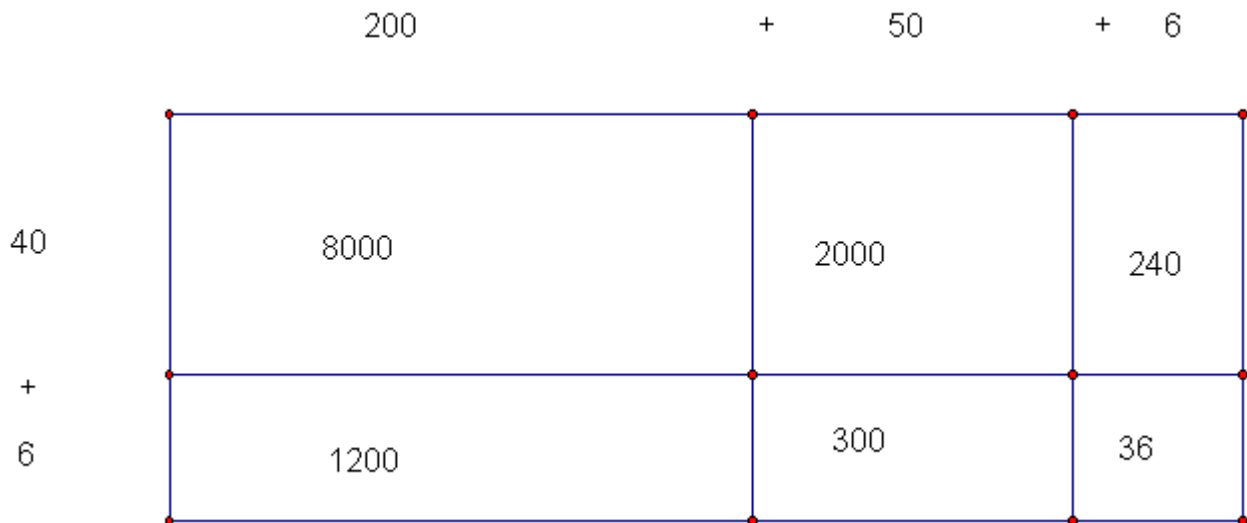


## Multiplication: Lattice Algorithm with Rectangular Array

256 times 46



Notice that the amounts 256 and 46 have been expressed in expanded notation. Using a similar idea to a multiplication table to fill in the amounts represented by the rectangle. Several different little things can now be witnessed by this representation of a multiplication problem.

Firstly, note that any one digit number multiplied by another one digit number is at most a two-digit amount. Thus ones times ones is at most tens and ones, and no more.

Secondly, if the amounts in question are from place values other than ones leads to the second idea to be noticed. An number from any place value can be thought of as a single digit amount times a power of ten. Fifty can be expressed as 5 times 10; likewise, 900 can be thought of as 9 times 100.

Thirdly, addition is bound to place value as all of our operations. Ones are added to ones and hundreds are added to hundreds.

Fourthly, multiplication of numbers from different place values must be thought of as simple multiplications involving place value. 40 times 300 is nothing more than 4 times 10 and 3 times 100. From the associative property we know that the order of the multiplication does not matter as long as all of the multiplications are performed. Therefore, multiply 4 times 3 to get 12 and then multiply 10 and 100 to get 1000. Multiply the last two fact together to get 12000. Notice that the digits that are not zeros are 1 and 2 and occupy the place values of thousands and ten-thousands.

Ones times ones === tens and ones  
 ones times tens === hundreds and tens  
 ones times hundreds === thousands and hundreds  
 and so on.....

Tens times tens === thousands and hundreds  
 tens times hundreds === ten-thousands and thousands  
 tens times thousands === hundred- thousands and ten-thousands

hundreds times hundreds === hundred-thousands and ten-thousands  
 hundreds times thousands === millions and hundred-thousands

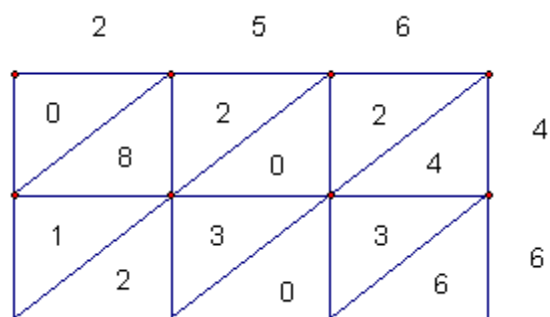
With this information a new algorithm can be developed as outlined below:

Below one can see that the use of multiplication having a two-digit out come is used to fill in the blocks without using the zeros due to place value, but the columns and rows determine the place value.

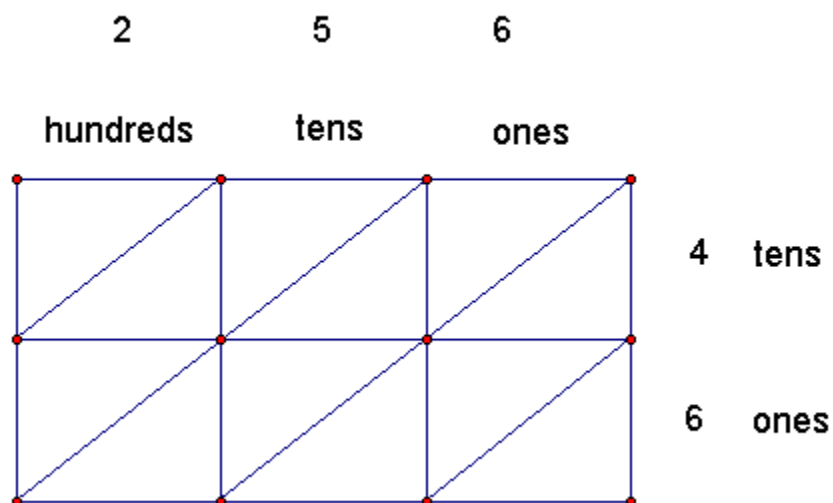
	2	5	6
4	08	20	24
6	12	30	36

Notice how the diagram is related to the rectangle array provided at the top of the page. The draw back to the diagram above is that adding these numbers to achieve the correct solution would be difficult.

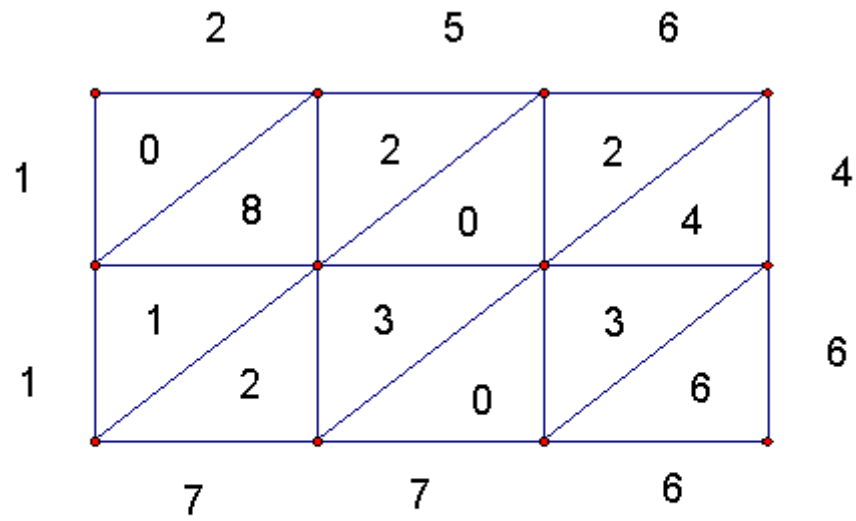
If each block were divided into two locations the addition could be performed along the diagonals. This leads to the following diagram that is still closely related to the area rectangle.



Notice that the place values are related to figure.



Thus the final solution is provided in the last figure.



$$256 \times 46 = 11776$$