**Title: Introduction to algebra.**

Target: On completion of this worksheet you should understand the use of algebra and be able to write simple algebraic expressions.

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**Algebra** is a tool that mathematicians use for shorthand.
A letter denotes a quantity of unknown value or a **variable** that is a quantity whose value changes.

**Example.**
The price of an apple is \( p \). Write down an expression for the price of two apples.

There are two possible answers: \( p + p \) and \( 2 \times p \).

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Once we have denoted the quantities by letters we need to learn the rules of the shorthand used. These are as follows:

- \( 3 \times p \) is written as \( 3p \). Here any number could replace \( 3 \).
- \( 1p \) is written as \( p \).
- \( x \times y \) is written as \( xy \).

**Example.**
1. A unit of electricity costs \( c \) pence. Write down an expression for the cost in pence of 350 units.

   \[
   350 \times c = 350c.
   \]

2. An average household uses \( n \) units of electricity a year. The cost of a unit of electricity is \( c \) pence. Write down an expression for the average cost of electricity per household for a year.

   \[
   n \times c = nc.
   \]

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**Exercise.**
1. An apple has price \( a \) pence and a pear has price \( p \) pence. Write down an expression for the price of 1 apple and 1 pear.

2. A workman works \( h \) hours for 3 days a week and \( k \) hours for 2 days a week. The remaining days he rests. Write down an expression for the number of hours that he works a week.

3. A lecturer is paid \( p \) pounds a year. Of this she pays \( t \) pounds in tax. Write down an expression of the amount she receives.

4. A gardener grows \( g \) Gladioli in his first year at a nursery. He sells them all at a price of \( p \) pence each. Write down an expression for the value of his Gladioli sales in the first year.

5. The gardener in question 4 doubles the number of the Gladioli he grows in the first year during his second year. The price of each plant remains the same. Write down an expression for the value of his Gladioli sales in the second year.

6. If a square has side length \( x \) write down an expression for its perimeter.

7. If a rectangle has length \( l \) and width \( w \) write down an expression for its perimeter and its area.

8. If a cuboid has length \( l \), width \( w \) and depth \( d \) write down an expression for its volume.

(Answers: \( a + p \), \( 3h + 2k \), \( p - t \), \( pg \), \( 2pg \), \( 4x \), \( 2l + 2w \), \( lw \), \( lwd \).)

**Remark.** Notice that since \( p \times q = q \times p \), \( pq = qp \).
That is the order doesn’t matter.
To find the value of quantities we will often write an **equation**. An equation is an algebraic expression where the possible values of the letters are restricted by a condition. An equation contains an equals sign, $=$, which is shorthand for the words “*is the same as*”.

**Example.**
The price of 2 apples is 60 pence. Write down an equation to represent this.

Let $a$ pence be the price of one apple. Then $2a = 60$.

**Exercise.**
Write down an equation for each of the following.

1. A number multiplied by 4 is 70. Let $n$ be the number.
2. A number added to 6 is 12. Let $n$ be the number.
3. 3 times a number plus 7 is 34. Let $n$ be the number.
4. The perimeter of a square is 40. Let $x$ be the side length of the square.
5. The angles in a triangle are $x$, $x+30$ and $x+60$.
6. Peter has twice Jane’s pocket money. In total they receive £2.40. Let Jane’s pocket money be $p$ pence.

(Answers: $4n = 70$, $n + 6 = 12$, $3n + 7 = 34$, $4x = 40$, $x + x + 30 + x + 60 = 180$, $2p + p = 250$.)

A **formula** is an algebraic expression describing a relationship between several variables. It contains an equal’s sign, $=$.

**Examples.**
$A = lw$ is a formula.
$V = IR$ is a formula.

We will usually be given a formula and be asked to use it.

A formula does not restrict the possible values of the letters because it contains more than one variable.

To find out more about formulas refer to the algebra sheets on substitution and changing the subject.