CONJECTURES

Answer all of these questions. Remember to show your working out in all questions.

MAIN QUESTIONS

1.

1, 4, 9, 16, 25

> Perfect squares: n^2

2.

2, 3, 5, 7, 11

> Prime numbers

3.

1, 1, 2, 3, 5, 8

> Fibonacci sequence: F(n) = F(n-1) + F(n-2)

4.

1, 3, 6, 10, 15

> Triangular numbers: n(n+1)/2

5.

1, 8, 27, 64, 125

> Cubes: n^3

6.

2, 4, 8, 16, 32

> Powers of 2: 2^n

7.

1, 4, 7, 10, 13

> Arithmetic sequence: 3n - 2

8.

3, 6, 12, 24, 48

> Geometric sequence: $3 \times 2^{n-1}$

9.

1, 2, 4, 7, 11, 16

> Add consecutive integers: $a_n = a_{n-1} + (n-1)$

10.

1, 3, 7, 15, 31

> $2^n - 1$

11.

1, 5, 14, 30, 55

> Square pyramidal numbers: n(n+1)(2n+1)/6

12.

1, 2, 6, 24, 120

> Factorials: n!

13.

1, 4, 9, 16, 25, 36

> Perfect squares: n^2

14.

2, 6, 18, 54, 162

> Geometric sequence: $2 \times 3^{n-1}$

15.

1, 8, 21, 40, 65

> Hexagonal numbers: n(2n-1)

16.

1, 3, 9, 27, 81

> Powers of 3: 3^{n-1}

17.

1, 5, 13, 25, 41

> Centred square numbers: $n^2 + (n-1)^2$

18.

1, 2, 4, 8, 16, 32

> Powers of 2: 2^{n-1}

19.

1, 4, 10, 20, 35

> Tetrahedral numbers: n(n+1)(n+2)/6

20.

1, 3, 6, 10, 15, 21

> Triangular numbers: n(n+1)/2

21.

2, 5, 10, 17, 26

> $n^2 + 1$

22.

1, 6, 15, 28, 45

> Hexagonal numbers: n(2n-1)

23.

1, 4, 13, 40, 121

> $3^n - 2$

24.

1, 5, 12, 22, 35

> Pentagonal numbers: n(3n-1)/2

25.

2, 3, 5, 9, 17

> $2^{n-1} + 1$

26.

1, 3, 8, 21, 55

> Every second Fibonacci number

27.

1, 4, 9, 16, 25, 36, 49

> Perfect squares: n^2

28.

1, 2, 5, 14, 41

> $3^{n-1} + 1$

29.

1, 7, 19, 37, 61

30.

1, 4, 10, 22, 46

MASTER QUESTIONS

M1.

A sequence begins 1, 3, 6, 10, 15. If this pattern continues, what is the 20th term?

> The 20th triangular number is 210

M2.

In a Fibonacci-like sequence, each term is the sum of the previous two terms. If the first two terms are 5 and 8, what is the 10th term?

> The 10th term is 233

M3.

A pattern of dots forms triangular numbers. How many dots are in the 15th triangular number?

> The 15th triangular number has 120 dots

M4.

A sequence of square numbers starts from 1. What is the sum of the first 10 square numbers?

> The sum of the first 10 square numbers is 385

M5.

In a geometric sequence, the first term is 2 and the common ratio is 3. What is the 8th term?

> The 8th term is 4374

M6.

A pattern shows that the sum of the first n odd numbers equals n^2. Using this, find the sum of the first 25 odd numbers.

> The sum of the first 25 odd numbers is 625

M7.

The number of diagonals in a convex polygon with n sides is given by n(n-3)/2. How many diagonals does a 12-sided polygon have?

> A 12-sided polygon has 54 diagonals

M8.

A sequence is defined by $a_n = 2a_{n-1} + 1$ with $a_1 = 1$. What is the 7th term?

> The 7th term is 127

M9.

The maximum number of regions created by n lines in a plane is $n(n+1)/2 + 1$. How many regions are created by 10 lines?

> 10 lines create 56 regions

M10.

A pattern shows that the sum of the angles in a convex polygon with n sides is $(n-2)\times180°$. What is the sum of angles in a 15-sided polygon?

> The sum of angles in a 15-sided polygon is 2340°