Year 8 Knowledge Organiser – Substitution and formulae Sequences and graphs

Objectives

- Substitute numerical values into scientific formulae
- Rearrange formulae to change the subject
- Generate terms of a sequence from either a term-to-term or a position-to-term rule and calculate the nth term of linear sequences
- Plot graphs of equations that correspond to straight-line graphs
- Identify and interpret gradients and intercepts of linear functions graphically
- Recognise, sketch, and interpret graphs of linear functions and simple quadratic functions
- Plot and interpret graphs and graphs of non-standard (piece-wise linear) functions in real contexts

Key Vocabulary

Sequence – a particular order in which related terms follow each other

Linear sequence – a sequences which increases/decreases by the same amount each time

Nth term - a formula with 'n' in it which enables you to find any term of a sequence without having to go up from one term to the next

Coordinate – locates a position on the x and y axes

Quadrant – one of the four regions of the Cartesian plane bounded by the x-axis and y-axis

Gradient – the steepness of a line

Intercept – where a line passes through the y-axis

Quadratic – an equation containing a squared variable

Substitute – swap a variable for a numerical value

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

Finding the nth term

This is the 4 times table → 4, 8, 12, 16, 20…

4n

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

4n + 3

This is the constant difference between the terms in the sequence

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

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**

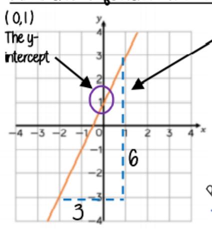
The equation of a line can be rearranged. Eg:

y = c + mx

c = y – mx

Identify which coefficient you are identifying or comparing

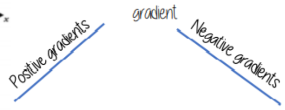
Find the equation from a graph



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

$$y = 2x + 1$$

The direction of the line indicates a positive gradient



Changing the subject of a formula

This follows the same rules as when solving equations.

e.g. make u the subject of the formula

$y = 2u + 3p$ (−3p)

$y - 3p = 2u$ (÷2)

$\frac{y - 3p}{2} = u$

e.g. make c the subject of the formula

$m = 5(c - 1)$

There are 2 options here:

Method 1: expand the bracket first

$m = 5(c - 1)$ (expand)

$m = 5c - 5$ (+5)

$m + 5 = 5c$ (÷5)

$\frac{m + 5}{5} = c$

Method 2: divide by the coefficient first

$m = 5(c - 1)$ (÷5)

$\frac{m}{5} = c - 1$ (+1)

$\frac{m}{5} + 1 = c$

Tip – examiners tell schools that method 1 usually has a higher success rate in an exam than method 2 does!

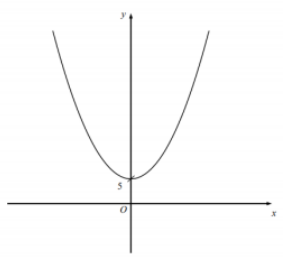
Sketching quadratics

All you need to know is whether it forms a u or a n shape, and identify where it would cross the y-axis.

e.g. sketch the graph $y = 3x^2 + 5$

a = 3 so is positive. So this is a u shape

c = 5, so crosses at (0, 5)



As it is a sketch, there is no need to plot any points accurately. The graph should be symmetrical about the y-axis and just label the crossing point.

Substitution

Means swapping a variable for a value. Be careful with negative values!

e.g. 4y + 12

If y = 6, then 4 x 6 + 12 = 36

If y = -5, then 4 x (-5) + 12 = -8

You will need to use substitution in sequences and graphs…

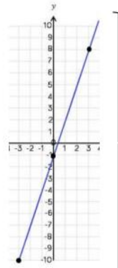
Plotting y = mx + c graphs

$y = 3x - 1$ → 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

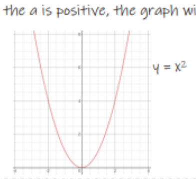
Plotting more points helps you decide if your calculations are correct (if they do make a straight line)

Remember to join the points to make a line

General form of a quadratic equation

The general equation of a quadratic is $y = ax^2 + bx + c$, where a, b and c are all constant values. The +c represents the intercept and tells us where the graph will cross the y-axis.

If the a is positive, the graph will form a u shape.



The graph is a smooth curve between each point and is called a parabola.

If the a is negative the graph will form a n shape.