Knowledge Organiser: Year 9 Maths; Sequences and Straight Line Graphs

Arithmetic/ Geometric sequences

Arithmetic Sequences change by a common difference. This is found by addition or subtraction between terms

Geometric Sequences change by a common ratio. This is found my multiplication/ division between terms.

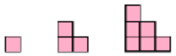
Term to term rule – how you get from one term (number in the sequence) to the next term

Position to term rule – take the rule and substitute in a position to find a term. E.g. Multiply the position number by 3 and then add 2

Other sequences

Fibonacci Sequence
1, 1, 2, 3, 5, 8 . . .
Each term is the sum of the previous two terms

Triangular Numbers – look at the formation



1, 3, 6, 10, 15 . . .

Square Numbers – look at the formation

1, 4, 9, 16. . .

Sequences are the repetition of a patten

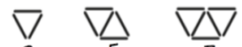
Describe and continue a sequence diagrammatically

Count the number of circles or lines in each image

1 $\xrightarrow{+2}$ 3 $\xrightarrow{+2}$ 5 $\xrightarrow{}$

What will the next number be? Can you draw this?

Predict and check terms



3 $\xrightarrow{+2}$ 5 $\xrightarrow{+2}$ 7

CHECK – draw the next terms

9 11 13

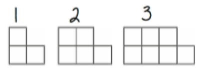
Predictions:
Look at your pattern and consider how it will increase.

e.g. How many lines in pattern 6?

Prediction - 13
If it is increasing by 2 each time - in 3 more patterns there will be 6 more lines

Sequence in a table and graphically

Position: the place in the sequence



"The term in position 3 has 7 squares"

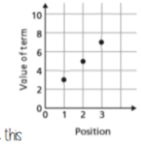
Term: the number or variable (the number of squares in each image)

Graphically

In a table

Position	1	2	3
Term	3	5	7

+2 +2



Because the terms increase by the same addition each time this is linear – as seen in the graph

Linear and Non Linear Sequences

Linear Sequences – increase by addition or subtraction and the same amount each time

Non-linear Sequences – do not increase by a constant amount – quadratic, geometric and Fibonacci

- Do not plot as straight lines when modelled graphically
- The differences between terms can be found by addition, subtraction, multiplication or division

Fibonacci Sequence – look out for this type of sequence

0 1 1 2 3 5 8 . . .

Each term is the sum of the previous two terms

Continue Linear Sequences

7, 11, 15, 19...

How do I know this is a linear sequence?
It increases by adding 4 to each term
How many terms do I need to make this conclusion?
At least 4 terms – two terms only shows one difference not if this difference is constant (a common difference)
How do I continue the sequence?
You continue to repeat the same difference through the next positions in the sequence

Continue non-linear Sequences

1, 2, 4, 8, 16 ...

How do I know this is a non-linear sequence?
It increases by multiplying the previous term by 2 – this is a geometric sequence because the constant is multiply by 2
How many terms do I need to make this conclusion?
At least 4 terms – two terms only shows one difference not if this difference is constant (a common difference)
How do I continue the sequence?
You continue to repeat the same difference through the next positions in the sequence

Explain term-to-term rule

How you get from term to term

Try to explain this in full sentences not just with mathematical notation
Use key maths language – doubles, halves, multiply by two, add four to the previous term etc

To explain a whole sequence you need to include a term to begin at . . .

The next term is found by tripling the previous term. The sequence begins at 4

4, 12, 36, 108...
x3 x3 x3

First term

Sequences from algebraic rules

This is substitution!

$3n + 7$

This will be linear - note the single power of n. The values increase at a constant rate

$3n^2 + 7$

This is not linear as there is a power for n

$2n - 5$ → Substitute the number of the term you are looking for in place of 'n'

eg
1^{st} term = $2(1) - 5 = -3$
2^{nd} term = $2(2) - 5 = -1$
100^{th} term = $2(100) - 5 = 195$

Checking for a term in a sequence

Form an equation

Is 201 in the sequence $3n - 4$?

$3n - 4 = 201$

Algebraic rule

Term to check

Solving this will find the position of the term in the sequence.
ONLY an integer solution can be in the sequence.

H Finding the algebraic rule

This is the 4 times table
4n

→ 4, 8, 12, 16, 20...

↓ ↓ ↓

7, 11, 15, 19, 22 ← This has the same constant difference – but is 3 more than the original sequence

$4n + 3$

$4n + 3$

This is the constant difference between the terms in the sequence

This is the comparison (difference) between the original and new sequence

Keywords

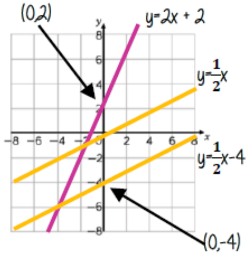
Sequence: items or numbers put in a pre-decided order
Term: a single number or variable
Position: the place something is located
Rule: instructions that relate two variables
Linear: the difference between terms increases or decreases by the same value each time
Non-linear: the difference between terms increases or decreases in different amounts
Difference: the gap between two terms
Arithmetic: a sequence where the difference between the terms is constant
Geometric: a sequence where each term is found by multiplying the previous one by a fixed non zero number

Knowledge Organiser: Year 9 Maths; Sequences and Straight Line Graphs

Compare Intercepts

$y = mx + c$

The value of c is the point at which the line crosses the y-axis. Y intercept



The coordinate of a y intercept will always be (0,c)

Lines with the same y-intercept cross in the same place

y = mx + c

The coefficient of x (the number in front of x) tells us the gradient of the line

$y = mx + c$

The value of c is the point at which the line crosses the y-axis. Y intercept

y and x are coordinates.

The equation of a line can be rearranged. Eg.

y = c + mx

c = y – mx

Identify which coefficient you are identifying or comparing.

Keywords

Quadrant: four quarters of the coordinate plane.

Coordinate: a set of values that show an exact position.

Horizontal: a straight line from left to right (parallel to the x axis)

Vertical: a straight line from top to bottom (parallel to the y axis)

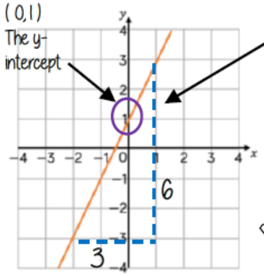
Origin: (0,0) on a graph. The point the two axes cross

Parallel: Lines that never meet

Gradient: The steepness of a line

Intercept: Where lines cross

Find the equation from a graph



The Gradient $\frac{6}{3} = 2$

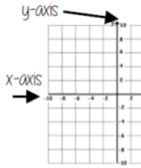
$y = 2x + 1$

The direction of the line indicates a positive gradient

Positive gradients

Negative gradients

Coordinates in four quadrants



Coordinate (x, y) (6, 4)

From the origin this coordinate is 6 places along the positive x axis and 4 places up the positive y axis

(x, y)

Always the position on the x axis first

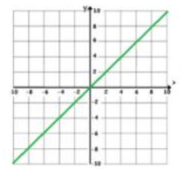
Always the position on the y axis second

(0, a) Will be always be a point on the y axis (a can be any number)

(a, 0) Will be always be a point on the x axis (a can be any number)

Recognise and use the line y=x

This means the x and the y coordinate have the same value

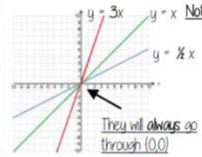


Examples of coordinates on this line: (0, 0) (-3, -3) (8, 8)

The axes **scale is important** – if the scale is the same y = x will be a straight line at 45°

Recognise and use the lines y=kx

The value of k changes the steepness of the line



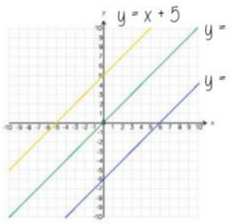
Note: y =x is the same as y= 1x

They will always go through (0,0)

The bigger the value of k the **steeper** the line will be

The closer to 0 the value of k the closer the line will be to the x axis

Lines in the form y = x + a



All the lines are parallel because the gradients are the same

y = x + a

This is the line y=x when the y and x coordinate are the same

This shows the translation of that line.
e.g. y = x + 5
Is the line y=x moved 5 places up the graph

5 has been added to each of the coordinates

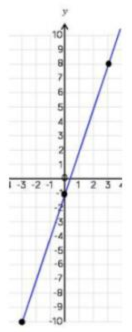
Plotting y = mx + c graphs

$y = 3x - 1$ → 3 x the x coordinate then – 1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

This represents a coordinate pair (-3, -10)



You only need two points to form a straight line

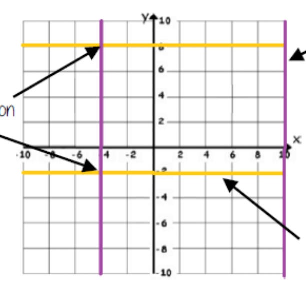
Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

Remember to join the points to make a line

Lines parallel to the axes R

All the points on this line have a x coordinate of 10

'a' can be ANY positive or negative value including 0



Lines parallel to the y axis take the form x = a and are **vertical**

Lines parallel to the x axis take the form y = a and are **horizontal**

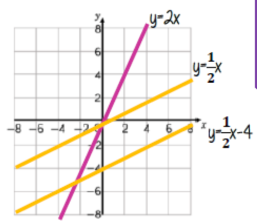
All the points on this line have a y coordinate of -2

eg (3, -2) (7, -2) (-2, -2) all lay on this line because the y coordinate is -2

Compare Gradients

$y = mx + c$

The coefficient of x (the number in front of x) tells us the gradient of the line



The greater the gradient – the steeper the line

Parallel lines have the same gradient

Positive gradients

Negative gradients

Plotting y = mx + c graphs R

$y = 3x - 1$ → 3 x the x coordinate then – 1

x	-3	0	3
y	-10	-1	8

Draw a table to display this information

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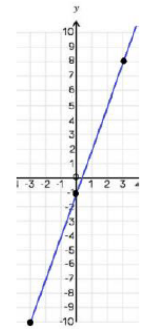

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How do we use Knowledge Organisers in Mathematics?

How can you use knowledge organisers at home to help us?

- **Retrieval Practice**: Read over a section of the knowledge organiser, cover it up and then write down everything you can remember. Repeat until you remember everything.
- **Flash Cards:** Using the Knowledge Organisers to help on one side of a piece of paper write a question, on the other side write an answer. Ask someone to test you by asking a question and seeing if you know the answer.
- **Mind Maps:** Turn the information from the knowledge organiser into a mind map. Then reread the mind map and on a piece of paper half the size try and recreate the key phrases of the mind map from memory.
- **Sketch it:** Draw an image to represent each fact; this can be done in isolation or as part of the mind map/flash card.
- **Teach it:** Teach someone the information on your knowledge organiser, let them ask you questions and see if you know the answers.

How will we use knowledge organisers in Mathematics?

Knowledge organisers will be used before I complete a Learning Check or Common Assessment. I will spend part of the lesson looking over each of the key topics of the half term before completing the Learning Check or Common Assessment.

I will also use these at home to complete my own independent learning and revision of these key topics.