## Factorising

## What's factorising?

Factorising a number is the process of splitting into two factors:

multiplying out
Factorising an expression is the process of putting the expression into brackets:


Factorising involves converting an expression with no brackets into one with brackets. When the brackets are multiplied out, they will give the original expression. This is because factorising and expanding are inverse operations - that is, they counteract each other.

## Factorising quadratic expressions

Quadratic expressions crop up a great deal in both maths exams and real life. Factorising quadratics is the best way to solve them, so it's a very useful skill to have.

In general, you have a quadratic expression of the form $x^{2}+b x+c$ that you want to factorise.

Once you've factorised this quadratic expression, it will be of the form $(x+p)(x+q)$

What you do is think of two numbers, $p$ and $q$, that add up to $b$ and multiply together to $c$.

In symbols, $p+q=b$ and $p q=c$. The process is just trial and error.

The people who write maths exams always choose questions that have simple values of $p$ and $q$, so you're only looking for small numbers, usually between 1 and 9 .

## Here's an example:

Factorise $x^{2}+7 x+12$.
It's the same every time. We need to find two numbers, $p$ and $q$.
$p+q=7$ and $p q=12$.
Often it's easier to start with the multiplication.
We know that $p q=12$, so we could have the following possibilities:

| 1 | $\times$ | 12 | $=12$ |
| :---: | :---: | :---: | :---: | :---: |
| 2 | $\times$ | 6 | $=12$ |
| 3 | $\times$ | 4 | $=12$ |
| -1 | $\times-12$ | $=12$ |  |
| -2 | $\times-6$ | $=12$ |  |
| -3 | $\times$ | -4 | $=12$ |

How do we decide which pair of numbers is correct? We simply consider which pair adds to 7 - there will only be one pair that works.

| $1+12$ | $=$ | 13 |  |
| :---: | :---: | :---: | :---: |
| $2+$ | 6 | $=$ | 8 |
| 3 | + | $=$ | 7 |
| $-1+$ | -12 | $=$ | -13 |
| -2 | + | -6 | $=$ |
| -3 | +-8 | $=$ | -7 |

The only pair of numbers that add to $\mathbf{7}$ and multiply to 12 is 3 and 4 .
Therefore, $p$ and $q$ are 3 and 4 (it doesn't matter which is which).
So we have solved the problem
$x^{2}+7 x+12=(x+?)(x+?)$.
The answer is
$x^{2}+7 x+12=(x+3)(x+4)$

