Practice questions for GCSE Mathematics from 2010

GCSE Mathematics A, Mathematics B, Applications of Mathematics and Methods in Mathematics

General Certificate of Secondary Education   **J562**, **J567, J925, J926**

This document consists of past papers for OCR's GCSE Additional Mathematics pilot specification (J915) and may be useful in teaching the new OCR GCSE Mathematics and Linked Pair pilot specifications from September 2010.

Introduction

OCR's innovative GCSE Additional Mathematics pilot specification (J915) has proved hugely popular with centres and was fully subscribed with 10 000 learners taking the papers in summer 2008 and 2009.

The GCSE Additional Mathematics papers include questions in the style of new Assessment Objective 3, which requires candidates to "Interpret and analyse problems and generate strategies to solve them." (AO3 in Methods in Mathematics also includes mathematical reasoning.)

GCSE Additional Mathematics is assessed by a single paper covering all grades from G to A*. Each part of a question is designed to build on the previous parts and step up in demand. The intention is that learners of all abilities can attempt at least a part of each question and that the final parts of some questions will provide a suitable challenge for the most able mathematicians.

Taken as a whole, these papers therefore have a different style and 'feel' to papers for the new Mathematics and Linked Pair pilot specifications and are not indicative of the style of the new specifications' papers. However it is anticipated that teachers will find individual questions interesting and useful classroom resources in preparing students to tackle problem solving questions in Mathematics.

The following series of question papers and mark schemes are available.
June 2007
January 2008
June 2008
January 2009
June 2009

Please use the PDF bookmarks to navigate to each paper or mark scheme.

As pilot centres are still preparing learners for GCSE Additional Mathematics examinations (the specification runs until January 2012) the most recent papers have not been included so that these can continue to be used as mock examinations. However further papers and mark schemes will be added to this booklet in the future.

We hope you find this resource useful.

GENERAL CERTIFICATE OF SECONDARY EDUCATION **J915/01**

GCSE LEVEL 1/2 IN ADDITIONAL MATHEMATICS

FRIDAY 29 JUNE 2007
Morning

Time: 2 hours

Candidates answer on the question paper.
Additional materials: Electronic calculator
Geometrical instruments
Tracing paper (optional)

Candidate Name	

Centre Number					

Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Show your working. Marks may be given for working that shows that you know how to solve the problem even if you get the answer wrong.
- You are expected to use an electronic calculator for this paper.
- Final answers should be rounded to an appropriate degree of accuracy.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.

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 100.
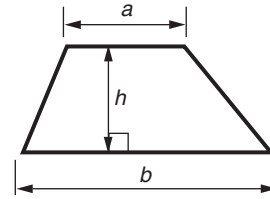- Unless otherwise instructed in the question, take π to be 3.142 or use the π button on your calculator.
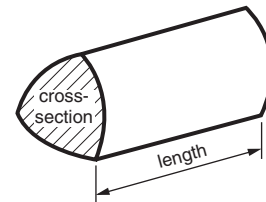
For Examiner's Use

This document consists of **20** printed pages.

Formulae Sheet

Area of trapezium $= \frac{1}{2}(a + b)h$
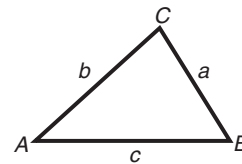
Volume of prism = (area of cross-section) x length

In any triangle *ABC*

Sine rule $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$
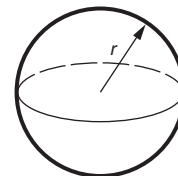
Cosine rule $\; a^2 = b^2 + c^2 - 2bc \cos A$

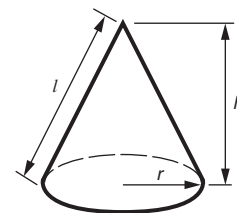**Area of triangle** $= \frac{1}{2} ab \sin C$

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

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

1 **(a)** Jo has the following nine coins in her purse.

<div align="center">10p 1p 2p 50p 10p 1p 20p 2p 1p</div>

    (i) Work out the median.

                                              (a)(i) _____ p [2]

    (ii) Write down the range.

                                              (ii) _____ p [1]

(b) Twenty people emptied their pockets and counted the number of coins they had. The frequency table shows the data.
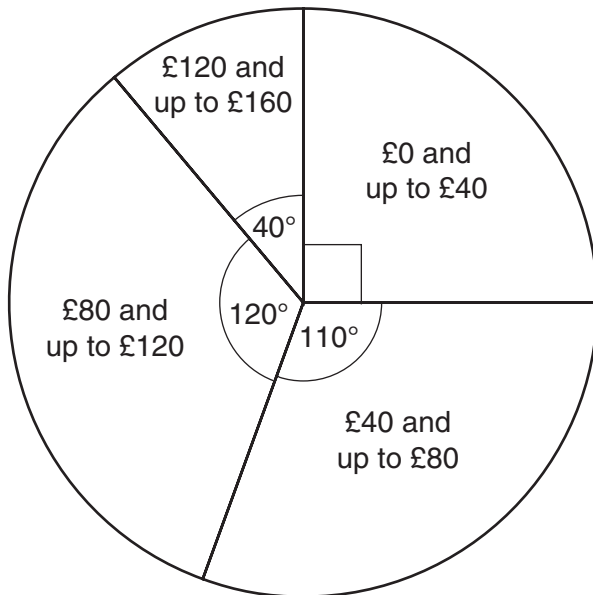
Number of coins	Frequency
5	3
7	6
8	5
10	4
15	2

Work out the mean.

                                              (b) _____[3]
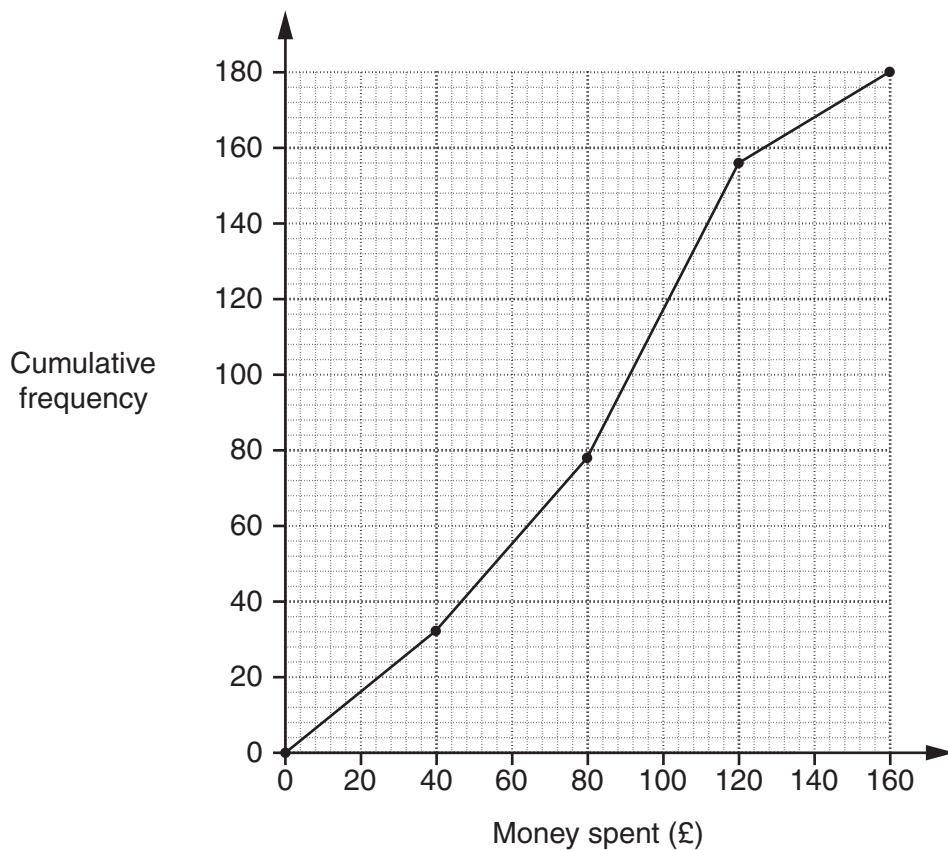
[Turn over

(c) Peta and Chloe each carried out a survey on the amount of money that students, aged 16, spent during one month.

There were 180 students in each survey.

Peta drew this pie chart to show her results.

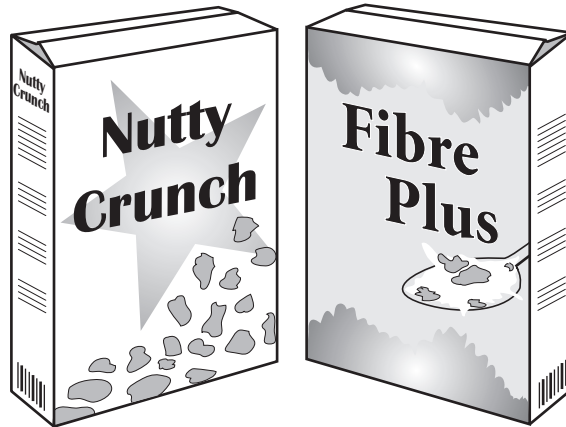Chloe drew this cumulative frequency diagram to show her results.

Find a similarity and a difference in the results of the two surveys.

Use calculations to justify your answers.

Similarity: _____

_____

Difference:_____

_____[8]

_____

[Turn over

2

The table shows some nutritional information for 100 g of each of these cereals.

		Nutty Crunch	**Fibre Plus**
energy	kJ	1661	1548
sugar	g	35	24
salt	g	1.15	1.5
iron	mg	7.9	8.8

(a) In a 100 g serving

  (i) which cereal supplies more energy,

(a)(i) _____[1]

  (ii) how many more kilojoules (kJ) of energy does it supply?

(ii) _____[2]

(b) Nutty Crunch is supplied in 40 g packets, Fibre Plus in 50 g packets.

  (i) How much sugar (in grams) does a 50 g Fibre Plus packet contain?

(b)(i) _____ g [1]

(ii) A 40 g packet of Nutty Crunch contains more sugar than a 50 g packet of Fibre Plus: how much more?
Give your answer in grams.

(ii) _____ g [3]

(iii) A packet of Fibre Plus contains more salt than a packet of Nutty Crunch: how much more?
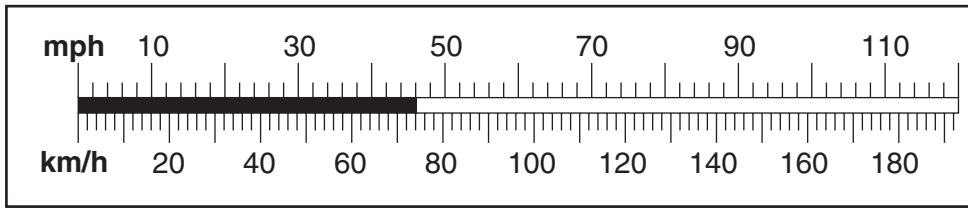Give your answer in grams.

(iii) _____ g [4]

(c) 100 g of Nutty Crunch provides 55% of the recommended daily allowance of iron.
100 g of Fibre Plus provides 65% of the recommended daily allowance of iron.

Calculate the recommended daily allowance of iron.

(c) _____ mg [4]

[Turn over

3 **(a)** The diagram shows a car's speedometer.

mph 10	30	50	70	90	110
km/h 20 40	60 80	100 120	140	160	180

(i) What is the speed of this car in miles per hour?

(a)(i) _____mph [1]

(ii) The speed limit is 70 miles per hour.

Approximately, what is this in kilometres per hour?

(ii) _____ km/h [1]

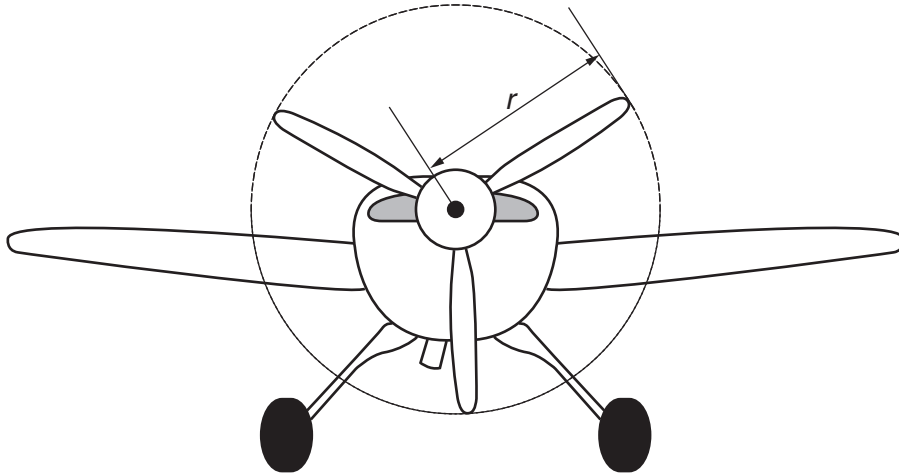(iii) Convert 250 km/h to miles per hour.

(iii) _____mph [2]

(b) A car travels a distance of 920 metres in 1 minute.

Work out the average speed of the car in kilometres per hour.

(b) _____ km/h [3]

(c)

The propeller on a Red Bull racer turns 50 times each second.
The tip of the propeller is travelling at 340 m/s, the speed of sound.

Calculate the radius, *r*, of the propeller.

(c) _____ m **[5]**

4 **(a)** Here is a sequence of multiples of 3.

<p style="text-align:center">3   6   9   12   15   _____   _____</p>

Write down the next two numbers in the sequence. [1]

ALL the sequences in the rest of this question start with a positive whole number and use this rule to work out the numbers.

> **Look at the last number recorded:**
> - **if it is a multiple of 3, divide it by 3;**
> - **if it is not a multiple of 3, add 2.**

(b) One sequence starts as follows.

<p style="text-align:center">17   19   21   7   _____   _____   _____   _____</p>

17 is not a multiple of 3 so we add 2, getting 19.

21 is a multiple of 3 so we divide by 3, getting 7.

 (i) Write down the next four numbers in the sequence. [2]

 (ii) Write down the 100th number in the sequence. Explain how you decided.

_____ because _____

_____[2]

(c) Another sequence starts with 10 and uses the same rule as before.

Find the 100th number in this sequence.

(c) _____[3]

(d) The **second** number in another sequence is 7.

Find **both** the possible starting numbers.

(d) _____ , _____[2]

(e) In this question k is a positive integer.
Give your answers to the following in terms of k, simplifying expressions where possible.

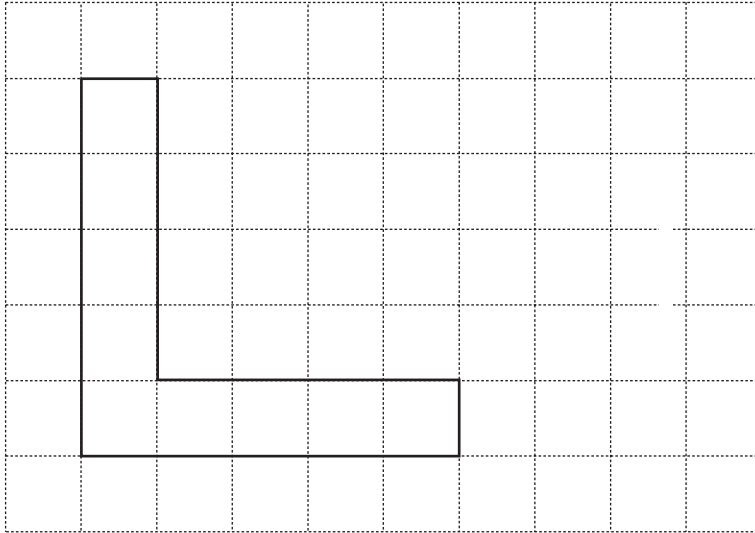 **(i)** The first term of one of these sequences is $3k$; find the next term.

(e)(i) _____[1]

  (ii) The first term of another of these sequences is $3k + 1$; find the next two terms.

(ii) _____ _____[2]

  (iii) The first term of a further one of these sequences is $3k + 2$; find the next three terms.

_____ _____ _____[2]

[Turn over

5 (a)

(i) Find the area of this L-shape.
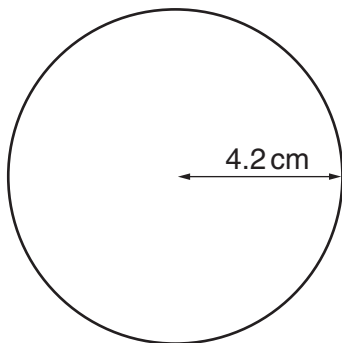
(a)(i) _____ cm² [1]

(ii) On the grid, draw a square with the same area as the L-shape. [1]
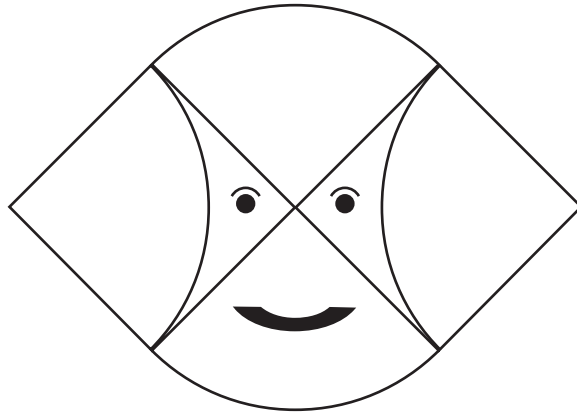
(b) (i) Calculate the area of this square.

4.2 cm
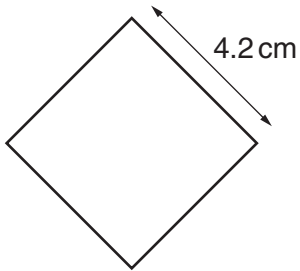
(b)(i) _____ cm² [2]

(ii) Calculate the area of this circle.
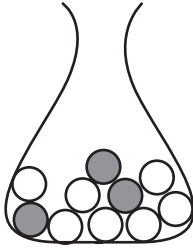

4.2 cm

(ii) _____ cm² [2]

(c) Sam cut a circle, of radius *r* cm, into quarters. She arranged the quarter circles and glued them onto paper to make this face of an alien.

Find, in terms of *r*, the total area of the alien's face.

(c) _____ cm² [5]

[Turn over

6 **(a)** Peter has a bag of 10 marbles.
There are 3 green marbles in the bag.

Peter chooses a marble at random from the bag.

Write down the probability that Peter chooses a green marble.

(a) _____[1]

(b) Sally has a bag of marbles.
Some of the marbles are orange; the rest are purple.

The probability of choosing an orange marble at random from the bag is $\frac{1}{5}$.

Sally doubles the number of orange marbles in the bag, without changing the number of purple marbles.

Work out the new probability of choosing an orange marble at random from the bag.

(b) _____[3]

(c) Reuben has a bag of marbles.
The marbles are red, yellow or blue.
There are 8 blue marbles in the bag, x red marbles and y yellow marbles.
The probability of choosing a red marble at random is 0.4.

(i) Show that $3x - 2y = 16$. [3]

(ii) Reuben triples the number of yellow marbles in the bag, without changing the number of red and blue marbles.
The new probability of choosing a yellow marble at random is 0.6.

Find the values of x and y.

(c)(ii) $x =$ _____ $y =$ _____[5]

[Turn over

7 **(a)** Here is the formula for working out a gas bill.

> Total bill = number of units used × rate per unit.

The rate per unit is 2.25 pence per unit.

Find the total bill when 3924 units are used.

(a) £ _____[2]

(b) **(i)** Evaluate $a - 2b - 8c$ when $a = 28$, $b = 5$ and $c = \frac{3}{4}$.

(b)(i) _____[1]

(ii) Evaluate $4x + 3y$ when $x = 35$ and $y = -12$.

(ii) _____[1]

(c) Write down an expression for the total cost of x computers at £473 each and y printers at £72 each.

(c) £ _____[2]

(d) The table shows the number of articles available on an Internet encyclopaedia site.
The data are for 1st January each year from 2003 to 2007.

Date	2003	2004	2005	2006	2007
Time from January 2003 (t years)	0	1	2	3	4
Number of articles (N_t)	11 000	23 000	49 000	102 000	215 000
$\dfrac{N_t}{N_{t-1}}$		2.09			

(i) Explain why $\dfrac{N_1}{N_0}$ is approximately 2.09.

_____[1]

(ii) Complete the last row of the table and explain how this shows that the growth is approximately exponential.

_____[2]

(iii) Estimate (to the nearest thousand) the number of articles available on this site on 1st January 2008.

(d)(iii) _____[1]

(iv) Find an approximate formula for N_t in terms of t.

(iv) $N_t =$ _____[2]

[Turn over

8 **(a)**
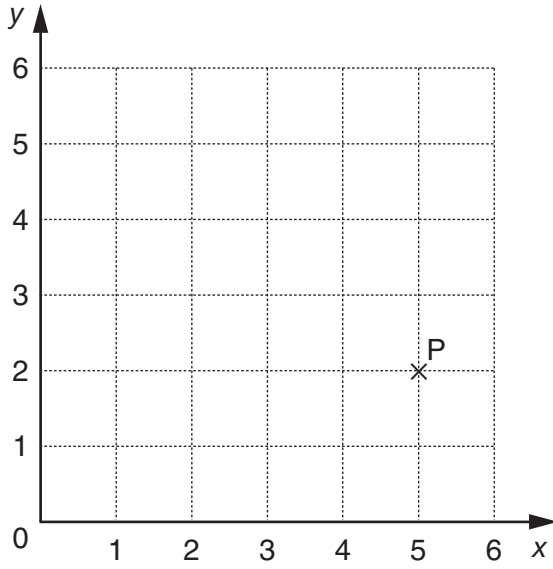
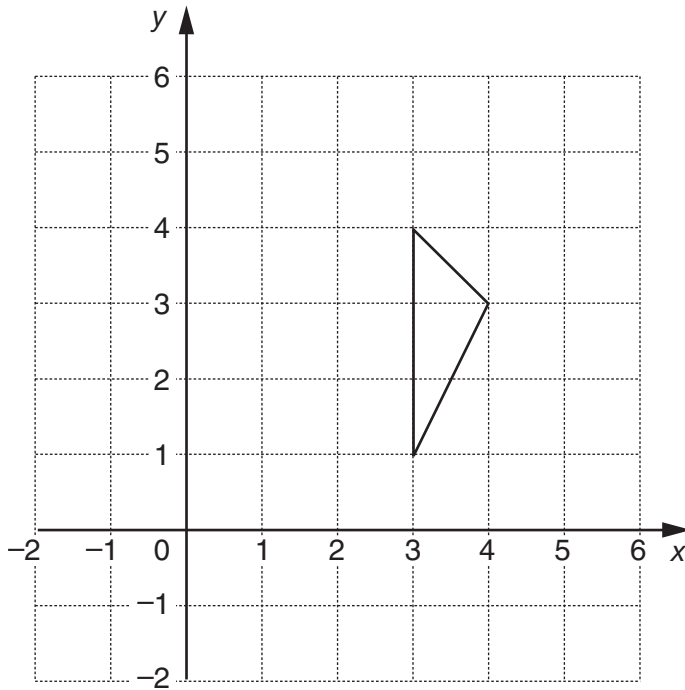**(i)** Write down the coordinates of the point P.

(a)(i) (_____ , _____)[1]

(ii) Plot the point Q (3, 4). [1]

(b) Translate the triangle by vector $\begin{pmatrix} 1 \\ -2 \end{pmatrix}$. [2]

(c) Vectors **a** and **b** are such that

- **a** ≠ **b**,
- **a** + **b** and **a** – **b** are two vectors equal in magnitude.

Show that the vectors **a** and **b** are perpendicular. [5]

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GCSE

Mathematics

General Certificate of Secondary Education **GCSE J915**

Mark Scheme for the Component

June 2007

CONTENTS

General Certificate of Secondary Education

Mathematics (J915)

MARK SCHEMES FOR THE COMPONENT
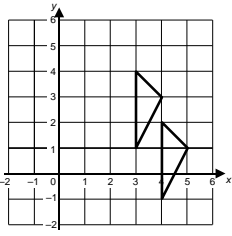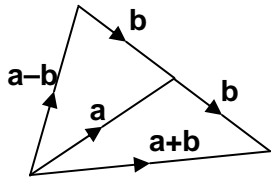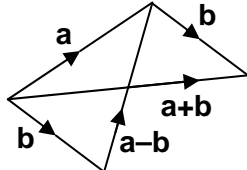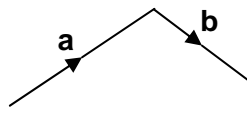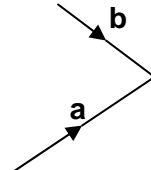
	Final mark scheme details J915/01	Mark	June 2007
1	(a)(i) 2	2	**M1**: Data ordered. e.g. 1,1,1,2,2,… oe First or last 5 values
	(ii) 49	1	
	(b) 8·35	3	**M1**: fx evaluated; condone 2 slips (Σfx =15+42+40+40+30=167) **M1**: Candidate's Σfx $\div$20
	(Accept 8·3 and 8·4; accept 8 supported)		
	(c) **Similarity**: same modal class, 80 to 120 oe or: top class is least common oe	2	**SC1**: same (unidentified) modal class or same range oe or recognises sig. of steepness of cf graph
	Difference: supported comparison of means e.g. Peta's mean, 72 < Chloe's mean, 81 Comments must relate to what surveys show not how results are presented.	6	**B5**: comparison of medians, iqrs or sds e.g. P's median, 73 < C's median, 86 Peta's iqr, 64 > Chloe's iqr, 58 Peta's sd, 38·7 > Chloe's sd, 37·3 **OR** **B3**: correct comparison of location or spread without calculating mean, median, etc e.g. P's students spent less than C's; or Peta's students' spending was more spread out than Chloe's or P's median < C's median with evidence **OR** **M1**: 2 freqs or cum.freqs soi eg propns **DM1**: Peta's cf graph or table for mean **A1**: Peta's median, iqr, mean or sd **DM1A1**: Chloe's mean or sd **or B1**: Chloe's median or iqr **B1**ft: Compares like with like (medians, iqr, means, freqs or propns in eg 0–40 class) or compares location or spread from (e.g.) cf graphs or non-trivial correct comparison without work.

	Peta	Chloe
	f (cf) %	f (cf)(±2) %
0 –	45 (45) 25	32 (32) 17·8
40 –	55 (100) 30·6	46 (78) 25·6
80 –	60 (160) 33·3	78 (156) 43·3
120 – 160	20 (180) 11.1	24 (180) 13·3
(max) range	160	160
lq	40	51±2
median	73±2	86±2
uq	104±2	109±2
iqr	64±4	58±4
mean	13000/180 =72·2 ±3	14560/180 =80·9 ±3
st dev	38·6(6…)	37·3(4…)

2	(a)(i) Nutty Crunch	1	
	(ii) 113	2	**M1**: 1661 − 1548 attempted
	(b)(i) 12	1	
	(ii) 2	3	**M1:** 35 × 0·4 or ÷2·5 (= 14) Condone ×40 **DM1:** cand's 14 − (b)(i) provided ans > 0
	(iii) 0·29 (Accept 0·3)	4	**M1:** 1·15 × 0·4 or ÷2·5 (= 0·46) **M1:** 1·5 × 0·5 (= 0·75) **DM1:** cand's 0·75 − cand's 0·46

	(c) 14 (Condone 14·0)	4	**SC3:** 13·5 or 14·4 or 13·9(…)
			 M1: 0·55 or 0·65 soi
			      eg ×100÷55 or ×55÷100
			 DM1A1: 7·9/0·55 ≈ 14·3(…)
			        or 8·8/0·65 ≈ 13·5(3…)
			
			 <u>Alternative approaches:</u>
			 ①
			 55% ≡ 7·9 & 65% ≡ 8·8 so 120% ≡ 16·7
			 leads to **M1**: 1·2 soi (as above)
			 DM1A1A1: 16·7÷1·20 = 13·9(…) ≈14
			 ②
			 55% ≡ 7·9 & 65% ≡ 8·8 so 10% ≡ 0·9
			 leads to **B4**: 9 (must be supported)
			        or part marks as above
			 or **M1**: 8·8 + multiples (or steps) of 0·9
			 DM1A1A1: 8·8 + 3·5 × 0·9 = 11·9(5) ≈12
			 (Sim. for 7·9 + 4·5 × 0·9 = 11·9(5) ≈12)

3	(a)(i) 46	1	
	(ii) 113 (Tol: ±1)	1	
	(iii) 155 (Tol: ±5)	2	**M1**: 250×5/8, 250/1·6, 2 × 77 or 78, etc 250×12/20, 250 × mph ÷ corresp km/h Condone 2×74
	(b) 55(·2)	3	**M2**: 920 × 60 / 1000 or **M1**: 920 × 60 or 920 / 1000
	(c) 1·08 Accept 1 or 1·1 following 1·08(…) seen	5	**B4**: 1·08 (…) or 1·1 **SC4**: 2·16 with reference to d or diameter **M1**: 50×2πr **DM1**: = 340 **DM1**: ($r =$) 340/100π **SC1**: 2πr soi or 340/50 (= 6·8)
4	(a) 18, 21	1	
	(b)(i) 9, 3, 1, 3	2	**M1**: starts with 9
	(ii) 3 because 3, 1 alternate or 100 is even or I checked to 10th term	2	**B1**: 3 **B1**: recognises correct alternating pattern
	(c) 6	3	**M2**: 4, 6, 2 cycle recognized (eg 4, 6, 2, 4 seen or 4, 6, 2 seen & ans = 2 or 4) or **M1**: (12,) 4, 6, 2 seen
	(d) 5, 21	2	**B1** each term**,** either order
	(e)(i) k isw	1	Condone unsimplified answers in (e).
	(ii) 3k + 3, k + 1 isw	2	**M1**: 3k + 3 in either answer space
	Accept reversed order here & in (iii)		
	(iii) 3k + 4, 3k + 6, k + 2 isw	2	**M1**: 3k + 6 in 2nd answer space

5	(a)(i) 9	1	
	(ii) 3 cm by 3 cm square drawn. No ft.	1	Condone freehand.
	(b)(i) 17·64 (Accept 17·6)	2	**M1**: 4·2×4·2
	(ii) 55·(4…) Condone 55·3(…)	2	**M1**: π×4·2×4·2
	(c) $2r^2 + \pi r^2/2$ oe Mark final answer. Do not isw Accept $3·57(…)r^2$ and unsimplified answers	5	**M1DM1**: $\pi r^2 / 2$ Accept $\pi r^2 / 4$ **M1DM1**: $r^2 \times 2$
6	(a) 3/10 Accept 0·3 or 30%	1	Do not accept 3:10
	(b) 1/3 oe Condone 0·333 or better Accept 1:3 only if 3:10 was given for (a)	3	**M1**: Doubles no. of orange marbles (specific labelled value) **DM1**: No. of purple marbles $= 4 \times$ original no. of orange marbles Or new total no. of marbles $= 6 \times$ original no. of orange marbles **Alternative**: $\dfrac{k}{5k} \to \dfrac{k+k}{5k+k}$ **M1** **DM1**
	(c)(i) $\dfrac{x}{x+y+8} = \dfrac{2}{5}$ $5x = 2x + 2y + 16$ $3x - 2y = 16$	3	**B1**: $x + y + 8$ **B1**: $\dfrac{x}{x+y+8}$ **B1**: forms equation & completes proof
	(ii) $x = 12$, $y = 10$ (Must be supported; answer alone gets 0)	5	**B1**: $x + 3y + 8$ **B1**: $\dfrac{3y}{x+3y+8}$ **M1**: $\dfrac{3y}{x+3y+8} = \dfrac{3}{5}$ **DM1**: simplifying to $15y = 3x + 9y + 24$ or $x - 2y = -8$ or attempting to eliminate a variable by using (c)(i) **A1**: $x = 12$ and $y = 10$

7	(a) 88.29 Condone 88.29p	2	**M1**: $2\cdot25\times3924$ soi eg: 8829
	(b)(i) 12	1	
	(ii) 104	1	
	(c) $(473x + 72y)$ Mark final answer. Condone omission of brackets	2	**M1**: either term; condone $x473$, etc in working but not in final answer.
	(d)(i) $N_1/N_0 = 23000/11000$ oe	1	Accept eg 23000 is a bit more than 2×11000
	(ii) $2\cdot1(3\ldots)$, $2\cdot0(8\ldots)$, $2\cdot1(0\ldots)$ N_{t+1}/N_t is (approximately) constant oe	2	**B1**: 2 correct quotients; accept art $2\cdot1$ **B1**: constant multiplier recognized
	(iii) 452 000 Must be rounded to nearest thousand.	1	Accept 430, 449, 450, 451, 452, 453 or 454 thousand.
	(iv) $11000\times2\cdot1^t$ Allow $2\cdot1 \pm 0\cdot1$	2	**M1**: $a\times b^t$ with a, b numerical, $a \neq 1$; or b^t with $b = 2$ or better.

8	(a)(i) (5, 2)	1	
	(ii) Point plotted at (3, 4). May be plotted on grid for (b).	1	If several points plotted go by label Q. If several points labelled Q: 0.
	(b) Δ translated correctly	2	**M1**: translated 1 to right **or** 2 down
	(c) Full illustrated proof	5	
	Alternative:		**B1**: **a** & **b** drawn with arrows and **a** ≠ **b** **M1**: **a** + **b** shown eg
	B1M1M1: as before **DM1**: Δ with 2 sides equal ⇒ isos. Δ **A1**: so **a** (from vertex to midpoint of base) is perpendicular to **b**.		**M1**: **a** − **b** shown eg **DM1**: equal length diags. ⇒ rectangle **A1**: so **a** & **b** are perpendicular

General Certificate of Secondary Education

Additional Mathematics (J915)

June 2007 Assessment Series

Component Threshold Marks

Component	Max Mark	A*	A	B	C	D	E	F	G
J915/01	100	71	59	47	35	28	22	16	10

Overall

	A*	A	B	C	D	E	F	G
Percentage in Grade	8.8	16.2	24.8	24.8	10.7	6.3	4.8	2.4
Cumulative Percentage in Grade	8.8	25.0	49.8	74.6	85.3	91.6	96.4	98.8

The total entry for the examination was 6279.

Statistics are correct at the time of publication.

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GENERAL CERTIFICATE OF SECONDARY EDUCATION   **J915/01**

GCSE IN ADDITIONAL MATHEMATICS

FRIDAY 11 JANUARY 2008   Afternoon

                                              Time: 2 hours

Candidates answer on the question paper.
Additional materials: Electronic calculator
                          Geometrical instruments
                          Tracing paper (optional)

Candidate Forename		Candidate Surname	

Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Show your working. Marks may be given for a correct method even if the answer is incorrect.
- Final answers should be rounded to an appropriate degree of accuracy.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- 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 **100**.
- You are expected to use an electronic calculator for this paper.
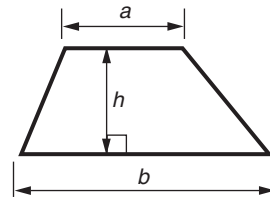- Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
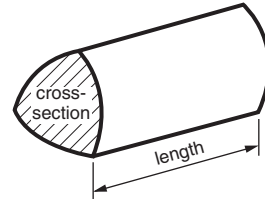
FOR EXAMINER'S USE

This document consists of **20** printed pages.

Formulae Sheet

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

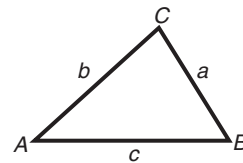**Volume of prism** = (area of cross-section) x length

In any triangle *ABC*

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

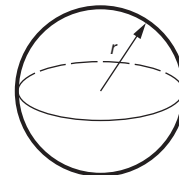**Cosine rule** $a^2 = b^2 + c^2 - 2bc\cos A$
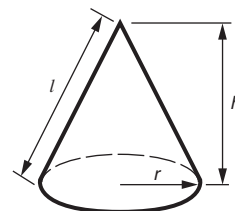
Area of triangle $= \frac{1}{2}ab\sin C$

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

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

1 **(a)** Two ways are in common use when quoting the fuel consumption of a car.

miles per gallon   litres per 100 kilometres

The graph shows the relationship between them.
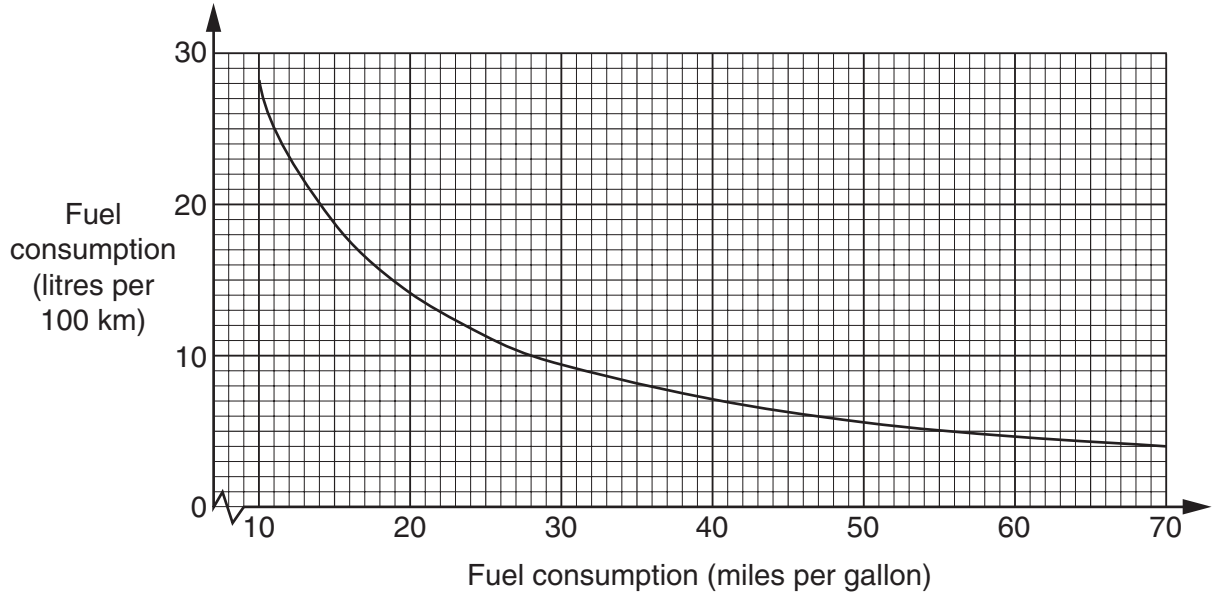
(i) Change 40 miles per gallon into litres per 100 km.

(a)(i) _____ litres/100 km [1]

(ii) Change 17.5 litres per 100 km into miles per gallon.

(ii) _____ miles/gallon [1]

[Turn over

(b) **(i)** Write down the coordinates of the point labelled P on the grid below.

(b)(i) (_____ , _____) [1]
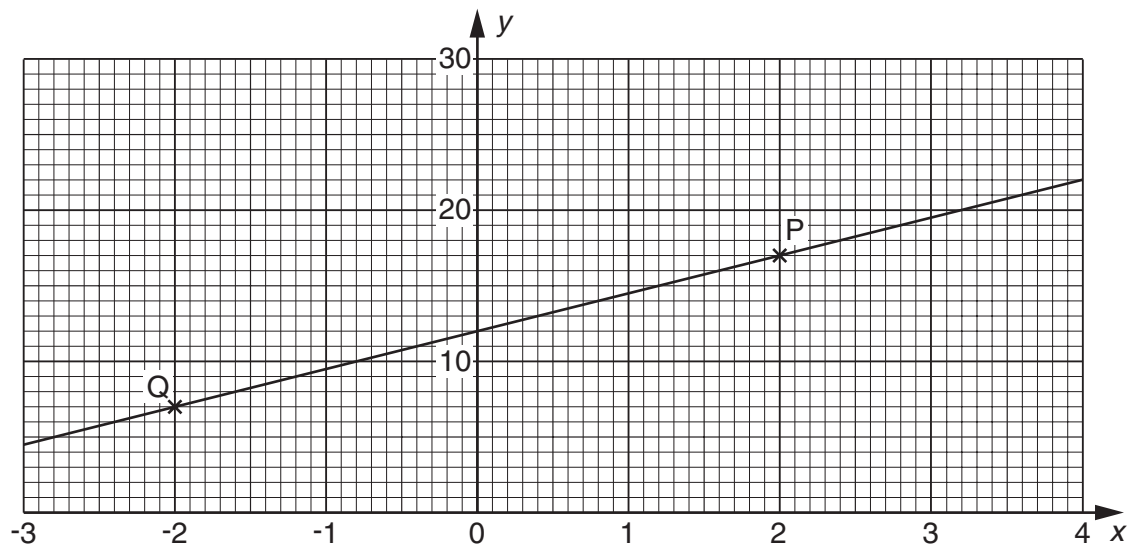
(ii) Find the equation of the straight line PQ.

(ii) _____[3]

(iii) Complete the table of values for the equation $y = 27 + 3x - 2x^2$.

x	−3	−2	−1	0	1	2	3	4
y	0	13	22		28	25	18	

[2]

(iv) On the grid for part **(b)(i)** draw the graph of $y = 27 + 3x - 2x^2$ for values of x from −3 to 4.

[2]

(v) Write down the x-coordinates of the points where the line PQ intersects this curve.

(v) _____ , _____ [2]

(vi) The x-coordinates you found in part **(b)(v)** are the solution of a quadratic equation.
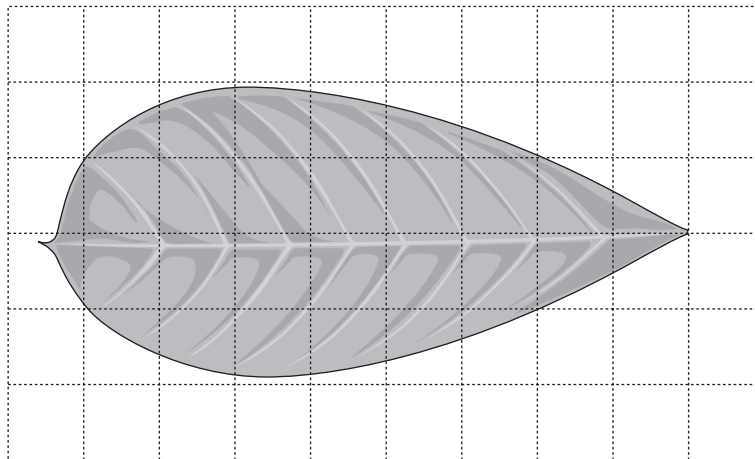
Write down that equation.
You are not required to simplify the equation.

(vi) _____[1]

---

2 (a) Estimate the area of this leaf. It is shown on a 1 cm square grid.

(a) _____cm² [2]

(b) Under each solid write its mathematical name.

(b) _____   _____ [2]

[Turn over
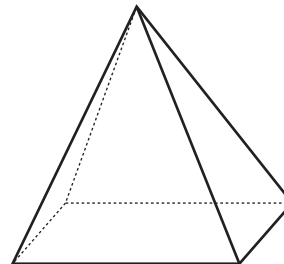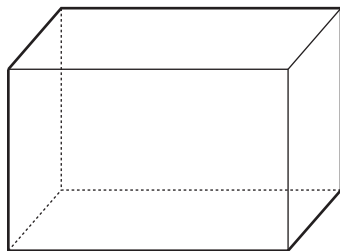
(c) The diagram shows a jar of marmalade and its label.

6.5 cm   6.5 cm

7.5 cm

A   B

D   C

Marmalade

Marmala

OCR
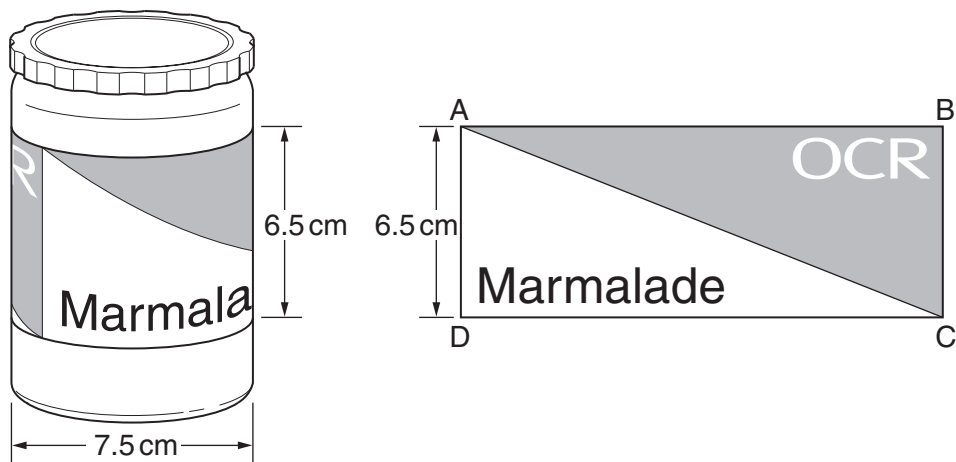
The label is a rectangle, ABCD, 6.5 cm tall; it fits exactly round the cylindrical jar.
The diameter of the jar is 7.5 cm.

Calculate the length of

(i) DC,

(c)(i) _____ cm [2]

(ii) the diagonal, AC, of the label.

(ii) _____ cm [3]

(d) The picture shows a wire toast rack.
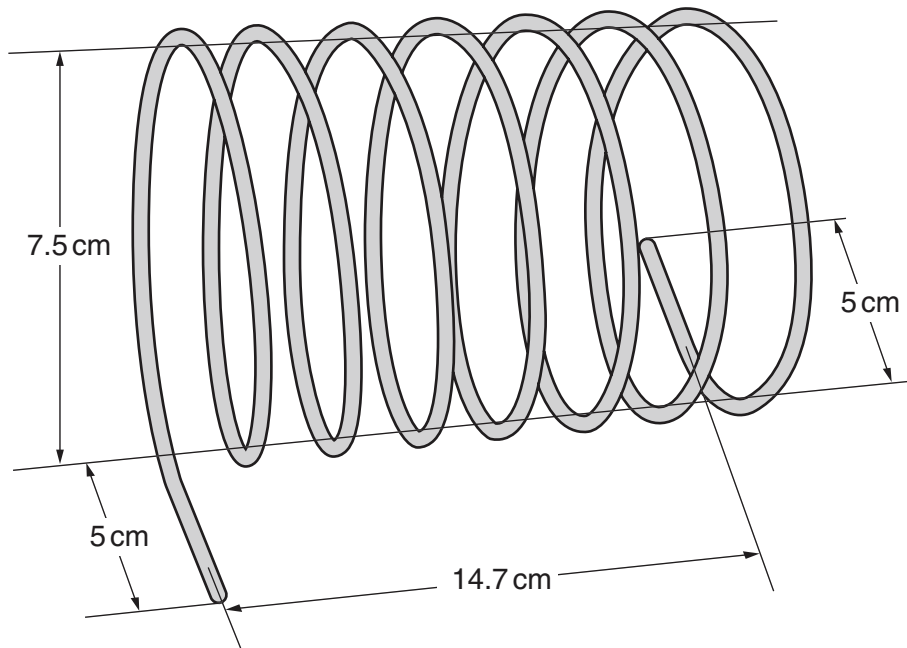
It consists of 7 loops of a cylindrical spiral, uniformly spread out.
The base of the toast rack is 14.7 cm long.
The diameter of the spiral is 7.5 cm.
At each end of the spiral there is a straight, horizontal section of length 5 cm.

Calculate the total length of the wire, making your method clear.

(d) _____ cm [5]

[Turn over

3 **(a)** Reuben, an entertainer, invites Jeremy and Mary to play *The Number Game* by following these six instructions.

1	**Select any whole number between 2 and 9**
2	**Multiply this number by 2**
3	**Add 5**
4	**Multiply the answer by 50**
5	**If you have already had your birthday this year add 1758;** **if you haven't, add 1757**
6	**Now subtract the four-digit year that you were born**

Jeremy was born on 6th February 1991 and is playing the game on 11th January 2008.
He selects 6 as his response to instruction 1.

(i) Find the number that Jeremy should obtain when he has worked through all six instructions.

(a)(i) _____[3]

Mary was born on 5th January; she is also playing the game on 11th January 2008.
She uses n for her response to instruction 1.

(ii) Find, in terms of n, what Mary's answer should be when she has worked through the first **five** instructions.
Simplify your answer.

(ii) _____[3]

Reuben claims that the correct answer to instruction 6 has these properties:

- the first digit is the number the player first thought of;
- the last two digits are the player's age.

(iii) Using your answer to part **(ii)**, explain why Reuben's claims are usually correct for those who have already had their birthday this year. [2]

There are some players for whom Reuben's claims are wrong.

(iv) How old are these players?

(iv) _____[1]

(b) Simon's birthday is on 1st January.
Sometime in the future the square of his age (in completed years) will be equal to the 4-digit year number.

Find how old Simon is now.
You may use trial and improvement.

(b) _____ years [3]

[Turn over

4 **(a)** A farmer recorded the number of days in January that the temperature fell below freezing. These are his results for the last 10 years.

$$9 \quad 12 \quad 15 \quad 12 \quad 10 \quad 10 \quad 16 \quad 13 \quad 15 \quad 15$$

(i) Calculate the mean of these data.

(a)(i) _____ days [2]

(ii) Write down the modal value.
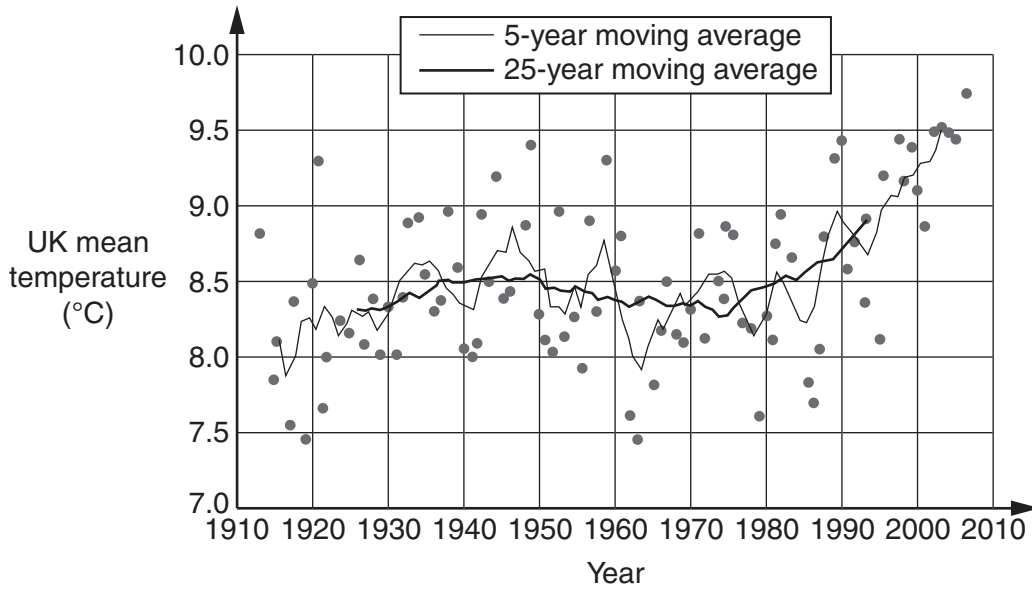
(ii) _____ days [1]

(b) The diagram shows the UK mean temperature (in degrees Celsius) for each of the 93 years from 1914 to 2006 inclusive; the median and quartiles for these data are also shown.
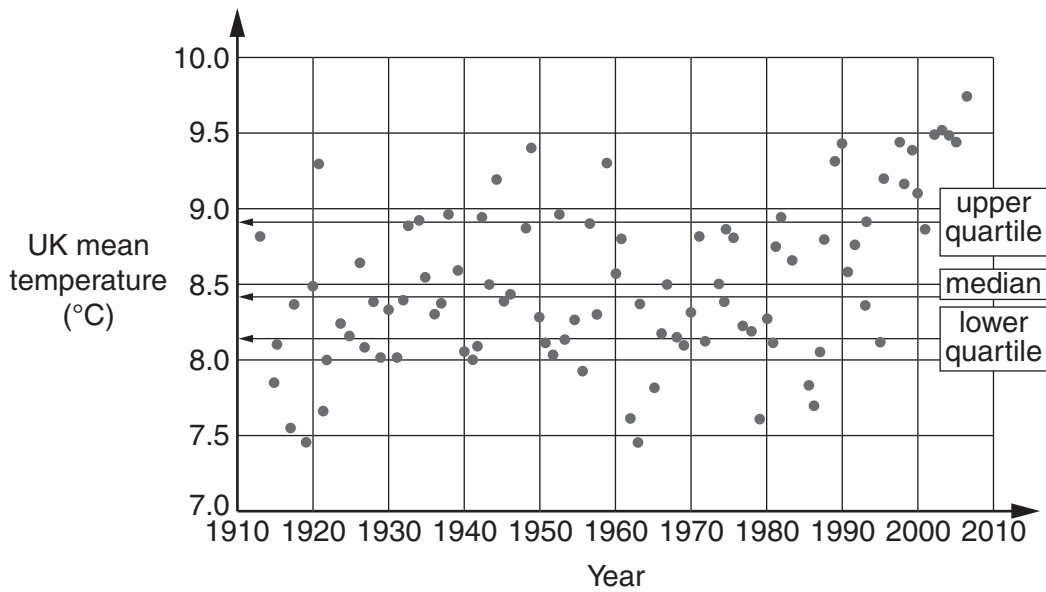
(i) What does the diagram show about UK mean temperatures?
Give details to justify your answer.

_____

_____[2]

This diagram shows the same data, together with the 5-year and 25-year moving averages.

   (ii) Describe any trends you see, giving relevant dates.

   _____

   _____

   _____

   _____[2]

   (iii) Explain why the 25-year moving averages produce the smoother graph.

   _____

   _____[1]

(c) Daryl uses 7-day and 21-day moving averages to predict changes in share prices.

   State one advantage and one disadvantage of using the 21-day moving averages rather than the 7-day moving averages when predicting changes in share prices.

   Advantage: _____

   _____

   Disadvantage: _____

   _____[2]

[Turn over

5 **(a)** Here is the formula for working out Billie's wage.
She is paid £5.45 per hour.

> Total wage = number of hours worked × pay per hour + bonus

Find her total wage when she worked 32 hours and is due a bonus of £27.50.

(a) £ _____ [2]

(b) Use the formula $v = 63 - 6t$ to find v when $t = 7$.

(b) _____ [2]

(c) Solve.

(i) $5c + 17 = 38$

(c)(i) _____ [2]

(ii) $4(2d - 5) = 48$

(ii) _____ [3]

13

(d) Write down an expression for the total cost (in pounds) of

c clarinets at £119 each
and d drum kits at £153 each.

(d) £ _____[2]

(e) Simplify.

   (i) $p^3 \times p$

(e)(i) _____[1]

   (ii) $\dfrac{z^2 - 5z}{z^2 - 25}$

(ii) _____[3]

[Turn over

6 **This question is about letters posted on Mondays.**

They may be posted 1st class or 2nd class.
They are never delivered on Monday.
They are all delivered on or before Friday of that week.
The day a letter is delivered is independent of the day on which any other letter is delivered.

The table shows possible delivery days and some of their probabilities.

Delivered on	1st class letter	2nd class letter
Tuesday	0.8	0.1
Wednesday	0.15	0.6
Thursday	0.05	0.2
Friday	0	

(a) The table shows the probability that a 1st class letter is delivered on Friday is 0.

Explain briefly what this means.

_____[1]

(b) Work out the probability that a 2nd class letter is delivered on Friday.

(b) _____[2]

(c) Two letters are posted on Monday, one 1st class, the other 2nd class.

Work out the probability that the 1st class letter is delivered on Thursday and the 2nd class letter on Thursday or Friday.
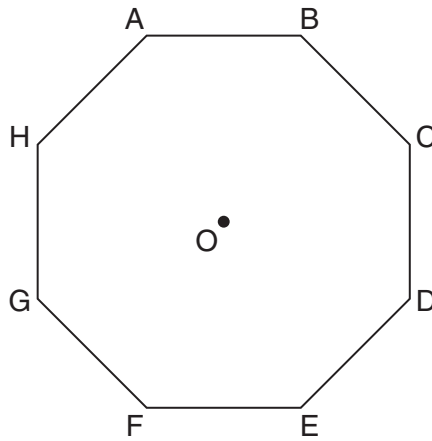
(c) _____[3]

(d) Two letters are posted on Monday, one 1st class, the other 2nd class.

Work out the probability that the 2nd class letter is delivered on any day before the 1st class letter.

(d) _____[4]

[Turn over

7   The diagram shows a regular octagon ABCDEFGH, with centre O.

(a) Draw all the lines of symmetry that **pass through vertices** of the octagon. [2]

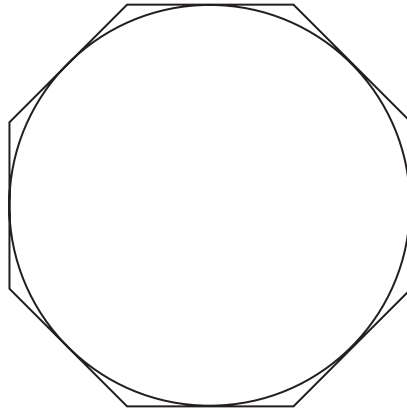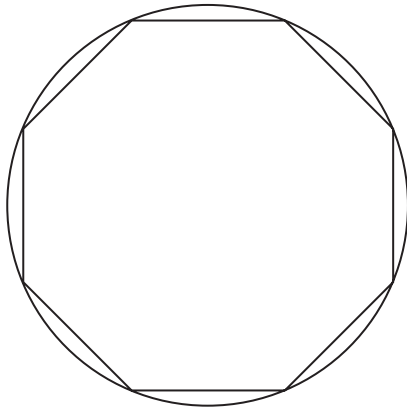**(b)** Show working to explain why

    (i)   angle AOB = 45°, [1]

    (ii)   angle ABC = 135°. [2]

(c) (i) Calculate the area of the octagon when OA = 5 cm.

                                                (c)(i) _____ cm^2 [3]

(ii) The two diagrams show circles each with radius 5 cm.
One diagram also shows the largest regular octagon that just fits inside the circle.
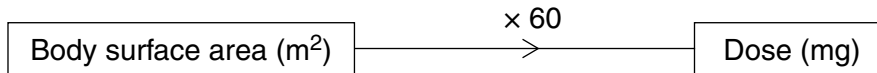The other diagram also shows the smallest regular octagon that just contains the circle.

NOT DRAWN
FULL-SIZE

By considering the areas of the circles and the octagons, show that

$$2.82 < \pi < 3.32 .$$

[5]

[Turn over

8 **(a)** A hospital treats Gill with a drug.
This formula is used to calculate the dose.

$$\boxed{\text{Body surface area (m}^2)} \xrightarrow{\times 60} \boxed{\text{Dose (mg)}}$$

Calculate the dose for Gill who has a body surface area of $1.75\,\text{m}^2$.

(a) _____ mg [2]

(b) The drug is mixed in saline to make 1 litre of mixture which is given to Gill at a steady rate.
At this rate it takes 2 hours to give Gill 1 litre of the mixture.
Gill has received 0.68 litres.

How long will it take for Gill to receive the rest of the mixture?
Give your answer to the nearest minute.

(b) _____ minutes [3]

(c) Some hospitals use the formula

$$A = 0.007184h^{0.725}m^{0.425}$$

to estimate *A*, the body surface area of a patient in square metres, where the patient is *h* cm tall and weighs *m* kg.

(i) The formula for body surface area was developed in 1916 from data obtained in a survey of 9 individuals of varying age, shape and size.

Make two comments on the survey from which this formula was developed.

1 _____

_____

2 _____

_____[2]

(ii) Use the formula to calculate the value of *A* for a patient who is 162 cm tall and weighs 65 kg.

(c)(ii) _____ m^2 [1]

(iii) By changing 0.425 into a fraction, express $m^{0.425}$ in the form $\sqrt[a]{m^b}$ where *a* and *b* are whole numbers with no common factors.

(iii) _____[3]

(iv) The formula is sometimes expressed in the alternative form

$$A = cH^{0.725}m^{0.425}$$

where *c* is a constant, the patient is *H* metres tall and weighs *m* kilograms and again *A* is the body surface area in square metres.

Find the value of *c*.

(iv) _____[2]

PLEASE DO NOT WRITE ON THIS PAGE

GCSE

Mathematics

General Certificate of Secondary Education **GCSE J915**

Mark Schemes for the Component

January 2008

CONTENTS

General Certificate of Secondary Education

Mathematics (J915)

MARK SCHEMES FOR THE COMPONENT

J915/01 Paper 1

				Mark	
1	**(a)**	**(i)**	7	**B1**	
		(ii)	6	**B1**	
	(b)	**(i)**	(2, 17)	**B1**	
		(ii)	$y = 2.5x + 12$ oe Condone omission of "$y =$"	**B3**	M1: $\delta y/\delta x$ soi A1: $2.5x$ SC1: $(y =)\ mx + 12,\ m \neq 2.5$
		(iii)	27, 7	**B1+1**	
		(iv)	Points plotted ft $\pm$1mm Smooth curve through pts ft $\pm$1mm	**P1** **C1**	Condone 1 mistake Condone 1 omission
		(v)	−2.6, 2.8 or 2.9 ft $\pm$0.1	**B1+1**	Ignore any y-coordinates given SC1: −3, 3
		(vi)	$27 + 3x − 2x^2 = 2.5x + 12$ oe ft from (ii)	**B1**	Accept: $2x^2 − 0.5x − 15 = 0$ ft from (ii) $(x + 2.6)(x − 2.8) = 0$ ft from (v)
2	**(a)**		Accept answers between 20 & 24	**B2**	M1: evidence of counting squares half or more than half full, OR of filling leaf with rectangles and/or triangles
	(b)		Cuboid (or rectangular prism), pyramid	**B1+1**	Condone strange spelling bod: triangular pyramid
	(c)	**(i)**	23.6 Accept 23.5(…)	**B2**	M1: $7.5 \times \pi$
		(ii)	24.4(…)	**B3**	M1: $[(c)(i)]^2 + 6.5^2$ ($\approx 597.4…$) Dep M1: $\sqrt{(their\ 597.4…)}$
	(d)		176 Accept 175.6 www (without wrong working)	**B5**	M1: $[(c)(i)]^2 + 2.1^2$ ($\approx 559.5…$) Dep M1: $\sqrt{(their\ 559.5)}$ ($\approx 23.65…$) Dep M1: *their* 23.65…$\times 7$ A1: $\approx 165.5…$ **Alternatively**: M1: $7 \times (c)(i)$ ($\approx 164.9…$) M1: $[7(c)(i)]^2 + 14.7^2$ (≈ 27419.9) Dep M1: $\sqrt{(their\ 27419)}$ A1: $\approx 165.5…$ SC4: 152 or 151.9 Or SC1: 2.1 or 14.7/7 seen

3	(a)	(i)	616	B3	M1: $(6 \times 2 + 5) \times 50$ (= 850) M1: + 1757 (=2607)
		(ii)	$100n + 2008$	B3	M1: $2n + 5$ oe M1: "$(2n + 5)$" $\times 50$ (=$100n + 250$)
		(iii)	Full explanation	B2	M1: 2008 – year of birth gives age; A1: adding $100n$ (where n is single digit & age <100) gives 3-digit number with n as the first digit Accept "100"
		(iv)	They are 100 or more years old. oe	B1	M2: (Born in) 1980
	(b)		28	B3	or M1: $45^2 = 2025$, or $\sqrt{2000} \approx 44 \cdot 7$ or 45 seen
4	(a)	(i)	12·7	B2	M1: Evidence of Σx (= 127) attempted
		(ii)	15	B1	

	(b)	(i)	The temperature is rising with appropriate evidence.
			
			Accept the following with justification.
			The temperature was rising till the '50s.
			The temperature was rising after the '70s.
			
			SC1: The data shows little (or no) correlation.
				B2	Possible evidence:
					• The 5 hottest years were post 2000.
					• The 7 hottest years were post 1989.
					• 8 of 9 hottest years were post 1989.
					• Yrs when temp > uq are mostly post 1980 (14) rather than pre 1960 (9).
					
					• (Weak) +ve correlation till 1950.
					• (Weak) +ve correlation from 1970.
					
					B1: • The temperature is rising.
					    • The temperatures vary.
					    • A true observation without giving justification.

		(ii)	Any 2 correct statements. (1 each; must have approx dates)	B2	Mean temperature was • rising until about 1950 • declining from '50s to mid '70s • rising towards end of data.
		(iii)	The more points used, the less effect each value has on the (moving) average.	B1	Oe
	(c)		**Advantage:** The 21-day chart is less likely to indicate a false start to a trend. **Disadvantage:** By the time a 21-day moving average signals a trend, much of the price change has already passed.	B1	**Alt**: The 21-day chart only signals major (or long-lasting) changes. **Alt**: The 21-day chart is subject to a time delay. **In (c) do not accept comments about temperatures.**

5	(a)	201·9(0)	**B2**	M1: $32 \times 5·45$ (= 174·4)
	(b)	21	**B2**	M1: 6×7 (= 42) clearly calculated first
	(c)	(i) 4·2 oe	**B2**	M1: $38 - 17$ (= 21) or better seen **T&I** M1: correct trial with 4·2
		(ii) 8·5 oe	**B3**	M1: $2d - 5 = 12$ or $8d - 20 = 48$ M1: $2d = 17$ or $8d = 68$ **T&I** M2: correct trial with 8·5 or M1: a correct 1st trial
	(d)	$(119c + 153d)$ Condone omitted brackets	**B2**	B1: one term correct or $c119$ or $153 \times d$
	(e)	p^4	**B1**	
	(f)	$\dfrac{z}{z+5}$ www - mark final answer	**B3**	M1: $z(z - 5)$ and M1: $(z - 5)(z + 5)$
6	(a)	All (1st class) letters arrive by Thursday. oe	**B1**	Accept: No (1st class) post arrives on Fridays.
	(b)	0·1 Condone "1 out of 10"	**B2**	M1: $1 - (0·1 + 0·6 + 0·2)$
	(c)	0·015	**B3**	M2: $0·05 \times (0·2 + 0·1)$ or M1: $0·05 \times 0·2$ or $0·05 \times 0·1$ or $0·2 + 0·1$ or $0·05 \times (0·2 \times 0·1)$
	(d)	0·05	**B4**	M3: $0·15 \times 0·1 + 0·05 \times 0·1 + 0·05 \times 0·6$ or M2: sum of two of these products or M1: one correct product attempted or evidence of looking at any of W & Tu, Th & Tu, or Th & W.

3

7	(a)	4 correct lines drawn & no other lines
		Condone: short lines, freehand
			B2	B1: only 3 correct lines drawn
				    or 4 correct lines drawn and extra
				      lines of symmetry drawn

	(b)	**(i)** 360/8 or $8 \times 45 = 360$	B1	
		(ii) $2 \times (180–45)/2$ or $180(8 – 2)/8$	B2	M1: 180–45 or 180(8 – 2) or 1080 seen
	(c)	**(i)** 70·7(1…)	B3	M1: $\frac{1}{2} \times 5^2 \times \sin 45^\circ$ ($\approx 8·838…$) Alt: $5\sin 22·5^\circ \times 5\cos 22·5^\circ$ Dep M1: … $\times 8$
		(ii) 82·8(4…)	B3	M1: $5 \times 5 \times \tan 22·5^\circ$ ($\approx 10·35…$) Dep M1: … $\times 8$
		$70·7(…) < \pi \times 5^2 < 82·8(…)$ $2·828(…) < \pi < 3·313(…)$	M1 A1	If no other marks earned in (c)(ii): SC1: $\pi \times 5^2$ ($\approx 78·5…$) seen
8	(a)	105	B2	M1: $60 \times 1·75$
	(b)	38	B3	M1: $1 – 0·68 (= 0·32)$ Condone 32 Dep M1: $\times 2 \times 60$ $(= 38·4)$
	(c)	**(i)** Two distinct correct comments	B2	1 mark each e.g. • Data set is very small. • Formula may need up-dating. • Obsn. that various ages used. • Obsn. that various shapes used. • Obsn. that various sizes used. **DO NOT ACCEPT** that age should not have been varied.
		(ii) 1·69(337)	B1	Accept 1·7
		(iii) $\sqrt[40]{m^{17}}$	B3	M1: 425 / 1000 seen A1: 17/40 seen SC1: $a = 40$ or $b = 17$ soi
		(iv) 0·202(47)	B2	M1: $100^{0·725}$ ($\approx 28·18…$) soi

4

Component Threshold Marks

General Certificate of Secondary Education
Additional Mathematics (J915)
January 2008 Assessment Series

Component	Max Mark	A*	A	B	C	D	E	F	G
J915/01	100	71	59	47	35	28	22	16	10

Overall

	A*	A	B	C	D	E	F	G
Percentage in Grade	0.6	6.5	13.3	24.6	17.2	14.2	8.4	8.7
Cumulative Percentage in Grade	0.6	7.1	20.4	45.0	62.2	76.4	84.8	93.5

The total entry for the examination was 334.

For a description of how UMS marks are calculated see:
http://www.ocr.org.uk/learners/ums_results.html

Statistics are correct at the time of publication.

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OCR
RECOGNISING ACHIEVEMENT

GENERAL CERTIFICATE OF SECONDARY EDUCATION
GCSE IN ADDITIONAL MATHEMATICS

J915/01

TUESDAY 13 MAY 2008

Afternoon
Time: 2 hours

Candidates answer on the question paper
Additional materials (enclosed): None

Additional materials (required):
Electronic calculator
Geometrical instruments
Tracing paper (optional)

Candidate Forename		Candidate Surname	

Centre Number		Candidate Number	

INSTRUCTIONS TO CANDIDATES

* Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
* Use blue or 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.
* Show your working. Marks may be given for a correct method even if the answer is incorrect.
* Final answers should be rounded to an appropriate degree of accuracy.
* 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 **100**.
* You are expected to use an electronic calculator for this paper.
* Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
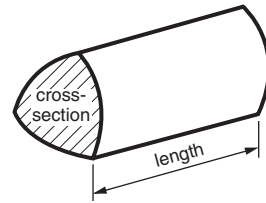
FOR EXAMINER'S USE

This document consists of **19** printed pages and **1** blank page.
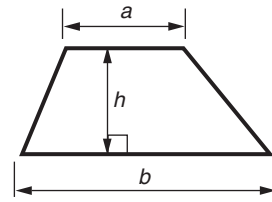
Formulae Sheet

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

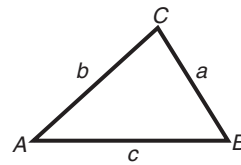**Volume of prism** = (area of cross-section) x length

In any triangle *ABC*

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

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

Area of triangle $= \frac{1}{2} ab \sin C$
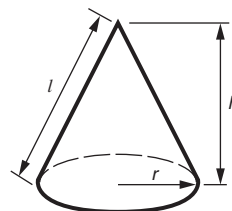
Volume of sphere $= \frac{4}{3} \pi r^3$

Surface area of sphere $= 4\pi r^2$
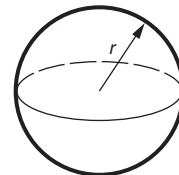
Volume of cone $= \frac{1}{3} \pi r^2 h$

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

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

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

1 **(a)** A clock strikes once at one o'clock, twice at two o'clock, and so on.
It also strikes once at half past **each** hour.

How many times altogether does this clock strike in 12 hours?
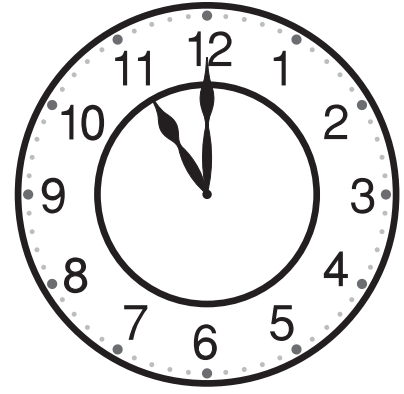
(a) _____ [4]

(b) John starts his computer counting 1, 2, 3, …
Each number takes 1 second to count.

How many years does it take for the computer to get to 1 billion (1 000 000 000)?

(b) _____ [5]

(c)

London	Toronto
15:00	**10:00**
BST	**EST**
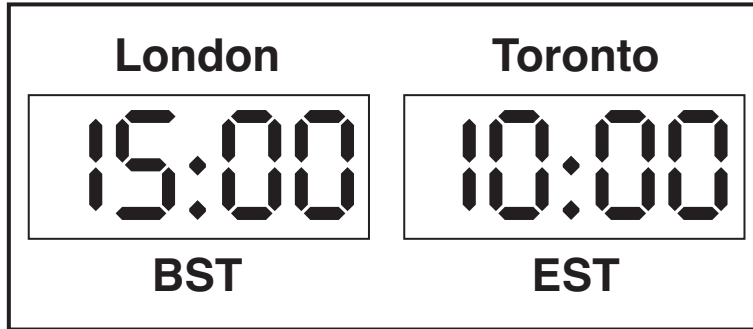
Toronto uses Eastern Standard Time (EST).
EST is 5 hours behind British Summer Time (BST).
For example: 15:00 BST is 10:00 EST.

A flight leaves London on Wednesday at 15:15 BST and arrives in Toronto
at 18:00 EST the same day.
A tail wind means the return flight to London takes one hour less time.
The return flight leaves Toronto on Wednesday at 20:25 EST.

When does it arrive in London?
Give your answer as BST.

(c) _____ BST on _____ day [6]

[Turn over

2 **(a)** Two identical triangles PQR and P´Q´R´ are shown below, drawn on a rectangular piece of paper.
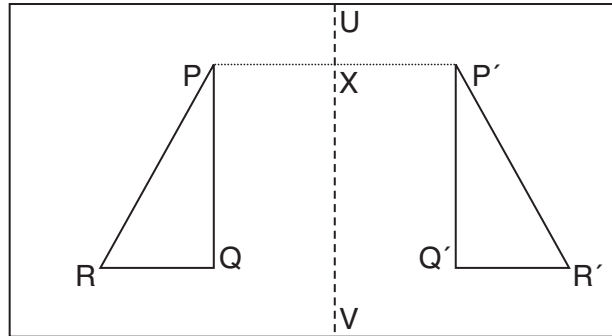
Folding the paper along the line UV maps P to P´, Q to Q´ and R to R´.
The line UV meets the line PP´ at X, the midpoint of PP´.

(i) What else do you know about the lines UV and PP´?

(a)(i) _____ [1]

(ii) Describe the single transformation that maps triangle PQR onto triangle P´Q´R´.

(ii) _____ [2]

(b) The diagram shows parallel lines, m and n, and a flag labelled F.
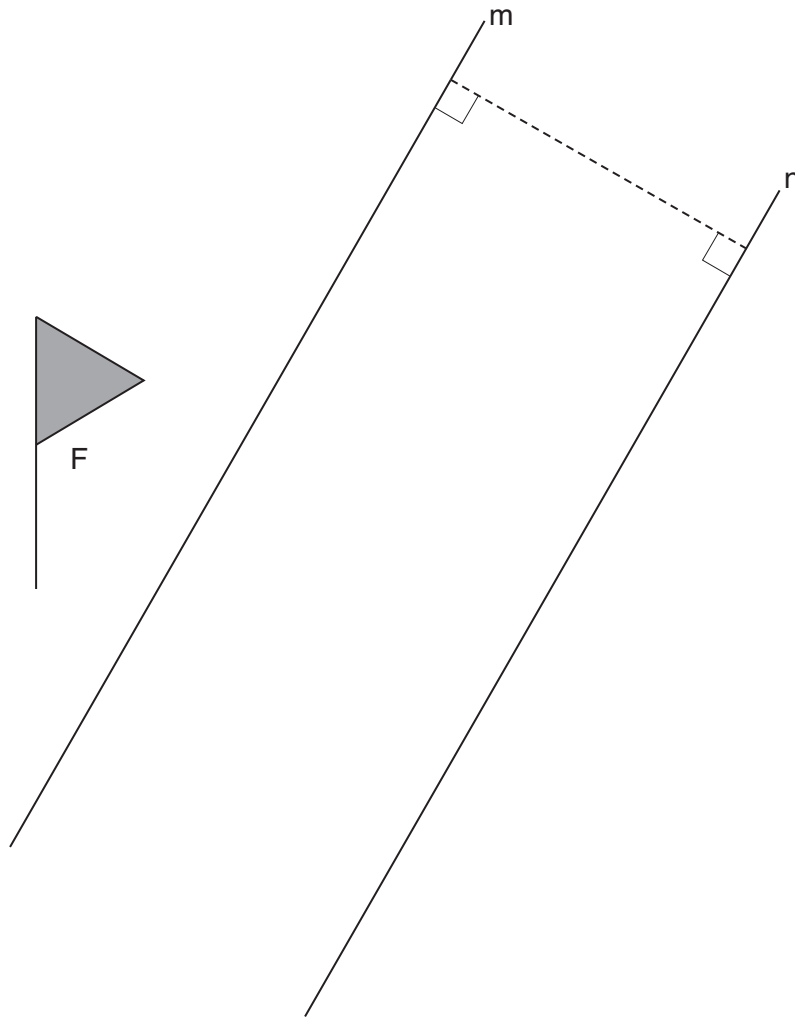
(i) Measure the perpendicular distance between the two lines, m and n.

(b)(i) _____ cm [1]

(ii) Draw the reflection of flag F in line m. [2]

(iii) Give a full description of the **single** transformation that is equivalent to reflection in line m followed by reflection in line n.

(iii) _____

_____ [5]

[Turn over

3 **(a)** These two formulae each give the flow rate for blood passing through our arteries, in appropriate units.

Flow rate = 70 × heart rate	**Flow rate = $\dfrac{1000}{\text{resistance}}$**

 (i) Work out the flow rate when the heart rate is 80.

 (a)(i) _____ [1]

 (ii) Work out the flow rate when the resistance is 0.2 .

 (ii) _____ [1]

 (iii) Work out the heart rate when the flow rate is 4200.

 (iii) _____ [2]

 (iv) How would the flow rate change when the heart rate is doubled?

 (iv) _____ [1]

 (v) How would the flow rate change when the resistance is doubled?

 (v) _____ [1]

(b) **(i)** Explain what is meant by r^4.

(b)(i) _____ [1]

(ii) Blood flows at a rate of Q cm^3/s through a blood vessel.

The formula for Q is $Q = \dfrac{\pi r^4 P}{8LV}$, where

- L is the length of the blood vessel in centimetres,
- P is the pressure difference (in Pascals) along the length of the blood vessel,
- r is the radius of the blood vessel in centimetres,
- V is the viscosity (or thickness) of the blood in Pascal seconds.

Calculate the rate of flow of blood in a blood vessel of length 0.5 cm, and radius 0.0015 cm, given that the pressure difference along the blood vessel is 6650 Pascals, and the blood has viscosity 0.005 Pascal seconds.

(ii) _____cm^3/s [2]

(iii) The sketch graphs represent

$$Q = ar^4, \quad Q = bP \quad \text{and} \quad Q = \frac{c}{L},$$

where a, b and c are constants.
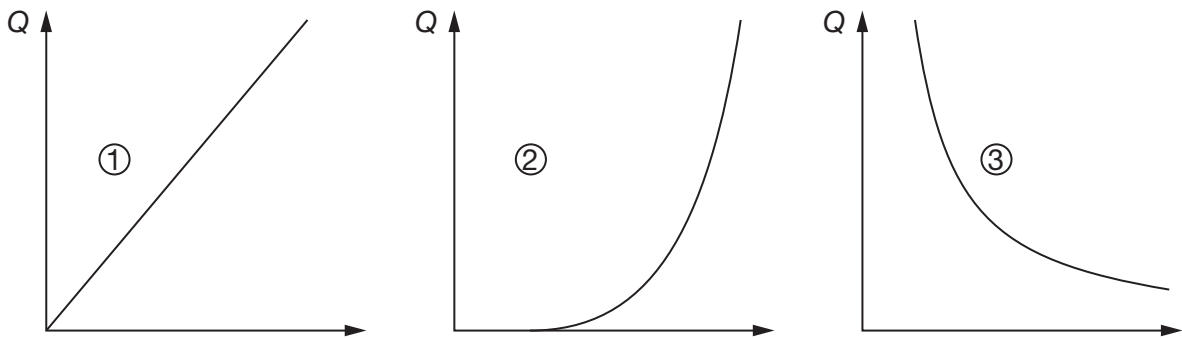
Match each graph to its equation.

(iii) Graph ① _____

Graph ② _____

Graph ③ _____ [3]

[Turn over

4 **(a)**

| 2 | 6 | 5 |

(i) Write down the largest and smallest 3-digit numbers you can make using all these digits.

(a)(i) Largest: _____ ; smallest: _____ [2]

(ii) Subtract your smallest number from your largest number.

(ii) _____ [1]

(iii) Using the three digits from your answer to part **(ii)** repeat parts **(i)** and **(ii)**.
Continue doing this until you keep obtaining the same 3-digit number.
Write down that number.

(iii) _____ [3]

(b) Ian chose *p*, *q* and *r* as his three digits.
Explain why one of the 3-digit numbers he can make using these digits may be written as

$$100q + 10r + p.$$ [2]

(c) Show that the answer to part **(a)(ii)** will always be a multiple of 99 no matter what three digits (all different) you start with in part **(a)(i)**. [4]

[Turn over

5 **(a)** All the faces of a 3 by 3 by 3 solid cube are painted.
It is then cut, as shown, into 27 unit cubes, each cube being 1 by 1 by 1.
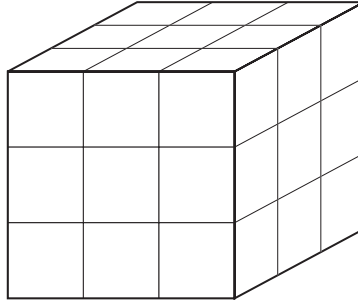
Some of the unit cubes have 0 painted faces, some have 1 painted face, and so on.

Complete the table to show how many unit cubes there are of each type.

Number of painted faces	Number of unit cubes
0	
1	
2	
3	
More than 3	
Total	27

[5]

(b) All the faces of a n by n by n solid cube are painted.
It is then cut into n^3 unit cubes.
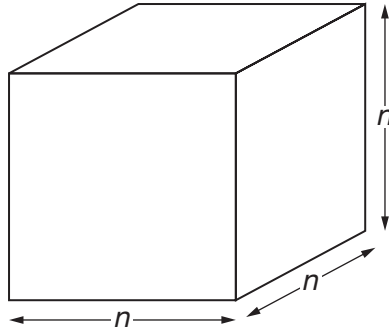
(i) Explain why there are $6(n-2)^2$ unit cubes with 1 painted face. [3]

(ii) Complete the table to show how many unit cubes there are of each type.

| Number of painted faces	Number of unit cubes
0	$(n-2)^3$
1	$6(n-2)^2$
2	
3	
More than 3	

[3]

[Turn over

6 The Thames Barrier is designed to be closed to protect London from flooding.
The table and chart show the number of closures each year from 1983 to 2006.

© D Martin / OCR

Year	Number of closures
1983	1
1984	0
1985	0
1986	0
1987	1
1988	1
1989	0
1990	3
1991	0
1992	1
1993	5
1994	1
1995	3
1996	4
1997	0
1998	3
1999	3
2000	6
2001	11
2002	2
2003	8
2004	2
2005	5
2006	1
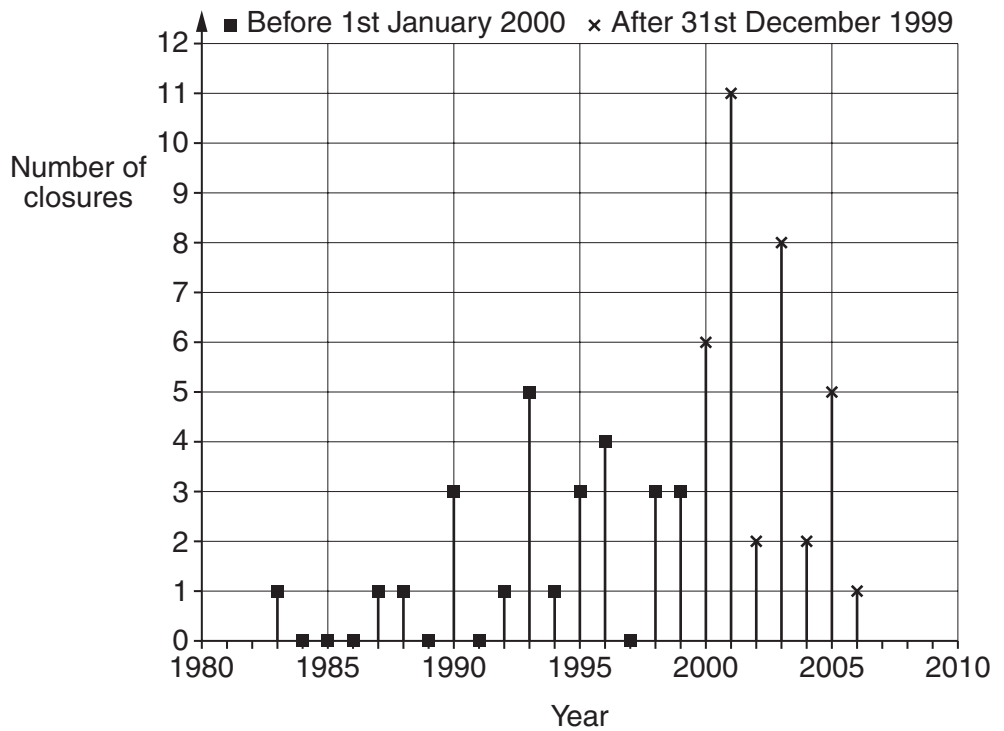
Source:
The Environment Agency

(a) The average number of closures before 2000 is less than the average number of closures since then.

Write down two other ways in which the data collected before 2000 differs from the data collected since then.

1. _____

_____

2. _____

_____ [2]

(b) A log book is kept for each of the years 1983 to 2006 inclusive.

  (i) Jack picks one of these log books at random.

  Find the probability that the log book belongs to the period 2000 to 2006 inclusive.

(b)(i) _____ [2]

  (ii) Freddie randomly chooses two log books from the period before 2000.

  Find the probability that the Barrier was closed **more than** twice in both of those years.

(ii) _____ [3]

(c) For the period 1983 to 1999 the mean number of closures is 1.53, correct to two decimal places.
For the period 2000 to 2006 the mean number of closures is 5.

Suppose the Thames Barrier was closed just once per year from 2006 onwards.
In which year would the mean number of closures for the period from 2000 onwards drop below 1.53?

(c) _____ [5]

[Turn over

7 (a) The diagram shows part of a ventilator cover containing identical holes.
Each hole is a rectangle, 4.55 cm long and 0.95 cm wide.

NOT TO SCALE

4.55cm

0.95cm
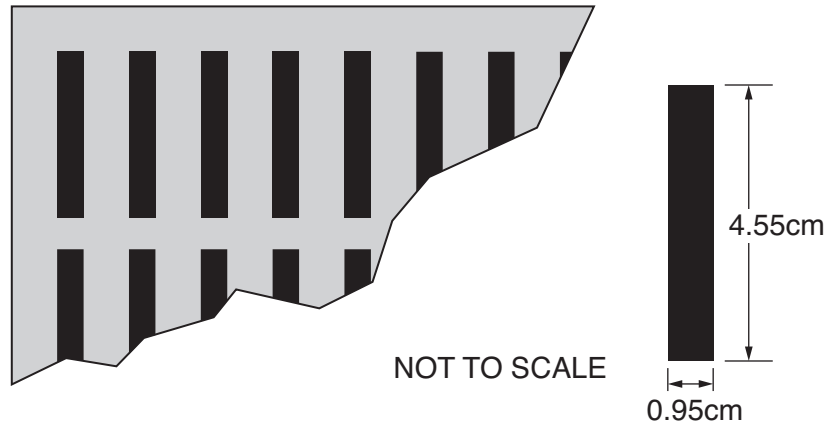
Gas regulations state that the total area of the holes must be at least 100 cm^2.

Find the minimum number of holes needed.

(a) _____ [5]

**(b)** The diagram represents a circular seal; O is the centre of both circles.
The radii of the circles are R cm and r cm.
The chord PQ, of length 28 cm, touches the inner circle at T.

P

R

O T 28

r

Q

NOT TO
SCALE
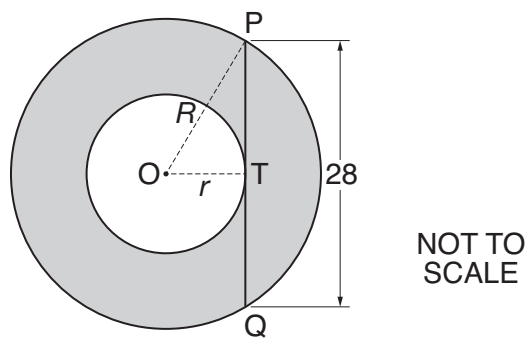
Find the shaded area.
Give your answer in terms of π.

(b) _____ cm^2 [5]

(c) The diagram represents a cross-section of three cylindrical ventilation ducts, each of radius 5.8 cm, tightly enclosed in a larger cylinder.
A, B, C and D are the centres of the four circles.

A•

•B

D•

C•
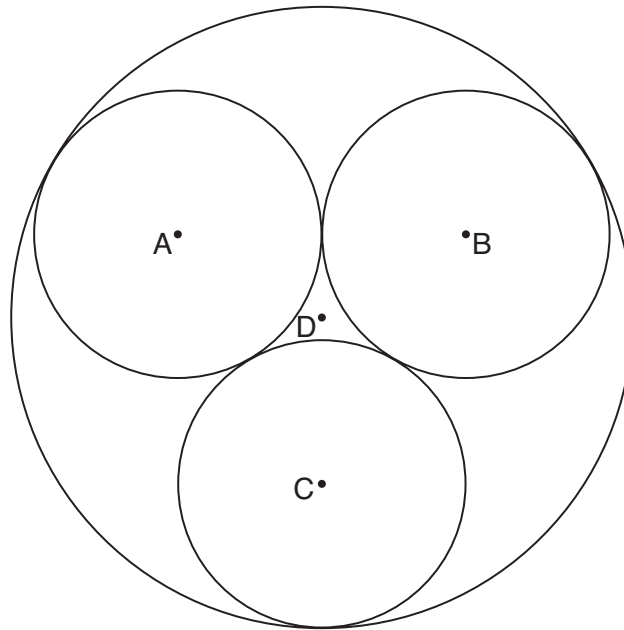
Calculate the radius of the larger cylinder.

(c) _____ cm [5]

[Turn over

8 A UK airport recorded the delays to flights arriving one February.
The tables summarise the data for both scheduled flights and chartered flights.

Scheduled flights (You may wish to use these spare columns.)

| Delay (t minutes)	Frequency				
$0 < t \leq 15$	10706				
$15 < t \leq 30$	2322				
$30 < t \leq 60$	1380				
$60 < t \leq 180$	782				

Number of scheduled flights = 15190
Mean delay = 19.0 minutes
Median = 10.6 minutes
Interquartile range = 14.1 minutes

Chartered flights (You may wish to use these spare columns.)

Delay (t minutes)	Frequency				
$0 < t \leq 15$	1231				
$15 < t \leq 30$	419				
$30 < t \leq 60$	329				
$60 < t \leq 180$	214				

Number of chartered flights = 2193

(a) Using these data compare the delays experienced by scheduled flights and chartered flights, describing one similarity and one difference.

Justify your answers with relevant calculations **and** diagrams.
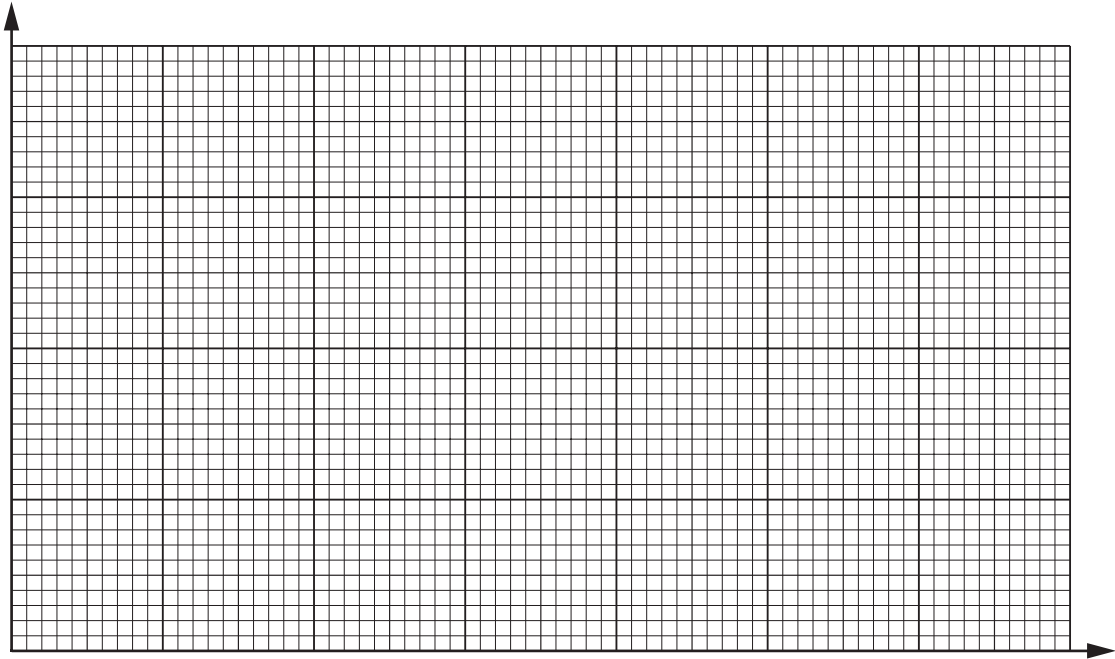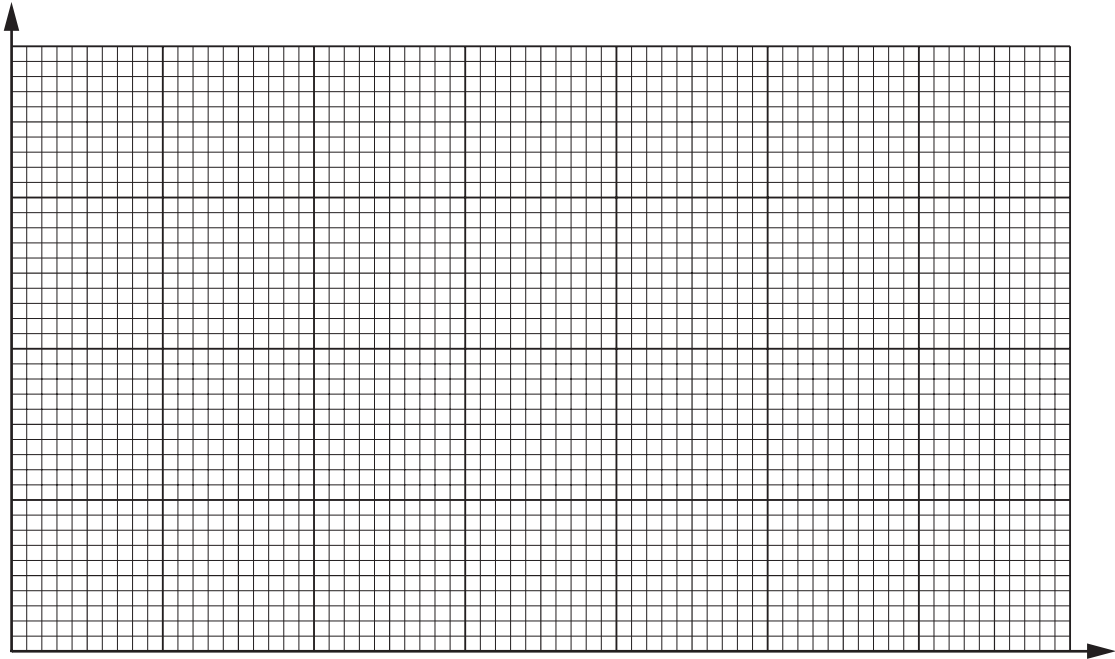
Similarity: _____

_____

Difference: _____

_____ [10]

(b) The data given do not include the information that
- 165 scheduled flights were more than 180 minutes late,
- 38 chartered flights were more than 180 minutes late.

How would this extra information affect estimates of the mean and median?

_____

_____ [2]

_____

GCSE

Mathematics

General Certificate of Secondary Education **GCSE J915**

Mark Schemes for the Units

June 2008

Any enquiries about publications should be addressed to:

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CONTENTS

General Certificate of Secondary Education

Mathematics (J915)

MARK SCHEMES FOR THE UNITS

J915/01 Paper 1

			Mark scheme	Mark	Details
1	**(a)**		90	4	**M1**: Adds 3 consec. ints. eg 2+3+4 **M1**: 1+2+3+4…+12 (= 78) **M1**: + 12 (89 or 91 seen gets **M2**)

	(b)		31.7
			or 32 or 31 www
				5	**B4**: 31.70…, 31.68…, 31.79 or 31.8 seen
					or **M3**: 60×60×24×365 (=31536000)
					or **M2**: 3 correct factors
					        or 4 correct & 1 faulty
					or **M1**: 2 correct factors
					For ×365 accept ×365.25 (=31557600)
					        or ×7×52 (=31449600)
					        or ×12×30 (=31104000)
					+**M1**: 1 000 000 000/product
					For product accept 1 or more relevant factors.
					SC3: 317… or 318… seen
					        18:00

	(c)		(0)8:10 on Thursday
			Accept "next" or "following" day oe
			
			Unsupported answers
			3:10 & 9:10 get M4; …:10 gets M2
				6	**M1**: + 5 (= 23:00)
					M1: − 15:15 (= 7:45)
					M1: − 1 (= 6:45)
					M1: + 20:25 (= 27:10 or 03:10)
					M1: + 5 = 32:10 or 08:10
					        The above means:
					        M3 for 6:45 seen
					        M2 for 7:45 or 1:45 seen
					        M1 for 2:45 seen

2	**(a)**	(i)	They are perpendicular oe	1	
		(ii)	Reflection in UV oe	2	**M1**: reflection Accept "flip", "mirror image" but not "fold"
	(b)	(i)	4.5 (±0.1)	1	
		(ii)	Correct image	2	**M1**: attempted to reflect F in m **SC1**: any reflection of F

		(iii)	Translation
			 9 cm (±0.2) ft or ✓
			 perpendicular to m (or n) oe
			
			 OR translation $\begin{pmatrix} 7.8 \\ -4.5 \end{pmatrix}$ (±0.2)
				5	**B3**: translation
					B1: 9 cm [ft: 2 × (i)] (±0.2)
					B1: perpendicular to m (or n) oe
					        eg on bearing of 120° (±5°)
					
					or **B1B1**: $\begin{pmatrix} 7.8 \\ -4.5 \end{pmatrix}$ (±0.2) or in words
					
					SC1: vector with components swapped
					If not **B3**, but **M1** or better for (b)(ii) then
					   M1: attempts to reflect (b)(ii) in line n
					   A1: correct image

3	**(a)**	(i)	5600	1	
		(ii)	5000	1	
		(iii)	60	2	**M1**: 4200/70
		(iv)	doubled oe	1	
		(v)	halved oe	1	If neither last two **B1**s scored: **SC1** for (iv) 11200 **or** (v) 2500 or both (iv) increase **&** (v) decrease.
	(b)	(i)	$r \times r \times r \times r$ or $(r^2)^2$, or $r^2 \times r^2$, or $r^3 \times r$ or above in words	1	Condone "multiply r by itself 4 times" Condone interpreted r
		(ii)	$0.000\,0053$ or 5.3×10^{-6} or $0.000\,0052(8\dots)$ or $5.2(8\dots) \times 10^{-6}$	2	**M1**: correct arithmetic expression or 53 or 52… seen
		(iii)	①: $Q = bP$ ②: $Q = ar^4$ ③: $Q = c/L$	3	**B2**: 2 or 3 correct identifications made or **B1**: one correct identification made
4	**(a)**	(i)	652; 256	2	1 each answer **SC1**: answers reversed
		(ii)	396 ft	1	Ignore – as in –396 here & in (iii)
		(iii)	495 ft from 3-digit integer	3	**M1**: $963 - 369$ (= 594) (Implied by 459) **DM1**: $954 - 459$ (= 495)
	(b)	Identifies q as 100s or 1st digit r as 10s or 2nd digit & p as units or 3rd or last digit		2	Accept numerical illustration **M1**: one of these identifications
	(c)	Complete algebraic proof		4	**M1**: $100a + 10b + c$ **or** $100c + 10b + a$ **M1**: $100a + 10b + c$ **&** $100c + 10b + a$ **M1**: $100a + 10b + c - 100c - 10b - a$ correct subtraction, no brackets **Not** $100a + 10b + c - 100c + 10b + a$ **nor** $-\dfrac{100a+10b+c}{100c+10b+a}$ unless simplified to correct result below. **A1**: $= 99a - 99c$ **or** $99(a - c)$
5	**(a)**	1, 6, 12. 8, 0		5	1 for each answer Accept "naught", "none" or "zero" for 0 here and in (b)(ii).
	(b)(i)	6 faces (Accept "sides" but not "cubes") each square subtract 1 for each end		3	1 for each point Accept diagrammatic explanation

(ii)

0	$(n-2)^3$
1	$6(n-2)^2$
2	$12(n-2)$ oe
3	8 cao
> 3	0 cao

3   1 for each answer
NB: $n^3-(n-2)^3-6(n-2)^2-8 \equiv 12(n-2)$

6	(a) eg 1. There is more variation in later period. 2. Post 2000 there have been no years with no closures. 3. Before 2000 there were no years with more than 5 closures. 4. Median before 2000 is 1; for later group median is 5. 5. Mode increases (from 0 to 2). 6. Highest no. of closures rises from 5 to 11. 7. Range doubles (or increases by 5) after 2000. 8. iqr increases (from 3 to 6). 9. The total number of closures in 2000–6 exceeds the total number of closures previously. 10. Frequencies were increasing (with time) before 2000, but decreasing from 2000 on. 11. Positive correlation changes to negative.	2	1 for each correct difference Answers must include time period. **Do not accept**: 1. The average increases after 2000. 2. The mean increases from 1.53 to 5. 3. There were less closures before 2000. 4. There is an increase in the amount of data collected. 5. London was more likely to be flooded post 2000. 6. Range changes. 7. Range is smaller. (unless qualified) 8. Range is bigger. (unless qualified)
	(b) (i) $\frac{7}{24}$ isw Accept 0.29… or 29%	2	**M1**: Denominator or numerator correct or 7:24 or 7 in 24 or 7 out of 24 **SC1**: $\frac{6}{23}$
	(ii) 15/136 isw Accept 0.11(029…) or 11%	3	**M1**: $\frac{6}{17}$ **M1**: $\times \frac{5}{16}$ or $\times \frac{n-1}{d-1}$
	(c) 2052 Candidates may form other correct equations with n standing for eg the number that must be added to 2000 to get final date. Marks available should correspond to the example given. <u>Step-by-step or T&I</u>: **M1** for each of candidate's steps/trials up to max 3. See below.	5	**B4**: 45(.8…) or 46 seen or 2051 or 2053 OR **M1**: $1.53 = (7{\times}5 + n)/(7 + n)$ **DM1**: $1{\cdot}53(7 + n) = 7{\times}5 + n$ $10.71 + 1.53n = 35 + n$ **DM1**: $0.53n = 24.29$ **A1**: $n = 45(.8…)$

Table shows mean if there was 1 closure per year from 2006 until that date.

Year	2070	2080	2090	2100			2007	2008	2009	2010
Mean	1.394	1.346	1.308	1.277			4.5	4.111	3.8	3.545
Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Mean	3.333	3.154	3	2.867	2.75	2.647	2.556	2.474	2.4	2.333
Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Mean	2.273	2.217	2.167	2.12	2.077	2.037	2	1.966	1.933	1.903
Year	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Mean	1.875	1.848	1.824	1.8	1.778	1.757	1.737	1.718	1.7	1.683
Year	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Mean	1.667	1.651	1.636	1.622	1.609	1.596	1.583	1.571	1.56	1.549
Year	2051	2052	2053	2054	2055	2056	2057	2058	2059	2060
Mean	1.538	1.528	1.519	1.509	1.500	1.491	1.483	1.475	1.467	1.459

7	**(a)** 24	5	**B4**: 23 **M1A1**: 4.55×0.95 (= 4.3225) **DM1A1**: 100/4.3225 = 23.1…
	(b) 196π (dependent on Pythagoras seen)	5	**M1**: right angled triangle soi **M1**: Pythagoras attempted eg $R^2 \pm r^2 = x^2$ **M1**: $R^2 - r^2 = 14^2$ **M1**: $\pi R^2 - \pi r^2 = \pi \times 14^2$ **SC2**: $\pi R^2 - \pi r^2$ or SC1: πR^2 or πr^2
	(c) 12.5 www **Alt. method using sine rule** **M1**: isos. $\triangle$ (eg BCD) soi **M1**: sine rule used **M1**: 2×5.8×sin30°/sin120° (= 6.697…) **DM1**: + 5.8 = 12.497… **Alt. method using supplied scale drawing** (Max 3) **M1**: either fraction $\frac{5.8}{1.9}$ or $\frac{R}{4.1}$ **A1**: $\frac{5.8}{1.9} = \frac{R}{4.1}$ **A1**: R = 12.5(…) See below. Allowing measuring tolerances of ±0·1 in lengths 1·9 & 4·1 leads to the following acceptable values for R by this method.	5	**M1**: right angled $\triangle$ soi **M1**: correct trig ratio used **M1**: 5.8/cos30° (= 6.697…) **DM1**: + 5.8 (= 12.497…) Accept correct alternative methods eg **M2**: altitude of equil. $\triangle$ = 5.8√3 (= 10.05) **M1**: centroid to vertex = $\frac{2}{3}$ × 5.8√3

R	1.8	1.9	2.0
4	12.8…	12.2…	11.6
4.1	13.2…	12.5…	11.8…
4.2	13.5…	12.8…	12.1…

8	**(a)** <u>Processing</u>: Histograms **or** cum fr graphs	3+1	<u>Histograms</u>: **B1**: 3 fr densities calculated **B1**: 1st two blocks **B1**: last 2 blocks & horizontal scale **B1**: 2nd graph **of same type** **OR**
	Fds: 714, 155, 46, 6.5 82, 28, 11, 1.8		
	Cum frs: 10706, 13028, 14408, 15190 1231, 1650, 1979, 2193		<u>Cf graphs</u>: **B1**: cum frs calculated **B1**: plots at (15,1231) & (30,1650) or at (15,10706) & (30,13028) **B1**: Remaining plots, pts joined (straight or curved) & horizontal scale **B1**: 2nd graph **of same type** **or boxplot for Charter flights**
	For chartered flights: mean (27.0 $\pm$0.2) **or** median (13.4 $\pm$0.2) ft graph **or** iqr (23.2 $\pm$0.4) ft graph	3	**M1**: 3 mid pts; **M1**: Σfx attempted (at least two classes) **OR** **M1**: reads at cf=1097 **A2**: median=13.4 $\pm$0.2 ft graph or (**A1**: $\pm$0·4) **OR** **M1M1**: reads at cf $\approx$ 550 & 1645
	<u>Similarity</u>: For most flights: delay < 15 minutes Evidence: eg both medians are in $0 < t \leq 15$	1 1	
	OR Both data sets exhibit (rapid) decay oe Evidence eg see diagrams		The evidence mark (**E1**) may be earned under **either** similarity **or** difference. It is for stating **on the answer line** the evidence for the sim. or dif. cand. gives.
	<u>Difference</u>: Mark depends on supporting calcns. Scheduled flts are less delayed Evidence: **or** Scheduled mean (19) < Chartered mean (27) **or** Sched. median (11) < Charted median (13)	1	Do not accept: There are more scheduled flights than chartered flights.
	OR Delays on charter flights are more variable Evidence: Sch iqr (14) < Chart iqr (23)		Accept: Sched. sd (26.1) < chartered sd (33.3)
	(b) Medians would be increased. Accept: Means would be increased. or Medians would stay in same class.	1	Do not accept: One increases & the other decreases. **SC1**: (1.1% & 1.7%) extra data will cause minimal changes
	Means cannot be estimated reliably. oe (eg: there would be problems estimating means)	1	

Grade Thresholds

General Certificate of Secondary Education
Additional Mathematics (Specification Code J915)
June 2008 Examination Series

Component Threshold Marks

Component	Max Mark	A*	A	B	C	D	E	F	G
Written Paper	100	70	58	46	34	27	21	15	9

Specification Options

Overall

	A*	A	B	C	D	E	F	G
Percentage in Grade	4.8	12.7	21.7	25.8	12.6	9.0	6.8	4.5
Cumulative Percentage in Grade	4.8	17.5	39.2	65.0	77.6	86.5	93.3	97.8

The total entry for the examination was 9691.

Statistics are correct at the time of publication.

Candidates answer on the question paper

OCR Supplied Materials:
None

Other Materials Required:
* Electronic calculator
* Geometrical instruments
* Tracing paper (optional)

Thursday 22 January 2009
Afternoon

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.
* Show your working. Marks may be given for a correct method even if the answer is incorrect.
* Final answers should be rounded to an appropriate degree of accuracy.
* Answer **all** the questions.
* Do **not** write in the bar codes.
* Write your answer to each question in the space provided, however additional paper may be used if necessary.
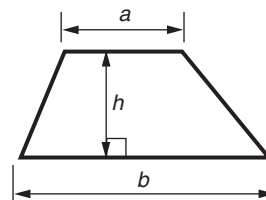
INFORMATION FOR CANDIDATES

* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* You are expected to use an electronic calculator for this paper.
* Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
* The total number of marks for this paper is **100**.
* This document consists of **20** pages. Any blank pages are indicated.
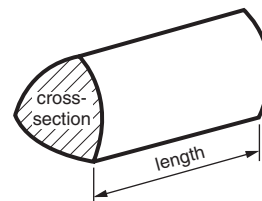
FOR EXAMINER'S USE

OCR is an exempt Charity

Turn over

Formulae Sheet

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

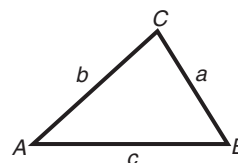**Volume of prism** = (area of cross-section) × length

In any triangle *ABC*

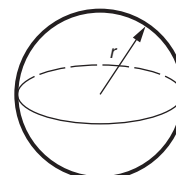**Sine rule** $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

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

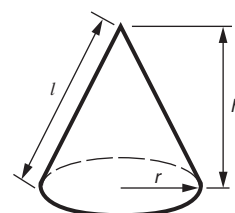**Area of triangle** $= \frac{1}{2} ab \sin C$

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 $= \pi rl$

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 **(a)** The diagram shows a fair blue dice.
The 6 faces are marked with the numbers 1, 1, 6, 6, 8, 8.
Barry throws the blue dice.

What is the probability that it lands with 8 on the top face?

Blue

(a) _____ **[2]**

(b)

Red   Green

The diagram shows two fair dice, one red and one green.
The 6 faces of the red one are marked with the numbers 3, 3, 5, 5, 7, 7.
The 6 faces of the green one are marked with the numbers 2, 2, 4, 4, 9, 9.
When the red dice and the green dice are thrown at the same time, the one with the higher number on the top face wins.

(i) Complete the table to show the winning dice.

		Red		
		3	5	7
	2	R		
Green	4	G		
	9			

[2]

(ii) Find the probability that the red dice wins.

(b)(ii) _____ **[2]**

(c) The **blue** dice from part **(a)** and the **green** dice from part **(b)** are thrown together, the one with the higher number on the top face wins.

Find the probability that the blue dice wins.

(c) _____ **[3]**

Turn over

2 **(a)** Write down the next two numbers in this sequence.

10   20   30   40   _____   _____   **[1]**

(b) When you divide 72 by 10 the remainder is 2.
When you divide 63 by 7 the remainder is 0.

(i) Find the remainder when you divide 59 by 7.

(b)(i) _____ **[1]**

(ii) Complete the list of all the possible remainders when you divide a whole number by 7.

(ii) 0, 1, 2, 3, _____ **[1]**

Short bar codes are 8 digits long.
They consist of a 7-digit number followed by a check digit.

This is the
check digit

The check digit is found from a calculation using the first 7 digits.

The rest of this question is about such check digits.

(c) One method of forming the check digit is to use the remainder when the number formed by the first 7 digits is divided by 7.

(i) Find the check digit when this method is used with the 7-digit number 1234 567.

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

(ii) One bar code is 1234 3214.
Adam's scanner misreads it as 1234 3914; Barbara's misreads it as 1234 8214.

By calculating the check digits for 1234 3914 and 1234 8214 show that one mistake is detectable but not the other. **[3]**

(d) Another way of forming the check digit, *c*, for a 7-digit number uses a Weighted Sum of Digits, WSD.

$$\text{WSD} = 3 \times \text{(the sum of the 1st, 3rd, 5th and 7th digits)}$$
$$+ \text{(the sum of the 2nd, 4th and 6th digits)} + c$$

c is the 1-digit number that makes WSD into a multiple of 10; *c* cannot be negative.

Here is an example.

> Let the check digit for the number 9362 145 be *c*.
>
> $$\text{WSD} = 3 \times (9 + 6 + 1 + 5) + (3 + 2 + 4) + c$$
> $$= 72 + c.$$
> To make WSD a multiple of 10, *c* = 8.

(i) Use the WSD method to find the check digit for the 7-digit number 1234 567.

(d)(i) _____ **[2]**

(ii) A packet has a bar code with the check digit calculated by WSD.
One scanner reads the bar code as 5382 9122, another reads it as 5832 9122.

Comment. **[4]**

3 Sam is a tree surgeon.
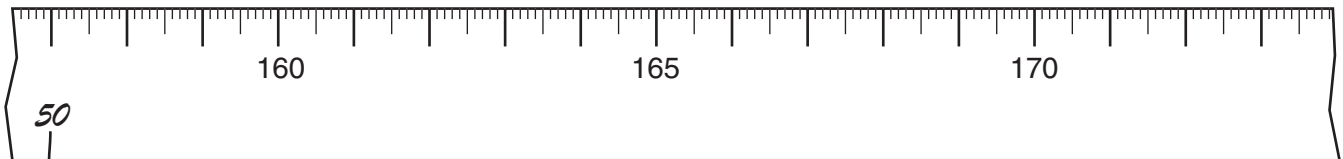
(a) Sam estimates that a tree is 25 feet tall.

What is 25 feet in metres, to the nearest metre?

(a) _____ m **[1]**

(b) Show that a circle of diameter 50 cm has a circumference of about 157 cm. **[1]**

In the rest of this question assume that tree trunks have circular cross-sections.

(c) The diagram shows, full size, part of Sam's tape measure; the top edge is marked in centimetres.

Sam measures the circumferences of tree trunks with his tape measure.
He needs to record the diameters.
He marks diameters on the bottom edge of the tape opposite the corresponding circumferences.
He has already marked 50.

(i) Explain why 50 is opposite 157. **[1]**

(ii) Write 55 on the tape in the correct place to indicate a diameter of 55 cm. **[3]**

Turn over

(d) Sam estimates the height of a tree.
He stands 18 m from the tree and holds a ruler vertically 60 cm in front of him.
He measures the distance between the lines from his eye to the base and the top of the tree.
This distance is 68 cm, as shown in the diagram.

NOT TO SCALE

68 cm

60 cm

18 m
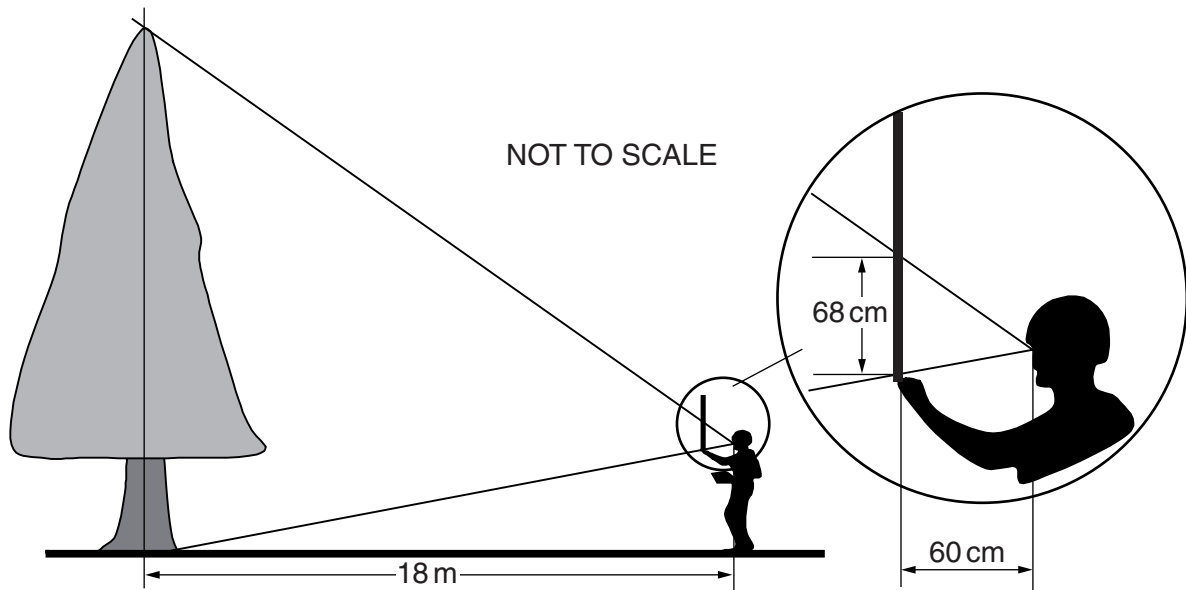
Use similar figures to estimate the height of the tree showing your calculations.

(d) _____ m **[3]**

(e) Sam prices one job at £500, including VAT at $17\frac{1}{2}$%.

Find how much of the £500 is VAT.

(e) £ _____ **[4]**

(f) To estimate the volume of a tree trunk Sam thinks of the trunk as a cone.

- The height of the cone = the height of the tree.
- The diameter of the cone = the diameter of the base of the tree.

He estimates the total volume of the tree, including branches, by multiplying the volume of the trunk by 1.9;
24% of the total volume of the tree is carbon.
The density of carbon is 0.96 tonnes/m^3.

An oak tree is 35 m tall; its base has a diameter of 1.2 m.

Estimate the mass of the carbon in this tree.

(f) _____ tonnes **[4]**

4 **(a)** **(i)** The sum of the whole numbers from 1 to 6 inclusive is $1 + 2 + 3 + 4 + 5 + 6$.

Calculate $1 + 2 + 3 + 4 + 5 + 6$.

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

(ii) Work out $\frac{1}{2}n(n + 1)$ when $n = 6$.

(ii) _____ **[2]**

(iii) What do you notice about your answers to parts **(i)** and **(ii)**?

(iii) _____ **[1]**

In the rest of this question you should use the following.

$$1 + 2 + 3 + ... + n = \tfrac{1}{2}n(n + 1)$$

This means that the sum of the whole numbers from 1 to n inclusive is $\frac{1}{2}n(n + 1)$.

(b) **(i)** Find the sum of the whole numbers from 1 to 50 inclusive.

(b)(i) _____ **[2]**

**(ii)** Find the sum of the whole numbers from 1 to 100 inclusive.

(ii) _____ **[2]**

(iii) Using your answers to **(b)(i)** and **(ii)** find the sum of the odd numbers from 1 to 99 inclusive.

(iii) _____ **[2]**

(c) The diagram shows tablets arranged in rows in one corner of a triangular tray.

- Each row of tablets is full.
- There is one tablet in the bottom row.
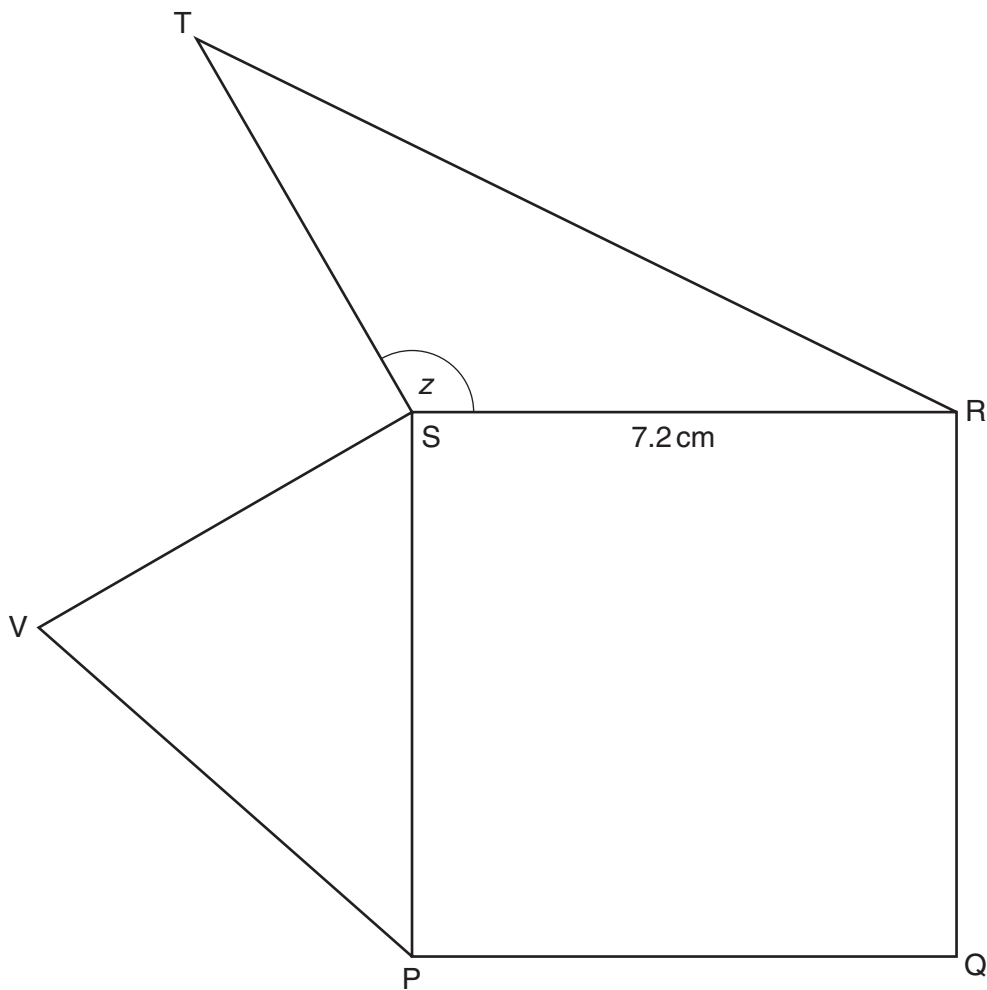- Apart from the bottom row each row contains one tablet more than the row below.
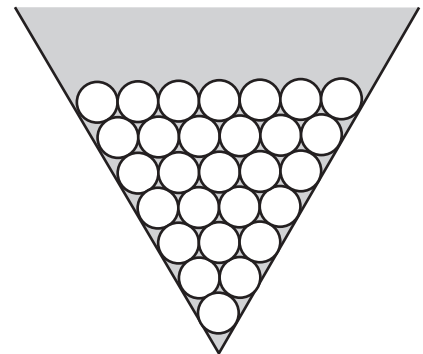
(i) How many tablets would be contained in 15 full rows?

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

(ii) Using an algebraic method find how many full rows are needed to hold 300 tablets.

(ii) _____ **[5]**

Turn over

5 **(a)** The diagram shows the square PQRS and triangles PSV and RST; RS = 7.2 cm.

(i) Measure the length ST in centimetres and the size of angle *z* in degrees.
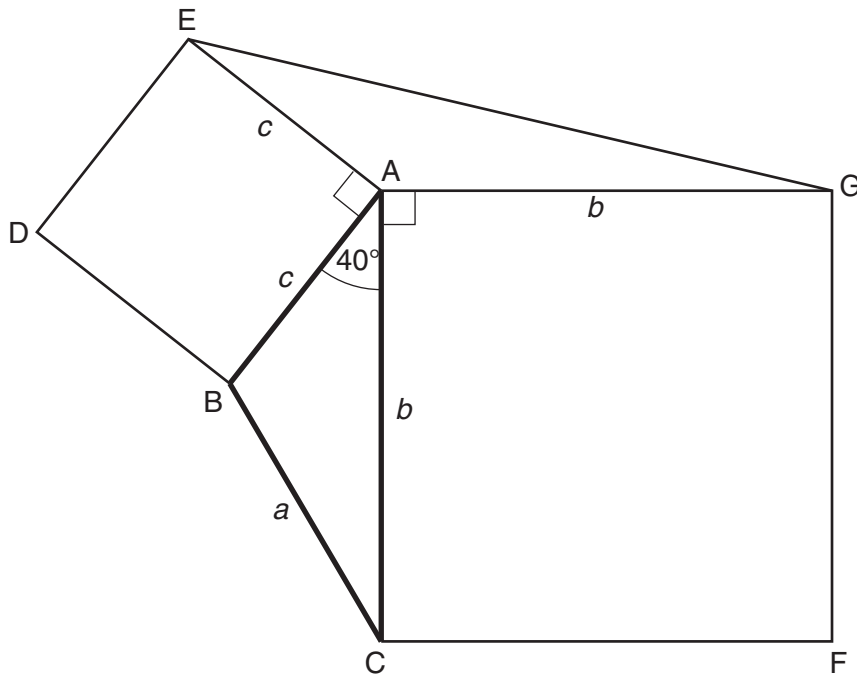
(a)(i) ST = _____ cm; angle *z* = _____° **[2]**

(ii) Mark accurately the point U so that STUV is a square.   **[2]**

(iii) Taking any extra measurements you may need, calculate the areas of triangles PSV and RST.

Triangle PSV = _____ cm²; triangle RST = _____ cm² **[4]**

(b) The diagram shows triangle ABC, with sides of lengths *a*, *b* and *c*.
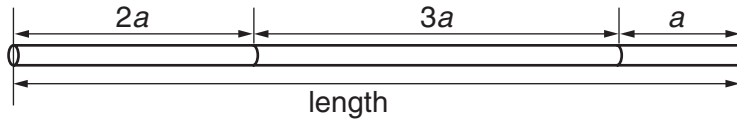Angle CAB = 40°.

NOT TO
SCALE

Two squares, ABDE and ACFG, have been drawn on two sides of the triangle.

(i) Work out angle EAG.

(b)(i) _____ ° **[1]**

(ii) Show that triangles ABC and AEG have the same area. **[3]**

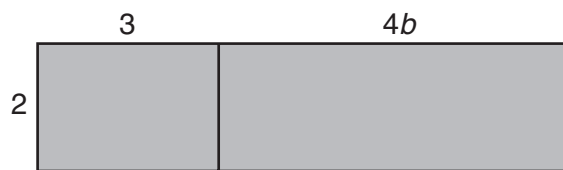**Turn over**

6 **(a)**

NOT TO
SCALE

Work out $2a + 3a + a$ to find the total length of the three rods.
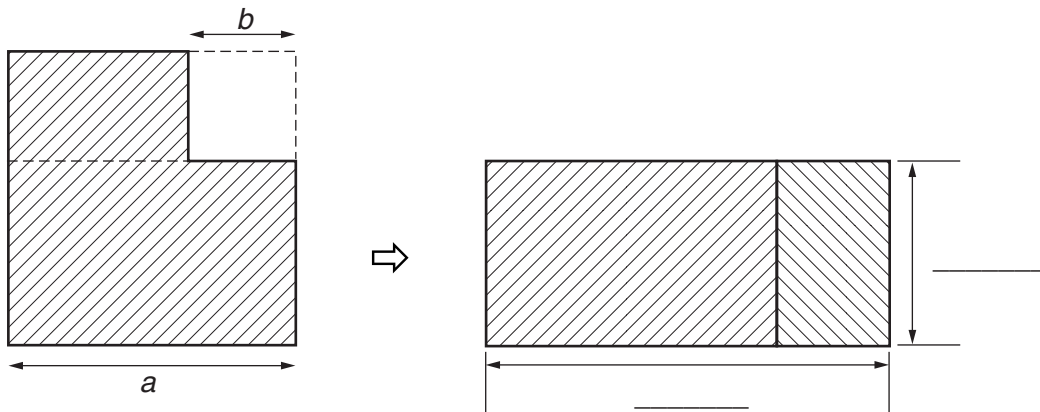
(a) _____ **[1]**

(b)

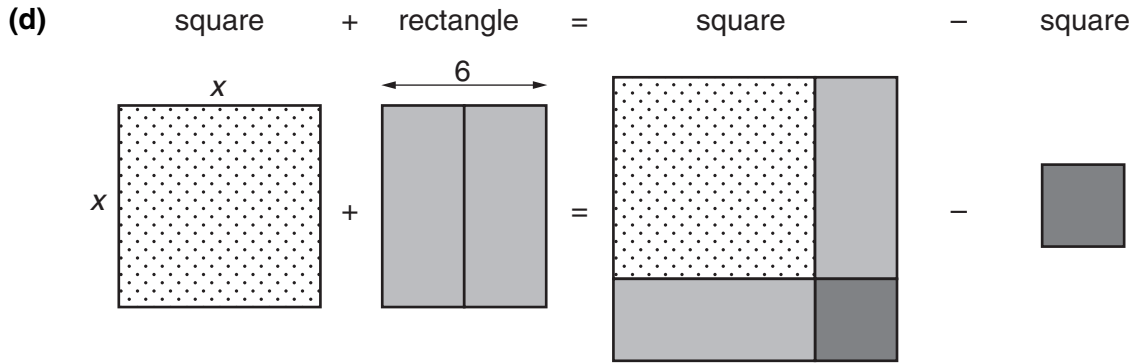Multiply out $2(3 + 4b)$ to find the shaded area.

(b) _____ **[2]**

(c)

The first diagram shows a square of side a from which a square of side b has been removed.
It has been cut and rearranged to form a rectangle, as shown.

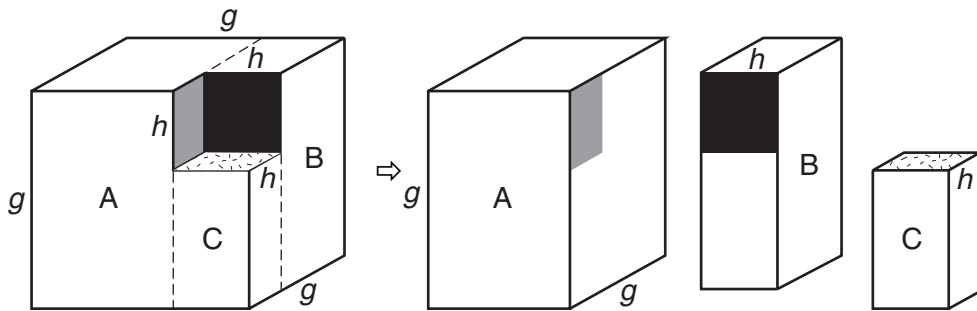Complete the dimensions on the second diagram. **[2]**

(d)   square   +   rectangle   =   square   −   square

The diagram illustrates the process known as "completing the square".

Express $x^2 + 6x$ in the form $(x + c)^2 - d$.

(d) _____ **[3]**

(e) A small cube is removed from one corner of a large cube.
The resulting shape is then cut along the broken lines to form three cuboids, A, B and C.

Work out the volumes of the cuboids A, B and C and hence factorise $g^3 - h^3$.

(e) _____ **[4]**

7 Phil was investigating the times of sunrise and sunset.
The table shows some of the data he found from the internet.
All times are in Greenwich Mean Time (GMT).

Date	Time of sunrise hours:minutes (GMT)	Time of sunset hours:minutes (GMT)
1st January	08:13	15:54
1st March	06:47	17:39
1st May	04:27	19:28
1st July	03:39	20:29
1st September	05:10	18:49
1st November	06:58	16:29

(a) (i) On which of these six dates did the sun rise earliest?

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

(ii) Calculate the time between sunrise and sunset on 1st January.
Give your answer in hours and minutes.

(ii) _____hours _____minutes **[2]**

(iii) Calculate the time between sunrise and sunset on 1st September.
Give your answer in hours correct to two decimal places.

(iii) _____ h **[3]**

Phil calculated *t*, the time in hours between sunrise and sunset.
He numbered the days from 0 on 21st June, the so-called "longest day", 1 on 22nd June, and so on.

Diagram ① shows Phil's sketch of *t* against the day number (*d*).
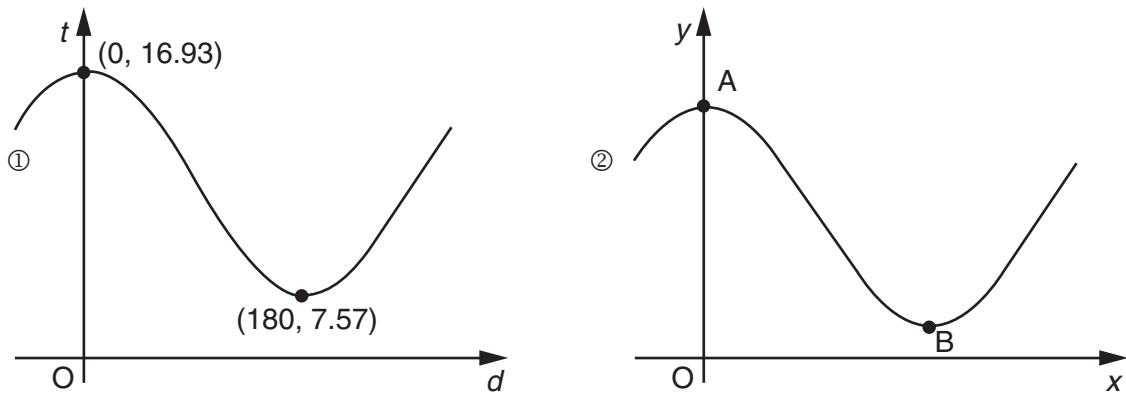
Phil realised that diagram ① was similar to a cosine graph.
He sketched the graph of $y = 4 \times \cos x° + 5$ which is shown in diagram ②.

(b) In diagram ② the highest and lowest points are labelled A and B.

(i) Work out the coordinates of A.

(b)(i) (_____ , _____) **[1]**

(ii) Show that the coordinates of B are (180, 1). **[1]**

(c) Phil thinks that the curve in diagram ① has equation $t = a \times \cos d° + c$.

Using the coordinates given in diagram ①, find approximate values for *a* and *c*.
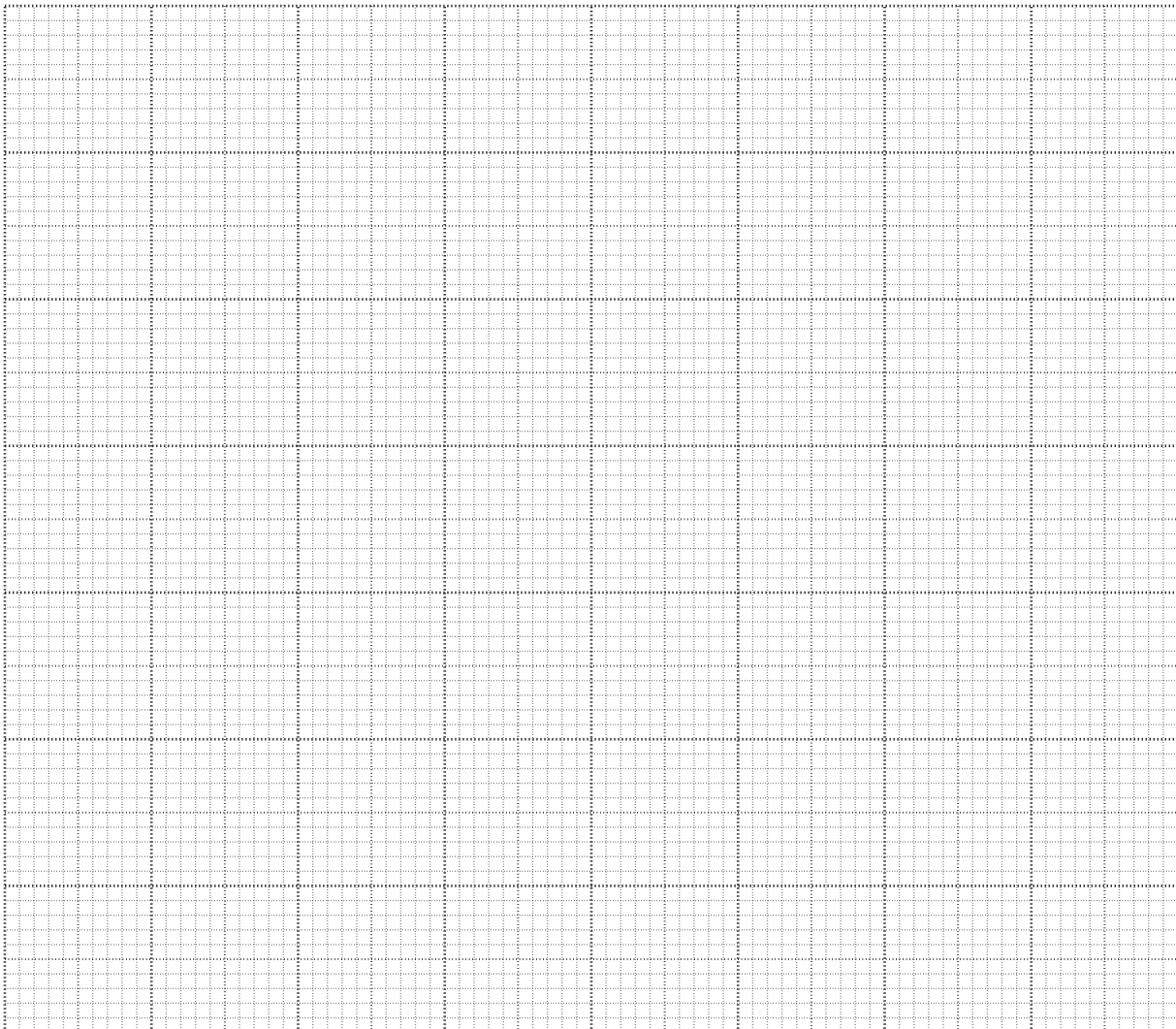
(c) *a* = _____ ; *c* = _____ **[4]**

Turn over

8 The table contains data about numbers of passengers (in thousands) travelling by air or by sea. The table shows data for travel between the UK and Europe, the UK and the rest of the world, and for cruising. All the data have been rounded to the nearest thousand.

Thousands	1993	1995	1997	1999	2001
By air					
Europe	60 013	69 351	76 474	90 249	99 596
Rest of world	27 335	31 542	37 594	42 619	42 591
By sea					
Europe	34 685	34 321	36 258	31 381	27 754
Rest of world	37	33	29	26	27
Cruising	193	207		445	469

Source: Office for National Statistics, www.statistics.gov.uk. Crown copyright material is reproduced with the permission of the Controller of HMSO and the Queen's Printer for Scotland.

Describe and compare the trends in air and sea travel during this period.

You should
- include at least one diagram,
- show any calculations you do,
- estimate how many passengers went cruising in 1997, showing your method.

Numbers cruising (thousands) in 1997: _____

_____

_____

_____

_____ **[9]**

PLEASE DO NOT WRITE ON THIS PAGE

Mark Schemes for the Components

January 2009

CONTENTS

General Certificate of Secondary Education

Mathematics (J915)

MARK SCHEMES FOR THE COMPONENTS

J915/01 Paper 1

1	(a)	1/3 oe	2	**M1**: $n/6$, with $0 < n < 6$
	(b)	(i) RRR GRR GGG	2	**M1**: 2 rows or 2 columns correct
		(ii) 5/9 oe Accept 0.55 or better.	2	**M1**: $n/9$, with $0 < n < 9$
	(c)	4/9 oe Accept 0.44 or better.	3	**M2**: Correct 3×3 table with headings **or** tree with labels and probabilities **or** $\frac{1}{3} \times \frac{1}{3} \times 4$ oe **Or M1**: table with headings and 2 rows or 2 columns correct or tree without probabilities or $\frac{1}{3} \times \frac{1}{3}$ oe seen
2	(a)	50, 60	1	
	(b)	(i) 3	1	
		(ii) (0, 1, 2, 3,) 4, 5, 6 cao	1	
	(c)	(i) 5	1	
		(ii) Adam's 1st 7 digits→check digit = 4 - mistake is not detected Barbara's 1st 7 digits→check digit = 0 - mistake is detected	3	**M1**: started correct method to find either check digit **A1**: one conclusion **A1**: the other conclusion **OR** : **A1** : both check digits correct **A1** : both conclusions
	(d)	(i) 0 **www**	2	**M1**: $3 \times (1 + 3 + 5 + 7) + 2 + 4 + 6$ soi
		(ii) Both codes are valid Transposition may not be detected	4	**M1**: intention to find either check digit **A1**: either check digit found (=2) **www** **M1**: transposition oe **A1**: not detected

3	(a)	8 (accept 7)	1	
	(b)	50π seen	1	
	(c)	(i) When diameter = 50, circum. = 157	1	
		(ii) Mark in 172 to 173	3	**M1A1**: 55π = 172.(…)
	(d)	20.4	3	**M1**: h/18 = 68/60 **OR M1**: Scale factor of 3(00) or1/3 etc **DepM1**: $18 \times 68/60$
	(e)	74.47	4	**M1**: 1.175 soi **DepM1A1**: 500/1.175 = 425.(53) soi
	(f)	5.8 or 5.(7…) www Accept 6 if supported	4	**M1** $\pi \times 0.6^2 \times 35/3$ (= 13.19…) **DepM1**: x two correct factors **DepM1**: x third correct factor **SC3**: Answer that rounds to 24 **SC1** : ….x 1.9x0.24x0.96
4	(a)	(i) 21	1	
		(ii) 21	2	**M1**: $\frac{1}{2} \times 6 \times (6 + 1)$ or better seen
		(iii) They are the same (**ft** essential)	1	Accept any reasonable comment.
	(b)	(i) 1275	2	**M1**: $50 \times 51 \div 2$
		(ii) 5050	2	**M1**: $100 \times 101 \div 2$
		(iii) 2500 **ft**: (ii) – 2 × (i)	2	**M1**: $5050 - 2 \times 1275$
	(c)	(i) 120	1	
		(ii) 24 **provided** $n^2 + n - 600$ or $(n + \frac{1}{2})^2$ seen	5	**B4**: $(n \pm 24)(n \pm 25)$ (= 0) or $(n + \frac{1}{2})^2 = 600 + \frac{1}{4}$ oe **B3**: $n^2 + n - 600$ (= 0) or $(n + \frac{1}{2})^2$ **B2**: $n^2 + n \ldots$ soi **M1**: $\frac{1}{2}n(n+1) = 300$ **or SC2**: 24
5	(a)	(i) 5.7 ($\pm$0.1) 120^o ($\pm$1)	2	**B1** each
		(ii) U within 2 mm of correct point	2	**M1**: any correct method attempted
		(iii) PSV = 18 Accept answers in [17.2, 18.4]	2	**M1**: $\frac{1}{2} \times$ base $\times$ height attempted **or** $\frac{1}{2} \times 7.2 \times 5.7 \times \sin60^o$
		RST = 18 Accept answers in [17.2, 18.4]	2	**M1**: $\frac{1}{2} \times 7.2 \times 5.7 \times \sin120^o$ **or** $\frac{1}{2} \times$ base $\times$ height attempted
	(b)	(i) 140°	1	

		(ii) ABC = 0.5bc sin 40°
		   AEG = 0.5bc sin 140°
		     = 0.5bc sin 40°
		   because sin$X$ = sin(180° – X)
			3	**M1**: (ABC =)0.5$bc \times$ 0.642…
				M1: (AEG =)0.5bc sin 140°
				A1: = 0.5$bc \times$ 0.642… or better
				SC1: stating sin140^o = sin 40°

6	(a)	$6a$	1	**No** isw
	(b)	$6 + 8b$	2	**M1**: either term
	(c)	$a + b$, $a - b$	2	**B1**: each expression
	(d)	$(x + 3)^2 - 9$	3	**M1**: $d = 3^2$ soi **M1**: $x + 3$ soi
	(e)	$(g - h)(g^2 + gh + h^2)$	4	**M1**: each of… $g^2(g - h)$, $gh(g - h)$, $h^2(g - h)$ seen **SC2** all three terms without brackets
7	(a)	(i) 1st July	1	
		(ii) 7h 41m	2	**B1 + B1** **SC1** 16 hours 50 minutes
		(iii) 13.65	3	**M2**: $18\frac{49}{60} - 5\frac{10}{60}$ or $13\frac{39}{60}$ **M1**: $18\frac{49}{60}$ or $5\frac{10}{60}$ or 13h 39m or 13:39 **SC1** ……65
	(b)	(i) (0, 9)	1	
		(ii) Lowest point on $y = \cos x^o$ is (180, −1)	1	Accept: $4 \times (-1) + 5 = 1$ Accept: $4\cos 180^o + 5 = 1$
	(c)	$a = 4.6(8)$, $c = 12.2(5)$	4	**M1** 16.93=a+c oe soi **M1** 7.57=-a+c oe soi **A1**: $a = (16.93 - 7.57)/2 = 4.68$ **A1**: $c = (16.93 + 7.57)/2 = 12.25$
8		Air traffic increased by 66% in Europe, **or** by 56% in Rest of World, **or** by 67% in Total	2	**B1**: Air traffic increased oe **B1**: increase quantified for one named region
		Sea traffic decreased by 20% in Europe, **or** by 27% in Rest of World, **or** by 20% in Total	2	**B1**: Sea traffic decreased oe **B1**: decrease quantified for one named region
		Cruising increased by 143%	2	**B1**: Cruising increased oe **B1**: increase quantified
		Estimate: cruising in 1997: 330 ($\pm$20) (thousand)	2	**M1**: line of best fit or S-shaped curve attempted on scattergraph of cruising passengers/date **or** (193+207+445+469)/4 (=1314/4)
		One correct and useful diagram e.g. scattergraph	B1	**or** column graphs, stacked or separate

Grade Thresholds

Component Threshold Marks

Component	Max Mark	A*	A	B	C	D	E	F	G
Written paper	100	70	58	46	34	28	22	17	12

Overall

	A*	A	B	C	D	E	F	G
Percentage in Grade	3.5	5.0	12.2	23.4	14.1	17.3	11.5	9.2
Cumulative Percentage in Grade	3.5	8.5	20.7	44.1	58.2	75.5	87.0	96.2

The total entry for the examination was 1491

Statistics are correct at the time of publication.

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RECOGNISING ACHIEVEMENT

GENERAL CERTIFICATE OF SECONDARY EDUCATION
GCSE IN ADDITIONAL MATHEMATICS   **J915/01**

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.
* Show your working. Marks may be given for a correct method even if the answer is incorrect.
* Final answers should be rounded to an appropriate degree of accuracy.
* Answer **all** the questions.
* Do **not** write in the bar codes.
* Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

* The number of marks is given in brackets **[ ]** at the end of each question or part question.
* You are expected to use an electronic calculator for this paper.
* Use the π button on your calculator or take π to be 3.142 unless the question says otherwise.
* The total number of marks for this paper is **100**.
* This document consists of **24** pages. Any blank pages are indicated.

Formulae Sheet

Area of trapezium $= \frac{1}{2}(a+b)h$
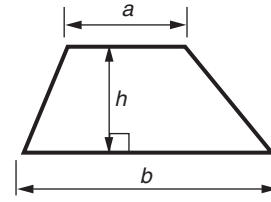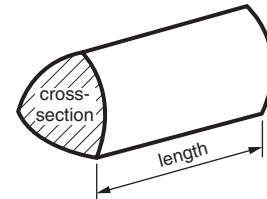
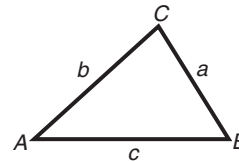**Volume of prism** = (area of cross-section) × length

In any triangle *ABC*

Sine rule $\quad \dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C}$
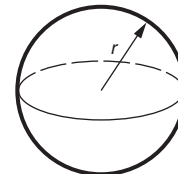
Cosine rule $\quad a^2 = b^2 + c^2 - 2bc \cos A$

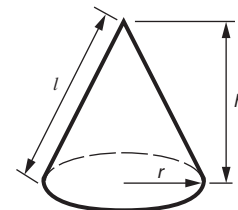**Area of triangle** $= \frac{1}{2}ab\sin C$

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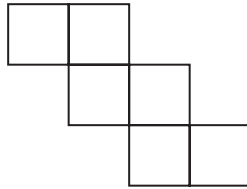where $a \neq 0$, are given by

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

PLEASE DO NOT WRITE ON THIS PAGE

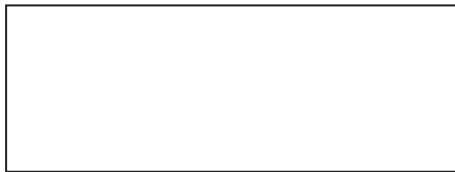**1** **(a)** For the following statements write

> T if you think it is true,
> F if you think it is false.

(i) This diagram is a net of a cube.

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

(ii) This rectangle has 4 lines of symmetry.

(ii) _____ **[1]**

Turn over

(b) Here are pairs of statements.
In each case the first statement is not always true.

Complete the second statement so that it is **always** true.

(i) The median of a set of 5 marks is the 3rd mark.

The median of a set of 5 marks is the 3rd mark if _____ **[1]**

(ii) When x and y are prime numbers, $x + y$ is even.

When x and y are prime numbers, x + y is even unless _____

_____ **[2]**

(iii) When k is any number, k^2 is a positive number.

k^2 is a positive number except when _____ **[1]**

(iv) When k is any number, k^2 is greater than k.

k^2 is greater than k if _____ or _____ **[2]**

Turn over

2 The set of numbers 1, 1, 2, 3, 5, … is known as the **Fibonacci sequence**.

1st term	2nd term	3rd term	4th term	5th term	6th term	7th term	8th term	9th term	10th term	11th term	12th term
1	1	2	3	5		13	21	34			144

The first two terms are both 1; after this each term is the sum of the two previous terms.

For example: the 3rd term = the sum of the 1st and 2nd terms = 1 + 1 = 2,
the 4th term = the sum of the 2nd and 3rd terms = 1 + 2 = 3,
the 5th term = the sum of the 3rd and 4th terms = 2 + 3 = 5.

(a) Find the sum of 3 and 5 and write your answer as the 6th term in the table. **[1]**

(b) Write the 10th and 11th terms in the table. **[2]**

(c) The pattern

odd, odd, even, odd, odd, even, …

continues throughout the Fibonacci sequence.

Explain why this happens. **[3]**

(d) Here is part of a spreadsheet.

Sam plans to enter a formula in cell C2 and then drag it to the right to generate further terms of the Fibonacci sequence.

What formula should Sam enter into cell C2?

(d) _____ **[2]**

(e) The letters *v*, *w*, *x*, *y*, *z* represent, in ascending order, five consecutive terms of the Fibonacci sequence.

(i) Express *x*, *y* and *z* in terms of *v* and *w*, simplifying your answers.

(e)(i) *x* = _____ , *y* = _____ , *z* = _____ **[6]**

(ii) Hence prove that if *v* is a multiple of 3 then *z* is also a multiple of 3. **[2]**

Turn over

3 The table shows data about Internet access for the households in Great Britain during the years 2002 to 2007.

Year	Percentage of households with Internet access	Number of households with Internet access (millions)	Growth as a percentage of the number of households with access the previous year
2002	46	11.02	–
2003	50	11.88	8
2004	51	12.16	2
2005	55	13.26	9
2006	57	13.93	5
2007	61	14.94	7

Source: www.statistics.gov.uk/pdfdir/inta0807.pdf

(a) (i) In which year did the number of households with Internet access first exceed 12 million?

(a)(i) _____ **[1]**
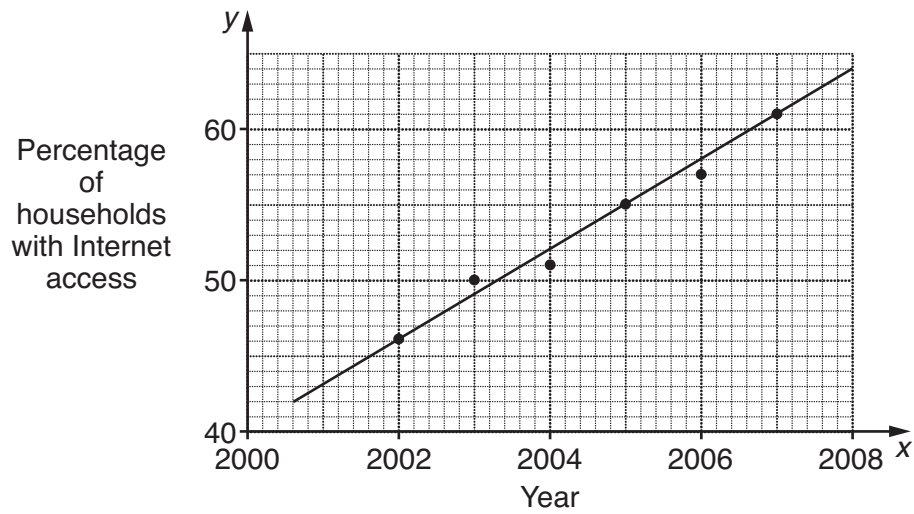
(ii) Calculate the mean of the number of households with Internet access during these 6 years.

(ii) _____ million **[3]**

(iii) Write down a full calculation which would show that the growth in Internet access from 2005 to 2006 was 5%.

(iii) _____ **[3]**

(b) Jeni wants to estimate when all the households in Great Britain will have Internet access. She prepared this scatter graph.

She then drew the line of best fit shown; this passes through three of her plotted points.

(i) Show that the gradient of Jeni's line of best fit is 3. **[1]**

(ii) By finding the equation of Jeni's line of best fit, find the value of x when $y = 100$.
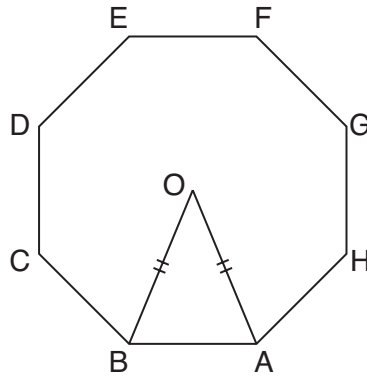
Equation: _____ ; $x =$ _____ when $y = 100$. **[4]**

(iii) Give two reasons why a line of best fit is not appropriate for Jeni's estimation task.

1. _____

_____

2. _____

_____ **[2]**

4 **(a)** The diagram shows a regular octagon, ABCDEFGH, with centre O.

(i) What kind of triangle is triangle AOB?

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

(ii) On the diagram, using 3 of the 9 labelled points, draw and shade a triangle that is congruent to triangle AOB. **[1]**

(iii) Explain why angle AOB = 45°. **[1]**

(iv) N is the midpoint of AB; ON = 14 m.

By calculation show that AB is just under 11.6 m. **[3]**

(v) Calculate the area of triangle AOB.

(v) _____ m² **[2]**

(b) The diagram shows the floor plan of an octagonal school building.

The floor plan is a regular octagon, ABCDEFGH, with centre O.

N is the midpoint of AB; ON = 14 m.

The inner octagon shown is the floor plan of an assembly hall; its vertices are at the midpoints of the lines that join the vertices of the outer octagon to O.

The assembly hall is surrounded by 8 identical spaces: 7 classrooms, numbered ① to ⑦, and an entrance lobby, shown shaded.
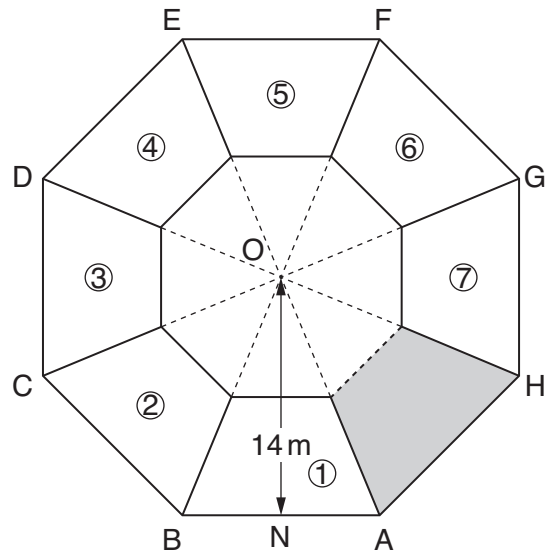
(i) Explain in detail why the floor area of the assembly hall is 25% of the total floor area of the building. **[3]**

(ii) Regulations require schools to allow classroom space of at least 1.8 m^2 per pupil.

Using your answer to part **(a)(v)**, or otherwise, calculate the maximum number of pupils allowed in one of the classrooms.

(b)(ii) _____ **[4]**

5 **(a)** Each letter of the phrase 'A RANDOM DRAW' is written on separate, identical cards.

| A | R | A | N | D | O | M | D | R | A | W |

The 11 cards are shuffled and one card is chosen at random.

(i) Write a probability word that describes the following event.

The card chosen has the letter Q written on it.

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

(ii) Which letter is most likely to be on the card chosen?

(ii) _____ **[1]**

(iii) Which letters in 'A RANDOM DRAW' are least likely to be on the card chosen?

(iii) _____, _____, _____, _____ **[3]**

(b) Each of the 9 letters of the phrase 'LUCKY DRAW' is written on separate, identical cards.

| L | U | C | K | Y | | D | R | A | W |

These 9 cards are put with a 10th identical, blank card.

The 10 cards are shuffled and cards are drawn one at a time, at random.
Once a card is drawn it is NOT replaced.

(i) Write down the probability that the first card drawn has a letter on it.

(b)(i) _____ **[2]**

(ii) Explain why the probability that the first two cards drawn both have letters on them is $\frac{4}{5}$. **[3]**

(iii) Calculate the probability that all 9 letter cards are drawn before the blank card.

(iii) _____ **[4]**

Turn over

6 A year has 365 days unless it is a leap year when it has 366 days.
The year 2008 was a leap year.
Every 4th year is a leap year, so the years 2012, 2016, and so on will be leap years.

(a) 1st January 2008 was a Tuesday.

   (i) Find the remainder when you divide 366 by 7.

(a)(i) _____ **[2]**

   (ii) Using your answer to part **(i)** explain why 1st January 2009 was a Thursday. **[1]**

   (iii) Which day of the week will 1st January 2010 be?

(iii) _____ **[1]**

(b) 1st January 2008 was a Tuesday.

   Explain why 1st January 2012 will be a Sunday, a change of 5 days. **[1]**

(c) In a leap year the 'extra' day is at the end of February.
Tony and Val were married on a Saturday in January.

Which day of the week will their wedding anniversary be on 50 years later?

Your answer should take account of whether they were married
  • in a leap year,
  • one year after a leap year,
  • two years after a leap year,
  • or three years after a leap year.

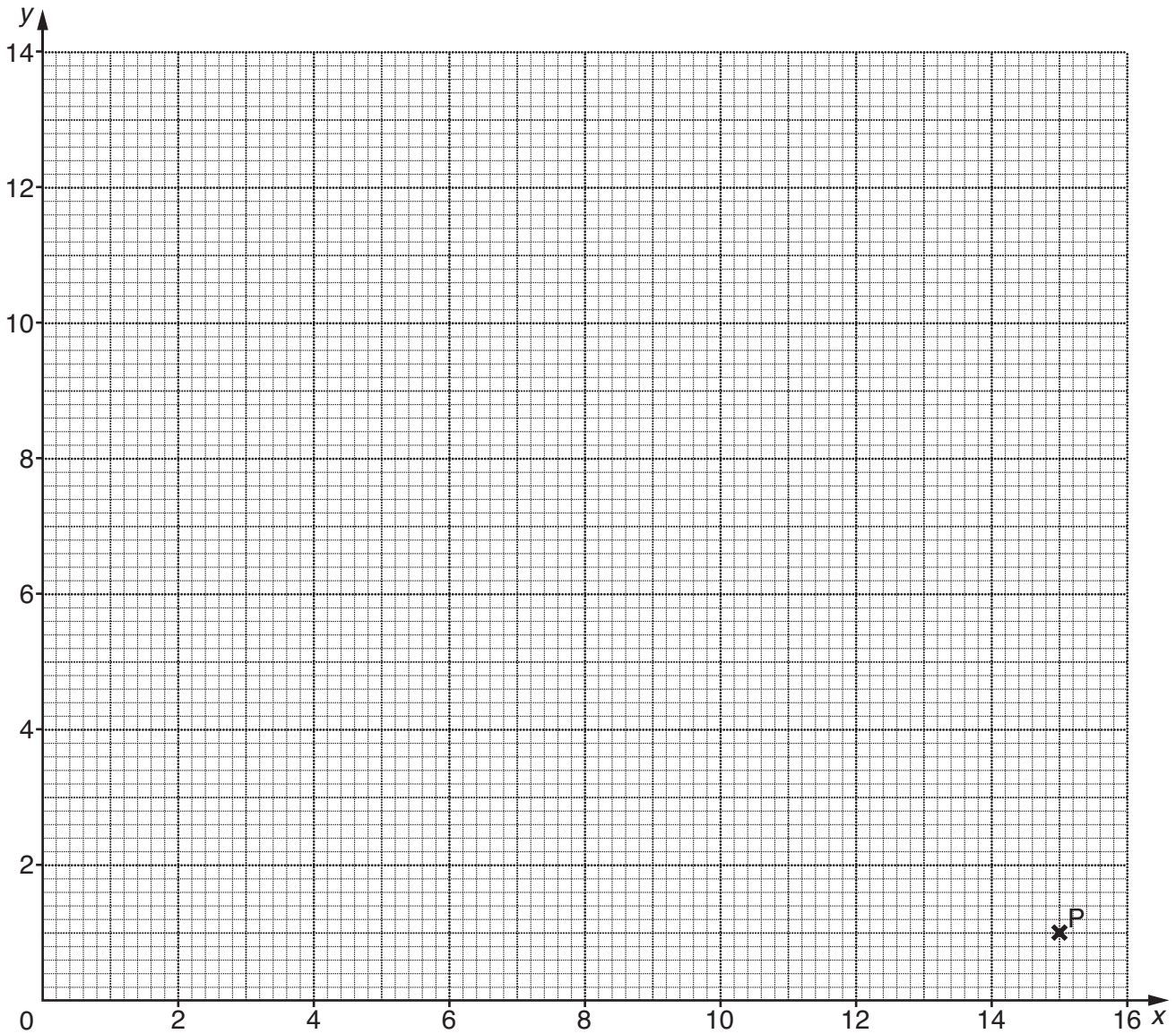**(c)** If they were married in a leap year: _____

If they were married one year after a leap year: _____

If they were married two years after a leap year: _____

If they were married three years after a leap year: _____ **[5]**

7 **(a)** **(i)** Write down the coordinates of the point labelled P on the grid below.

(a)(i) (_____ , _____) **[1]**

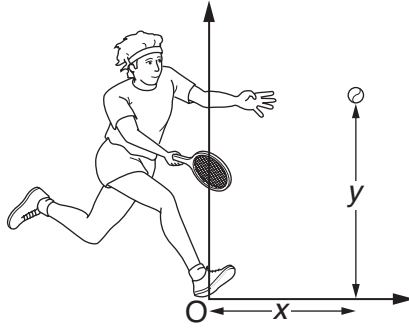

(ii) Complete the table of values for $y = 1 + 3x - 0.2x^2$.

x	0	3	6	9	12	15
y	1	8.2		11.8		1

[2]

(iii) On the grid draw the graph of $y = 1 + 3x - 0.2x^2$. **[2]**

(b) Robin has just hit a tennis ball.

Using the point where Robin's foot was touching the ground as the origin, O, the ball is at the point (x, y) where

$$y = 1 + 3x - 0.2x^2$$

and x and y are measured in metres.
The ground is horizontal.

(i) Use the graph you drew in part **(a)(iii)** to estimate how far the ball has travelled horizontally when it is 10 m above the ground.

(b)(i) _____ m and _____ m **[2]**

(ii) Estimate the angle to the horizontal at which the ball leaves the racquet.

(ii) _____ ° **[1]**

(iii) The ball hits the ground at Q. Robin wants to calculate OQ.

Explain why Robin needs to solve the equation $1 + 3x - 0.2x^2 = 0$. **[1]**

Turn over

(iv) Using the formula for solving quadratic equations, calculate OQ.

(iv) _____ m **[3]**

(v) Showing your method, **calculate** the maximum height of the ball above the ground.

(v) _____ m **[2]**
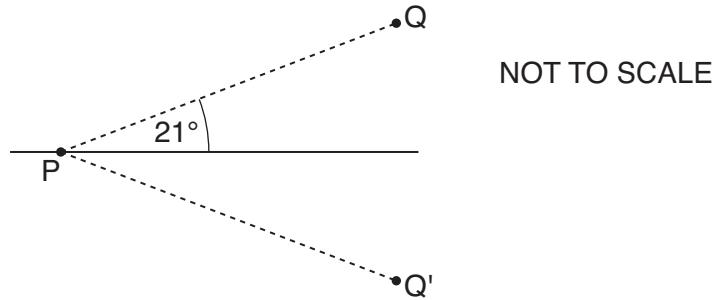
8 **(a)** HEXAGN is a regular hexagon. Its centre is at O.
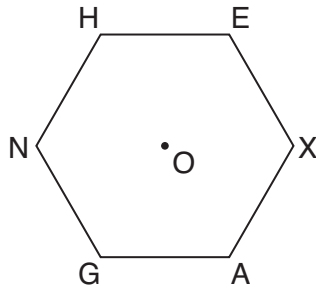
(i) State the order of rotational symmetry of a regular hexagon.

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

(ii) Find the size of angle HOE.

(ii) _____ ° **[2]**

(b) The diagram shows two points, Q and Q', and a point P on a line.

NOT TO SCALE

Q' is the reflection of Q in the line.
PQ makes an angle of 21º with the line.

Explain why angle QPQ' = 42°.

Angle QPQ' = 42° because _____

_____ **[1]**

Turn over

(c)

line of
symmetry
of nut

$t°$
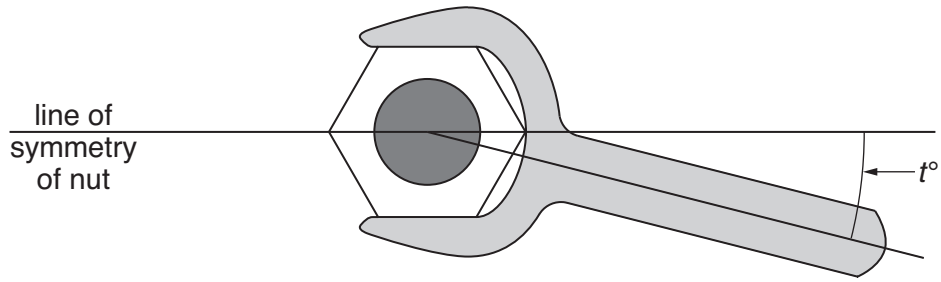
Diagram 1

Diagram 1 shows an open-ended spanner being used to turn a nut.
The nut is a regular hexagon.
The handle of the spanner makes an angle of $t°$ with the line of symmetry drawn.

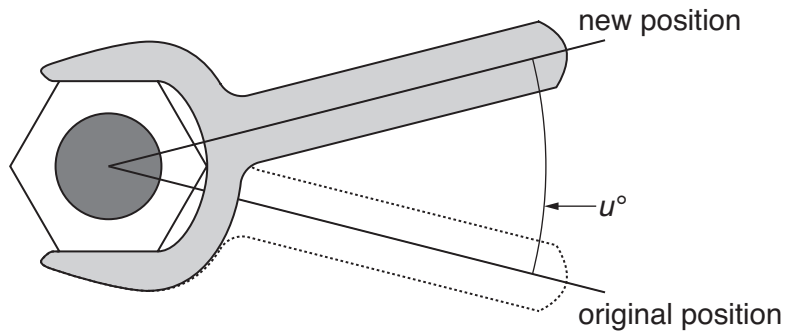The spanner can be turned over to fit the nut as shown in Diagram 2.

new position

$u°$

original position

Diagram 2

The angle between the two possible positions of the handle is $u°$.

(i) Express u in terms of t, explaining your reasoning.
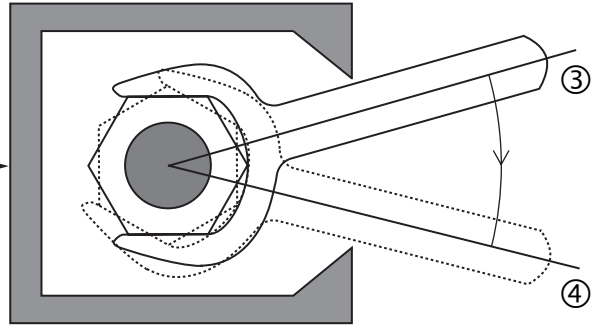
$u =$ _____ because _____

_____ **[2]**

The instructions below show how you can use the spanner to turn a nut in an obstructed position.

| ① | Fit the spanner on the nut. |
| ② | Rotate the spanner and nut clockwise as far as possible, as shown dotted. |

| ③ | Turn the spanner over and fit it on the nut. |
| ④ | Rotate the spanner and nut clockwise as far as possible. |
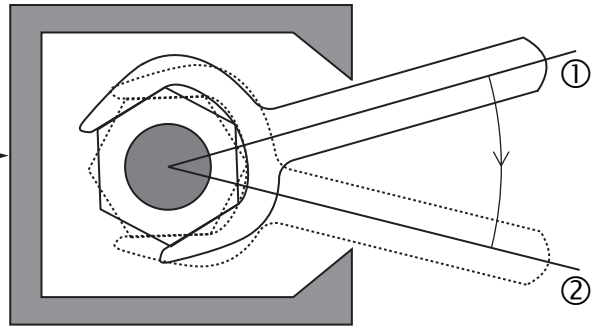
Turn the spanner over again and fit it on the nut, as in ①.
Repeat this sequence of moves.

In this way the nut can be turned through any number of degrees.

(ii) Using your answer to part **(a)(ii)**, calculate the best value for *t*.
Explain your reasoning.

t = _____ because _____

_____ **[3]**

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GCSE

Mathematics

General Certificate of Secondary Education **GCSE J915**

Mark Schemes for the Units

June 2009

CONTENTS

General Certificate of Secondary Education

Mathematics (J915)

MARK SCHEMES FOR THE UNITS

J915/01 Paper 1

1	**(a)**	(i) T	1	
		(ii) F	1	
	(b)	(i) they are ordered oe	1	Accept "sequential".
		(ii) x or y = 2 but not both oe	2	B1: any other reference to x or y being 2. SC1: "x or y is even but not both" oe eg just one of x or y is odd.
		(iii) $k = 0$ oe	1	
		(iv) $k > 1$ $k < 0$	2	B1: either part
2	**(a)**	8	1	
	(b)	55, 89	2	B1: each part.
	(c)	odd + odd = even odd + even = odd even + odd = odd	3	B1: O+O = E B1: O+E (either order) = O B1: a 3rd useful and valid statement eg "and so on" or "It starts with 2 odds"
	(d)	=A2 + B2 OR =A\$2+B\$2 OR =SUM(A2:B2) Accept: =SUM(A2+B2)	2	B1: A2+B2 (i.e. omits =) OR A2+B2 = (ie misplaced =) OR C2 =A2+B2 OR Σ(A2:B2)
	(e)	(i) $v + w$, $v + 2w$, $2v + 3w$	6	B1: $x = v + w$ M1: $y = w + x$ OR $w + v + w$ A1: = $v + 2w$ M1: $z = x + y$ + M1: = $v + w + v + 2w$ with or without () A1: = $2v + 3w$ ft from linear x & y.
		(ii) If v is a multiple of 3 then so is $2v$. The sum of multiples of 3 is a multiple of 3.	2	B1: each part
3	**(a)**	(i) 2004	1	
		(ii) 12·86 or 12·87 or 12·865 Accept 12·9 www (Not 13)	3	M1: sum (77·19) attempted + M1: ÷ 6
		(iii) $\dfrac{13 \times 93 - 13 \times 26}{13 \times 26} \times 100$ oe eg 13·93/13·26 – 1 = 0·05…	3	M1: correct subtraction + M1: division by 13·26 (Not 13·93) + DM1: times 100 (depends on ÷13·26) OR M1A1: 13·93/13·26 = 1·05… + M1: 1·05... implies 5% (increase)
	(b)	(i) (55–46)/3 OR (61–46)/5 OR (61–55)/2	1	Accept 9/3, 15/5, 6/2
		(ii) $y = 3x - 5960$ $x = 2020$	4	B2: correct equation + B2: 2020 or B1: $y = 3x + k$, $k \neq -5960$ or M1: $100 = 3x - 5960$ soi (ft from equation)
		(iii) Linear relation implies that percentage exceeds 100% in due course. oe Jeni cannot foretell future pattern.	2	B1: each reason One reason should be about why linear model is not appropriate as percentage nears 100. The other reason should criticise extrapolation.

4	(a)	(i) Isosceles	1	Accept: Acute (angled)
		(ii) Correct Δ drawn & **shaded**	1	
		(iii) 360/8 oe	1	Accept 8 × 45 = 360
		(iv) (AB =) 14tan22·5° × 2 = 11·59… or 11·58 Must be slightly less than 11·6.	3	M1: Attempt to use 22·5° or 67·5° DM1: 14×tan 22·5° oe SC2: 15·6... or 10·3... (from rads or grads)
		(v) Accept 81·2 or 81·1…	2	M1: 14 × 11·6 (or better) ÷ 2 **No ft** OR 15·15...^{2} × sin45^o/2
	(b)	(i) The octagons are **similar** (length) sc. factor = 0·5 (or 2) area sc. factor = 0·5^2 (or 2^2)	3	B1 for each point Accept enlargement for similar. **Do not accept circular argument.** SC2: 4 small Δs fit in each large Δ oe
		(ii) **33**	4	B3: 34
5	(a)	(i) Impossible oe	1	
		(ii) A	1	
		(iii) M, N, O, W	3	B2: 3 correct, no extras B1: 2 correct, no extras OR 3 correct, 1 extra
	(b)	(i) $\frac{9}{10}$ oe	2	M1: Numerator or denominator correct SC1: 9 in 10, 9 out of 10, 9:10, etc
		(ii) $\frac{9}{10} \times \frac{8}{9} = \frac{4}{5}$	3	M1: $\frac{8}{9}$ seen + M1: $\frac{8}{9} \times \frac{9}{10}$
		(iii) $\frac{1}{10}$ **(or 0·1) www**	4	M3: $\frac{9}{10} \times \frac{8}{9} \times \frac{7}{8} \times .... \times \frac{1}{2}$ or M2: $\frac{9}{10} \times \frac{8}{9} \times \frac{7}{8} \times \frac{6}{7}$ or M1: $\frac{9}{10} \times \frac{8}{9} \times \frac{7}{8}$ SC1: the correct 9 fractions seen.
6	(a)	(i) 2	2	M1: 366 ÷ 7 (= 52·28…)
		(ii) … date falls **2 days (later)**	1	Must refer to 2
		(iii) Friday	1	
	(b)	2+1+1+1 (=5) or 1+1+1+2 (=5) seen	1	Accept list of year date and start day. Accept: Friday + 2 days = Sunday
	(c)	**Saturday** **Friday** **Friday** **Saturday**	5	B1: 50 yrs ≡ 63 days + B1: ≡ 0 (or 7) days (fwd) or Saturday + B1: 50 yrs ≡ 62 days + B1: ≡ 6 days (fwd) or 1 day back **OR:** B1: 48 yrs ≡ 60 days (fwd) + B1: ≡ 4 days (fwd) or Wednesday **OR:** M1: sequence such as …MoTuWeTh SaSuMoTu Th… or …ThFrSaSu TuWeThFr Su…

7	(a)	(i) (15, 1)	1	
		(ii) 11·8, 8·2	2	B1 each
		(iii) Correct plots & curve	2	P1: 5 plots ft table, tol: 1 mm C1: curve (not ruled) passing within 1 mm of 5 plots and rising above y = their plotted 11·8.
	(b)	(i) 4·1, 10·9	2	B1 each **Answers must ft from graph ±0·1.**
		(ii) 70° (±5°)	1	
		(iii) (Hits ground when) $y = 0$	1	Accept: Height or ground level = 0
		(iv) 15·3 www and not by completing the square. Accept 15·33 or 15·32	3	M1: $\dfrac{-3 \pm \sqrt{3^2 - 4(-0.2)(1)}}{2(-0.2)}$ or better A1: 15·32(6…) (or –0·326)
		(v) 12·25	2	M1: substitutes $x = 7\cdot5$ into $1 + 3x - 0\cdot2x^2$ or $-0\cdot5(x - 7\cdot5)^2 + ...$ seen
8	(a)	(i) 6	1	
		(ii) 60	2	M1: $360 \div 6$ oe
	(b)	Reflections preserve angles oe	1	eg: PQ' & PQ form equal angles with line
	(c)	(i) 2t spanner is "reflected" (in symmetry line)	2	B1: 2t or $t + t$ B1: the reason
		(ii) 15 Steps ① to ④ must turn nut 60°. oe eg: The spanner must be able to turn (up to) 30°.	3	B2: 15 B1: Reason. Depends on B2 for 15. SC1: $t = 30$ on answer line or $u = 30$ seen.

Grade Thresholds

General Certificate of Secondary Education
Mathematics E (J915)
June 2009 Examination Series

Component Threshold Marks

Component	Max Mark	A*	A	B	C	D	E	F	G
Paper 1	100	70	57	44	32	27	22	17	12

Specification Options

Overall

	A*	A	B	C	D	E	F	G
Percentage in Grade	6.0	11.5	17.8	27.6	13.8	11.4	7.1	3.1
Cumulative Percentage in Grade	6.0	17.5	35.3	63.0	76.7	88.1	95.2	98.3

The total entry for the examination was 9624

Statistics are correct at the time of publication.

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