

Match the corresponding terms:

$2n$

add 2 onto n

$2 + n$

$2 \times n$

$\frac{n}{2}$

$2 \times n \times n$

$2n^2$

$n \div 2$

Completing a sequence

What

- are the next 3 terms of these sequences?
- is the rule?
- the 30th term?

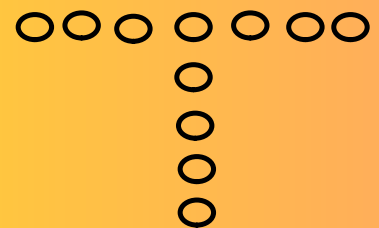
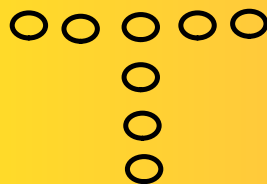
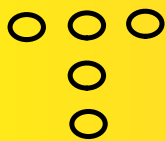
$$T_{30} = 14$$

$$-3n + 104$$

$$-3n + 13$$

$$-90 + 13 = -77$$

- 1) 2, 4, 6, 8... 10, 12, 14
 $T_n = 2n$ $T_{30} = 60$
- 2) 5, 7, 9, 11... 13, 15, 17
 $T_n = 2n + 3$
- 3) 101, 98, 95, 92... 89, 86, 83 $T_{30} = 63$
 $-3, -6, -9$
- 4) 10, 7, 4, 1, ... -2, -5, -8
 $-3, -6, -9$
- 5) 7



Generating sequences

n	1	2	3	4	5	6	7	8	9	10	11	
2n	2	4	6	8	10	12	14	16	18	20	22	
2n+1												
n-1												
3n												
3n+2												

Some important sequences.

Write down the first 5 terms of sequences that have these rules:

1. n

1, 2, 3, 4, 5, ...

2. $2n$

2, 4, 6, 8, 10

3. $2n-1$

1, 3, 5, 7, 9

4. $10n$

10, 20, 30, 40, 50

5. n^2

1, 4, 9, 16, 25

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~~25~~

30, 28, 26, 24

$-2n$ -2, -4, -6, -8

$$T_n = -2n + 32$$

1) 7, 9, 11, 13, 15, ...

2 4 6 8 10 $2n$

$$T_n = 2n + 5$$

2) 6, 11, 16, 21, 26

5 10 15 20

$$S_n \quad T_n = 5n + 1$$

3) 17, 24, 31, 38, 45, ...

7 14 21 28

$$7n \quad 7n + 10$$

4) 10, 8, 6, 4, 2, ...

-2 -4 -6 -8

$$T_n = -2n + 12$$

5) 108, 138, 168, 198, ...

30 60

$$T_n = 30n + 78$$

Finding rules

n	1	2	3	4	5	6	7	8	9
a) $2n$	2	4	6	8	10	12	14	16	18
b) $n-1$	0	1	2	3	4	5	6	7	8
c) $2n+1$	3	5	7	9	11	13	15	17	19
d) $5n$	5	10	15	20	25	30	35	40	45
e) $4n-1$	3	7	11	15	19	23	27	31	35

$4 \quad 8 \quad 12 \quad 16$

How to find the rule for a sequence

Look at the first 5 terms of sequence.
Work out the difference between each term.
If the difference is always the same your rule begins: difference $\times n$.
Compare your sequence with that one.
Example:

5, 7, 9, 11, 13...

Difference is always 2, so the rule begins $2n$.

compare 5, 7, 9, 11, 13...
with $2n$: 2, 4, 6, 8, 10...

You need to add 3 each time
So the rule is $2n + 3$.

Worksheet.

Making the rules

Find the rule and the 20th term for each sequence.

Linear - because it always goes up by the same amount.

1) 4, 9, 14, 19, 24... $\nearrow -1$
 $5n$ 5, 10, 15, 20, 25

$$T_n = 5n - 1$$

$$T_{20} = 99$$

2) 8, 18, 28, 38, 48...
 $10n$ 10, 20, 30, 40, 50

$$T_n = 10n - 2$$

$$T_{20} = 198$$

3) 4, 13, 22, 31, 40...
 $9n$ 9, 18, 27, 36

$$T_n = 9n - 5$$

$$T_{20} = 175$$

4) 5, 4, 3, 2, 1, 0, -1...
 $-n$ -1, -2, -3, -4, -5

$$T_n = -n + 6$$

$$T_n = 6 - n$$

$$T_{20} = -14$$

Here are some sequences.

Find

- the next 3 terms
- the 20th term
- the term number of the term shown in red.
- The rule for the sequence

$$T_n = 5n + 1$$

$$T_{20} = 101$$

1) 6, 11, 16, 21, 26, 31... 36, 41, 46 ¹⁵⁶
 $5n$ 5, 10, 15, 20

$$5n + 1 = 156$$

$$\underline{n = 31} \quad \begin{matrix} 5n = 156 - 1 \\ 5n = 155 \end{matrix}$$

2) 7, 9, 11, 13, 15, 17... ¹⁰¹

$$T_n = 2n + 5 \quad T_{20} = 45$$

3) -11, -1, 9, 19, 29, 39... ²⁷⁹

$$T_n = 10n - 21 \quad T_{20} = 179 \quad T_{30} = 279 \quad \begin{matrix} 2n + 5 = 101 \\ 2n = 96 \\ \underline{\underline{n = 48}} \end{matrix}$$

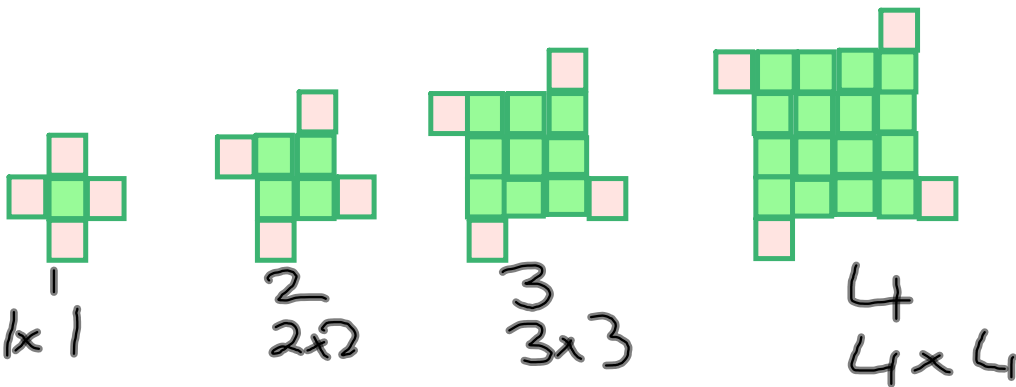
4) 6, 4, 2, 0, -2, -4, -6 ... ⁻²²

$$-2, -4, -6 \quad T_n = -2n + 8 \quad T_{20} = -32 \quad T_{15} = -22$$

5) 1, 4, 9, 16, 25, 36... ¹⁹⁶

$$T_n = n^2 \quad T_{20} = 400$$

Windmills



1. Describe the next term

2. What will the tenth term look like?

3. How many tiles will there be on the 20th term?

4. What is the rule for finding the number of tiles?

5. Which pattern no will have 148 tiles?

Quadratic Sequences

Quadratics have a squared term.

Eg

$n^3 + n^2$ is not quadratic

$T_n = n^2$
 = 1, 4, 9, 16, 25, 36, 49, 64...

$n^2 : 1, 4, 9, 16, 25, \dots$

Generate the first five terms of these quadratic sequences:

$T = 3n^2$ 3, 12, 27, 48, 75

$T = n^2 + 5$ 6, 9, 14, 21, 30
 1, 4, 9, 16, 25

$T = 2n^2 - 3$ -1, 5, 15, 29, 47, ...

$T = n^2 + n$ 2, 6, 12, 20, 30, ...

1	4	9	16	25	n^2
1	2	3	4	5	n

Looking at differences:

		1	4	9	16	25	36	49	64
$T = n^2$	1st difference		3	5	7	9	11	13	15
	2nd difference			2	2	2	2	2	2

		3	12	27	48	75	108	36
$T = 3n^2$	↑	9	15	21	27	33		
the co-efficient		6	6	6	6			

$T = n^2 + 5$ | If the second difference is a constant the rule is quadratic.
 You halve the second difference to get the co-efficient of n^2 .

$T = 2n^2 - 3$

$T = n^2 + n$

$$T_n = 5n^2$$

$$\begin{array}{ccccc} 1 & 4 & 9 & 16 & 25 \\ \frac{1}{2} & 2 & 3 & 4 & 5 \\ 5 & 20 & 45 & 80 & 125 \end{array}$$

$$T_n = n^2 - n$$

$$0, 2, 6, 12, 20$$

$$T_n = n^2 + 2n$$

$$3, 8, 15, 24, 35, \dots$$

$$T_n = \frac{1}{2}n^2$$

$$0.5, 2, 4.5, 8, 12.5$$

$$T_n = 20 - n^2$$

$$19, 16, 11, 4, -5$$

$$T_n = 4(n^2 + 5)$$

$$T_n = 3n^2 - n^2 = 2n^2$$

$$24, 36, 56, 84, 120, \dots$$

For Tuesday

1. Solve by trial and improvement

$$x^3 + 2x = 100$$

2. Page 125 T1 - T3

Generating quadratic sequences

n	1	2	3	4	5
n^2	1	4	9	16	25
n^2+3	4	7	12	19	28
n^2-2	-1	2	7	14	23
$5n^2$	5	20	45	80	125
$2+5n^2$	7	22	47	82	127

Find the rule for these sequences:

$6n^2$

6, 24, 54, 96, 150

6, 24, 54, 96, 150, 216, 294

18 30 42 54 66 78
12 12 12 12 12

$10n^2$

10, 40, 90, 160, 250, 360, 490

10, 40, 90, 160, 250, 360, 490

30 50 70 90 110 130
20 20 20 20 20

$$T_n = 10n^2$$

$4n^2$

4, 16, 36, 64, 100

4, 16, 36, 64, 100, 144, 196

12 20 28 36 44 52
8 8 8 8 8

$$T_n = 4n^2$$

Quadratic sequences

Find the rule for these sequences.

n	1	2	3	4	5	6	7	8	9	10	11
	1	4	9	16	25	36	49	64	81	100	121
	3	6	11	18	27	38	51	66	83	102	123
	-3	0	5	12	21	32	45	60	77	96	117
→	2	8	18	32	50	72	98	128	162	200	242

$\underbrace{\quad\quad\quad}_6 \quad \underbrace{\quad\quad\quad}_{10} \quad \underbrace{\quad\quad\quad}_{14} \quad \underbrace{\quad\quad\quad}_{18} \quad \underbrace{\quad\quad\quad}_{22} \quad \underbrace{\quad\quad\quad}_{26} \quad \underbrace{\quad\quad\quad}_{30}$
 $\underbrace{\quad\quad}_4 \quad \underbrace{\quad\quad}_4 \quad \underbrace{\quad\quad}_4 \quad \underbrace{\quad\quad}_4$
 $\underline{2} \quad \underline{8}$

$T_n = 2n^2$

12	15	20	27	36	47	60	75	92
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12	15	20	27	36	47	60	75	92
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1	4	9	16
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0	2	6	12	20	30	42	56	72
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Extension

$4, 11, \overset{27}{\cancel{20}}, 37, 56, 79$
 $\underbrace{\quad\quad\quad}_7 \quad \underbrace{\quad\quad\quad}_{10} \quad \underbrace{\quad\quad\quad}_{16}$
 $5, 11, 19, 29, 41, 55$

Which group of numbers do these rules generate?

$$T=2n$$
$$T=2n-1$$
$$T=1/2 n (n+1)$$
$$T=n^2$$

Making the Rules

Find the rules for these sequences.
Use your rule to find the 20th term of each sequence.

1. 4, 5, 6, 7, 8,
2. 5, 9, 13, 17, 21....
3. 4, 15, 26, 37, 48, 59...
4. 32, 62, 92, 122, 152....
5. 3, 2, 1, 0, -1, -2.....
6. 8, 6, 4, 2, 0, -2.....
7. 2.5, 3, 3.5, 4, 4.5....
8. 7.5, 5, 2.5, 0, -2.5.....
10. 2, 5, 10, 17, 26,

How to use excel to generate a sequence

1. Start a new excel page
2. Type in column A the first term of your sequence.
3. In column B type your rule, starting with =.
4. Using the small black cross drag across 20 cells.

Finding Rules

Find rules for these sequences:

5, 9, 13, 17, 21, 25...

1 4 9 16 ~~25~~

$$T_n = 4n + 1$$

-2, 1, 6, 13, 22, 33

1 4 9 16

$$T_n = n^2 - 3$$

$3n^2$

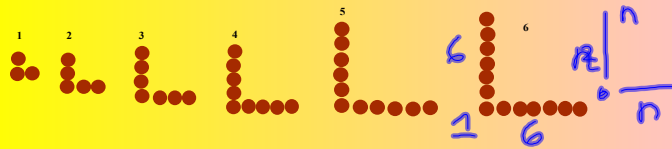
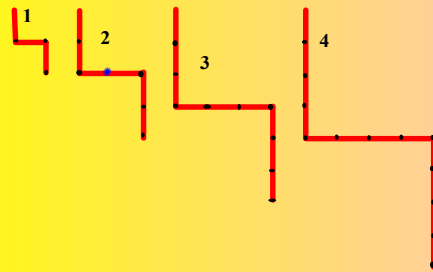
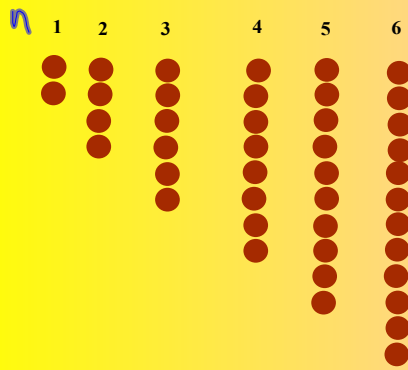
3 12 27 48

7, 16, 31, 52, 79, 112..

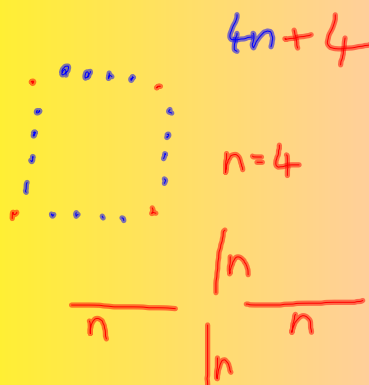
$$T_n = 3n^2 + 4$$

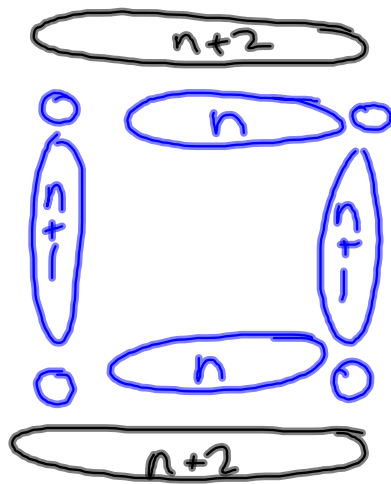
9 15 21 27 33
6 6 6 6

Patterns and rules



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$$\begin{aligned}
 & 2n + 2(n+1) + 4 \\
 &= 2n + 2n + 2 + 4 \\
 &= 4n + 6
 \end{aligned}$$

Tuesday

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p121 D4

p 125 T3, T4

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(d) Show that 11 is a term in both sequence A and sequence B but not sequence C. Grade C AO2

Grade C AO2

M9 The n th term of a sequence is $T_n = 5n - 3$.
For example $T_4 = 17$

(a) (i) Show that $T_1 + T_7 = 9$ Grade C AO1

(a) (ii) Show that $T_{n+1} = 5n + 2$ Grade B AO2

(a) (ii) Show that $T_{n+1} + T_{n+1}$ is a multiple of 10 Grade A AO2

(b) In a different sequence, $T_n = 3n^2$
Show that $T_{n+1} - T_n = 6n + 3$ Grade A AO3

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