Surname	Centre Number	Candidate Number
Other Names		0

GCSE LINKED PAIR PILOT

4361/02

S15-4361-02

APPLICATIONS OF MATHEMATICS

UNIT 1: Applications 1
HIGHER TIER

A.M. THURSDAY, 4 June 2015

2 hours

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**10**	
3.	**5**	
4.	**10**	
5.	**9**	
6.	**13**	
7.	**11**	
8.	**8**	
9.	**9**	
10.	**6**	
11.	**14**	
Total	**100**	

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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.

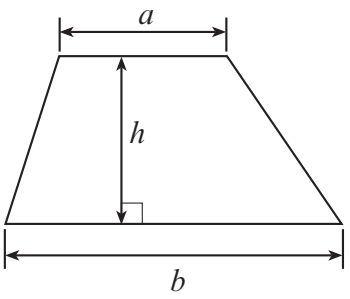
Scale drawing solutions will not be acceptable where you are asked to calculate.

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

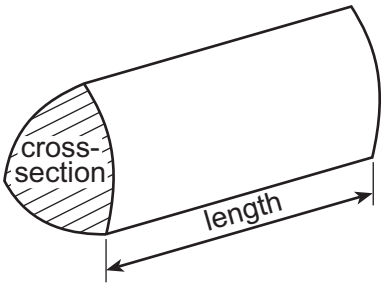
You are reminded that assessment will take into account the quality of written communication (including mathematical communication) used in your answer to question **6***(a)*.

Formula List

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

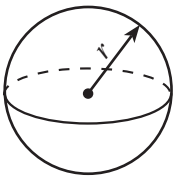


Volume of prism = area of cross-section × length



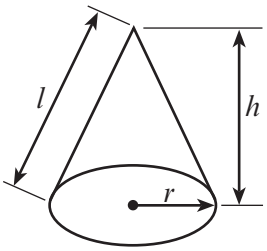
Volume of sphere = $\frac{4}{3}\pi r^3$

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



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

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

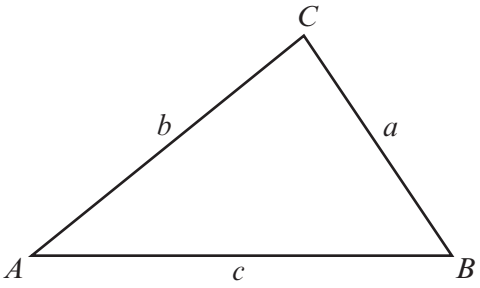


In any triangle ABC

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

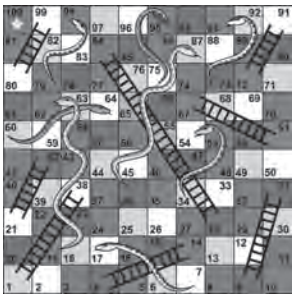
The solutions of $ax^2 + bx + c = 0$

where $a \neq 0$ are given by

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

Examiner only

1. *Vintage Games* makes board games such as snakes and ladders.

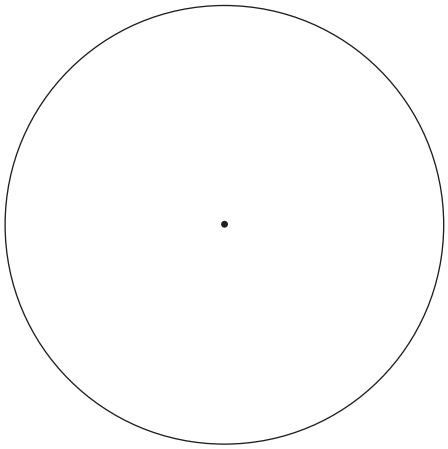


Vintage Games decides to make a biased spinner to include with their board games.
The spinner is numbered 1 to 4.
The probability of scoring each of the numbers has been decided.

Number	1	2	3	4
Probability	0·1	0·3	0·4	.....

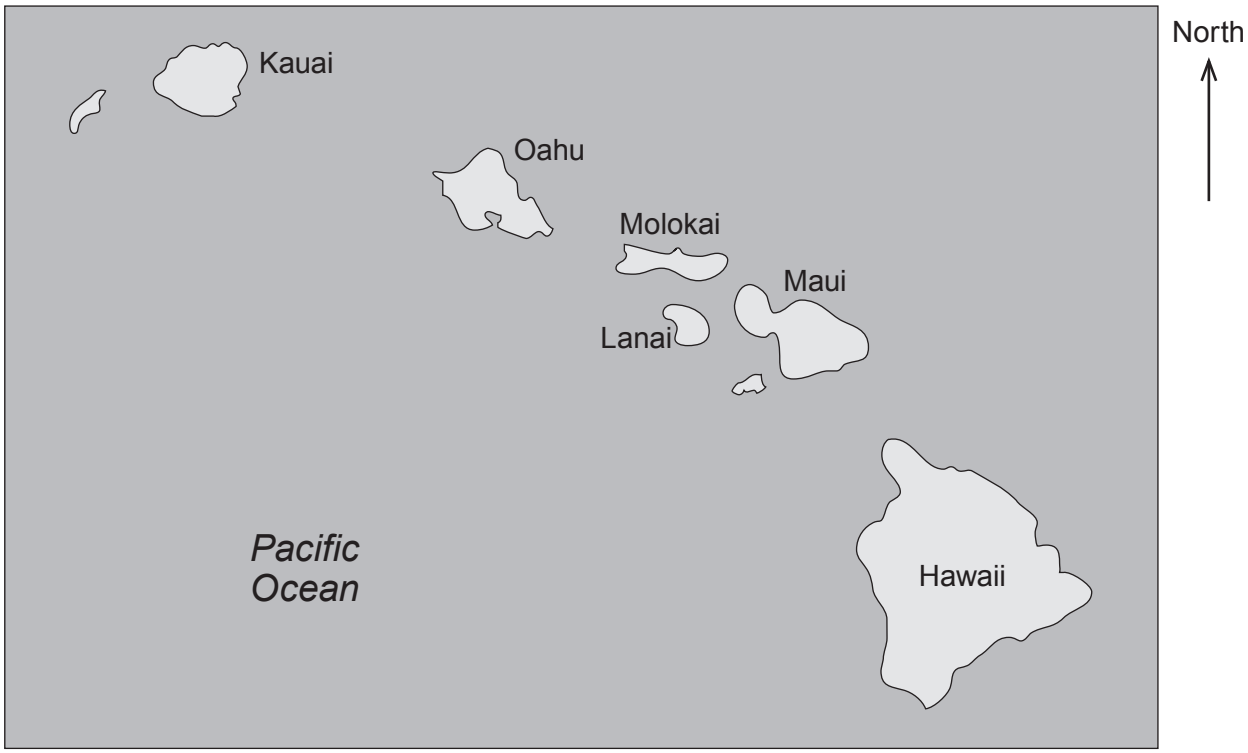
(a) Complete the table. [1]

(b) An outline of the biased spinner to be made by *Vintage Games* is shown below.
The centre of the spinner has been marked.
Using the information in the table, complete an accurate drawing of the biased spinner.
You must show your working. [4]



Examiner only

2. The state of Hawaii in the USA consists of 8 main islands.
The six largest of these islands are Hawaii, Maui, Oahu, Kauai, Molokai and Lanai.



(a) The land area of Oahu is 596·7 square miles.
1 square mile is approximately 2·59 km^2.
Calculate the land area of Oahu in km^2.
Give your answer correct to 3 significant figures. [3]

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Examiner only

(b) Place points on the diagram to mark the approximate centres of the islands of Kauai and Maui.

(i) Use these two central points to complete the sentence below. [3]

The island of Kauai is on a bearing of ..... from the island of Maui.

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(ii) Why is there a risk that your answer for the bearing may not be completely accurate? [1]

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(c)

1 foot = 12 inches
1 yard = 36 inches

The highest point on the island of Lanai is 3366 feet.
Express the measurement of the highest point on Lanai in inches.
Give your answer in standard form.
You must show all your working. [3]

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Examiner only

3. Shireen is working for *EcoEstates* to prepare plans for a new sports centre.
She is working on the ground plan of the entrance hall and the paths to the sports centre.
The entrance hall is to be in the shape of a rhombus.
A sketch of the plan is shown below.

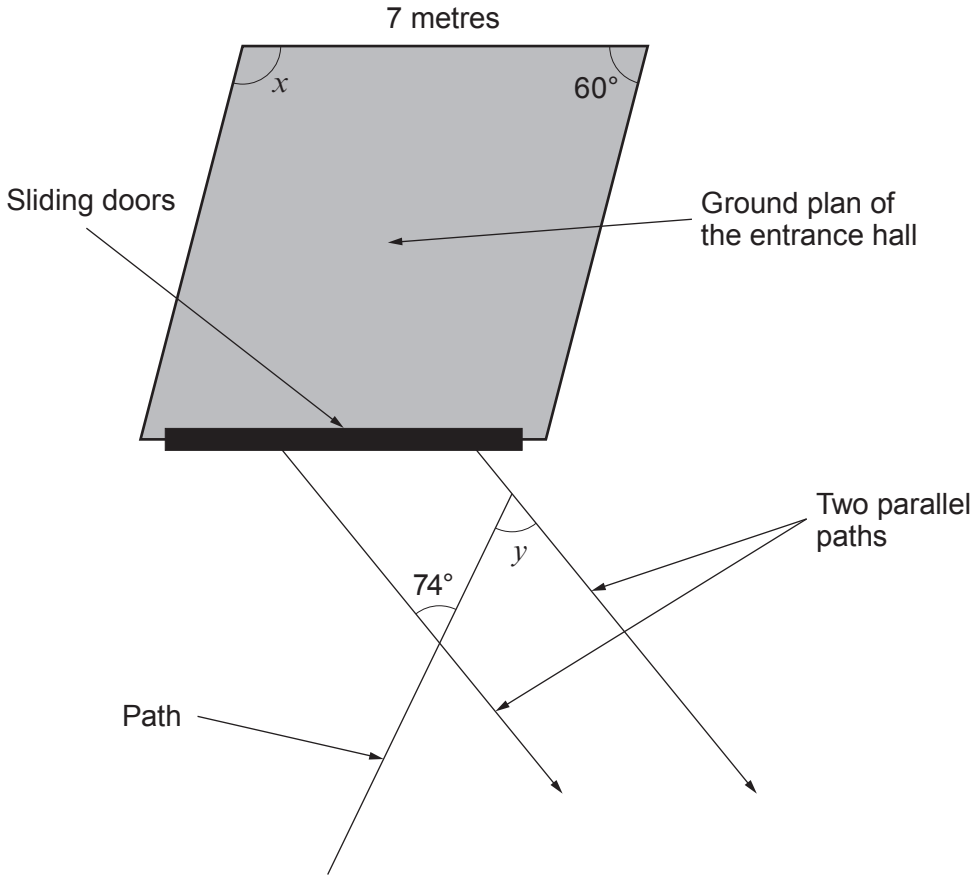

Diagram not drawn to scale

(a) Calculate the size of each of the angles x and y. [2]

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$x =$ ..... ° $y =$ ..... °

(b) Use the page opposite to construct an accurate scale drawing of the **rhombus** shown as the **ground plan of the entrance hall**.
You must use a pair of compasses and a ruler and show all your construction arcs.
Use a scale of 1 cm to represent 1 metre. [3]

Examiner only

Ground plan of the entrance hall drawn to a scale of 1cm to represent 1m.

Examiner only

4. *EcoEstates* has considered the dimensions of rectangular sports halls.
The dimensions have been expressed algebraically, as shown on the plan.

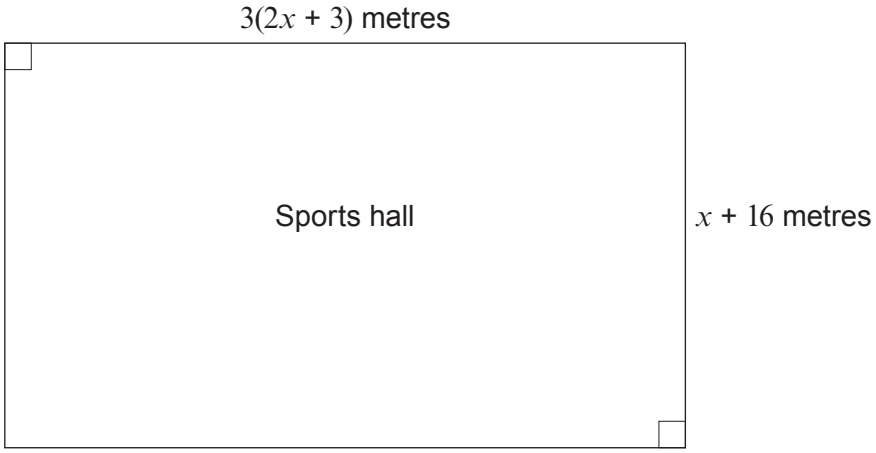

Diagram not drawn to scale

(a) Find the perimeter of a sports hall in terms of x.
Express your answer in its simplest form. [4]

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(b) Find the dimensions of the sports hall when $x = 4{\cdot}5$. [2]

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Length = ... metres Width = ... metres

Examiner only

(c) The area of the floor of a sports hall, in m^2, is given by the formula shown below.

$$\text{Area} = 6x^2 + 105x + 144$$

Calculate the area of the floor of the sports hall when $x = 4$. [2]

(d) Angus suggests that it is possible to use negative values for x in the expressions for the dimensions of the rectangular sports halls.
Is he correct?
Show all your working.
Give a reason for your answer. [2]

Examiner only

5. *Fisher Tours* has a new coach.

(a) On Sunday, the coach took 45 passengers on a trip to the zoo.
The ratio of men to women to children was 2 : 3 : 4.
How many children were on the coach? [2]

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(b) The coach has 47 seats for passengers.
Fisher Tours recorded the number of passengers on the coach every day during one week in the summer.
Fisher Tours says that this is typical data for any week in the summer.

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Number of seats occupied	45	30	40	38	34	38	41

(i) For a trip on a **Thursday** in the summer, calculate the best estimate of the probability that a seat on the coach, selected at random, would be empty. [2]

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(ii) One summer's day, Gareth says,

'If this is typical data then there should be 7 empty seats on the coach next Tuesday.'

Explain why this is not true and how *Fisher Tours* could improve the way they estimate the number of seats that might be empty each day. [2]

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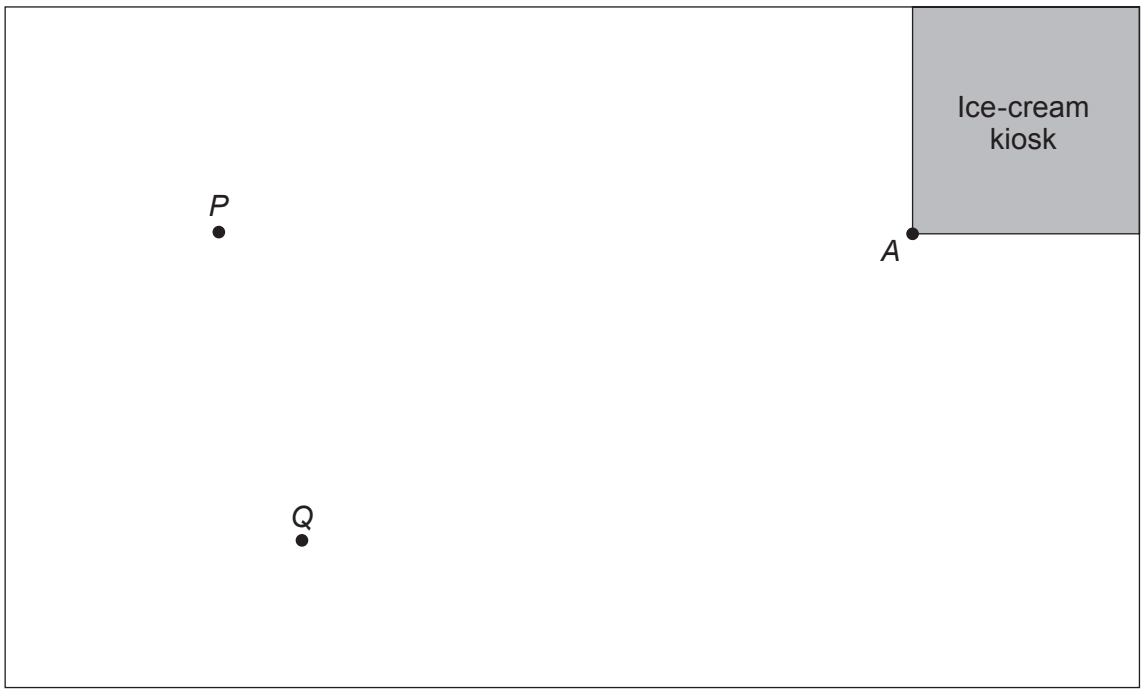
Examiner only

(c) When *Fisher Tours* takes a coach trip to the zoo they must follow instructions for parking. An accurate scale drawing of the entire coach-parking zone at the zoo is shown below. *Fisher Tours* has been allocated a parking area within this parking zone.



Scale: 1 cm represents 4 metres

The instructions for parking are as follows:

- Must be further than 12 metres away from point *A* at the ice-cream kiosk.
- Must be closer to the lamp post *Q* than to lamp post *P*.

Indicate, on the scale drawing above, the region in which *Fisher Tours* can park their coach. [3]

Examiner only

6. *GyroVac* makes and sells industrial vacuum cleaners.

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

Each wheel on the vacuum cleaners has a radius of 2·8 cm.

In cleaning a carpet in an office, the vacuum cleaner is pushed a total distance of 30 metres.
Calculate how many **complete** times each wheel on the vacuum cleaner rotated during the cleaning of the office carpet. [7]

Examiner only

(b) In the year 2000, *GyroVac* employed 10 people and sold 40 000 spare parts for its vacuum cleaners.

After the year 2000, the number of people employed by *GyroVac* increased by 15 each year.
Also after the year 2000, sales of spare parts reduced by 700 every year.

(i) Calculate how many spare parts *GyroVac* sold in 2006. [2]

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(ii) Write down the most efficient calculation that could be used to calculate the number of spare parts sold in 2013. [1]

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(iii) Derive a formula to calculate how many people *GyroVac* employed in any year from 2000.
You must use
- n to represent the number of years since 2000
- P to represent the number of people employed by *GyroVac*. [3]

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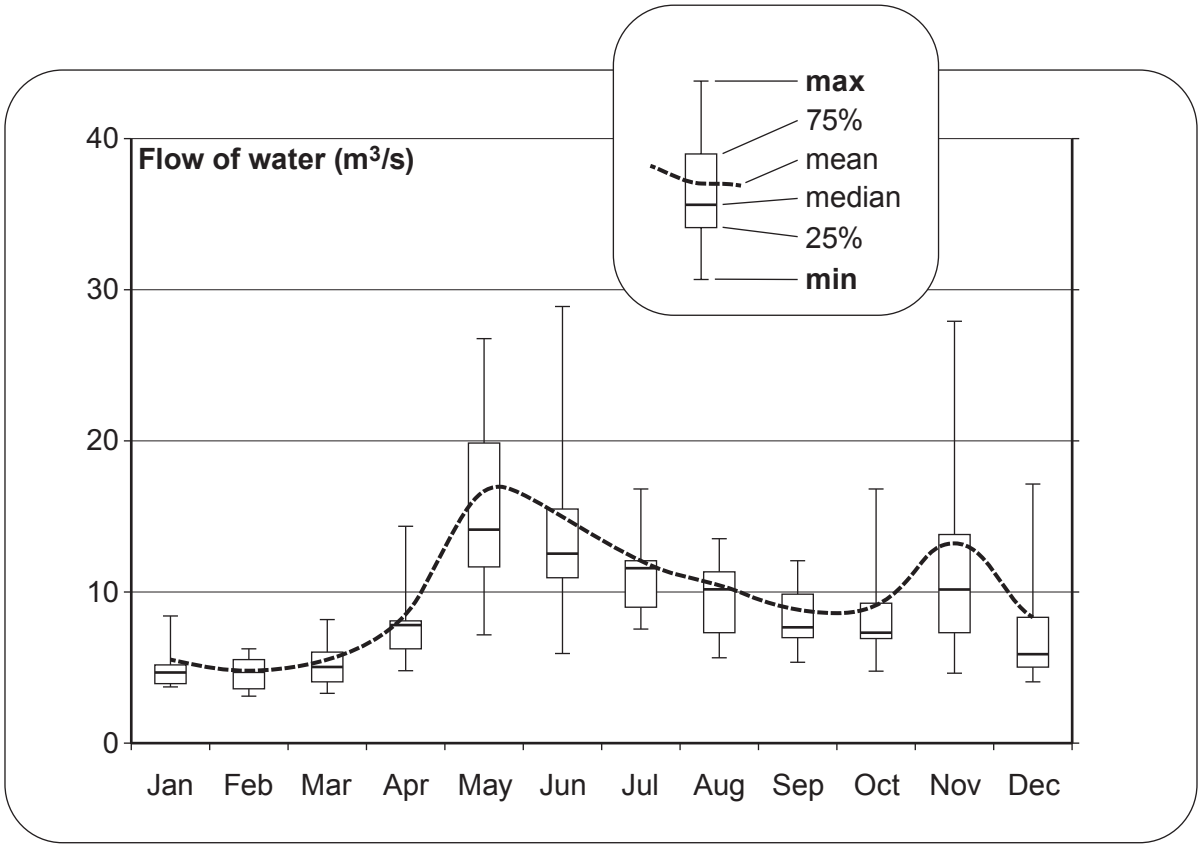
Turn over.

Examiner only

7. The information board shown below was seen by a river in the Italian mountains.



The information board gives monthly data about the volume of water flowing past a cross-section of the river every second.

(a) Write down the month with the greatest **mean** flow of water.
Estimate this greatest **mean** flow of water, giving the units of your answer. [3]

Month .....

Greatest mean flow .....

Examiner only

(b) Which month had the smallest range of water flow?
Estimate this range.
Your **must** show all your working. [2]

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Month .....

Range .....

(c) Which month had the greatest interquartile range of water flow?
Estimate this interquartile range.
You **must** show all your working. [3]

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Month .....

Interquartile range .....

(d) The local newspaper publishes a picture of the river with a caption.

The mean flow of the river for the year was .....

Complete this caption.
You **must** show all your working. [3]

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Examiner only

8. Kenny has an internet business selling USB drives.

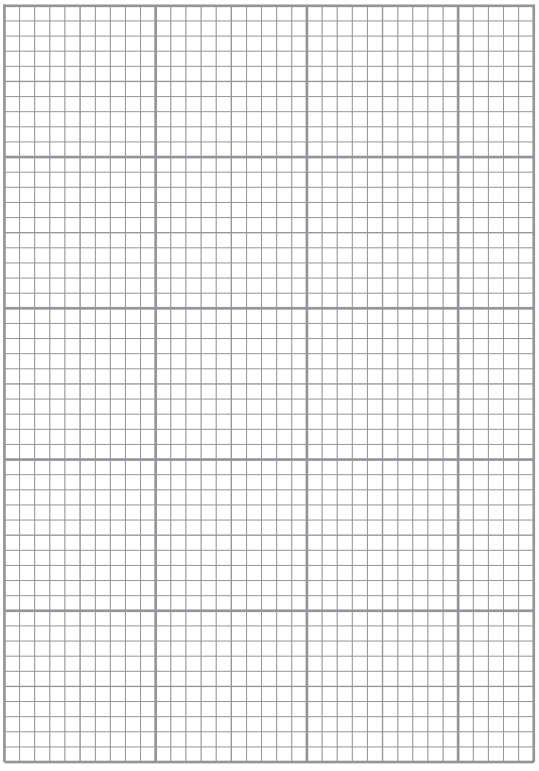
He posts orders out to customers every Monday, Wednesday and Friday.
Kenny sells both 8GB and 16GB USB drives.

The table below shows the number of USB drives he has posted.

Day	Week 1		Week 2		Week 3	
	8GB	16GB	8GB	16GB	8GB	16GB
Monday	8	10	12	6	8	6
Wednesday	6	16	14	14	10	8
Friday	14	12	2	2	20	2

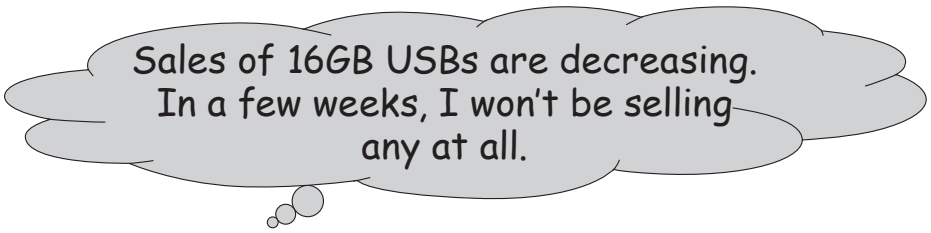
(a) (i) Use the graph paper to illustrate, on the same axes

- the trend in total weekly sales of 8GB USBs, and
- the trend in total weekly sales of 16GB USBs. [3]



Examiner only

(ii) Kenny thinks,



Explain to Kenny why he is wrong to draw this conclusion. [1]

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(b) (i) Kenny decides to calculate the 3-point moving averages for sales of **8GB** USBs.
Calculate the first three 3-point moving averages for the **8GB** USBs.
Complete the table below.
Give your answers correct to 1 decimal place. [3]

3-point period	Monday week 1 to Friday week 1	Wednesday week 1 to Monday week 2	..... to .....
3-point moving average	.....	.....	.....

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(ii) Why is it more sensible for Kenny to use 3-point moving averages rather than 5-point moving averages? [1]

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Examiner only

9. The lengths of the worms collected in a one square metre area of woodland were measured. The results are summarised in the grouped frequency distribution below.

Length, l (mm)	Frequency
$0 < l \leqslant 10$	4
$10 < l \leqslant 20$	2
$20 < l \leqslant 30$	10
$30 < l \leqslant 40$	20
$40 < l \leqslant 50$	24
$50 < l \leqslant 60$	24
$60 < l \leqslant 70$	0
$70 < l \leqslant 80$	2

It is decided by the team recording the lengths of the worms that:

- groups $0 < l \leqslant 10$ and $10 < l \leqslant 20$ should be combined
- groups $60 < l \leqslant 70$ and $70 < l \leqslant 80$ should be combined.

(a) Explain why you think this decision was made and whether you think it is a sensible idea. [1]

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Examiner only

(b) Complete the table below and draw a histogram to display the results for the lengths of the worms, keeping to the decision made for combining the results. [4]

Length, l (mm)	Frequency	Frequency density
$0 < l \leqslant 20$		
$20 < l \leqslant 30$		
$30 < l \leqslant 40$		
$40 < l \leqslant 50$		
$50 < l \leqslant 60$		
$60 < l \leqslant 80$		

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Examiner only

(c) Write down an estimate for the median length of the worms.
You **must** show your working. [4]

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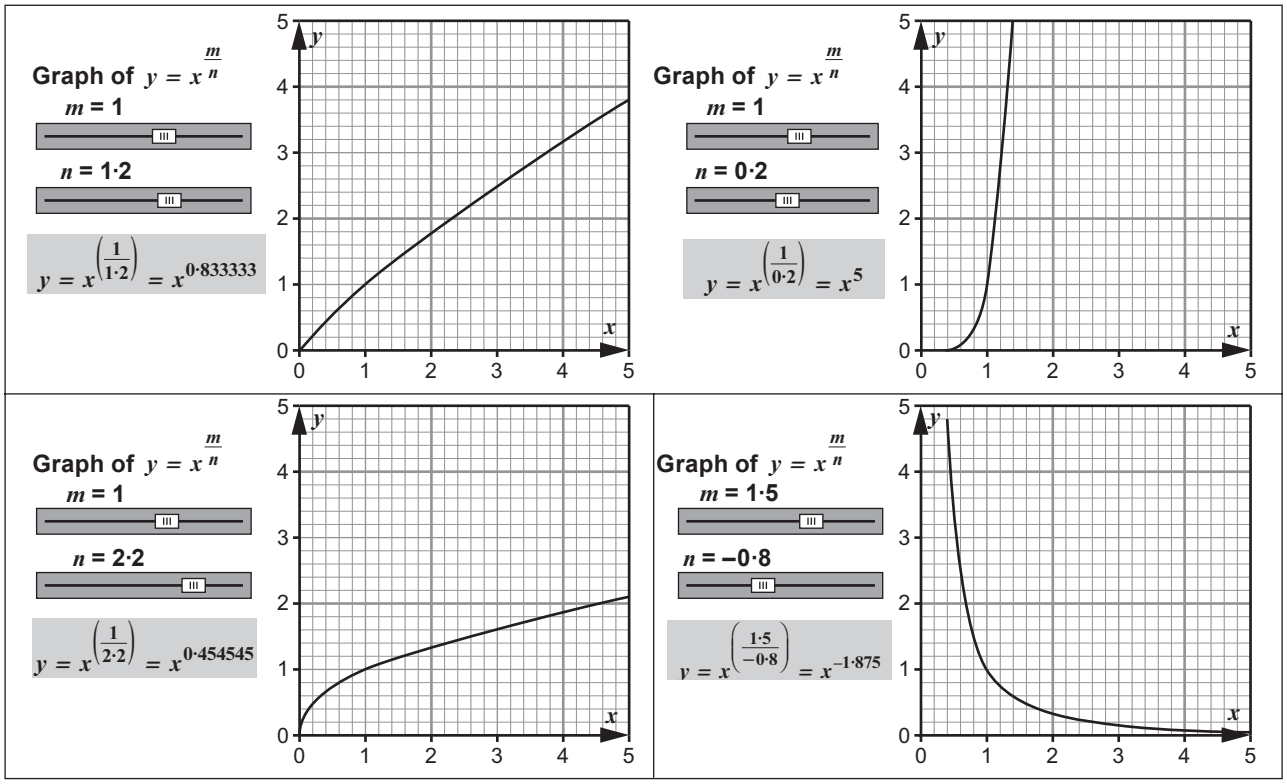
Turn over.

Examiner only

10. Dilys works as a financial researcher for a bank.

She looks at some graphs of $y = x^{\frac{m}{n}}$ on the internet.

Some of her results, using various values of m and n, are shown below.



(a) Write down possible values for m and n that Dilys could use to produce a straight line graph. [1]

$m =$ ..... $n =$ .....

(b) Dilys looks at the graph $y = x^{-1·875}$.
She states,

'I think that when $x = 500$ the value of y would be exactly zero.'

Dilys is not correct.

To help Dilys understand why she is not correct:

(i) write down the value of y when $x = 500$ expressed in standard form [2]

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Examiner only

(ii) explain what happens to the value of y as the value of x increases. [1]

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(c) Dilys has the following data:

$y = 24{\cdot}5$ $m = 3$ $n = 8$ $y = x^{\frac{m}{n}}$

Find the value of x. [2]

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Examiner only

11. In an experiment it was found that the velocity, v in m/s, of a particle at time t seconds after the start of the experiment was given by the equation $v = 3t - t^2$.

(a) Draw the **curved** graph of $v = 3t - t^2$ for values of t from 0 to 3, for increasing values of t in steps of 0·5. [5]

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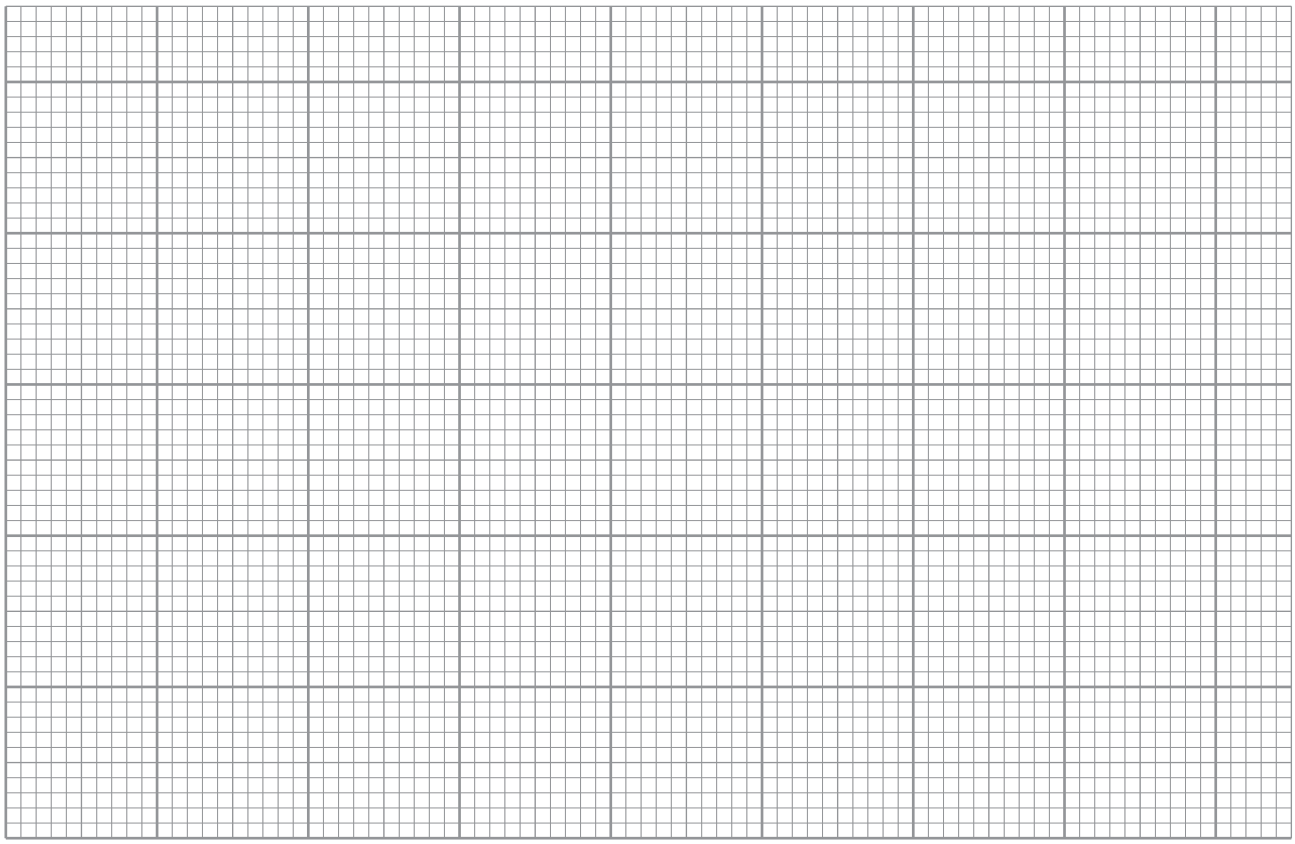

Examiner only

(b) The acceleration of the particle is the rate of change of the velocity.

(i) Find the time at which the acceleration of the particle is zero. [1]

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(ii) Find an approximation for the acceleration when $t = 2{\cdot}2$. [4]

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(c) The distance travelled by the particle can be found using the graph of $v = 3t - t^2$.
Use the trapezium rule to find an approximation for the distance travelled by the particle for values of t from 0 to 3. [4]

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