Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Quadratic sequences

Time allowed: 1 hour 25 minutes

Subject code **0580**

Mathematics

Questions from Paper 1, Paper 2 and Paper 4

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
You may use a calculator.

Total marks

/ 68

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 68 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 The nth term of a sequence is $n^2 - 1$.

Find the first three terms of this sequence.

..... , ... , ... [2]

Quadratic sequences Click for more variations

1	0 3 8	**2**	**B1** for 2 correct terms in correct position or **SC1** for −1 0 3

2 Find the nth term of this sequence.

8, 17, 32, 53, 80, …

..... [2]

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2	$3n^2 + 5$ oe final answer	**2**	**M1** for correctly finding second differences or an answer that is a quadratic sequence

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3 The nth term of a sequence is $n^2 + 12$.

(a) Find the first three terms of this sequence.

..... , ... , ... [2]

(b) Is 5196 a term in this sequence?
Give a reason for your decision.

..... because .....

..... [2]

(a) Quadratic sequences (b) Quadratic sequences Click for more variations

3(a)	13, 16, 21	**2**	**B1** for 2 correct terms in correct position or **SC1** for 12, 13, 16
3(b)	Yes $n = 72$	**2**	**M1** for $n^2 + 12 = 5196$ or better or for a correct worded description for finding n or for 5184 is a square number

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4 The table shows some information about two sequences.

	nth term	5th term
Sequence A	$60 - 4n$	
Sequence B	$n^2 - 300$	

(a) Complete the table.

[2]

(b) Find the smallest **positive** number in sequence B.

..... [2]

(a)(A) The nth term of a linear sequence (a)(B) Quadratic sequences (b) Quadratic sequences

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4(a)	40 –275	**2**	**B1** for each
4(b)	24	**2**	**B1** for 324 or 289 or $\sqrt{300}$ or 17.3…

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5 The nth term of a sequence is $an^2 + bn - 4$.

The first term is -3 and the second term is 2.

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [5]

Quadratic sequences Click for more variations

5	[a =] 2 [b =] − 1	**5**	**M2** for correct method to find two simultaneous equations e.g. two from $a \times 1^2 + b \times 1 - 4 = -3$ $a \times 2^2 + b \times 2 - 4 = 2$ $3a + b = 2 - - 3$ or **M1** for 1 correct equation **M1** for correctly eliminating one variable for *their* simultaneous equations **A1** for a = 2 **A1** for b = − 1

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6 The nth term of a sequence is $an^2 + bn$.

(a) Write down an expression, in terms of a and b, for the 3rd term.

..... [1]

(b) The 3rd term of this sequence is 21 and the 6th term is 96.

Find the value of a and the value of b.
You must show all your working.

a = ...

b = ... [4]

(a) Quadratic sequences (b) Quadratic sequences Click for more variations

6	**(a)**	$9a + 3b$	**1**	
	(b)	$36a + 6b = 96$ or $9a + 3b = 21$	**B1**	
		for correct method to eliminate one variable	**M1**	
		$a = 3$ $b = -2$	**A1** **A1**	If **M0 A0 A0** scored **SC1** for 2 values satisfying $36a+6b=96$ or $9a+3b=21$ or if no working shown, but 2 correct answers given

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7

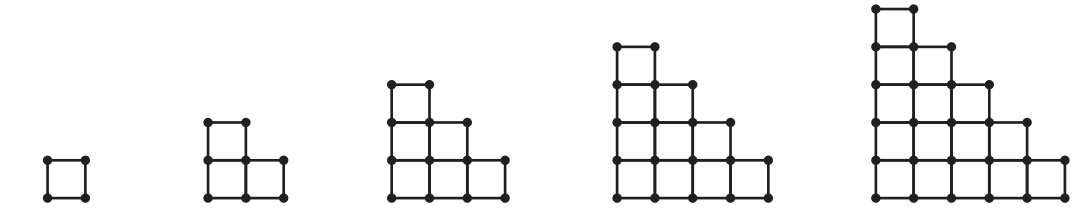


Diagram 1 Diagram 2 Diagram 3 Diagram 4 Diagram 5

The sequence of diagrams above is made up of small lines and dots.

(a) Complete the table.

	Diagram 1	Diagram 2	Diagram 3	Diagram 4	Diagram 5	Diagram 6
Number of small lines	4	10	18	28		
Number of dots	4	8	13	19		

[4]

(b) For Diagram n find an expression, in terms of n, for the number of small lines.

..... [2]

(c) Diagram r has 10 300 small lines.

Find the value of r.

r = ... [2]

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(d) The number of dots in Diagram n is $an^2 + bn + 1$.

Find the value of a and the value of b.

$a =$ .....

$b =$ ..... [2]

(a) Introduction to sequences (b) Quadratic sequences (c) Quadratic sequences (d) Quadratic sequences

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7(a)	40 54 26 34	**4**	**B1** for each
7(b)	$n^2 + 3n$ or $n(n+3)$ oe	**2**	**B1** for a quadratic expression or for 2nd common difference 2 (at least 2 shown) or for 2 correct equations seen or for subtracting n^2
7(c)	100	**2**	**M1** for *their* **(b)** = 10300 seen
7(d)	$[a =] \frac{1}{2}$ oe and $[b =] \frac{5}{2}$ oe	**2**	**B1** for each or **M1** for one correct equation or for 2nd difference = 1 soi (at least 2 shown)

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8

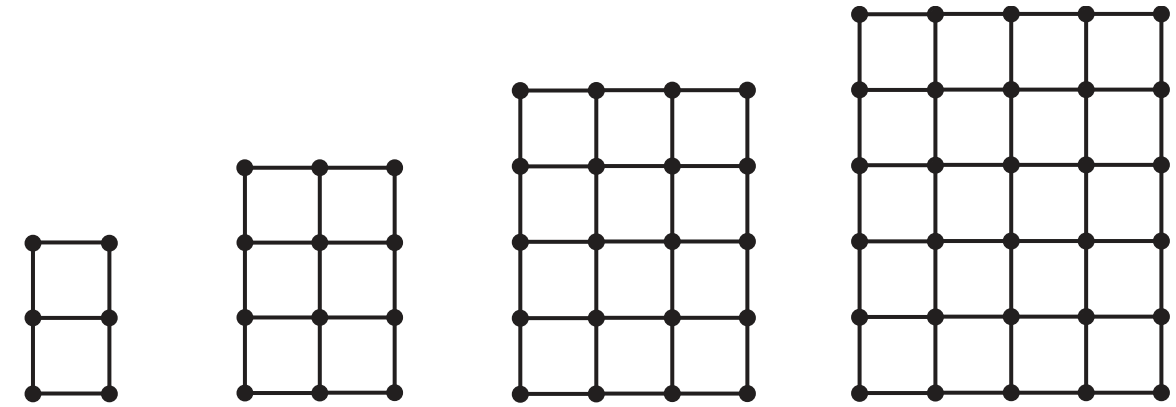


Diagram 1 Diagram 2 Diagram 3 Diagram 4

The first four Diagrams in a sequence are shown above.
Each Diagram is made from dots and one centimetre lines.
The area of each small square is 1 cm^2.

(a) Complete the table for Diagrams 5 and 6.

Diagram	1	2	3	4	5	6
Area (cm^2)	2	6	12	20		
Number of dots	6	12	20	30		
Number of one centimetre lines	7	17	31	49		

[4]

(b) The **area** of Diagram n is $n(n+1)$ cm^2.

(i) Find the **area** of Diagram 50.

Answer(b)(i) ..... cm^2 [1]

(ii) Which Diagram has an **area** of 930 cm^2?

Answer(b)(ii) ..... [1]

(c) Find, in terms of n, the number of **dots** in Diagram n.

Answer(c) ..... [1]

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(d) The number of one centimetre lines in Diagram n is $2n^2 + pn + 1$.

(i) Show that $p = 4$.

Answer(d)(i)

[2]

(ii) Find the number of one centimetre lines in Diagram 10.

Answer(d)(ii) ..... [1]

(iii) Which Diagram has 337 one centimetre lines?

Answer(d)(iii) ..... [3]

(e) For **each** Diagram, the number of squares of area 1 cm^2 is A, the number of dots is D and the number of one centimetre lines is L.

Find a connection between A, D and L that is true for each Diagram.

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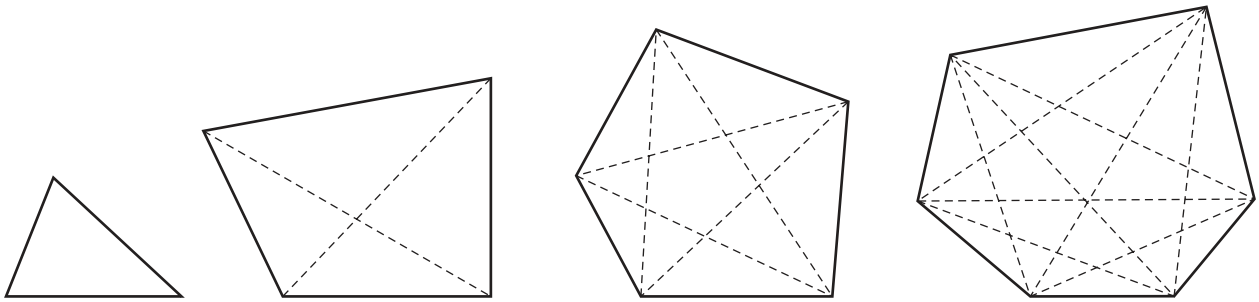
Answer(e) ..... [1]

(a) Introduction to sequences (b)(i) Quadratic sequences (b)(ii) Quadratic sequences
(c) The nth term of a linear sequence (d)(i) Quadratic sequences (d)(ii) Quadratic sequences
(d)(iii) Quadratic sequences (e) The nth term of a linear sequence Click for more variations

8	**(a)** 30 42 42 56 71 97	4	**B3** for 2 correct rows or **B2** for 1 correct row or **B1** for any term in column 5 correct
	(b) **(i)** 2550	1	
	(ii) 30	1	
	(c) $(n + 1)(n + 2)$ oe final ans	1	
	(d) **(i)** $2n^2 + pn + 1 = t$ Uses a value of n up to 6 and a matching t from the table e.g. puts $n = 3$ and $t = 31$ $2 \times 3^2 + 3p + 1 = 31$ **M1** **OR** Use $p = 4$ to get $2n^2 + 4n + 1 = 31$ and simplifies to 3 term eqn **M1** **OR** both $2 \times 9 + 4 \times 3 + 1 (= 31)$ **M1** with one part evaluated **OR** $n(n + 1) + (n + 1)(n + 2) - 1$ or better **M1**	2	Correct solution shown with 1 intermediate step to $p = 4$ **E1** Solve correctly to get $n = 3$ **E1** Conclusion e.g. $31 = 31$ **E1** Correct simplification to $2n^2 + 4n + 1$ **E1**
	(ii) 241	1	
	(iii) 12	3	**M1** for $2n^2 + 4n + 1 = 337$ and **M1** for $(n - 12)(n + 14)$ or correct expression for n using formula
	(e) $L = A + D - 1$ oe	1	

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9



The diagrams show some polygons and their diagonals.

(a) Complete the table.

Number of sides	Name of polygon	Total number of diagonals
3	triangle	0
4	quadrilateral	2
5		5
6	hexagon	9
7	heptagon	14
8		

[3]

(b) Write down the total number of diagonals in

(i) a decagon (a 10-sided polygon),

Answer(b)(i) ..... [1]

(ii) a 12-sided polygon.

Answer(b)(ii) ..... [1]

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(c) A polygon with n sides has a total of $\frac{1}{p}n(n-q)$ diagonals, where p and q are integers.

(i) Find the values of p and q.

Answer(c)(i) p = ...

q = ... [3]

(ii) Find the total number of diagonals in a polygon with 100 sides.

Answer(c)(ii) ..... [1]

(iii) Find the number of sides of a polygon which has a total of 170 diagonals.

Answer(c)(iii) ..... [2]

(d) A polygon with $n + 1$ sides has 30 more diagonals than a polygon with n sides.

Find n.

Answer(d) n = ... [1]

(a) 2D shapes (b)(i) Introduction to sequences (b)(ii) Introduction to sequences
(c)(i) Quadratic sequences (c)(ii) Quadratic sequences (c)(iii) Quadratic sequences
(d) Introduction to sequences Click for more variations

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9 (a)	Pentagon Octagon 20	1 1, 1	
(b)(i)	35	1	
(ii)	54	1	
(c)(i)	$p = 2, q = 3$	3	**M1** for substituting a value of n e.g. $\frac{1}{p}4(4-q) = 2 \quad n \geq 3$ **or M1** for number of diagonals from one vertex is $n-3$ (allow in words) **and B1** for one correct value. If 0, SC1 for $\frac{n}{2}(n-3)$ seen.
(ii)	4850 ft	1**ft**	**ft** their **(c)(i)** allow only if **ft** calculates to a positive integer.
(iii)	20 cao	2	**SC1** for answer of 17 or **M1** for their formula = 170
(d)	31 cao	1	

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10 The first three diagrams in a sequence are shown below.
The diagrams are made by drawing lines of length 1 cm.

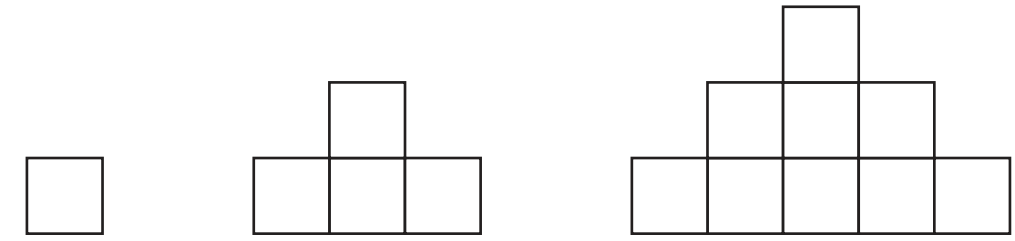


Diagram 1 Diagram 2 Diagram 3

(a) The areas of each of the first three diagrams are shown in this table.

Diagram	1	2	3
Area (cm^2)	1	4	9

(i) Find the area of Diagram 4.

Answer(a)(i) ..... cm^2 [1]

(ii) Find, in terms of n, the area of Diagram n.

Answer(a)(ii) ..... cm^2 [1]

(b) The numbers of 1 cm lines needed to draw each of the first three diagrams are shown in this table.

Diagram	1	2	3
Number of 1 cm lines	4	13	26

(i) Find the number of 1 cm lines needed to draw Diagram 4.

Answer(b)(i) ..... [1]

(ii) In which diagram are 118 lines of length 1 cm needed?

Answer(b)(ii) ..... [1]

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(c) The **total** number of 1 cm lines needed to draw both Diagram 1 and Diagram 2 is 17.
The **total** number of 1 cm lines needed to draw all of the first n diagrams is

$$\frac{2}{3}n^3 + an^2 + bn.$$

Find the value of a and the value of b.
Show all your working.

Answer(c) a = ...

b = ... [6]

(a)(i) Quadratic sequences (a)(ii) Quadratic sequences (b)(i) Introduction to sequences
(b)(ii) Introduction to sequences (c) Quadratic sequences Click for more variations

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10	**(a)** **(i)**	16	**1**	
	(ii)	n^2	**1**	
	(b) **(i)**	43	**1**	
	(ii)	7	**1**	
	(c)	$a = \frac{5}{2}$ oe, $b = \frac{5}{6}$ oe with supporting working	**6**	**M1** for any correct substitution eg $\frac{2}{3}(2)^3 + 2^2a + 2b$ **A1** for **one** of eg $\frac{2}{3} + a + b = 4$ or better eg $\frac{16}{3} + 4a + 2b = 17$ or better eg $\frac{54}{3} + 9a + 3b = 43$ or better **A1** for **another** of eg $\frac{2}{3} + a + b = 4$ or better eg $\frac{16}{3} + 4a + 2b = 17$ or better eg $\frac{54}{3} + 9a + 3b = 43$ or better **M1** for correctly eliminating one variable from two of *their* equations in a and b **A1** for $a = \frac{5}{2}$ oe **A1** for $b = \frac{5}{6}$ oe After zero scored, **SC2** for 2 correct answers without supporting working or **SC1** for 2 of 17, 43, 86, 150, 239 seen

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