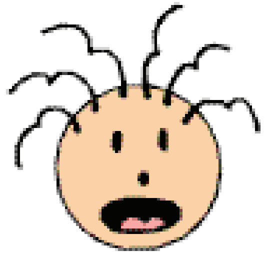
1. The Rules of Algebra



Let's just get one thing clear before we start…

Algebra really isn't anything to be afraid of, I promise

If anything, dealing with letters is a lot easier than just dealing with numbers.

Why?... because, as you will see, letters are always cancelling each other out, meaning the questions get easier and easier the more you get into them,

And… quite often you can know for sure if your answer is correct, or not!

So, take a deep breath, think positive thoughts, and let's give this Algebra thing a go…

What is Algebra and Why do we need it?

- On a simple level, Algebra is just maths with letters… but it is a lot more than that!

- By bringing in letters as well as numbers we can work out things that numbers alone would not allow us to.

- In Algebra, letters are called "Unknowns". Basically, we stick a letter in to stand for something when we don't know it's true value.

- Now, this could be anything from the price of Nintendo Wii, the number of hours you spend watching TV in a week, or the speed you walk to school in the morning.

- If we don't know what it is, call it a letter – any letter you like – and let's let algebra figure everything out for us.

And the whole of Algebra – right up to A Level and beyond – is built around 3 rules…

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The Lingo You Need:

Term – this is basically any part of an expression or equation that involves a letter

e.g. 4m -2r and p are all terms

Expression – this is kind of like a collection of terms, maybe with a few numbers chucked in e.g. 4m + 2r and $8z - 5p + 6q^2 - 7$ are all expressions

Equation – this is just the same as an expression, but with an equals sign

e.g. 4m + 2r = 7 and 8z – 5p + 6q2 – 7 = a

Rule 1: You can add or subtract LIKE TERMS but you cannot add or subtract DIFFERENT TERMS.

Okay, so by a LIKE TERM I mean a term that contains the exact same letter (or letters) as another term

e.g. $m + m = 2m$ $3p + 2p = 5p$ $16t^2 - 4t^2 = 12t^2$ $10pq - 7pq = 3pq$

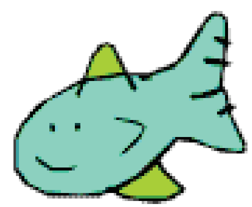
3 lots of something, plus 2 lots of something, gives you 5 lots of something

16 lots of something, minus 4 lots of something, gives you 12 lots of something

BUT…

$m + p$ Does Not = mp $3r + 2t$ Does Not = $5rt$

Because the terms are different!



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Simplifying Expressions

Now, once you have got to grips with Rule 1, it allows you to simplify nasty looking expressions into nice simple ones… which is called, believe it or not… simplifying.

To Simplify and Expression: Draw boxes around all the LIKE TERMS and deal with each set of like terms on their own.

Example 1

Simplify: $4m + 2p - m + 6p$

Okay, let's draw boxes around all the LIKE TERMS

Remember: Draw around the sign in front on the term as well!

$\boxed{4m}\ \boxed{+2p}\ \boxed{-m}\ \boxed{+6p}$

So, let's see what we've got:

$4m - m = 3m$

$2p + 6p = 8p$

Which gives us our answer of: $3m + 8p$

Note: if you cannot see a sign in front of a term, then just assume it is a PLUS

Example 2 – Tricky!

Simplify: $4t^2 - 5t - 2t - 3t^2$

Okay, let's draw boxes around all the LIKE TERMS

Remember: t and t^2 are DIFFERENT!

$\boxed{4t^2}\ \boxed{-5t}\ \boxed{-2t}\ \boxed{-3t^2}$

So, let's see what we've got:

$4t^2 - 3t^2 = t^2$

$-5t - 2t = -7t$

Note: write this instead of $1t^2$

Note: see how important it is you remember how to work with NEGATIVE NUMBERS!

Which gives us our answer of: $t^2 - 7t$

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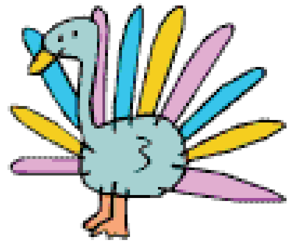
Rule 2: When Multiplying with Algebra, we need to remember the following things:

1. We CAN multiply different terms and like terms together
2. Always multiply the numbers together first
3. Put the letters in alphabetical order
4. Leave out the Multiplication Sign



Example 1

Simplify: $5b \times 2c \times 3a$

1. Okay, each of the three terms is different, but we are multiplying, so it's not a problem!
2. Let's multiply the numbers together first:

$$5 \times 2 \times 3 = 30$$

3. Now let's deal with the letters, remembering to write them in alphabetical order and leave out the multiplication sign

$$b \times c \times a = bca = abc$$

4. Putting them together, and again leaving out the multiplication sign, gives us our answer:

$$30abc$$

Example 2

Simplify: $4r \times -3p \times 3r \times q$

1. Again, no problem with the different terms
2. Let's multiply the numbers together first, being very careful with our negatives!:

$$4 \times -3 \times 3 \times 1 = -36$$

Note: there was no number in front of the q, which means it is just a 1!

3. Now let's deal with the letters:

$$r \times p \times r \times q = pqrr = pqr^2$$

Remember: if you multiply something by itself, it just means you are squaring it!

4. Which together gives us: $-36pqr^2$

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Rule 3: When Dividing with Algebra, the rules are just the same as when multiplying, but instead of a division sign like this ÷ we tend to write divisions as fractions!

Crucial: When dividing, watch for things cancelling out and disappearing!

Example 1

Simplify: $\frac{20xyz}{4z}$

1. Okay, just like when multiplying, different terms are no problem!

2. Let's divide the numbers first:

$$20 \div 4 = 5$$

3. Now let's deal with the letters:

$$xyz \div z = xy$$

What happened there? well, when you divide the z on the top by the z on the bottom you are left with **1** (just like if you divide anything by itself you get 1). But multiplying or dividing by 1 does not make a difference to our answer, so we can say that the z cancelled out!

4. So, our answer is: $5xy$

Example 2 – Nightmare!

Simplify: $\frac{5a^2b}{35ab^3}$

1. Different terms, no problem.

2. Dividing the numbers first:

$$5 \div 35 = \frac{5}{35} = \frac{1}{7}$$

Note: when you don't get a nice answer like in Example 1, you need to use Fractions!

3. Now let's deal with the letters (this requires a bit of knowledge about INDICES):

the a on the bottom wipes out one a on top, but still leaves an a behind on the top

the b^3 on the bottom wipes out the b on the top, and still leaves a b^2 behind on the bottom.

4. So, our answer is: $\frac{a}{7b^2}$

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