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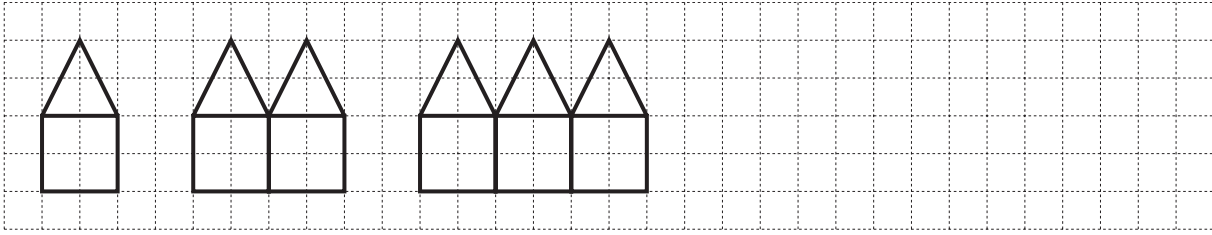


Diagram 1

Diagram 2

Diagram 3

The diagrams show a sequence of shapes.

(a) On the grid, draw Diagram 4.

[1]

(b) Complete the table showing the number of lines in each diagram.

Diagram (n)	Number of lines
1	6
2	11
3	
4	
5	

[3]

(c) Work out the number of lines in Diagram 8.

Answer(c) [1]

(d) Write down an expression, in terms of n , for the number of lines in Diagram n .

Answer(d) [2]

(e) Work out the number of lines in Diagram 100.

Answer(e) [1]

(f) The number of lines in Diagram p is 66.

Find the value of p .

Answer(f) $p =$ [2]

2 (a) Write down the next term in each of the following sequences.

(i) 2, 9, 16, 23, [1]

(ii) 75, 67, 59, 51, [1]

(iii) 2, 5, 9, 14, [1]

(iv) 2, 1, $\frac{1}{2}$, $\frac{1}{4}$, [1]

(v) 2, 4, 8, 16, [1]

(b) For the sequence in **part (a)(i)** write down

(i) the 10th term,

Answer(b)(i) [1]

(ii) the n th term.

Answer(b)(ii) [2]

(c) The n th term of the sequence in **part (a)(iii)** is $\frac{n^2 + 3n}{2}$.

Calculate the 50th term of this sequence.

Answer(c) [2]

(d) The n th term of the sequence in **part (a)(v)** is 2^n .

Calculate the 12th term of this sequence.

Answer(d) [1]

3 (a) Write down the next term in each of the following sequences.

(i) 8, 15, 22, 29, [1]

(ii) 3, 6, 12, 24, [1]

(iii) 1, 4, 9, 16, [1]

(iv) 0, 3, 8, 15, [1]

(b) Write down an expression, in terms of n , for the n th term of

(i) the sequence in **part(a)(iii)**,

Answer(b)(i) [1]

(ii) the sequence in **part(a)(iv)**.

Answer(b)(ii) [1]

(c) The n th term of a sequence is $7n - 3$.

(i) Write down the value of the 4th term.

Answer(c)(i) [1]

(ii) Which term has a value of 592?

Answer(c)(ii) [2]

(d) 1, 2, 2, 4, 8, 32, 256,

Work out the next two terms of this sequence.

Answer(d) , [2]

(e) Write down the next term in each sequence.

(a) 1, 2, 4, 8, 16, [1]

(b) 23, 19, 15, 11, 7, [1]

4 (a) Write down the next two terms in each of the following sequences.

(i) 71, 64, 57, 50, , [1]

(ii) -17, -13, -9, -5, , [2]

(b) The n th term of the sequence in **part (a)(i)** is $78 - 7n$.

Find the value of the 15th term.

Answer(b) [1]

(c) Write down an expression for the n th term of the sequence in **part (a)(ii)**.

Answer(c) [2]

(d) For one value of n , both sequences in **part (a)** have a term with the same value.

Use **parts (b) and (c)** to find

(i) the value of n ,

Answer(d)(i) $n =$ [2]

(ii) the value of this term.

Answer(d)(ii) [2]



Diagram 1



Diagram 2



Diagram 3



Diagram 4

Diagram 5

The Diagrams above form a pattern.

(a) Draw Diagram 5 in the space provided.

[1]

(b) The table shows the numbers of dots in some of the diagrams.
Complete the table.

Diagram	1	2	3	4	5		10		n
Number of dots	3	5							

[5]

(c) What is the value of n when the number of dots is 737?

Answer(c) [2]

(d) Complete the table which shows the **total** number of dots in consecutive pairs of diagrams.

For example, the **total** number of dots in Diagram 2 and Diagram 3 is 12.

Diagrams	1 and 2	2 and 3	3 and 4	4 and 5		10 and 11		n and $n + 1$
Total number of dots	8	12	16					

[3]

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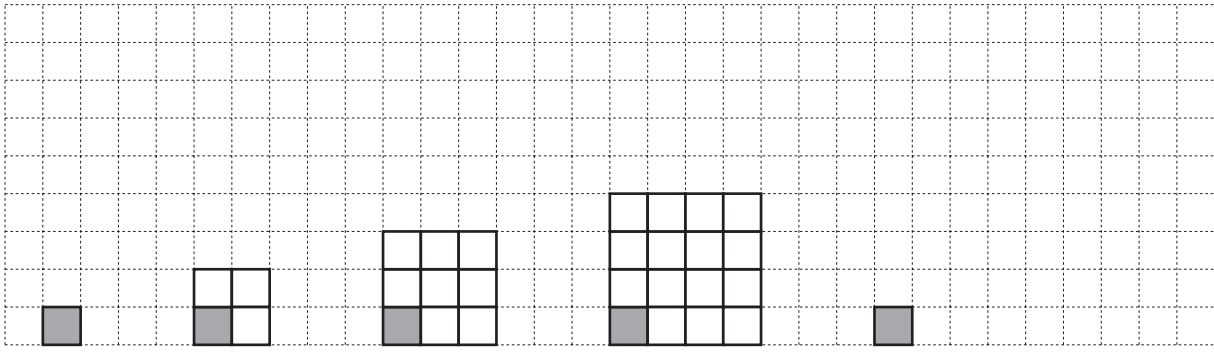


Diagram 1

Diagram 2

Diagram 3

Diagram 4

Diagram 5

Each of the diagrams above shows one small shaded square and a number of small unshaded squares. The diagrams form a sequence.

(a) Complete Diagram 5.

[1]

(b) Complete the table.

Diagram	1	2	3	4	5		50		n
Total number of small squares	1	4	9	16					
Number of small shaded squares	1	1	1	1					
Number of small unshaded squares	0	3	8	15					

[7]

(c) Diagram p has 9999 small unshaded squares. Find p .

Answer(c) $p =$ [1]

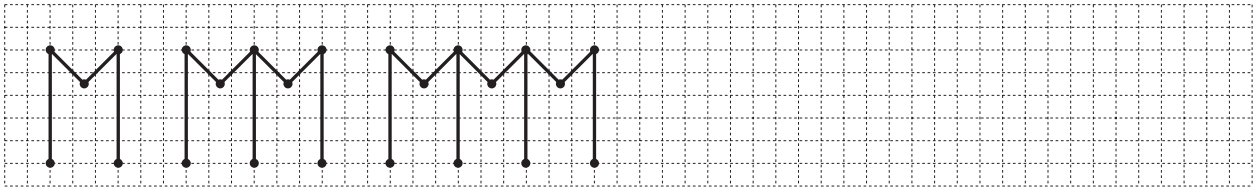


Diagram 1

Diagram 2

Diagram 3

Diagram 4

(b) The pattern of diagrams above is continued by adding more lines and dots.

(i) On the grid, draw diagram 4.

[1]

(ii) Complete the table below.

Diagram	1	2	3	4	5
Number of lines	4	7			

[2]

(c) How many lines will there be in

(i) Diagram 9,

Answer(c)(i) [1]

(ii) Diagram n ?

Answer(c)(ii) [2]

(d) The number of lines in Diagram r is 76.

Find the value of r .

Answer(d) $r =$ [2]

(e) Write down an expression, in terms of n , for the number of **dots** in Diagram n .

Answer(e) [1]

7 (a) (i)

0, 1, 1, 2, 3, 5, 8,

This sequence has the rule:

After the first two terms, any term is the sum of the two previous terms.

The first two terms are 0 and 1,
 the 3rd term is $0 + 1 = 1$,
 the 4th term is $1 + 1 = 2$,
 the 5th term is $1 + 2 = 3$ and so on.

Show that the 8th term is 13.

Answer(a)(i) [1]

(ii) Each of the following sequences have the same rule as **part (a)(i)**.

For each sequence write down the missing terms.

2, 5, 7, , [1]

4, 3, 7, , [1]

5, 2, , [1]

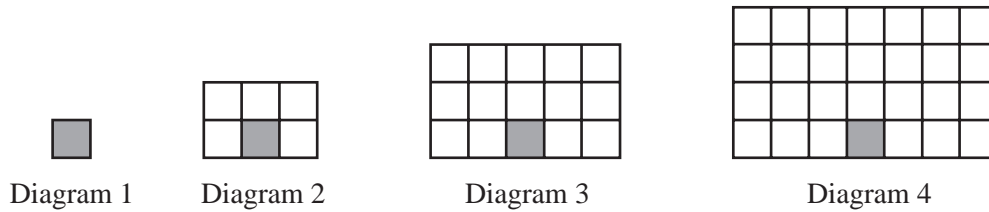
0, , 3, [1]

1, , , 9, [1]

..... , , 5, 7 [1]

(b) For the following sequences find the next term and the n th term.(i) 1, 3, 5, 7, 9, n th term = [3](ii) 1, 4, 9, 16, 25, n th term = [2](iii) 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$, n th term = [2]

8



Look at the sequence of diagrams.

(a) Diagram 2 has a height of 2.

Write down the height of

(i) Diagram 5,

Answer(a)(i) [1]

(ii) Diagram 10,

Answer(a)(ii) [1]

(iii) Diagram n .

Answer(a)(iii) [1]

(b) Diagram 2 has a width of 3.

Find the width of

(i) Diagram 5,

Answer(b)(i) [1]

(ii) Diagram 10,

Answer(b)(ii) [1]

(iii) Diagram n .

Answer(b)(iii) [2]

(c) There are 6 squares in Diagram 2 and 15 squares in Diagram 3.

(i) Write down how many squares there are in Diagram 5.

Answer(c)(i) [1]

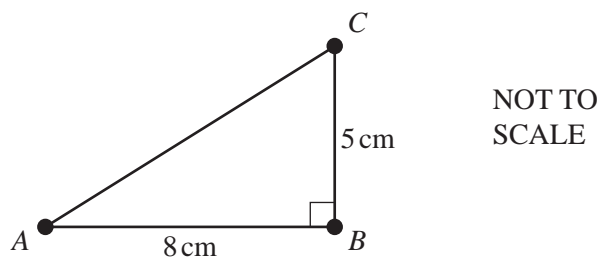
(ii) Explain how this is found from the height and width of the diagram.

Answer(c)(ii) [1]

(iii) Write down, in terms of n , how many squares there are in Diagram n .

Answer(c)(iii) [1]

- 9 Three bolts at A , B and C join the rods AB , BC and CA to form the right-angled triangle, ABC . Angle $ABC = 90^\circ$, $AB = 8$ cm and $BC = 5$ cm.



(a) Calculate

- (i) the length of the rod AC ,

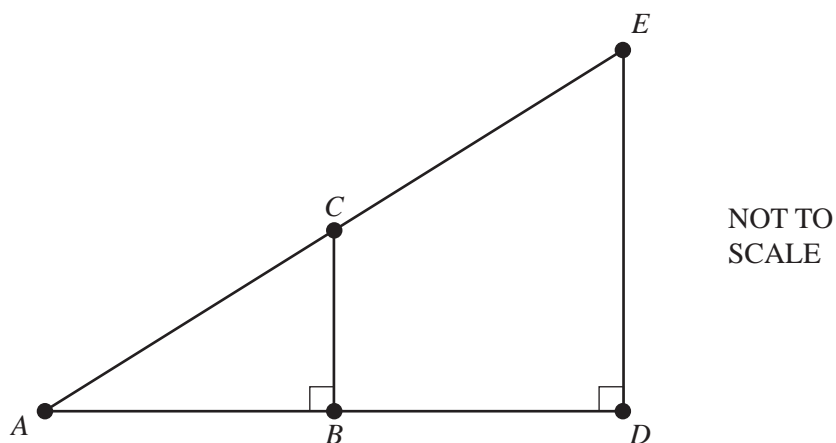
Answer(a)(i) $AC =$ cm [2]

- (ii) angle CAB .

Answer(a)(ii) Angle $CAB =$ [2]

(b) Another right-angled triangle, ADE , is formed by adding rods to triangle ABC .

AC is extended to E and AB is extended to D , with more bolts at D and E .
Rods AB and BD are the same length.

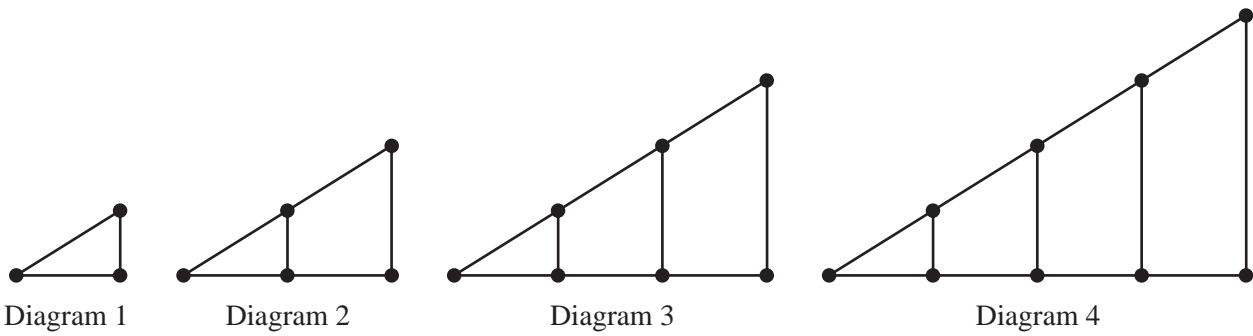


(i) Complete the following statement.

Triangle ADE is to triangle ABC . [1]

(ii) Describe clearly the **single** transformation which maps triangle ABC onto triangle ADE .

Answer(b)(ii) [3]



(c) The pattern of diagrams shown above is continued by adding more rods and bolts.

Complete the table below.

Diagram	1	2	3	4	5
Number of bolts	3	5	7		

[2]

(d) How many bolts are required for

(i) Diagram 10,

Answer(d)(i) [1]

(ii) Diagram n ?

Answer(d)(ii) [2]

(e) The number of bolts in Diagram n is 47.

Find the value of n .

Answer(e) $n =$ [2]

- 10 (a) The first four terms of a sequence are given below.

5 9 13 17

Write down

- (i) the next term,

Answer(a)(i) [1]

- (ii) the 8th term,

Answer(a)(ii) [1]

- (iii) an expression, in terms of n , for the n th term of the sequence.

Answer(a)(iii) [2]

- (b) The first four terms of a different sequence are given below.

4 10 18 28

- (i) Find the next term.

Answer(b)(i) [1]

- (ii) The n th term of this sequence is $n(n + p)$ where p is an integer.

Find the value of p .

Answer(b)(ii) $p =$ [2]

- (iii) Find the 100th term of this sequence.

Answer(b)(iii) [1]

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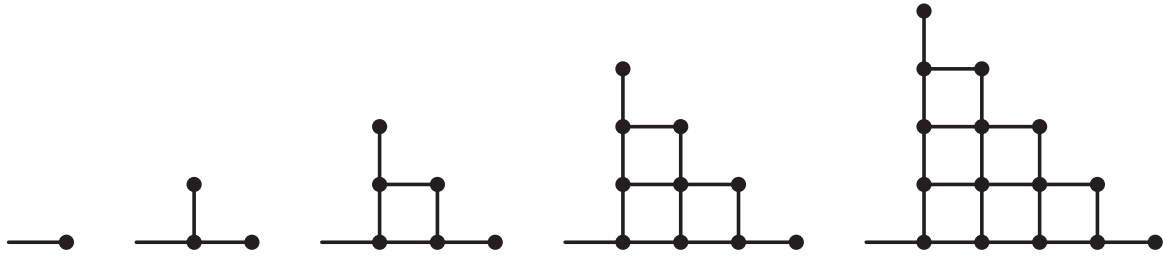


Diagram 1

Diagram 2

Diagram 3

Diagram 4

Diagram 5

The diagrams show a pattern of lines and dots.

(a) Complete the table below.

Diagram number	1	2	3	4	5
Number of lines	1	3	7		
Number of dots	1	3	6		

[4]

(b) Work out the number of lines and the number of dots in Diagram 7.

Answer(b) Number of lines = , Number of dots = [2]

(c) The number of dots in Diagram n is $\frac{1}{2}n(n+1)$.

(i) Use this formula to check your result for Diagram 5.

You must show your working.

Answer (c)(i)

[2]

(ii) How many dots are there in Diagram 20?

Answer(c)(ii) [2]

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

Use the information about Diagram 3 from the table to calculate the value of k .

Answer(d) $k = \dots\dots\dots$ [2]

12 (a) The first four terms of a sequence are 12, 7, 2, -3.

(i) Write down the next two terms of the sequence.

Answer(a)(i) and [2]

(ii) State the rule for finding the next term of the sequence.

Answer(a)(ii) [1]

(iii) Write down an expression for the n th term of this sequence.

Answer(a)(iii) [2]

(b) The first four terms of another sequence are -3, 2, 7, 12.

Write down an expression for the n th term of this sequence.

Answer(b) [2]

(c) Add together the expressions for the n th terms of both sequences.

Write your answer as simply as possible.

Answer(c) [1]

- 13 The first three diagrams in a sequence are shown below.
Each diagram has one more trapezium added on the right.

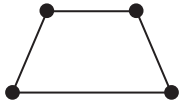


Diagram 1

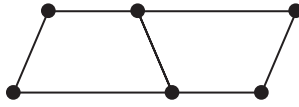


Diagram 2

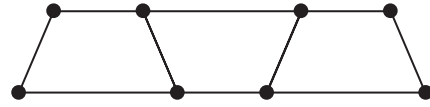


Diagram 3

- (a) Complete the table which shows the number of lines and dots in each diagram.

Diagram	1	2	3	4
Number of lines	4	7		
Number of dots	4	6		

[2]

- (b) Find the number of lines and dots in Diagram 10.

Answer(b) lines and dots [2]

- (c) For Diagram n , write down in terms of n , the number of

- (i) lines,

Answer(c)(i) [2]

- (ii) dots.

Answer(c)(ii) [2]

- (d) Find the **difference**, in terms of n , between your answers to **parts (c)(i) and (c)(ii)**.
Simplify your answer.

Answer(d) [2]

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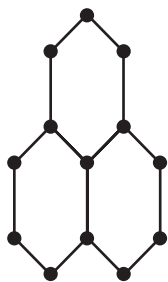


Diagram 1

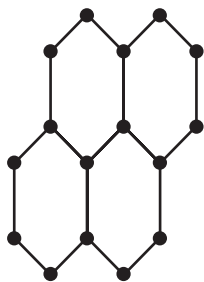


Diagram 2

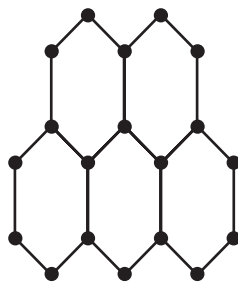


Diagram 3

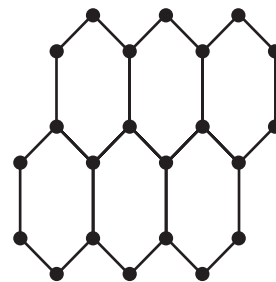


Diagram 4

Look at the sequence of diagrams above.

The number of dots in each diagram is given in the table below.

Diagram number	1	2	3	4	
Number of dots	13	16	19	22	

Find the number of dots in

(a) Diagram 5,

Answer(a) [1]

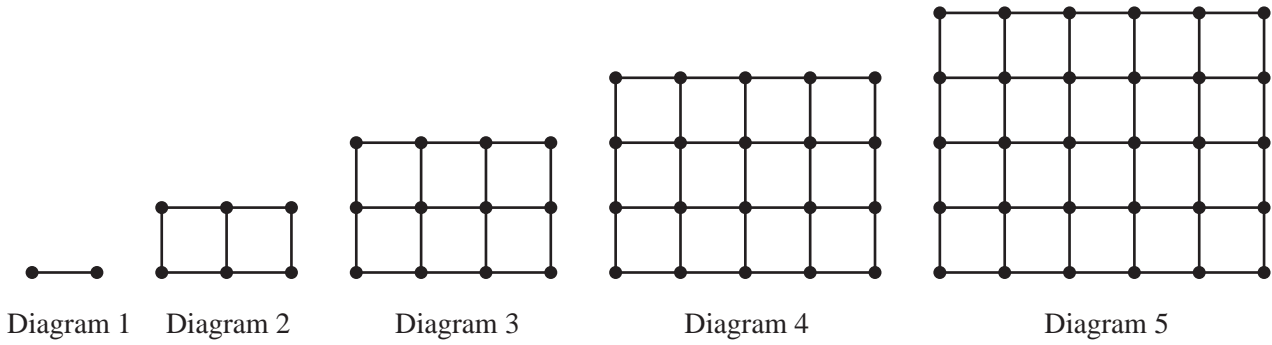
(b) Diagram 11,

Answer(b) [1]

(c) Diagram n .

Answer(c) [2]

15



Look at the sequence of five diagrams above.

Diagram 1 has 2 dots and 1 line.

Diagram 2 has 6 dots and 7 lines.

The numbers of dots and lines in each of the diagrams are shown in the table below.

Diagram number	1	2	3	4	5	6	7
Number of dots	2	6	12	20	30		
Number of lines	1	7	17	31	49		

(a) Fill in the empty spaces in the table for Diagrams 6 and 7.

[4]

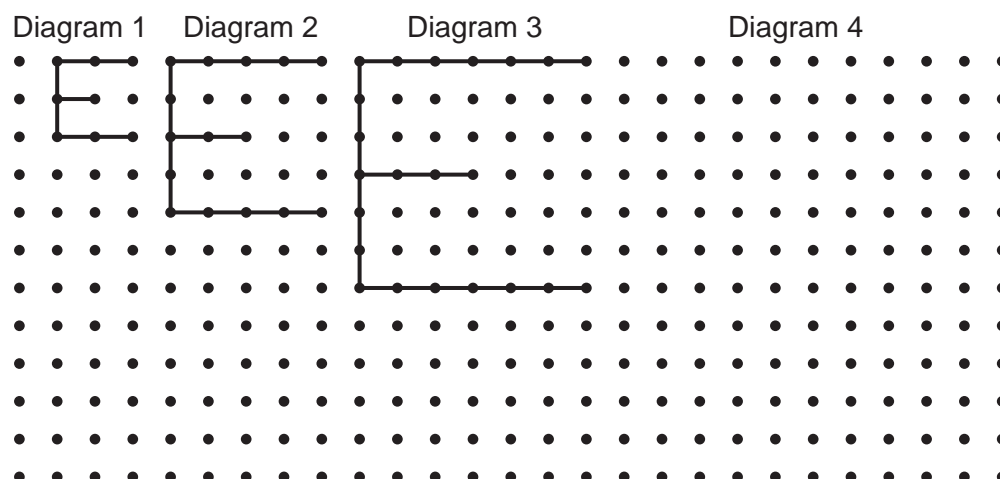
(b) How many dots are there in Diagram n ?

Answer(b) [2]

(c) The number of lines in Diagram n is $2n^2 - 1$.
Which diagram has 287 lines?

Answer(c) [2]

- 16 In the pattern below each diagram shows a letter E formed by joining dots.



- (a) Draw the next letter E in the pattern. [1]

- (b) Complete the table showing the number of dots in each letter E.

Diagram	1	2	3	4	5
Dots	8	15			

- (c) How many dots make up the letter E in [3]

- (i) Diagram 10,

Answer(c)(i) [2]

- (ii) Diagram n ?

Answer(c)(ii) [2]

- (d) The letter E in Diagram n has 113 dots.

Write down an equation in n and use it to find the value of n .

Answer(d) $n =$ [3]

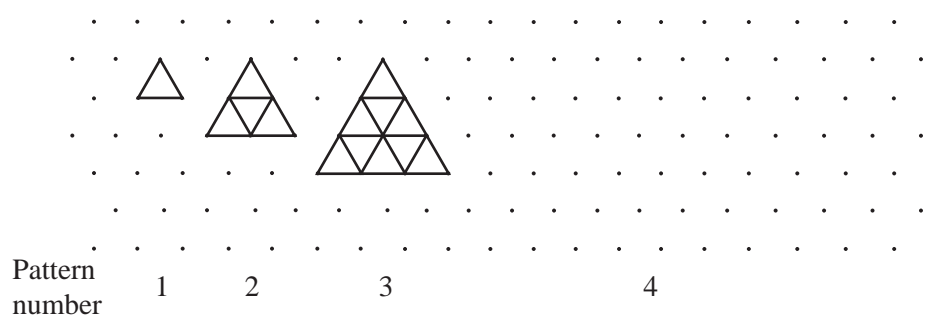
17 (a)

 $\frac{2}{3}$ 2 3 3.14 $\sqrt{35}$ 10 24 37 45 88

From the list of numbers above choose one that is

- (i) an irrational number, *Answer(a) (i)* [1]
- (ii) the cube root of 27, *Answer(a) (ii)* [1]
- (iii) a multiple of 9, *Answer(a) (iii)* [1]
- (iv) a prime number, *Answer(a) (iv)* [1]
- (v) a factor of 44, *Answer(a) (v)* [1]
- (vi) the product of 6 and 4. *Answer(a) (vi)* [1]

(b) The diagram below shows a sequence of patterns made with small triangular tiles.



- (i) Draw the next pattern in the sequence. [1]
- (ii) Complete the table below.

Pattern number	1	2	3	4	5	6
Number of tiles	1	4	9			

- (iii) How many tiles will be in the 100th pattern? [2]

Answer(b) (iii) [1]

- (iv) How many tiles will be in the n th pattern?

Answer(b) (iv) [1]

- (v) What is the special name given to the numbers in the second row of the table?

Answer(b) (v) [1]

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Diagram 1



Diagram 2

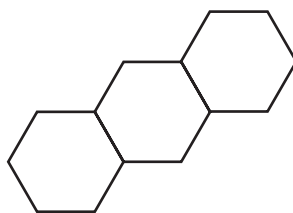


Diagram 3

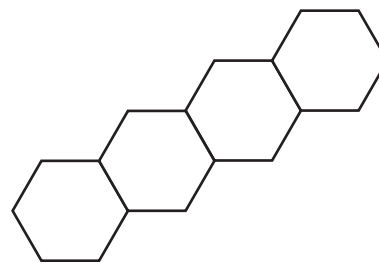


Diagram 4

The diagrams show a sequence of regular hexagons.
Sticks of equal length are used to make the hexagons.

(a) Complete the table for the number of sticks in each diagram.

Diagram	1	2	3	4	5
Sticks	6	11			

[3]

(b) How many sticks are there in the 20th diagram?

Answer(b) [2]

(c) How many sticks are there in the n th diagram?

Answer(c) [2]

(d) How many hexagons are there in a diagram which has 186 sticks?

Answer(d) [2]

- 19 (a)** A pattern of numbers is shown below.

[illegible]

- (i) On the diagram complete row 6. [1]

- (ii)** The last numbers in each row form a sequence.

1, 4, 9, 16, 25,

- (a)** What is the special name given to these numbers?

Answer(a)(ii)(a) [1]

- (b)** Write down the last number in the 10th row.

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

- (c) Write down an expression for the last number in the n th row.

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

- (iii)** The numbers in the middle column of the pattern form a sequence.

1, 3, 7, 13, 21, 31,

- (a)** Write down the next number in this sequence.

Answer(a)(iii)(a) [1]

- (b)** The expression for the n th number in this sequence is $n^2 - n + 1$.
Work out the 30th number.

Answer(a)(iii)(b) [2]

(b) Another pattern of numbers is shown below.

row

1	---	→	1	2	3	4	5	6	7	8	9	10
2	---	→	11	12	13	14	15	16	17	18	19	20
3	---	→	21	22	23	24	25	26	27	28	29	30
4	---	→	31	32	33	34	35	36	37	38	39	40

(i) What is the last number in the 10th row?

Answer(b)(i) [1]

(ii) Find an expression for the last number in the n th row.

Answer(b)(ii) [1]

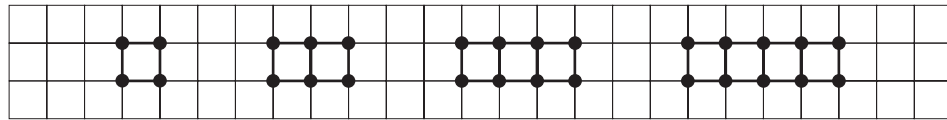
(iii) What is the **first** number in the 10th row?

Answer(b)(iii) [1]

(iv) Find an expression for the **first** number in the n th row.

Answer(b)(iv) [1]

- 20 (a) Look at the sequence of dots and squares below.



Number of dots	4	6	8	10
Number of squares	1	2	3	4

Find the number of dots when there are

- (i) 5 squares,

Answer(a)(i) [1]

- (ii) 9 squares,

Answer(a)(ii) [1]

- (iii) n squares.

Answer(a)(iii) [2]

- (b) Another sequence of dots and squares is shown below.

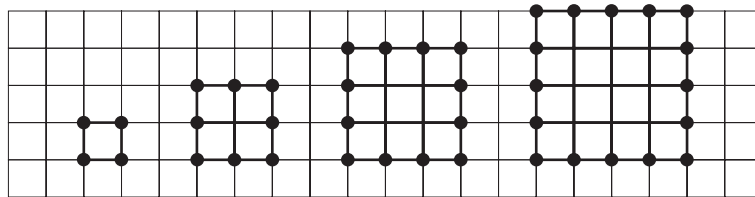


Diagram	1	2	3	4
Number of dots	4	8	12	16
Number of squares	1	4	9	16

- (i) For diagram 5, find

- (a) the number of dots,

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

- (b) the number of squares.

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

- (ii) Find the number of dots in the diagram that has 144 squares.

Answer(b)(ii) [2]

- (iii) Find the number of squares in the diagram that has 40 dots.

Answer(b)(iii) [2]

10 Look at this arrangement of numbers. It is known as Pascal's Triangle.

Line											Sum of numbers
1					1		1				2
2				1		2		1			4
3			1		3		3		1		8
4			1		4		6		4		16
5		1		5		10		10		5	32
6	—	—	—	—	—	—	—	—	—	—	—
7	—	—	—	—	—	—	—	—	—	—	—

(a) Complete lines 6 and 7 above. [5]

(b) (i) What is the sum of the numbers on the 9th line?

Answer (b)(i)..... [2]

(ii) What is the sum of the numbers on the n th line?

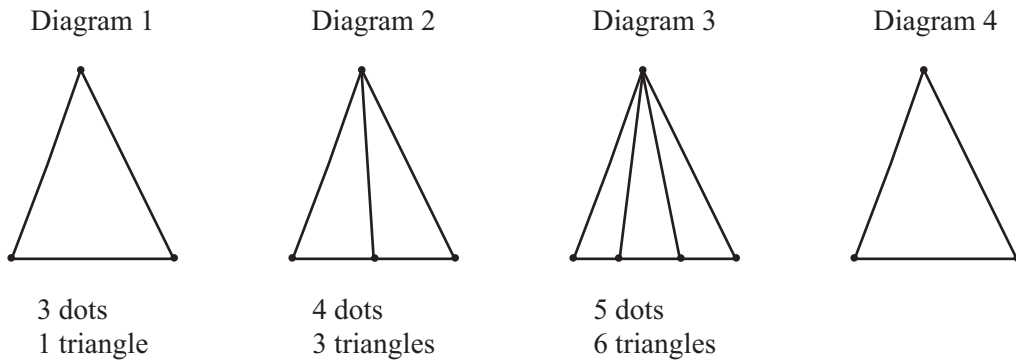
Answer (b)(ii)..... [2]

(c) The 12th line is given below. Fill in the blanks in the 11th line.

11	1	11	55	—	—	—	—	—	—	—	—	—	—
12	1	12	66	220	495	792	924	792	495	220	66	12	1

[2]

21



Look at the diagrams above.

(a) Complete Diagram 4 to continue the pattern. [2]

(b) Complete the table below.

Diagram	1	2	3	4	5		n
Number of dots	3	4	5				

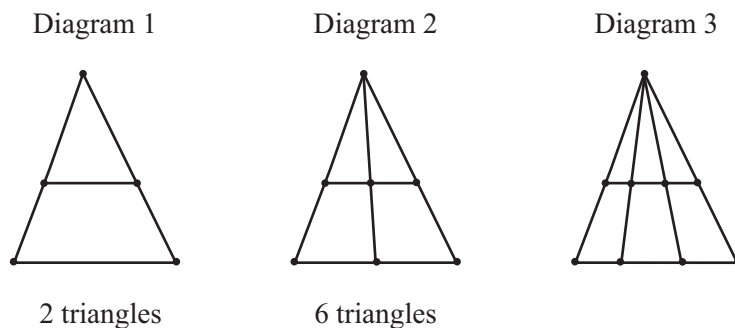
[3]

(c) Complete the table below.

Diagram	1	2	3	4	5	6		10
Number of triangles	1	3	6	10				

[3]

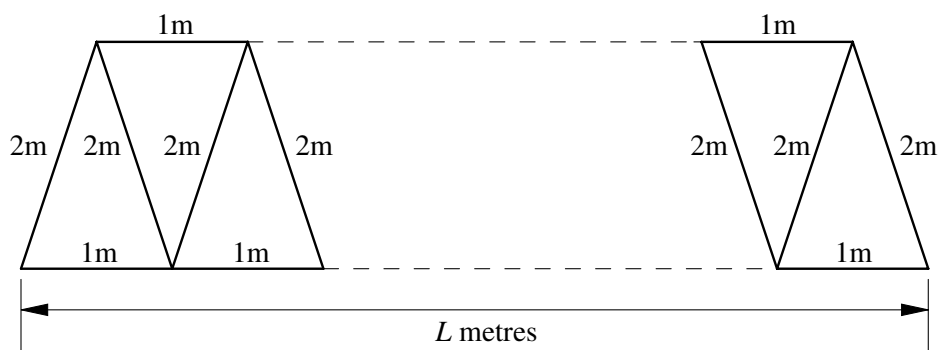
(d) A line is now drawn inside each of the diagrams as shown below.



How many triangles are there in Diagram 3?

Answer(d).....[2]

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The diagram shows wooden beams which support the roof of a house.

(a) Complete the table below.

Length of roof (L metres)	1	2	3	4	5	6
Number of 2 metre beams (x)	2	4			10	
Number of 1 metre beams (y)	1	3			9	
Total length of wood (T metres)	5	11			29	

[4]

(b) When $L = 10$, find the values of x , y and T .

Answer (b) $x = \dots\dots\dots$

$y = \dots\dots\dots$

$T = \dots\dots\dots$

[3]

(c) Write down a formula for

(i) x in terms of L ,

Answer (c)(i) $x = \dots\dots\dots$ [1]

(ii) y in terms of L ,

Answer (c)(ii) $y = \dots\dots\dots$ [1]

(iii) T in terms of L .

Answer (c)(iii) $T = \dots\dots\dots$ [2]

(d) When $T = 83$, find the value of L .

Answer (d) $L = \dots\dots\dots$ [1]