H

GENERAL CERTIFICATE OF SECONDARY EDUCATION

APPLICATIONS OF MATHEMATICS

A382/02

Paper 2
(Higher Tier)

Candidates answer on the Question Paper

OCR Supplied Materials:
None

Other Materials Required:
- Geometrical instruments
- Tracing paper (optional)
- Scientific or graphical calculator

SPECIMEN

Duration: 2 hours

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Your answers should be supported with appropriate working. Marks may be given for a correct method even if the answer is incorrect.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

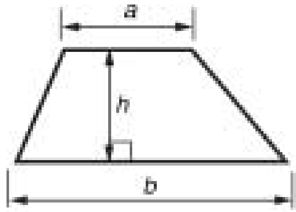
INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **90**.
- Use the π button on your calculator or take π to be 3·142 unless the question says otherwise.
- Your Quality of Written Communication is assessed in questions marked with an asterisk (*).
- This document consists of **24** pages. Any blank pages are indicated.

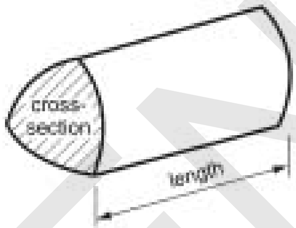
You are permitted to use a calculator for this paper.

Formulae Sheet: Higher Tier

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



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

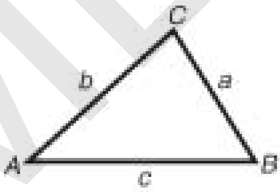


In any triangle *ABC*

Sine rule $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$

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

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

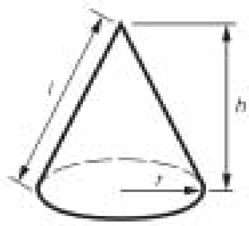


Volume of sphere $= \frac{4}{3}\pi r^3$

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

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

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



The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$,
where $a \neq 0$, are given by

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

PLEASE DO NOT WRITE ON THIS PAGE

1 Ryan wants to take hang-gliding lessons.
He looks on the internet and jots down some notes.

Sport	Number of very serious accidents	Activity	Estimate of probability of very serious accident
American Football	18	1 400 000 players	0·0000128
BASE Jumping	27	21 000 jumps	0·00128
Hang-gliding	3	100 000 flights	
Horse Riding	30	1 800 000 riders	0·0000166
Skiing	111	57 000 000 visits	
Skydiving	63	2 500 000 jumps	

(a) Ryan is worried about the risk of very serious accidents.

Use Ryan's figures to show how safe or otherwise hang-gliding is compared to the other sports in his list.

____

____

____

____ **[4]**

(b) Ryan goes hang gliding at New Mills.
When he was at a height of 600 m Ryan thought he could just see Manchester United's stadium.

Ryan found this information in a book.

> As you climb higher into the sky you can also see further.
> The distance, d kilometres, you can see from a height, h metres, is given by
> $d = \sqrt{12h}$.

He looked at a map when he got home.

Could he have seen Manchester United's stadium?
Support your answer with some calculations.

____

____

____

____ **[5]**

2* Sanjay has returned from holiday and wants to change some euros (€) back into pounds (£).
A euro is worth less than a pound.
Sanjay sees these commission-free rates advertised.

Bank	
euro (€)	
We buy at	1·1374
We sell at	1·1265

Money Exchange	
euro (€)	
We buy at	1·1462
We sell at	1·1175

This means the bank buys euros at a rate of 1·1374 euros for a pound and sells euros at a rate of 1·1265 euros a pound.

Explain whether Sanjay should use the bank or the money exchange.

____

____

____

____ **[3]**

3 A supplier is planning a new cuboid drink carton.
It will have a square base, x cm by x cm, and its height will be 9 cm more than its width.
In cubic centimetres, the volume, V, of the carton will be given by $V = x^3 + 9x^2$.

So, for example, when $x = 4$, $V = 4^3 + 9 \times 4^2 = 64 + 9 \times 16 = 64 + 144 = 208$.

Find x so that the volume of the carton is 1000 cm^3.
Give your answer to 1 decimal place.

x = ______________________ **[4]**

4 Nathan collected data on when tries were scored in rugby matches.
This table summarises the time, in minutes, when the first try of the match was scored.

Time (t minutes)	Number of matches	Middle of class	
$0 < t \leq 20$	60		
$20 < t \leq 40$	48		
$40 < t \leq 60$	30		
$60 < t \leq 80$	12		

Estimate the mean time when the first try was scored in these matches.

_______________ Minutes **[4]**

5 The retail price index (RPI) and consumer price index (CPI) are measures of the average price of various goods. The selections of goods used for each index differ slightly.
The table below gives monthly values of the CPI.

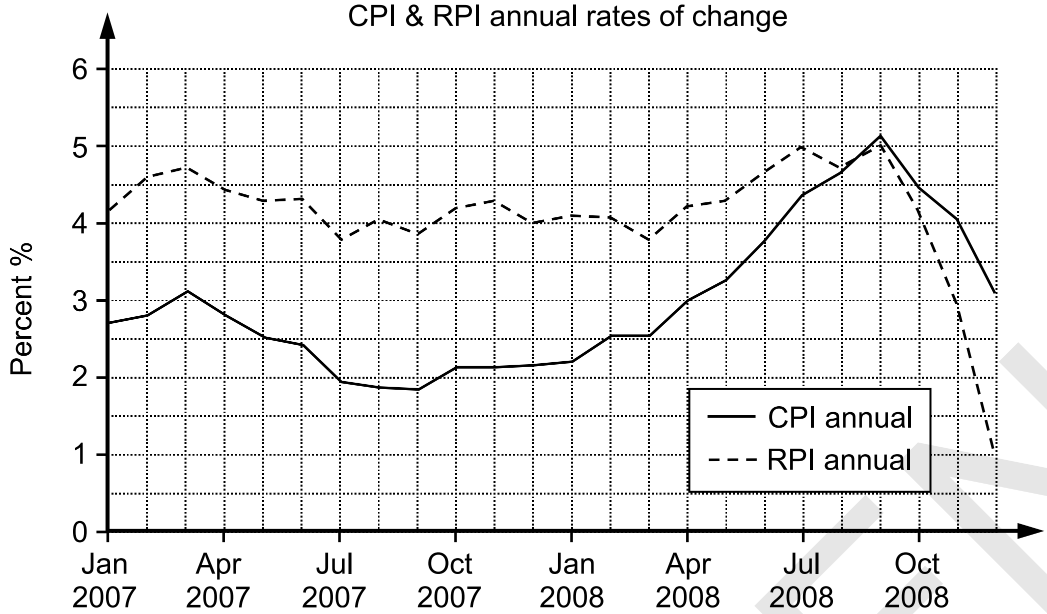
Date	CPI
2007 Jan	103·2
2007 Feb	103·7
2007 Mar	104·2
2007 Apr	104·5
2007 May	104·8
2007 Jun	105·0
2007 Jul	104·4
2007 Aug	104·7
2007 Sep	104·8
2007 Oct	105·3
2007 Nov	105·6
2007 Dec	106·2
2008 Jan	105·5

Data from National Statistics Online

The annual rates of change of CPI and RPI are used as measures of inflation.

(a) Use figures from the table to show that the annual CPI rate of change from January 2007 to January 2008 was 2·2%, correct to 1 decimal place.

[2]



(b) The government's inflation target is that the CPI annual rate of change should be 2%. The Governor of the Bank of England has to write a letter of explanation to the Chancellor of the Exchequer for any month when the target is missed by more than 1 percentage point either way.

In the time period shown on the graph, when did the Governor of the Bank of England have to write to the Chancellor about inflation?

(b) ______________________________ **[2]**

6 Thirty people in a shopping centre were asked to take part in an experiment.
Their task was to enter ”the quick brown fox jumps over the lazy dog” into a mobile phone.

They used their own phone and then one belonging to the person carrying out the experiment.

Here are the raw results

Subject	Age	Time (seconds)	
		Own	New
1	15	27	37
2	13	66	68
3	53	122	117
4	14	38	41
5	40	52	71
6	16	21	32
7	44	80	90
8	14	38	54
9	52	104	98
10	60	116	103
11	13	30	61
12	42	105	138
13	17	36	42
14	14	50	62
15	15	44	91

Subject	Age	Time (seconds)	
		Own	New
16	14	37	62
17	38	65	90
18	43	64	80
19	14	39	45
20	14	38	59
21	39	102	195
22	48	82	98
23	14	57	56
24	45	56	72
25	61	88	97
26	50	81	79
27	13	42	51
28	14	55	73
29	47	108	88
30	42	54	82

Draw two conclusions about the speed of their texting.
Provide supporting evidence for each of your conclusions.

[5]

7 The carbon emissions, C grams per kilometre, when a car travels at a speed of v kilometres per hour, are modelled by the formula

$$C = \tfrac{1}{20}(v^2 - 200v + 12400).$$

Part of a spreadsheet calculating values of C for different values of v is shown below.

	A	B	C	D	E
1	*v*				*C*
2	50	2500	10000	4900	245
3	60	3600	12000	4000	200
4	70	4900	14000	3300	165
5	80	6400	16000	2800	140
6	90	8100	18000	2500	125
7	100	10000	20000		
8	110	12100	22000		
9	120	14400	24000		
10	130	16900	26000		
11	140	19600	28000		

(a) The formula in cell B2 is **=A2*A2**.

What formula has been entered in

(i) cell C2,

(a)(i) ____________________________ **[1]**

(ii) cell D2

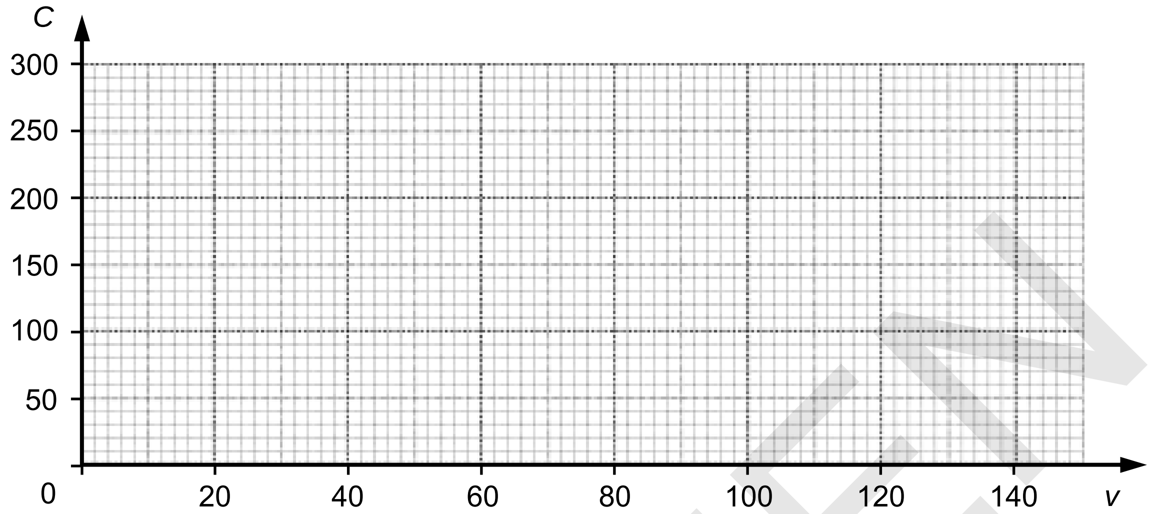
(ii) ____________________________ **[1]**

(b) Complete the results in columns D and E in the spreadsheet. **[3]**

(c) Based on the calculations in the spreadsheet, what speed results in the lowest carbon emissions?

(c) ________________________ km/h **[1]**

(d) Draw the graph of C against v.



An average car emits 170 g of carbon per km.

Use your graph to find the range of speeds the car can travel at to have carbon emissions which are below average.

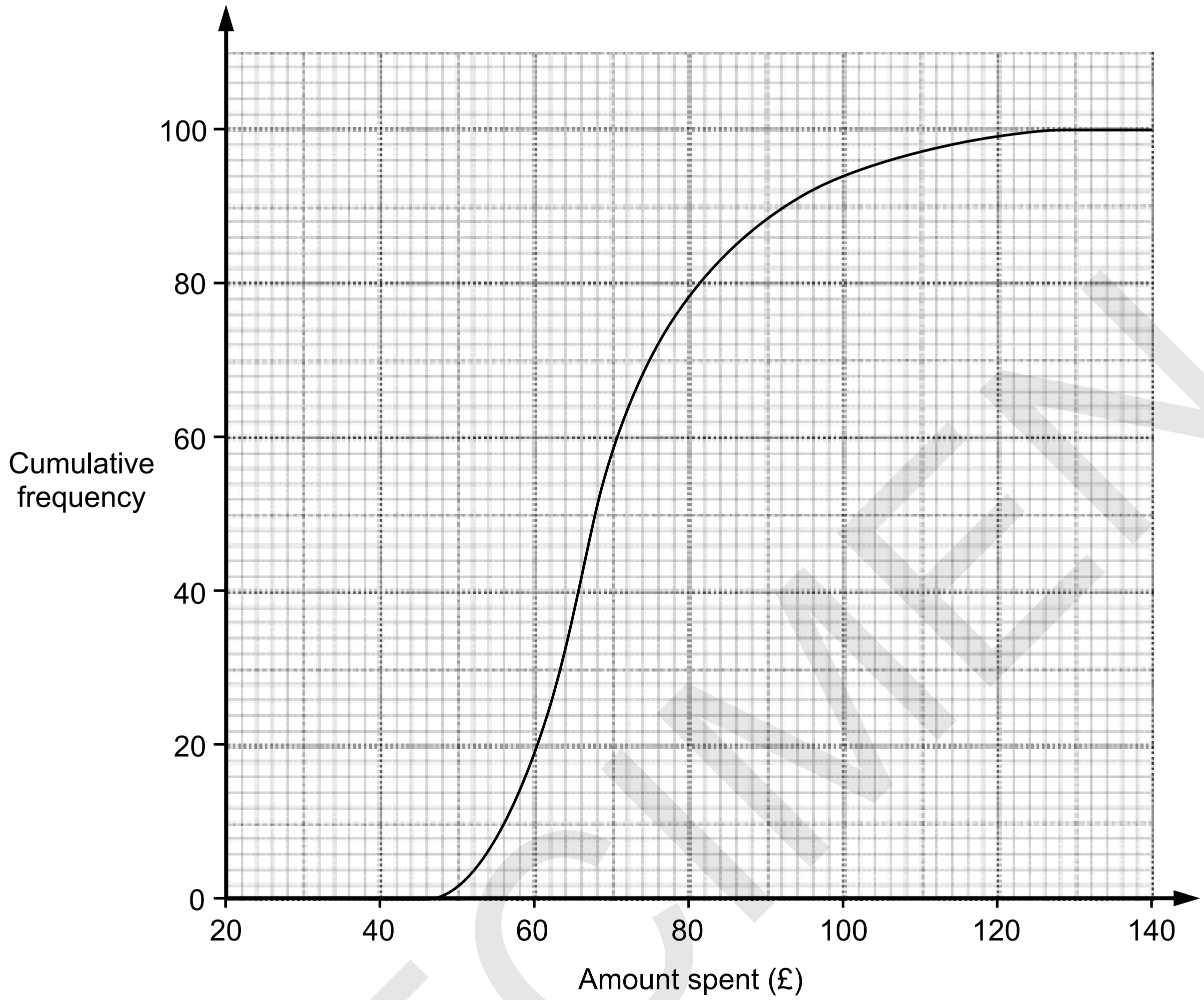
(d) ______________________ km/h **[4]**

(e) The car travels from Cardiff to London, a distance of 132 **miles**. A computer gives an estimate of 3 hours 8 minutes for the journey time.

Estimate the weight of the carbon emissions from this journey.

______________________ kg **[5]**

8 The cumulative frequency diagram shows the weekly expenditure on food of 100 families in England.



(a) Find

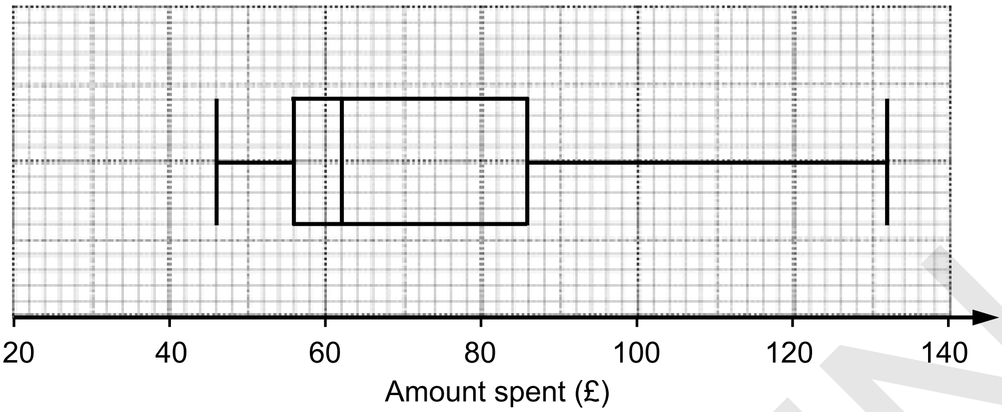
(i) the median,

(a)(i) £________________________ **[1]**

(ii) the interquartile range.

(ii) £________________________ **[2]**

(b) A similar survey was made of 100 families in Wales.
The box plot illustrates the results.



Describe **two** differences between the weekly spending on food of these families in England and in Wales.

1 ____

____

2 ____

____ **[2]**

9 Phillipa plans to use self-drive hire cars to supply the transport for a club outing.
A local company offers

- small cars that seat 4 people including the driver;
- large cars that seat 5 people including the driver.

Phillipa's plans must satisfy the following restrictions.

A 40 club members have booked to go on the outing.
B 12 members going are qualified drivers.
C 10 non-drivers have disabilities that mean they need to travel in large cars.
D To qualify for a special discount he must hire at least as many small cars as large.

(a) Restrictions B and D are represented by the inequalities $x + y \leq 12$ and $x \geq y$
where x is the number of small cars hired and y is the number of large cars hired.

(i) Explain why restriction C is equivalent to $y \geq 3$

____

____

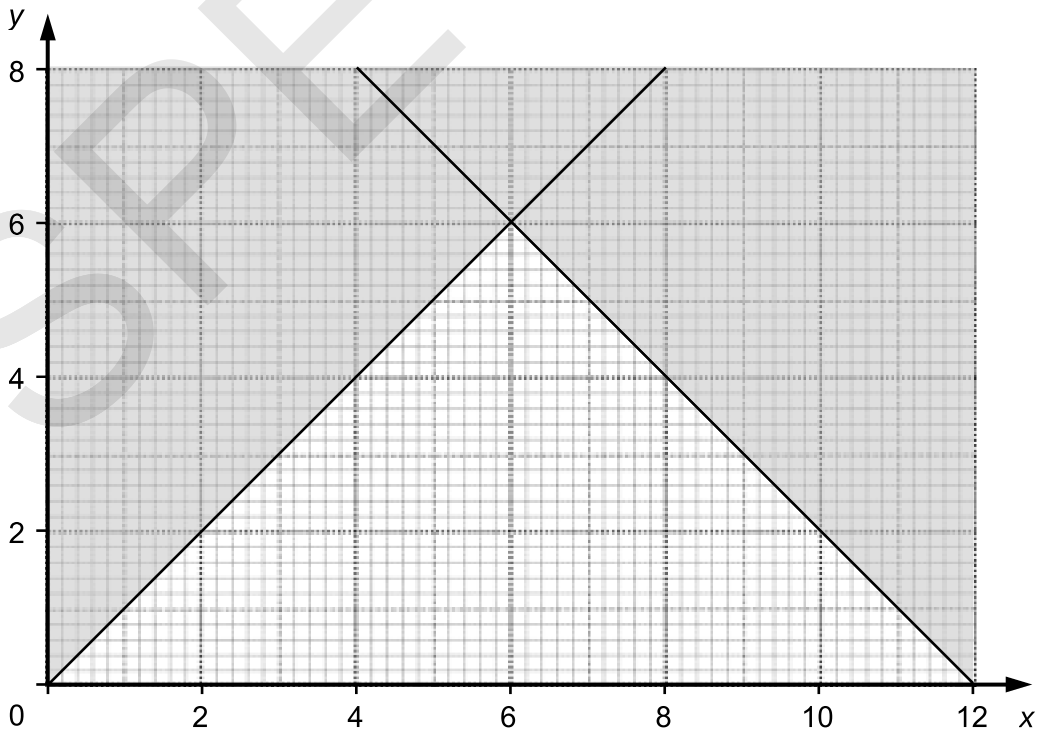
____ **[2]**

(ii) Write an inequality for restriction A.

(a)(ii) ______________________________ **[2]**

(b) Graphs of restrictions B and D have been drawn below.

On the same axes draw graphs of restrictions A and C.



[3]

(c) As a special offer the hire charges are £42 for each car, small or large.

(i) Write down an expression, in terms of x and y, for the total cost of hiring the cars.

(c)(i) __________________________ **[1]**

(ii) How many cars should Phillipa hire to minimise the total cost?

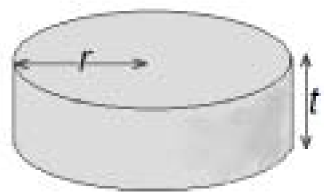
(ii) __________________ small cars and __________________ large cars **[2]**

(iii) If Phillipa books the numbers of cars you recommended in part **(c)(ii)** how many spare seats will there be?

(iii) ____________________________ **[1]**

10 (a) Show clearly that the surface area, S, of a cylinder of radius r and thickness t is given by

$$S = 2\pi r(r + t).$$



[3]

(b) Red blood cells are roughly cylindrical in shape.
The cells absorb oxygen on their surface.
This is then carried round the body.
When red cells stick together, there are fewer faces to absorb oxygen.
They stick together like coins in a pile.

Find and simplify an expression for the difference in area in the surface area of *n* free cells compared with *n* cells stuck together.

__________________________ **[6]**

11 The table gives the distance from the Sun of planets in the solar system.

Planet	Distance from Sun (km)
Earth	$1{\cdot}5 \times 10^8$
Jupiter	$7{\cdot}8 \times 10^8$
Mars	$2{\cdot}3 \times 10^8$
Mercury	$5{\cdot}7 \times 10^7$
Neptune	$4{\cdot}5 \times 10^9$
Saturn	$1{\cdot}4 \times 10^9$
Uranus	$2{\cdot}9 \times 10^9$
Venus	$1{\cdot}1 \times 10^8$

(a) Name the planets in order of distance from the sun with the planet nearest to the sun first.

____________ ____________ ____________ ____________

nearest

____________ ____________ ____________ ____________ **[3]**

furthest

(b) Light travels at $3{\cdot}0 \times 10^5$ km/s.

Calculate the time it takes for light to travel from the sun to Saturn.
Give your answer in hours correct to 1 decimal place.

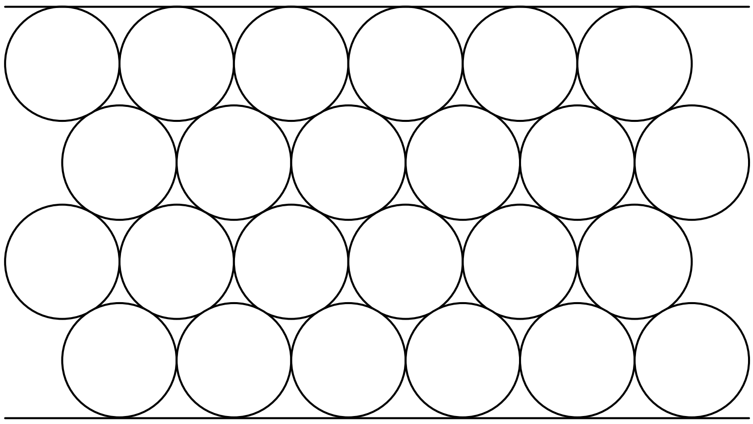
____________________ hours **[3]**

12 A restaurant is open every evening.
Each day the owner calculates a 7-point moving average of the number of customers.
The moving average for the period Saturday 6th to Friday 12th November was 84.
There were 133 customers on Saturday 6th.
There were 112 customers on Saturday 13th.

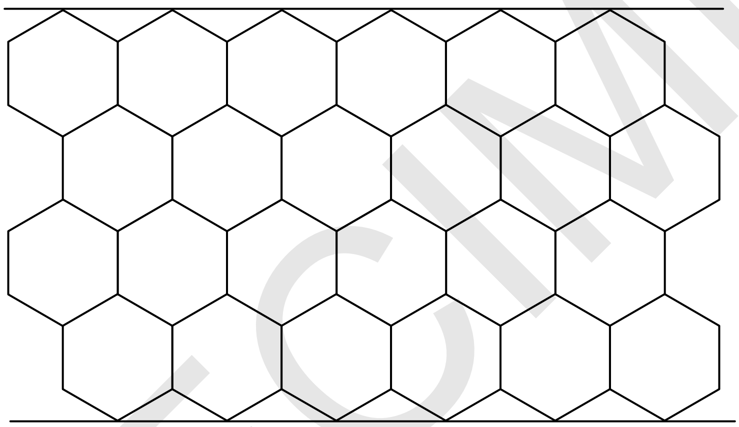
Calculate the 7-point moving average covering the period from Sunday 7th to Saturday 13th November.

_______________________________ **[3]**

13* In a biscuit factory, round biscuits, 7 cm in diameter, are cut from a long strip of dough.



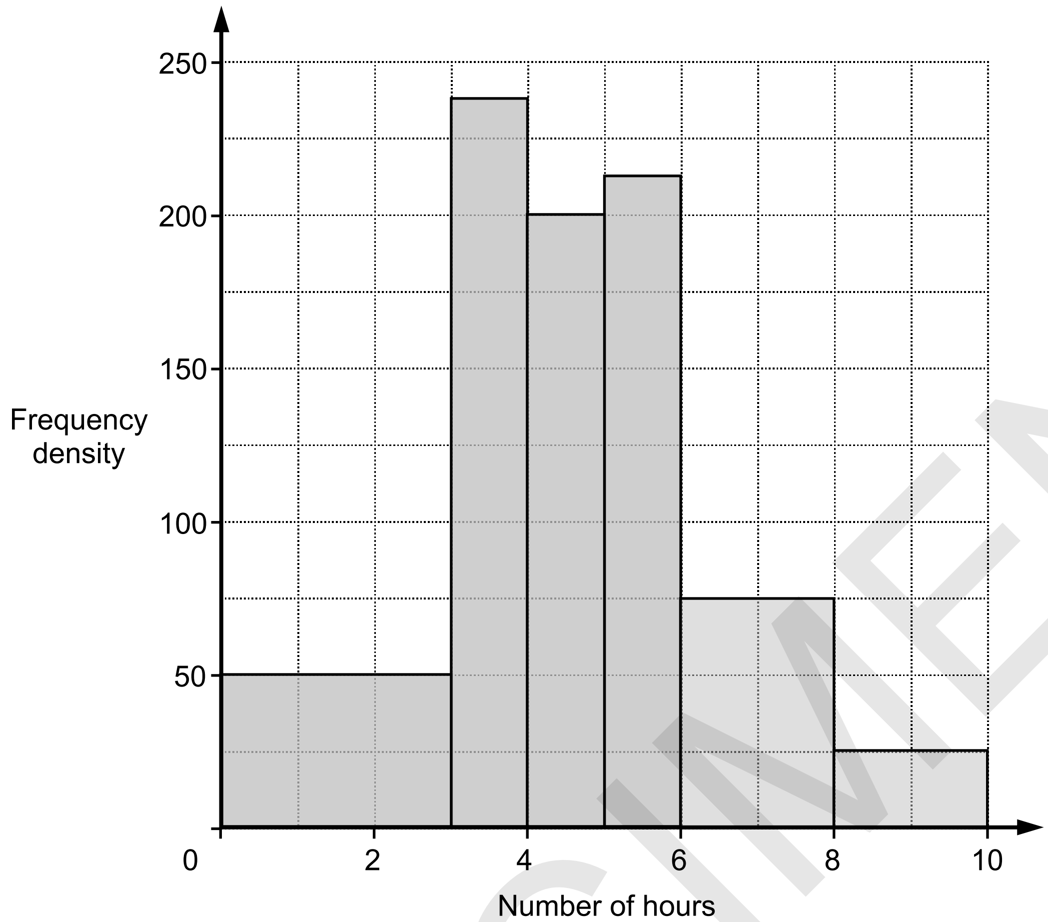
The diagram above shows how many biscuits fit across the strip of dough. To reduce waste, they decide to change to regular hexagonal biscuits. The following diagram shows how many biscuits fit across the strip of dough. The strip of dough is the same width. The manufacturer of the biscuit cutter needs to know the length of each side of the hexagonal biscuits.



How long is each side of the hexagonal biscuits?

______________________________cm **[6]**

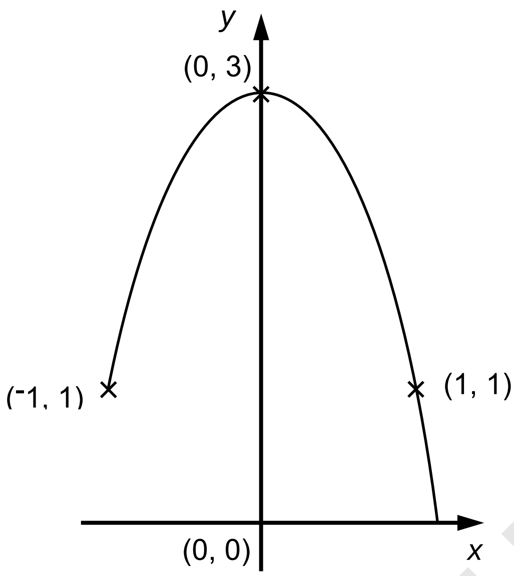
14 The histogram summarises the times visitors spent at the Castle Music Festival.



Estimate the percentage of visitors who spent between 2 and 7 hours at the Festival.

______________________________% **[3]**

15 The curve in the diagram represents a jet of water, part of an adventure playground.



The jet starts at A(⁻1, 1) and passes through B(0, 3) and C(1, 1).

The equation of the curve is $y = p - qx^2$.

Find the values of *p* and *q*.

p = ____________________, q = ____________________ **[3]**

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

General Certificate of Secondary Education

APPLICATIONS OF MATHEMATICS A382/02

Paper 2 (Higher)

Specimen Mark Scheme

The maximum mark for this paper is **90**.

This document consists of **6** printed pages.

1	**(a)**	Successful attempt to complete the probabilities in the right-hand column of the table. Comparing their probability for hang gliding with the other values. Making a clear and valid conclusion on the basis of these (their own) figures	**2** **1** **1**	For 1 or 2 correct award **B1**. Clearly and in "good English". [hang gliding : 0·00003 Skiing: 0·0000019 Skydiving : 0·000025]
	(b)	Attempt to measure map distance. Converting map distance into real distance. Successful attempt to use height (600 m) in the appropriate formula $d = \sqrt{12 \times 600} = 84{\cdot}85(28...)$ Comparing *d* with distance via map and making the relevant statement.	**1** **1** **1** **1** **1**	
2*		Structured argument, which includes supporting calculations e.g. a possible solution is to suppose Sanjay has 100 euros. At the bank he would get 100 ÷ 1·1374 = £87·92. At the money exchange he would get 100 ÷ 1·1462 = £87·24 therefore the bank is the better option. Clearly expressed recommendation. Comparison between bank and money exchange rates with minor errors in working **or** correct working with unclear recommendation No relevant comment or calculation.	**3** **1-2** **0**	For lower mark – an incomplete or incorrect attempt to compare the sell rates of the bank and the money exchange **or** partially correct working with a badly expressed conclusion.
3		7·7 WWW	**4**	**M1** for trial giving *V* > 1000. **M1** for trial between 7 and 8. **M1** for better trial between 7 and 8. **B1** for 7·7

<table>
<tr><td>4</td><td></td><td>29·2
Accept 29</td><td>4</td><td>B1 Two of 10, 30, 50, 70 seen.

M1 $600 + 1440 + 1500 + 840$ (= 4380)
Two fx added with
x chosen consistently from correct class.
M1 Cand's Σfx / 150</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>5</td><td>(a)</td><td>105·5 – 103·2 = 2·3
2·3 ÷ 103·2 = 0·0222…..</td><td>1
1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>March 2007
each month from May 2008 to December 2008</td><td>2</td><td>B1 March 2007
+ B1 May-Dec 2008</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>6</td><td></td><td>Conclusions to the effect that
“Subjects are slower with new mobile phones”

Supported by either an overall comparison of means or piecemeal subject by subject comparison.

“Younger people are quicker than older people”

Supported by a division of the set into two groups based on age.

The two groups compared using some measure of central location or if the groups are of equal size a simplistic comparison</td><td>1

1

1

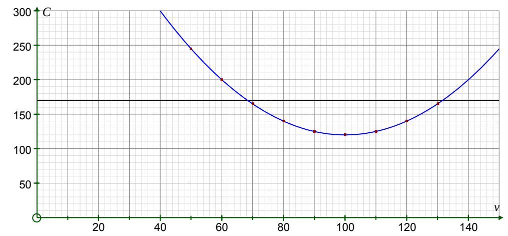
1

1</td><td>A conclusion without evidence may only gain 1 mark credit.

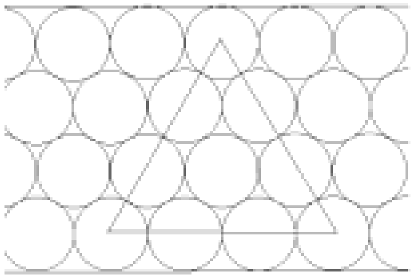
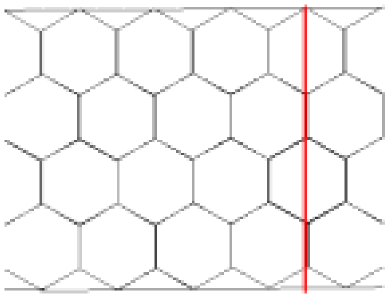
[under 30’s means
own: 41·2 new: 55·6

Over 30’s means
own: 85·2 new: 99·9]</td></tr>
<tr><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>7</td><td>(a)</td><td>(i) = 200*A2</td><td>1</td><td></td></tr>
<tr><td></td><td></td><td>(ii) = B2 − C2 + 12400</td><td>1</td><td></td></tr>
<tr><td></td><td>(b)</td><td>
<table>
<tr><td>v</td><td></td><td></td><td></td><td>C</td></tr>
<tr><td>50</td><td>2500</td><td>10000</td><td>4900</td><td>245</td></tr>
<tr><td>60</td><td>3600</td><td>12000</td><td>4000</td><td>200</td></tr>
<tr><td>70</td><td>4900</td><td>14000</td><td>3300</td><td>165</td></tr>
<tr><td>80</td><td>6400</td><td>16000</td><td>2800</td><td>140</td></tr>
<tr><td>90</td><td>8100</td><td>18000</td><td>2500</td><td>125</td></tr>
<tr><td>100</td><td>10000</td><td>20000</td><td>2400</td><td>120</td></tr>
<tr><td>110</td><td>12100</td><td>22000</td><td>2500</td><td>125</td></tr>
<tr><td>120</td><td>14400</td><td>24000</td><td>2800</td><td>140</td></tr>
<tr><td>130</td><td>16900</td><td>26000</td><td>3300</td><td>165</td></tr>
<tr><td>140</td><td>19600</td><td>28000</td><td>4000</td><td>200</td></tr>
</table>
</td><td>3</td><td>Allow B2 for one error in either column.

Allow B1 for up to 3 errors or omissions in either column.</td></tr>
<tr><td></td><td>(c)</td><td>100 km h^{-1}</td><td>1</td><td>ft from table.</td></tr>
</table>

	(d)		**1** **1**	Plot points (no more than one error) Smooth curve through points (ft).
		68 km h^{-1} to 132 km h^{-1} . (allow within plus or minus 2 km h^{-1} at each end)	**1** **1**	Read one value from graph. Answer given as a range of speeds in km h^{-1} (ft).
	(e)	Convert 132 miles in km at some point. Attempt with reasonable conversion factor. Arrive at 208 – 215. (using 8/5 answer is 211·2) Time is about 3 hours so average speed is about 70 km h^{-1} . At this speed, carbon emissions are 165 g km^{-1}. For 212 km (132 miles), this is about 35 kg.	**1** **1** **1** **1** **1**	(Average) speed Use of graph or table to find approx emissions per km. Accept 34 – 36 kg, with working, since a more accurate average speed is 67 km h^{-1}.
8	**(a)**	(i) 68	**1**	
		(ii) 16	**2**	**M1** 78($\pm$1) – 62($\pm$1)
	(b)	The Welsh spent less (in general / on average). And The Welsh spending was more spread out.	**2**	It must be clear which nationality is the subject.
9	**(a)**	**(i)** Each large cars takes 4 passengers. $\frac{10}{4} = 2\frac{1}{2}$ so 3 large cars are needed.	**2**	Complete, clear argument or **B1** detail incomplete or unclear, or extra detail 0 no relevant comment.
		(ii) $4x + 5y \geq 40$	**2**	**M1** $4x + 5y$
	(b)	2 correct ruled lines & correct shading	**3**	**B1** $y \geq 3$ drawn & shaded correctly. **M1** $4x + 5y = 40$ ruled correctly.
	(c)	**(i)** $42(x + y)$	**1**	Or $42x + 42y$
		(ii) 5 small and 4 large cars	**2**	**B1** evidence of evaluating total cost at integer grid points in unshaded region or sliding $x + y = k$,
		(iii) 0	**1**	ft from **(ii)** using $4x + 5y - 40$ for non-negative answer.
10	**(a)**	Area of two circular faces = $2 \times (\pi r^2)$ Area of curved side $2\pi rt$ Total area = $2 \times (\pi r^2) + 2\pi rt = 2\pi r(r + t)$	**1** **1** **1**	Clearly stated in "good English". Clearly stated in "good English". Must have both parts.

	(b)	For n cells stuck together Area of two circular faces = $2 \times (\pi r^2)$ Area of curved surface $n \times 2\pi rt$ Total surface area $2 \times (\pi r^2) + n \times 2\pi rt$ Area of n separate cells $n \times 2\pi r(r + t)$ So decrease is: $n \times 2\pi r(r + t) - 2 \times (\pi r^2) - n \times 2\pi rt$ $= 2\pi r(rn - r)$ or $2\pi r^2(n - 1)$	 **1** **1** **1** **1** **1** **1**	
11	**(a)**	Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune	**3**	**B2** for reverse order. **B1** if Mercury is at one end with Saturn, Uranus and Neptune (in any order) at the other end.
	(b)	1·3	**3**	**M1** $(1{\cdot}4 \times 10^9)/(3 \times 10^5)$ (=4666·…) **M1** …/60 soi
12		81	**3**	**M2** 81– (133 – 112)/7 or (84 × 7 – 133 + 112)/7 **Or** **M1** (133–112)/7 oe soi or 84 × 7 (= 588)
13*		A complete solution to the whole problem, clearly structured, leading to the correct answer given to an appropriate degree of accuracy (4, 3·9 or 3·87 cm). Calculation of the width of the dough (25·(…)) and an attempt to calculate the length of the side of a hexagon based on *their* width. An attempt at structuring their work. An attempt to calculate the width of the dough (25·(…)) with some evidence of the process they are using. No relevant comment or calculation.	**5-6** **3-4** **1-2** **0**	For lower mark - a complete solution to the whole problem, with some lack of clarity in the structure and correct answer given to an appropriate degree of accuracy (4, 3·9 or 3·87 cm). For lower mark - a calculation of the width of the dough (25·(…)) with minor errors together with an attempt at structuring their work. For lower mark - an attempt to calculate the width of the dough (25·(…)) with little evidence of the process they are using.

		 Triangle shown is equilateral with side 21cm. Height is 21 sin 60°= 18·186… cm. Width of dough is 18·186… + 7 cm = 25·186…cm.  Width of strip = 6*d* + *d* cos 60° where *d* is the side length of a hexagonal biscuit. 6·5 *d* =25·186…= 3·874… 3·9 cm.		
14		77·5	**3**	**M2** 31/40 or 775/1000 or **M1** any of 31, 40, 775, or 1000 seen or evidence that candidate recognises that each square rep. 25 visitors
15		$p = 3$, $q = 2$	**3**	**B1** $p = 3$ **M1** $p - q = 1$ or better

Assessment Objectives and Functional Elements Grid

GCSE Applications of Mathematics

A382/02 (Higher)

Qn	Topic	AO1	AO2	AO3	Functional
1a	Risk/probability	2	2		
1b	Estimation	3	1	1	5
2*	Finance			3	3
3	Trial and improvement	4			
4	Mean	4			
5a	Percentage/read graph		2		
5b	Read graph		2		2
6	Interpreting data		3	2	
7	Spreadsheet and graph	6	9		4
8	Median, IQR and boxplot	5			
9	Linear programming	5	2	4	
10	Surface area of disc	5		4	
11	Standard form	6			
12	Moving averag	3			
13*	Shape, trig Pythag			6	6
14	Histogram		3		
15	Coeffs. of quadratic		3		
	TOTAL	43	27	20	20