Knowledge Organiser: Mathematics
Year 8 Spring 1

Suggested websites: Maths Genie, Save My Exams and Corbett Maths

Smarks

Big Idea: Algebra

Key Vocabulary

Simplify, Substitute, Equivalent, Coefficient, Product, Highest Common Factor (HCF), Inequality.

What do I need to be able to do?

By the end of this unit you should be able to:

- Form Expressions
- Expand and factorise single brackets
- Form and solve equations
- Solve equations with brackets
- Represent inequalities
- Form and solve inequalities

DOUBLE BRACKETS — you get 4 terms, and usually 2 of them combine to leave 3 terms.

There's a handy way to multiply out double brackets — it's called the FOIL method and works like this:

First — multiply the first term in each bracket together
Outside — multiply the outside terms (i.e. the first term in the first bracket by the second term in the second bracket)
Inside — multiply the inside terms (i.e. the second term in the first bracket by the first term in the second bracket)
Last — multiply the second term in each bracket together

Expand and simplify $(n-1)(2n+5)$ EXAMPLE:

F O I L

$(n-1)(2n+5) = (n \times 2n) + (n \times 5) + (-1 \times 2n) + (-1 \times 5)$

$= 2n^2 + 5n - 2n - 5$

$= 2n^2 + 3n - 5$

The two n terms combine together.

Form expressions

For unknown variables, a letter is normally used in its place

More than – ADD
Less than/ difference – SUBTRACT

eg 4 more than t → $t + 4$
8 less than k → $k - 8$

Only similar terms can be grouped together

eg Find the perimeter of this shape (Perimeter = length around outside of shape)

Rectangle with sides t and $2t + 1$

$t + 2t + 1 + t + 2t + 1 \rightarrow 6t + 2$

Directed numbers

+ +	→ +
− −	→ +
+ −	→ −
− +	→ −

eg $a = -5$ and $b = 2$

$a^2 = a \times a = -5 \times -5 = 25$

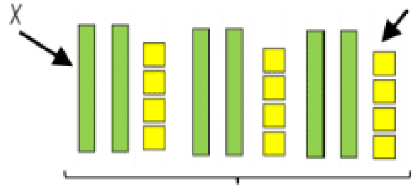
$b + a = 2 + -5 = -3$

Multiply single brackets

$3(2x + 4)$

	2x	4
3	3 x 2x 6x	3 x 4 12

$6x + 12$



$6x + 12$

2x + 4			2x + 4			2x + 4		
x	x	4	x	x	4	x	x	4
6x + 12								

Different representations of $3(2x+4) = 6x + 12$

Simple Inequalities

< less than
≤ Less than or equal to
> More than
≥ More than or equal to

x < 10
Say this out loud
"x is a value less than 10"

10 > x
Say this out loud
"10 is more than the value"

Note:
x< 10 and 10>x represent the same values

$x + 2 \leq 20$
"my value + 2 is less than or equal to 20"
$x \leq 18$
The biggest the value can be is 18

Form and solve inequalities

Two more than treble my number is greater than 11

Find the possible range of values

Form x → x3 → +2 → 11

$3x + 2 > 11$

Solve x ← −3 ← −2 ← 11

$x > 3$

Check
This would suggest any value bigger than 3 satisfies the statement
3 x 3 + 2 = 11 ✓ 10 x 3 + 2 = 32 ✓

Algebraic constructs

Expression
A sentence with a minimum of two numbers and one maths operation
Equation
A statement that two things are equal
Term
A single number or variable
Identity
An equation where both sides have variables that cause the same answer includes ≡
Formula
A rule written with all mathematical symbols
eg area of a rectangle A = b x h

Factorise into a single bracket

$8x + 4$

Rectangle $8x + 4$ with sides 4 and $2x + 1$

← Try and make this the **highest common factor**

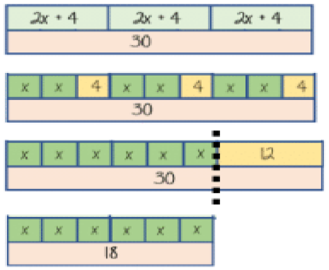
The two values **multiply** together (also the area) of the rectangle

$8x + 4 \equiv 4(2x + 1)$

Note:
$8x + 4 \equiv 2(4x + 2)$
This is factorised but the HCF has not been used

Solve equations with brackets

$3(2x + 4) = 30$



$3(2x + 4) = 30$

Expand the brackets

$6x + 12 = 30$

−12 −12

$6x = 18$

÷ 6 ÷ 6

$x = 3$

Substitute to check your answer. This could be negative or a fraction or decimal

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Big Idea: Algebra

Key Vocabulary

Sequence, Term, Position, Linear, Non-linear, Difference, Arithmetic, Geometric, Base, Power, Exponent, Indices, Coefficient, Simplify, Product.

What do I need to be able to do?

By the end of this unit you should be able to:

- Generate a sequence from term to term or position to term rules
- Recognise arithmetic sequences and find the nth term
- Recognise geometric sequences and other sequences that arise

What do I need to be able to do?

By the end of this unit you should be able to:

- Add/ Subtract expressions with indices
- Multiply expressions with indices
- Divide expressions with indices
- Know the addition law for indices
- Know the subtraction law for indices

Linear and Non Linear Sequences

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

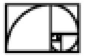
Non-linear Sequences – do not increase by a constant amount – quadratic, geometric and Fibonacci

- 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 …

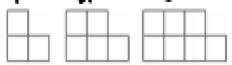
Each term is the sum of the previous two terms



Sequence in a table and graphically

Position the place in the sequence

1 2 3



3 5 7

Term the number or variable

(the number of squares in each image)

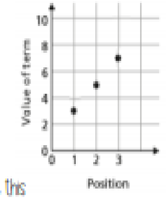
"The **term** in **position** 3 has 7 squares"

In a table

Position	1	2	3
Term	3	5	7

+2 +2

Graphically



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

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

1st term = 2 (1) – 5 = -3

2nd term = 2 (2) – 5 = -1

100th 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

Complex algebraic rules

Misconceptions and comparisons

$2n^2$ — 2 times whatever n squared is

eg

1st term = 2 x 1^2 = 2

2nd term = 2 x 2^2 = 8

100th term = 2 x 100^2 = 2000

$(2n)^2$ — 2 times n then square the answer

eg

1st term = $(2 \times 1)^2$ = 4

2nd term = $(2 \times 2)^2$ = 16

100th term = $(2 \times 100)^2$ = 40000

$n(n + 5)$ ←

eg

1st term = 1 (1 + 5) = 6

2nd term = 2 (2 + 5) = 14

100th term = 100 (100 + 5) = 10500

You don't need to expand the expression

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

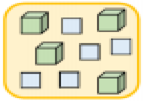
Addition/ Subtraction with indices

Coefficient Power

$5x^2 + 4x^4$

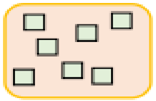
Term Term

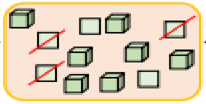
Expression

→ 

Each square represents x^2 and each cube represents x^4

Only similar terms can be simplified. If they have different powers, they are unlike terms

$5x^2 + 2x^2$ →  → $7x^2$

$5x^2 + 6x^4 - 3x^2 + x^4$ →  → $2x^2 + 7x^4$

Multiply expressions with indices

4b x 3a

≡ 4 x b x 3 x a

≡ 4 x 3 x b x a

≡ 12ab

5t x 9t

≡ 5 x t x 9 x t

≡ 5 x 9 x t x t

≡ $45t^2$

$2b^4 \times 3b^2$

≡ 2 x b x b x b x b x 3 x b x b

≡ 2 x 3 x b x b x b x b x b x b

≡ $6b^6$

There are often misconceptions with this calculation but break down the powers

Divide expressions with indices

$\frac{24}{36}$ → $\frac{2 \times 2 \times 2 \times 3}{2 \times 3 \times 2 \times 3}$ → $\frac{2}{3}$

$\frac{5a^3b^2}{15ab^6}$ → $\frac{5 \times a \times a \times a \times b \times b}{3 \times 5 \times a \times b \times b \times b \times b \times b \times b}$ → $\frac{a^2}{3b^4}$

Cross cancelling factors shows cancels the expression

$\frac{23a^7y^2}{5db^6}$

This expression cannot be divided (cancelled down) because there are no common factors or similar terms

Addition/ Subtraction laws for indices

$3^5 \times 3^2$ → 3^7

= (3 x 3 x 3 x 3 x 3) x (3 x 3)

The base number is all the same so the terms can be simplified

Addition law for indices

$a^m \times a^n = a^{m+n}$

$3^5 \div 3^2$ → 3^3

$\frac{3 \times 3 \times 3 \times 3 \times 3}{3 \times 3}$ → $\frac{3^3}{3^0}$ → $\frac{3^3}{1}$

Subtraction law for indices

$a^m \div a^n = a^{m-n}$