MATHEMATICS

SUPPORT CENTRE

Title: Simplification

Target: On completion of this worksheet you should be able to simplify algebraic expressions involving several letters.

An **algebraic expression** may involve several letters and numbers.
E.g. $y + 2x - 4$ and $xy + 3x - 2z$ are algebraic expressions.

It is important to be able to make an expression as easy to understand as possible. This is called **simplification.**
We need to recall two facts.

- p is shorthand for $1p$. We can remember this by considering that we say a pear to mean one pear. Here any letter can replace p.
- $\mathbf{3}\boldsymbol{a}$ is shorthand for $\mathbf{3}\times\boldsymbol{a}$. We can remember this by considering that we say **3 a**pples to mean **3** lots of one **a**pple. Here any number can replace 3.

To simplify an expression we group together terms involving the same letter.
Examples.

1. $3a + 2a = 5a$.
   We can see that this makes sense if we consider the fact 3 apples and 2 apples equals 5 apples.
2. $7b - b = 6b$. This is because b means $1b$.
3. $xy + 8xy = 9xy$.

Sometimes it is helpful to read the expression out loud to see if the simplification makes sense.

Exercise. Simplify the following.

1. $2x+4x$.
2. $5z-6z$.
3. $-3p+5p$.
4. $q+4q-6q$.
5. $2b^2+4b^2-3b^2$.
6. $7pq-5pq+pq$.

(Answers: $6x$, $-z$, $2p$, $-q$, $3b^2$, $3pq$.)

If we have an algebraic expression involving more than one letter then we should remember that we only add or subtract algebraic terms if they contain exactly the same letter(s).
Examples.
$2a + 3b$, $4x + 2$, $x^2 + 3x$ cannot be simplified.

When we have expressions that can be simplified, those that contain two or more terms that have exactly the same letter(s), we must remember that the sign stays with the term.

Examples.
Simplify
1) $5a + 2b - 3a$, 2) $3a + 2b - 4a$,
3) $4x+7y-3x-8y$ and 4) $3x+2xy+5x-xy$.

1. $5a + 2b - 3a = 2a + 2b$
2. $3a + 2b - 4a = -a + 2b$
3. $4x + 7y - 3x - 8y = x - y$
4. $3x + 2xy + 5x - xy = 8x + xy$

Exercise.
Simplify the following:

1. $3a+2b+2a+6b$.
2. $7p+3q-6p+4q$.
3. $3z-4k-8z+5k$
4. $3a+4+2a+b$
5. $8m-4n-6s-m+2n$.
6. $-2t+xy-6t-6xy$.
7. $st+4s-3st+2s$.
8. $x^2+3y-4x^2-6y+x$.

(Answers: $5a+8b$, $p+7q$, $-5z+k$, $5a+4+b$, $7m-2n-6s$, $-8t-5xy$, $-2st+6s$, $-3x^2-3y+x$.)

We can also simplify algebraic expressions involving multiplication by a number. We do this by writing out the expression in full.

Examples.

1) $3 \times 4x = 3 \times 4 \times x = 12 \times x = 12x$.
2) $-2 \times 6y = -2 \times 6 \times y = -12 \times y = -12y$.
3) $-7 \times -5c = -7 \times -5 \times c = 35 \times c = 35c$.

If you have difficulty with this see the number sheet on negative numbers.

Exercise.
Simplify the following:

1) $6 \times 6x$.
2) $4 \times 3pq$.
3) $-2 \times 4y$.
4) $-8 \times 3x^2$.
5) $-6 \times -4pq$.

(Answers: $36x$, $12pq$, $-8y$, $-24x^2$, $24pq$.)