Essential algebra

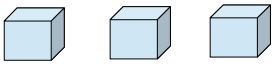
Algebra is the branch of mathematics in which letters are used to represent numbers.
You can use letters even when you do not know the number itself.

Example 1: Jas has some CDs. If he buys 3 more CDs, how many will he have altogether?
You do not know how many CDs Jas starts with, but you can use algebra to say:
Jas starts with x CDs x CDs and **3** CDs is x**+3** CDs

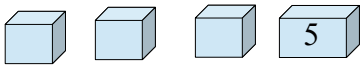
Example 2: Ann wins some cinema tickets. She gives 6 to friends. How many tickets has she got left?
You do not know how many tickets she had to start with, but you can say she had **y**. After giving away **6** tickets she has **y-6** tickets left.

Exercise 1 : Use algebra to write

1 3 more than a : _____ **2** x with 4 added: _____
3 x more than 7 : _____ **4** 2 less than b: _____
5 c with 3 taken away: _____ **6** p less than q: _____
7 x more than y : _____ **8** 4 together with a: _____
9 3b with 6 subtracted : _____
10 Paul has d DVDs. He buys 3 more. How many DVDs has he got now? _____
11 Rob has n apples. He eats 2 apples. How many apples has he got now?_____
12 Tom has £x. He spends £5. How much money has he got now? _____
13 Three boxes contain the same numbers of balls. There are x balls in each box. How many balls contain the three boxes altogether?: _____



14 How many balls do you get if you add another box containing 5 balls ?_____



Adding with letters
In algebra you can add letters that are the same. For example:
a+a can be written as **2a**
a+a+a can be written as **3a**

a means 1a
so 1a+1a=2a

Terms which use the same letter or arrangement of letters are called *like terms*:
a and **3*a*** are *like terms*, **2*g*** and **8*g*** are *like terms*.
Sometimes you can make algebraic expressions simpler by adding or subtracting like terms.
You can combine like terms by adding them:
2a+3a=5a **3b+4b+b=8b**

You can combine like terms by subtracting them:
5a-3a=2a **7a-a=6a**

Remember:
this is 7a – 1a

Exercise 2 Write these in a shorter form. The first one is done for you.

1 a+a+a+a+a+a=6a **2** p+p+p+p=___
3 b+b+b+b+b=____ **4** q+q+q+q+q+q=___

Exercise 3 Make these expressions simpler by adding or subtracting like terms.

1 2a+4a=___ **2** 3b+4b=___ **3** 5c+2c=___
4 5d-3d=___ **5** 7e-3e= ___ **6** 5f+f=___
7 3a+2a+2a=___ **8** 2a+5a-a=___ **9** 5c-3c-4c=___
10 6g-7g+g=___ **11** g-3g=___ **12** 9s-6s-12s=___

Collecting like terms
Sometimes algebraic expressions have more than one term and you can simplify them by collecting like terms together.
Example
To simplify **2a+4b+3a+5b**
Collect the a terms and the b terms: **2a+3a+4b+5b**
Combine the a terms and the b terms: **5a+9b**

Exercise 4 Simplify these expressions completely by collecting like terms.

1 3a+4b+4a+2b=_____
2 6m+5n+3m+2n=_____
3 2p+3q+p+2q =_____
4 8e+6c+8e=_____
5 5y+7p-3y-5p= _____
6 4a+8g-3a-2g+a=____
7 5k+3q-4k-2q=_____
8 6d+7f-8d-7f=_____
9 5h+8+2h+2=_____
10 3f-2f+4-f+8=_____
11 -7-8n+3-2n=_____
12 5+g-2h-8+g-h+3=_____

Multiplying with letters and numbers
Remember: **2a** is **a+a** **3a** is **a+a+a** **axa** is $\mathbf{a^2}$ and **bxbxb** is $\mathbf{b^3}$
But: **2a** also means 2 lots of **a** or 2 multiplied by **a** or **2xa**
3a means 3 lots of a or 3 multiplied by a or **3xa**
In algebra, when you want to multiply two items you just write them next to each other, like this:
2xa is written **2a**, **cxd** is written **cd**, **axb** is written **ab**, **3xexf** is written **3ef**

Exercise 5 Write these expressions in a simpler form. The first one is done for you.

1 p x q = pq
2 e x f = _____
3 r x s x t = _____
4 2 x e = _____
5 2 x c x d =_____
6 s x s =_____
7 txtxt = _____
8 2 x a x a =_____
9 a x a x b=_____

Multiplying algebraic expressions
Sometimes you can simplify an algebraic expression, such as **2*a*3*b***, by multiplying the terms by each other:
2*a*3*b*=2xax3xb=2x3xaxb=6ab

Exercise 6 Simplify these expressions by multiplying the terms by each other. The first one is done for you.

1 2ax4b = 8ab
2 3cx5d=_____
3 3px4q=_____
4 5sx4t =_____
5 fx2f=_____
6 2gxg=_____
7 9mx4n =_____
8 3ax2a=_____
9 9bx2b=_____
10 5px4r = _____
11 2ax6ab=_____
12 5px4qx2p=_____

Exercise 7 Simplify these expressions by multiplying the terms by each other and then collecting like terms. (Be careful a^2 and a are note like terms)

1 5ax2a+3x6a+a=_____
2 6b+2x3b+bxb+5b²=_____
3 4cxc-3c²+6cx3c=_____
4 dx3d-5d²x4+cxc+c²=_____
5 ex3e+4+3x5²-15e²=_____
6 f²-3fx5-2fx5f+g²+5=_____
7 -5+gxg²-g²+3=_____
8 -5h²+5ix-3i-2hx-3h=_____
9 -2x-5j- -5x-2j=_____
10 8k²-10k+15-+2kx-2x+2x5k+3x-5=_____