

## Times Tables and Factors (3)

Wow, what a lot of ideas we have covered and we have needed multiplication tables for all of them in one way or another.

So, here is another great idea. It's very simple really, but mathematicians and computers have spent many, many hours working on it.

At the moment this idea doesn't seem to have much practical use, but it is great fun.

We are talking about **Perfect Numbers**.

A **Perfect Number** is a number whose proper factors add up to the number itself.

You will remember that 'proper factors' are the factors of a number that **do not include the number itself**. (1, 2, 7 and 14 are the factors of 14, but only 1, 2 and 7 are the 'proper factors').

So, we need to find the proper factors of lots of numbers and add them up to see if they come to the number we started with.

As an example, **6** is the smallest perfect number.

The proper factors of **6** are **1, 2** and **3** and their total is **6**, which is the number we started with.

Now, if I was a nasty, cruel, horrible sort of person, I would say to you get on with it and find as many perfect numbers as you can, but as I am a nice, charming, delicate sort of chap, I am going to tell you something you could not possibly know.

What is this secret? It is the fact that there are very few perfect numbers in the number system. In fact **there are only five perfect numbers below one billion**.

You can see now why I need to give you some clues.

As it happens, the second perfect number is below **40**, so I think I can leave you to find that one. Here is another clue: All the perfect numbers that we know about are even, so you don't need to check the odd numbers.

So, start at **8** and find the proper factors of **8**. Add them up and see if the total is **8**.

If not, move on to **10** and try that. Pretty soon you should find the second perfect number. I'll just go and have a coffee and some choccy biscuits while you do that.



**I hope you are not just having a little peak, because if you are that is going to spoil the fun and your goose is cooked!**

To find the next perfect number, which is much bigger than the one you have just found, you are going to need another clue.

Here it is: All perfect numbers are also triangle numbers (that doesn't mean that all triangle numbers are perfect numbers. There are lots of triangle numbers that are not triangle numbers such as **10, 15, 21** and **36**). If you did the task on triangle numbers, you will be familiar with the first few and you probably remember that **6** and **28** are triangle numbers.

You may also remember that the formula  $\frac{n(n+1)}{2}$  gives you triangle numbers.

(If you did not do that task, you might like to do it before going further with this one or you may find it rather difficult.)

So, now I am going to help you find the next triangle number and here's the clue.

You can put the number **127** into the formula for triangle numbers and this will give you the next perfect number.

When you have put **127** into the formula and worked out the perfect number, you need to check that the proper factors add up to the perfect number. To help you find the factors, I will tell you that **127** is a prime number. That will help you with the divisions.

Okay, don't worry if you didn't quite get to the end of this task; it was pretty difficult towards the end. If you had a flavour of the topic that is great and perhaps you can come back to it in a couple of years when you have done some more mathematics at school and feel more confident.

If you did reach the end and tried all the exercises, very well done to you! You have not only practised your multiplication tables at a very high level, but your head should be buzzing with all these new ideas. There is a lot more to find out about perfect numbers and perhaps one day you may be able to solve the two great questions about perfect numbers that no-one has yet managed to solve:

- a)** Are there an infinite number of perfect numbers or do they stop **eventually**?
- b)** Are there any odd perfect numbers? All the ones that have been discovered so far are even.

Happy hunting.