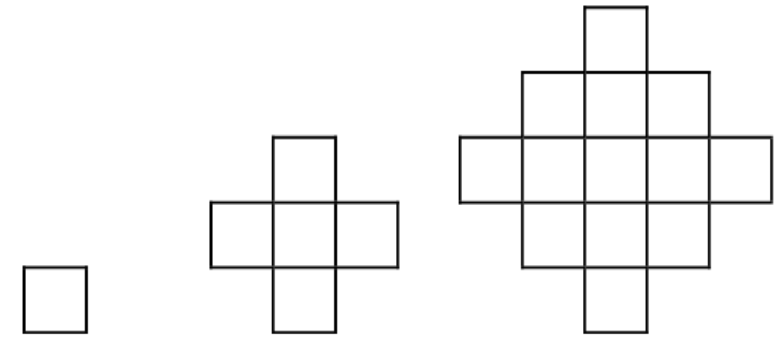
Question 8 **(Suggested maximum time: 20 minutes)**

The first three stages of a pattern are shown below.

Each stage of the pattern is made up of small squares.
Each small square has an area of one square unit.



Stage 1 **Stage 2** **Stage 3**

(a) Draw the next two stages of the pattern.

(b) The perimeter of Stage 1 of the pattern is 4 units.
The perimeter of Stage 2 of the pattern is 12 units.

Find a general formula for the **perimeter** of Stage n of the pattern, where $n \in \mathbb{N}$.

(c) Find a general formula for the **area** of Stage n of the pattern, where $n \in \mathbb{N}$.

(d) What kind of sequence (linear, quadratic, exponential, or none of these) do the **areas** follow? Justify your answer.

Question 2

(a) John thinks that he has a method for finding **all** prime numbers.
He says that if he uses the formulas in the table below, he will generate the prime numbers.
He also says that these formulas will generate **only** the prime numbers.

(i) Complete the table.

p	$6p + 1$	$6p + 5$
0	**1**	**5**
1		
2		
3		
4		
5		

(ii) Give two reasons why his method is not fully correct.

Reason 1:

Reason 2:

(b) The Swiss mathematician and physicist, Euler, first noticed (in 1772) that the expression $n^2 - n + 41$ gives a prime number for all positive integer values of n less than 41.

Explain why it does not give a prime number for $n = 41$.

Question 3

The table shows the height, in metres, of a ball at various times after being kicked into the air.

(i) Is the pattern of heights in the table linear, quadratic, or exponential? Explain your answer.

Time (seconds)	0	0·5	1	1·5	2	2·5	3
Height (metres)	0·3	3·4	5·7	7·2	7·9	7·8	6·9

(ii) Estimate the height of the ball after 3·5 seconds.

(iii) Estimate the total time the ball spends in the air. Justify your answer.