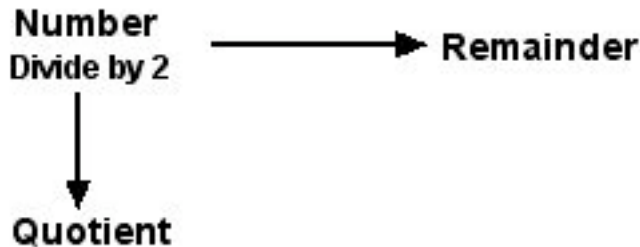


## A Base 2 – Math Trick

You may have seen this “trick” before under many different names, however, I will show you why it works.

Multiply  $82 \times 34$

Strategy: We will make up three columns under each number. The left-hand number will be multiplied by two and the right-hand number will be divided by two, with the quotient being written underneath and the remainder (a “1” or a “0”) will be written to the right. The diagram below illustrates this:



One keeps on multiplying and dividing by 2 until the right-hand column equals one. Here it is done below:

1 <sup>st</sup> number (Mult x 2)	2 <sup>nd</sup> number (Div ÷ 2)	Remainder
82	34	0
164	17	1
328	8	0
656	4	0
1312	2	0
2624	1	1

The next step is to cross out all columns where the remainder column contains a zero (0). See below:

1 <sup>st</sup> number	2 <sup>nd</sup> number	Remainder
<del>82</del>	<del>34</del>	0
164	17	1
<del>328</del>	<del>8</del>	0
<del>656</del>	4	0
<del>1312</del>	<del>2</del>	0
2624	1	1

Now add the two numbers left in the left-hand column ( $2624 + 164$ ) and you get your answer of 2 788. Sure enough,  $82 \times 34 = 2\,788$ , so it does work, although it takes some time to get it. But why does it work?

The key is base 2 or binary. I will write the number  $34_{10}$  as a base 2 number:  $100010_2$ . Does this number look familiar? Yes, it is the remainder column above read from the bottom up to the top!!!

So we have really done the following steps:

$$\begin{array}{lcl}
 82 & \times & 34 = & \text{Original numbers} \\
 82 & \times & (1 \times 32 + 0 \times 16 + 0 \times 8 + 0 \times 4 + 1 \times 2 + 0 \times 1) = & \text{write 34 in expanded base 2 form} \\
 82 \times 32 + 0 & + & 0 & + 0 & + 82 \times 2 + 0 = & \text{Use distributive property} \\
 2624 & & & + & 164 = 2\,788 & \text{Drop the zeroes and add what's left.}
 \end{array}$$