Finding The Square Root Of 190096 Using The Trachtenberg Method

1. Put a slash after every second digit as you go from right to left.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \]

2. The first group is 19. Since 4 squared is 16, 4 is the first digit of the answer.

3. Subtracting 16 from 19 we get 3.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \]
\[ -1\ 6 \]
\[ \frac{3}{3} \]

4. Half of 3, times ten is 15. Dividing 15 by 4 gives 3 as the second digit of the answer.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \ 3 \]
\[ -1\ 6 \]
\[ \frac{3}{3} \]

5. Looking at the answer so far we partially square the 43.
   a. 3 squared is 9.
   b. 3 times 4 is 12, doubled is 24
   So we have 249 under our answer.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \ 3 \]
\[ -1\ 6 \]
\[ \frac{3}{3} \]
\[ \frac{249}{3} \]

6. Subtracting the 2 from the table under the answer from the 3 we got from the subtraction, we get 1. We put the 1 up under the next digit, the zero. We also cross out the 2 in the table so we remember we have used it, here I will just highlight it in blue.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \ 3 \]
\[ -1\ 6\ 1 \]
\[ \frac{3}{3} \]
\[ \frac{249}{3} \]

7. We bring down the next digit, the zero, next to the 1 to make 10. We now subtract the 4 from the table under the answer from the 10.
\[ \sqrt{1\ 9/\ 0\ 0/\ 9\ 6} = 4 \ 3 \]
\[ -1\ 6\ 10 \]
\[ \frac{3}{3} \]
\[ \frac{249}{3} \]
\[ \frac{-4}{6} \]
8. We half the 6 and add a zero, giving us 30. Dividing 30 by 4 we get 7 as the next digit and last digit of the answer.

\[
\begin{array}{c}
\sqrt{190096} \\
-1610 \\
\hline
\phantom{00}346 \\
\phantom{00}249 \\
\hline
\end{array}
\]

9. On the answer side we now multiply the last and first digits of the answer, 7 and 4, then double it, which gives 56. We write the 56 under our answer so that the first digit is on the last column that we crossed out the digit, i.e. on the second column, and the six is in the third column.

\[
\begin{array}{c}
\sqrt{190096} \\
-1610 \\
\hline
\phantom{00}346 \\
\phantom{00}249 \\
\phantom{00}56 \\
\hline
\end{array}
\]

We can stop here because the 7 is too big and we will reduce it to 6.

Starting again with 6, we multiply 6 by 4 then double it, which gives 48. Put the 48 so the 4 is in column two on the second row.

\[
\begin{array}{c}
\sqrt{190096} \\
-1610 \\
\hline
\phantom{00}346 \\
\phantom{00}249 \\
\phantom{00}56 \\
\phantom{00}48 \\
\hline
\end{array}
\]

10. We now square the last digit of the answer, the 6, which is 36. Put the 3 of 36 so it is in the fifth column on the third row and carry the 3.

\[
\begin{array}{c}
\sqrt{190096} \\
-1610 \\
\hline
\phantom{00}346 \\
\phantom{00}249 \\
\phantom{00}56 \\
\phantom{00}48 \\
\phantom{00}36 \\
\hline
\end{array}
\]

We now multiply the third and second digits of the answer, the 6 and 3, then double it, which gives 36. Adding the 3 carried from the previous calculation we get 39. Write the 39 in the third and fourth column on the third row.

\[
\begin{array}{c}
\sqrt{190096} \\
-1610 \\
\hline
\phantom{00}346 \\
\phantom{00}249 \\
\phantom{00}56 \\
\phantom{00}48 \\
\phantom{00}36 \\
\hline
\end{array}
\]
11. We now subtract the 4 from column 2, row 2 of the table from the 6 of the second subtraction. We put the 2 up under the next digit of 190096, then bring down the remaining digits.

\[
\begin{array}{c}
1 & 9 & / & 0 & 0 & / & 9 & 6 \\
-1 & 6 & 10 & 20 & 9 & 6 \\
\hline
3 & 4 & 20 & 9 & 6 \\
\hline
\end{array}
\]

12. We now add up all the remaining digits in the partial square table under the answer.

\[
\begin{array}{c}
1 & 9 & / & 0 & 0 & / & 9 & 6 \\
-1 & 6 & 10 & 20 & 9 & 6 \\
\hline
3 & 4 & 20 & 9 & 6 \\
\hline
2 & 0 & 9 & 6 \\
\end{array}
\]

Remember back in step 9 when we had 7 as the last digit, we would have subtracted 5 from 6 then put 1 up and bought down zero, giving 10. From column three under the answer the 9 and 6 add up to 15, so ignoring the other digits we would have had something like 10xx – 15xx in this step which would be a negative number. This is why we stopped and reduced 7 to 6. When you are used to the method it becomes easy to “look ahead” as you are working.

13. We put the total from the partial square table up under the digits we bought down and subtract it. The answer is zero so the square root of 190096 is 436 exactly.