*Over 2500 years ago the Babylonians had a method for working square roots (without a calculator). It went something like this:*

To find $\sqrt{A}$ …

* Estimate the answer. Call this value $x\_{1}$ .
* Think: If $x\_{1}$ is an over-estimate, then $A÷x\_{1}$ will be an under-estimate (and vice versa)
* Conclude: Therefore the average of $x\_{1}$ and $A÷x\_{1}$ is a better estimate
* Work out this better estimate and call it $x\_{2}$: $x\_{2}=\frac{x\_{1}+A÷x\_{1}}{2}$
* Go through the process all over again: $x\_{3}=\frac{x\_{2}+A÷x\_{2}}{2}$
* And again, and again, and again … $x\_{n+1}=\frac{x\_{n}+A÷x\_{n}}{2}$

For example:

Find $\sqrt{20}$

* Take $x\_{1}=4$ as a first estimate.
* Now $20÷4=5$ . So the second estimate is $x\_{2}=\frac{4+5}{2}=4.5$ .
* Then $20÷4.5=4.444…$ So the third estimate is $x\_{3}=\frac{4.5+4.444…}{2}=4.47222…$
* The fourth estimate is $x\_{4}=\frac{4.47222…+20÷4.47222…}{2}=4.4720…$

**Task one**

Use the Babylonian method to estimate the square root of the following numbers. You may use a calculator to do the complicated calculations!

2

5

30

45

60

75

Can you work out how the ANS button on your calculator can be used to speed the process up?

**Task two: the spreadsheet approach**



This spreadsheet has been designed to work out all the calculations.

Any number can be entered B3. The spreadsheet will calculate the square root of this number.

A first estimate has to be chosen. This number is entered into C6.

All other calculations are done automatically.

The number in the blue box is a good estimate of the square root.

Create your own version of this spreadsheet:

* Set up the table
* In D6, enter the formula ‘=B$3/C6’
* In C7, enter the formula ‘=AVERAGE(C6,D6)’
* Copy the formulae down to fill the table

Now test it:

* Type a square number into B3. Check that your spreadsheet works out the correct square root.
* Use several different square numbers to check
* Experiment with different starting values:
* Can you make the spreadsheet find the square root more quickly?
* Does it matter if you choose a silly value for your first estimate?
* Use your spreadsheet to find the square roots of the six numbers in task one.