
Mars	3394	$6{\cdot}4 \times 10^{23}$
Jupiter	71 398	$1{\cdot}9 \times 10^{27}$

(a) Write down the radius of Mars, in km, correct to three significant figures in standard form for both of the websites.

.....

.....

.....

.....

www.sciencenow.com ..... km

www.planetalong.uk ..... km

[3]

Examiner only

(b) Use the data found at **www.sciencenow.com** to complete the statement below.
Give your answer correct to two significant figures.

Mass of Venus = ... × Mass of Mercury

.....

.....

.....

.....

[3]

(c) (i) The masses of the planets are recorded differently on the two websites.
Explain fully this difference.

.....

.....

.....

.....

.....

[2]

(ii) Calculate the difference between the values stated on the two websites for the mass of Mars.
Give your answer, in kg, in standard form.

.....

.....

.....

.....

[2]

Examiner only

10. Raul has been asked to look at some data.
He is asked to write the data in the form 2^n, where n is a whole number or a decimal.
Write the following numbers in the form 2^n.

(a) $\dfrac{1}{2^3}$

.....

.....

[1]

(b) $(2^{0\cdot3})^{0\cdot4}$

.....

.....

[1]

(c) $\left(\sqrt[4]{8}\right)^{12}$

.....

.....

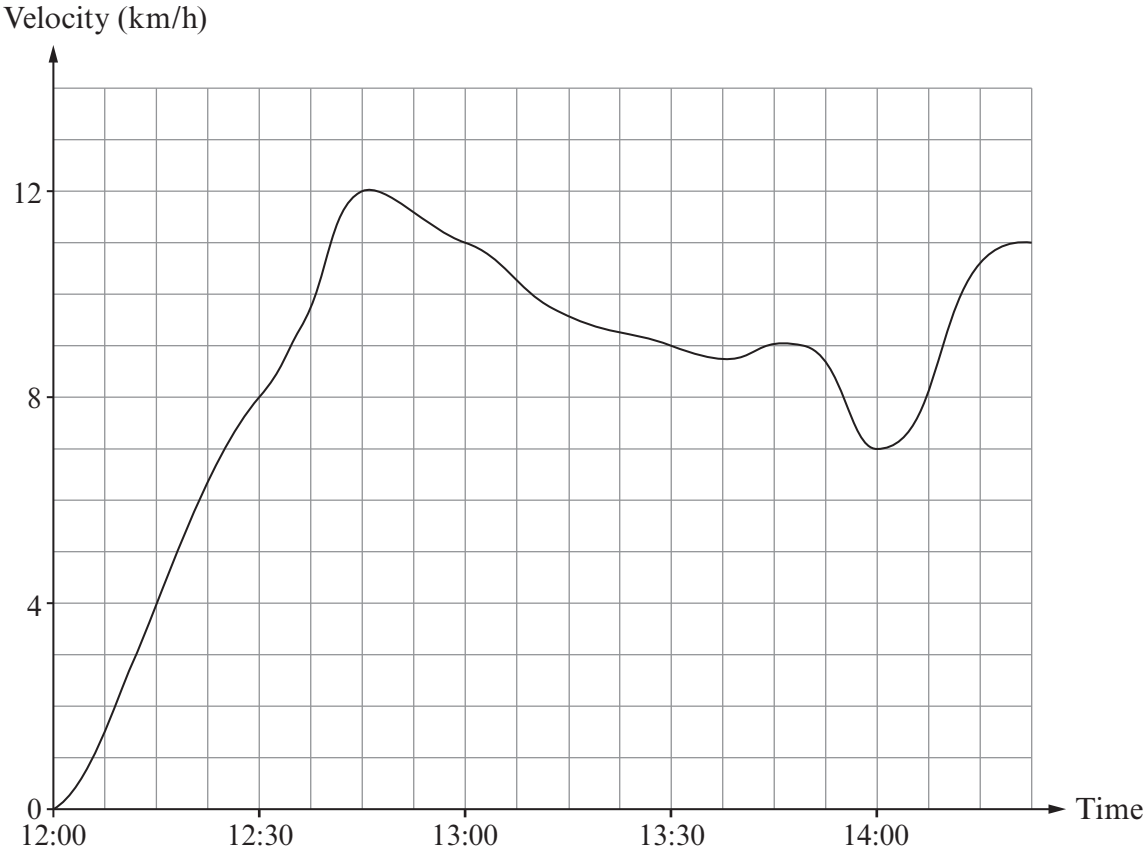
.....

.....

[2]

Examiner only

11. Sue rode her bike along a cycle path.
She started her ride at 12:00.
The graph shows information about her cycle ride.



By considering every $\frac{1}{2}$ hour of Sue's cycle ride, use the trapezium rule to calculate an estimate for the total distance travelled in the first 2 hours.
Give the units of your answer.

.....

.....

.....

.....

.....

.....

.....

.....

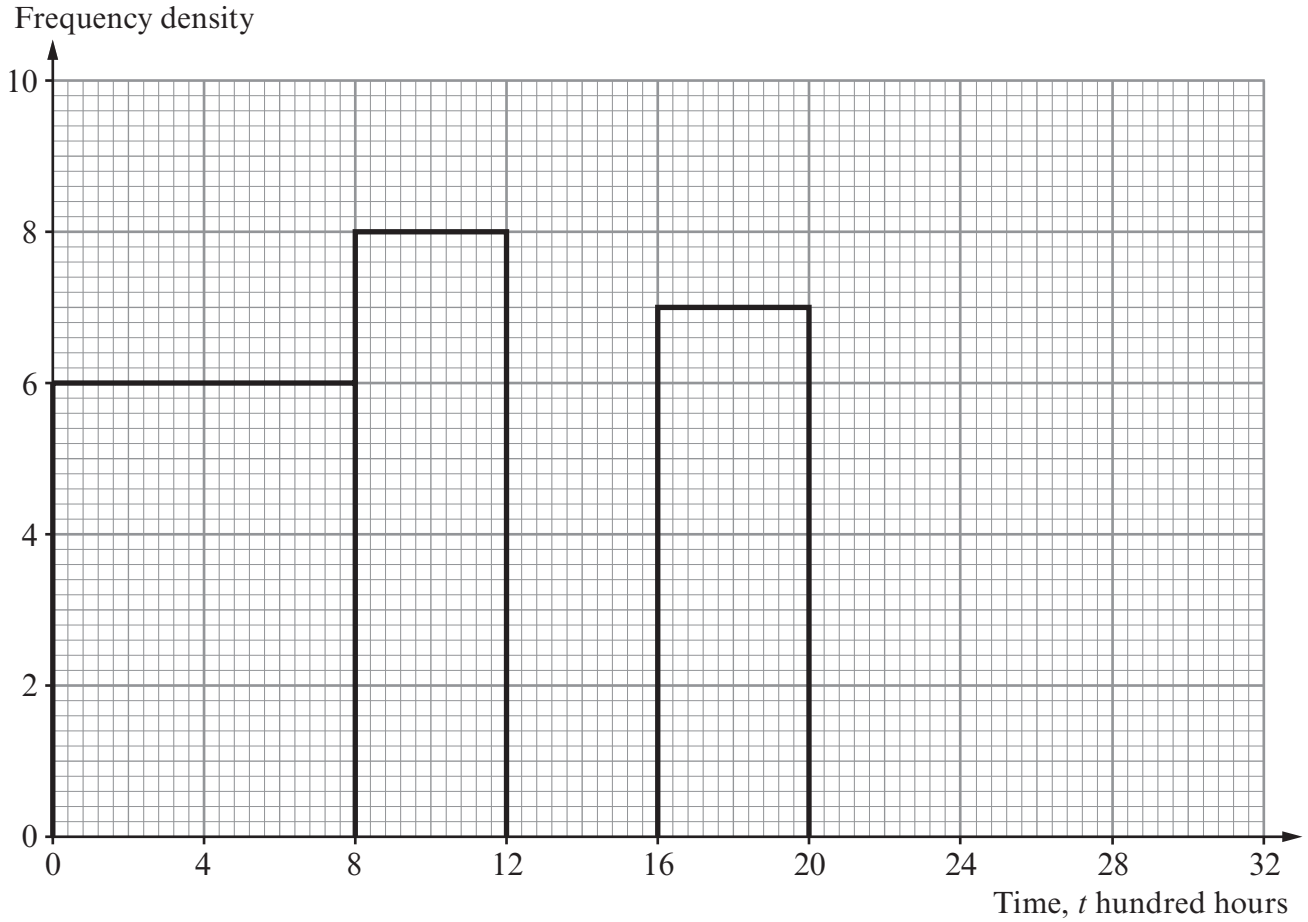
.....

[5]

Examiner only

12. The histogram and frequency table show some information about the time, in hundreds of hours, that a number of similar light bulbs lasted.

Time, t hundred hours	Number of light bulbs
$0 < t \leqslant 8$	48
$8 < t \leqslant 12$	.....
$12 < t \leqslant 16$	40
$16 < t \leqslant 20$	.....
$20 < t \leqslant 30$	20



Examiner only

(a) Complete the frequency table and the histogram shown opposite.

.....

.....

.....

.....

.....

.....

.....

[4]

(b) Find the estimate for the number of light bulbs that lasted between 2000 hours and 2400 hours.

.....

[1]

(c) There are 56 bulbs that lasted less than y hundred hours.
Calculate an estimate for y.

.....

.....

.....

.....

.....

.....

.....

.....

[3]

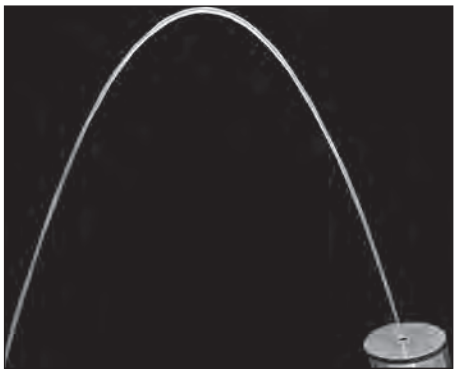
Examiner only

13. A fountain has jets of water that start from water level and reach different heights.

Rosie has taken a photograph of the fountain.
She has also recorded some information about one of the jets of water.

She finds

- the maximum height of the jet of water is 6·25 metres
- at its maximum height it is at a horizontal distance of 2·5 metres from the start of the jet of water
- the shape of the path of the water is a symmetrical curve



Rosie finds that the path of this jet of water is represented by $y = -x^2 + bx$, where y is the vertical height, x is the horizontal distance and b is a constant.

(a) Find the equation that represents the path of this jet of water.

.....

.....

.....

.....

.....

.....

Equation is .....

[4]

Examiner only

(b) The path of a different jet of water is represented by $y = -x^2 + cx$, where y is the vertical height, x is the horizontal distance and c is a constant.
This jet of water hits the surface of the water in the fountain 6 metres away.
The path of the jet of water is symmetrical.

Draw a sketch of the path of this jet of water.

You must indicate on your sketch
- the horizontal distance measured as the jet of water reaches its maximum height
- the maximum height of the jet of water

.....

.....

.....

.....

.....

.....

[5]

END OF PAPER

BLANK PAGE

BLANK PAGE