A **linear** sequence increases (or decreases) steadily by ... the same amount each time.

Example:

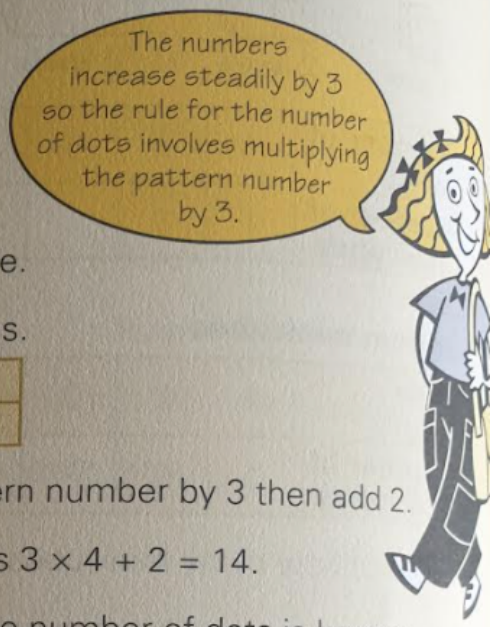
1. 5, 7, 9, 11, ... is a linear sequence, increasing steadily by adding 2 each time.
2. 5, 10, 20, 40, ... is **not** a linear sequence as it increases by **multiplication** by 2.

Many **spatial patterns** give rise to linear sequences of numbers.

Example:

A sequence of dot patterns is shown.

Each pattern has 3 more dots  than the one before.



The table continues the pattern for a few more terms.

Pattern number	1	2	3	4	5	6
Number of dots	5	8	11	14	17	20

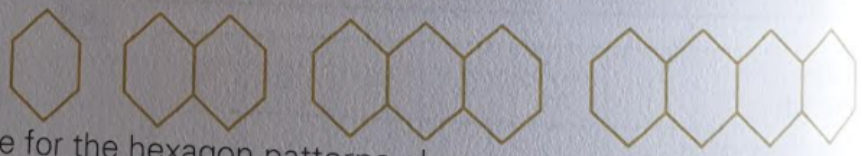
The rule for the number of dots is: Multiply the pattern number by 3 then add 2.

For example, the number of dots in the 4th pattern is $3 \times 4 + 2 = 14$.

Reverse the rule to find the pattern number when the number of dots is known.
For example, if a pattern has 32 dots then the pattern number is $(32 - 2) \div 3 = 10$.

Practising linear number and spatial patterns

1. Huddling hexagons



a. Complete the table for the hexagon patterns above.

Hexagon pattern	1	2	3	4	5	6
Number of sides	6	11				

b. How many extra sides do you get for each extra hexagon? _____

c. Complete the rule: The number of sides is found by multiplying the number of hexagons by 5 then adding ____.

d. How many sides would there be in a pattern with:

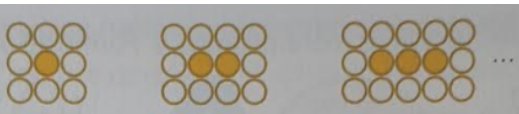
i. 10 hexagons _____

ii. 15 hexagons _____

e. Which hexagon pattern would have 66 sides?

_____

2. Plain and shaded circles



a. Complete the table (draw extra patterns if you need to).

Number of shaded circles	1	2	3	4	5	6
Number of plain circles	8	10				

b. How many extra plain circles are there for every extra shaded circle? _____

c. Complete the rule: The number of plain circles is found by multiplying the number of shaded circles by ____ then adding ____.

d. How many plain circles would there be in a pattern with 10 shaded circles? _____

e. How many shaded circles are there in a pattern with 30 plain circles? _____

3. Noughts and crosses

a. Complete the table (draw extra patterns if you need to).

Number of noughts	5	6	7	8	9	10
Number of crosses	4	6				

b. How many extra crosses are there for every extra nought? _____

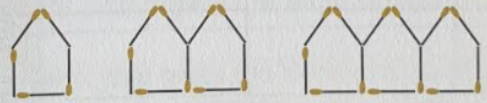
c. Write out the rule for the pattern in words: The number of crosses is found by

_____

d. How many crosses would there be in a pattern with 20 noughts? _____

e. How many noughts are there in a pattern with 18 crosses? _____

4. Matchstick houses



a. Complete the table (draw extra patterns if you need to).

Number of houses	1	2	3	4	5	6
Number of matchsticks	5	9				

b. How many extra matchsticks are there for every extra house? _____

c. Write out the rule for the pattern in words: The number of matchsticks is found by

_____

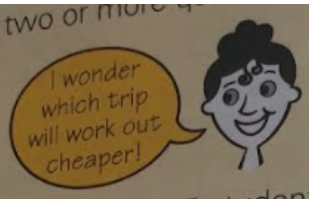
d. How many matchsticks would there be in a pattern with 10 houses? _____

e. How many houses are there if 33 matchsticks are used? _____

f. Write in words the rule for finding the number of houses if the number of matchsticks is known. _____

A **formula** is a rule linking two or more [illegible]

Example:



Remember: multiply before adding.

Mrs Millar wanted to take her class of 25 students on a trip.

- *Little Miss Muffet's Spider Farm* costs $30.00 for a talk about spiders and $2.00 per pupil to go in to see the spider displays.
- *Little Boy Blue's Cattle Farm* charges $50.00 for a talk on dairy farming and $1.00 per pupil for a farm tour.

Costs can be worked out using this formula:

Cost for visit = (talk charge) + (number of students) × (tour fee)

- Cost for visit to *Spider Farm*: $30 + (25 \times 2) = \$80.00$
- Cost for visit to *Cattle Farm*: $50 + (25 \times 1) = \$75.00$

Visiting *Little Boy Blue's Cattle Farm* is the cheaper option for 25 students.

Practising using word formulae

1. Fill in the table below to work out costs for the two trips, as above, for differing numbers of students. For each number of students, circle the cheaper trip, as shown.

	10 students	20 students	25 students	40 students
Little Miss Muffet's Spider Farm			$30 + (25 \times 2)$ $= \$80.00$	
Little Boy Blue's Cattle Farm			$50 + (25 \times 1)$ $= \$75.00$	

2. *Ready lawn* grass is sold in rectangular 'tiles' 10 cm longer than they are wide.

   The length of the 'tile' can be found by using the formula: length = width + 10

   The area of a 'tile' can be found by using the formula: area = length × width

   Use the formulae to work out the length and area of each 'tile' for the given widths. The first one has been done for you.

   * 70 cm wide — length = 70 + 10 = 80 cm — area = 70 × 80 = 560 cm²

   a. 90 cm wide — length = _____ = _____ cm — area = _____ = _____ cm²

   b. 20 cm wide — length = _____ = _____ cm — area = _____ = _____ cm²

   c. 50 cm wide — length = _____ = _____ cm — area = _____ = _____ cm²

   d. 100 cm wide — length = _____ = _____ cm — area = _____ = _____ cm²

3. Kieran, Kip and David start training for the school cross-country race.

- Kieran runs 14 km per day, five days a week, plus 16 km on each weekend day.
- Kip runs 15 km per day five days a week, plus 30 km in total during the weekend.
- David runs 16 km per day on each of the five weekdays, plus 18 km on Sunday.

Use the formula total distance = (weekday distance) × 5 + (weekend distance) to work out how far each boy runs in a week.

Working space

a. Kieran

b. Kip

c. David

d. Who ran the greatest distance?

4. The cost of an order of buns and loaves from a bakery is given by the formula

cost = (number of buns) × 2 + (number of loaves) × 3

a. Find the cost of the following orders.

Working space

i. A dozen buns and 2 loaves

ii. 4 loaves and 6 buns

iii. 1 loaf

iv. 1 bun

b. If an order has 3 loaves and costs $17, how many buns were bought?