Using Long Division

Let's divide whole numbers.

18.1 Notice and Wonder: Kiran's Calculations

Here are Kiran's calculations for finding $657 \div 3$:

$$\begin{aligned} 600 \div 3 &= 200 \\ 30 \div 3 &= 10 \\ 27 \div 3 &= 9 \\ \hline 657 \div 3 &= 219 \end{aligned}$$

What do you notice? What do you wonder?

18.2 Using Partial Quotients to Calculate Quotients

1. Andre calculated $657 \div 3$ using a method that was different from Kiran's.

He started by writing the dividend (657) and the divisor (3).

$$3 \overline{)\,6\,5\,7}$$

Next, he subtracted 3 groups of different amounts from 657, starting with 3 groups of 200 . . .

$$\begin{array}{r} 2\,0\,0 \\ 3 \overline{)\,6\,5\,7} \\ -\,6\,0\,0 \\ \hline 5\,7 \end{array}$$

. . . then 3 groups of 10, and then 3 groups of 9.

$$\begin{array}{r} 9 \\ 1\,0 \\ 2\,0\,0 \\ 3 \overline{)\,6\,5\,7} \\ -\,6\,0\,0 \\ \hline 5\,7 \\ -\,3\,0 \\ \hline 2\,7 \\ -\,2\,7 \\ \hline 0 \end{array}$$

Andre calculated 200 + 10 + 9, and wrote 219.

$$\begin{array}{r} \boxed{2\,1\,9} \\ 9 \\ 1\,0 \\ 2\,0\,0 \\ 3 \overline{)\,6\,5\,7} \\ -\,6\,0\,0 \\ \hline 5\,7 \\ -\,3\,0 \\ \hline 2\,7 \\ -\,2\,7 \\ \hline 0 \end{array}$$

a. Andre subtracted 600 from 657. What does the 600 represent?

b. Andre wrote 10 above the 200, and then subtracted 30 from 57. How is the 30 related to the 10?

c. What do the numbers 200, 10, and 9 represent?

d. What is the meaning of the 0 at the bottom of Andre's work?

2. How might Andre calculate $896 \div 4$? Explain or show your reasoning.

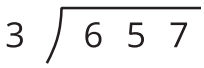
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18.3 Lin Uses Long Division

Here is how Lin found the quotient of $657 \div 3$.

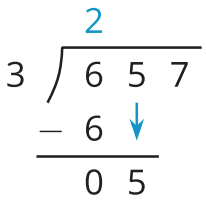
Lin arranged the numbers for vertical calculations.

Her plan was to divide each digit of 657 into 3 groups, starting with the 6 hundreds.

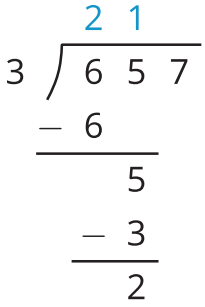


There are 3 groups of 2 in 6, so Lin wrote 2 at the top and subtracted 6 from the 6, leaving 0.

Then, she brought down the 5 tens of 657.

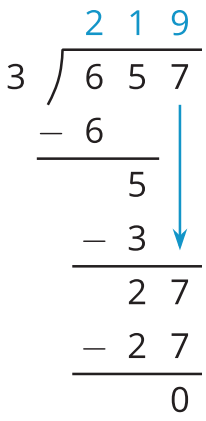


There are 3 groups of 1 in 5, so she wrote 1 at the top and subtracted 3 from 5, which left a remainder of 2.



She brought down the 7 ones of 657 and wrote it next to the 2, which made 27.

There are 3 groups of 9 in 27, so she wrote 9 at the top and subtracted 27, leaving 0.



1. Study Lin's steps. Then discuss with your partner:

   a. In the first step, Lin divided 6 by 3 to get 2. Why do you think she put the 2 over the 6?

   b. Lin subtracted $3 \cdot 2$ then $3 \cdot 1$, and lastly $3 \cdot 9$. Earlier, Andre subtracted $3 \cdot 200$ then $3 \cdot 10$, and lastly $3 \cdot 9$. Why did they have the same quotient?

   c. In the third step, why do you think Lin wrote the 7 next to the remainder of 2 rather than adding 7 and 2 to get 9?

2. Lin's method is called **long division**. Use this method to find the following quotients. Check your answer by multiplying it by the divisor.

   a. $846 \div 3$

   b. $1{,}816 \div 4$

   c. $768 \div 12$

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18.4 Dividing Whole Numbers

1. Use long division to calculate each quotient.

   a. $1001 \div 7$

   b. $2996 \div 14$

2. Here is Priya's calculation of $906 \div 3$.

$$
\begin{array}{r}
3\,2\,0 \\
3\overline{)\,9\,0\,6} \\
-\,9 \\
\hline
\,0\,6 \\
-\,6 \\
\hline
0
\end{array}
$$

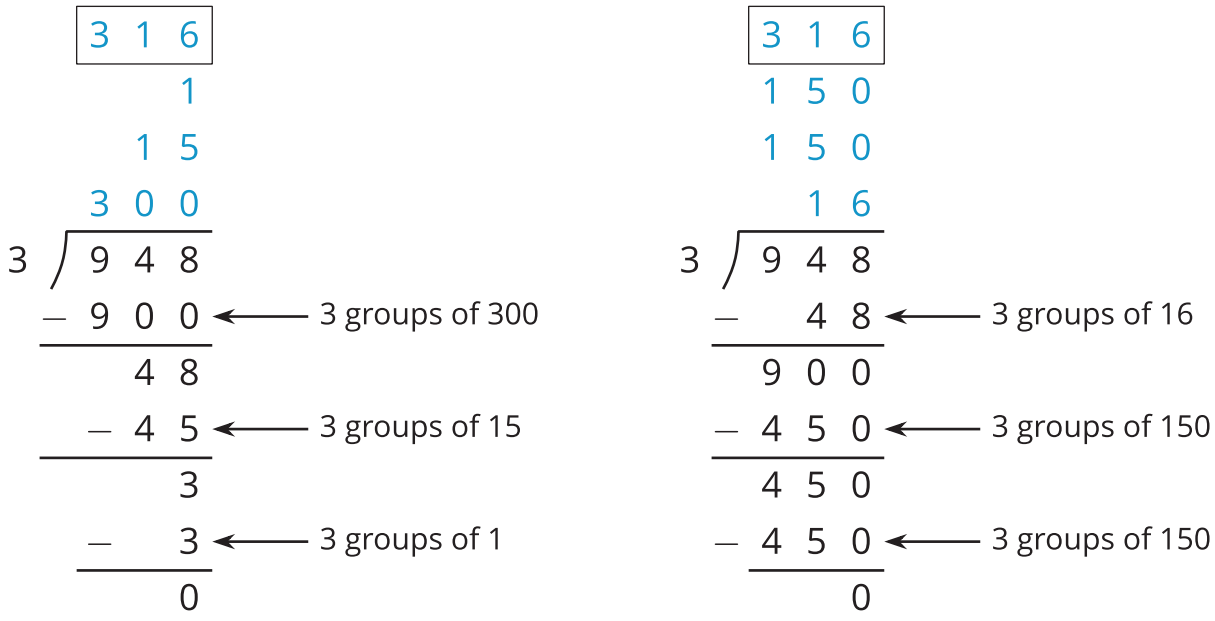
   a. Priya wrote 320 for the value of $906 \div 3$. Check her answer by multiplying it by 3. What product do you get?

   b. What does the product tell you about Priya's answer? Explain your reasoning. If you think her answer is incorrect, describe the error and show the correct calculation and answer.

Lesson 18 Summary

One way to find the quotient of $948 \div 3$ is by using partial quotients, in which we keep subtracting 3 groups of some amount from 948. We can organize the steps and record the partial quotients in a vertical calculation.

Here are two calculations for finding $948 \div 3$:



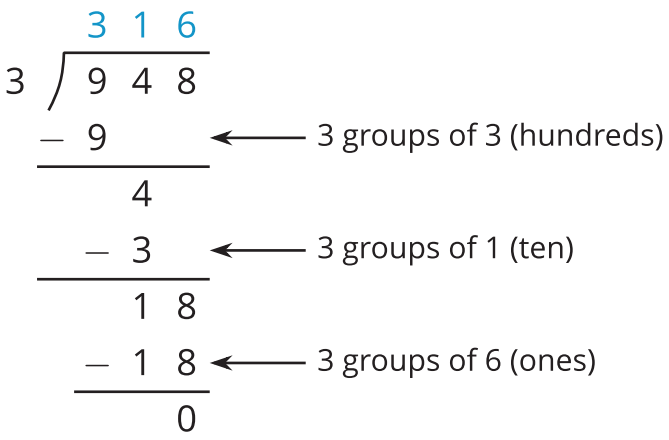
- In the calculation on the left, first we subtract 3 groups of 300, then 3 groups of 15, and then 3 groups of 1. Adding up the partial quotients ($300 + 15 + 1$) gives us 316.
- The calculation on the right shows a different amount per group subtracted each time (3 groups of 16, 3 groups of 150, and 3 more groups of 150), but the total amount in each of the 3 groups is still 316.

There are other ways of calculating $948 \div 3$ using partial quotients. We can calculate with fewer steps by removing groups of larger sizes.

Long division is another method for calculating quotients. It relies on place value to perform and record the division.

When we use long division, we work from left to right and with one digit at a time, starting with the leftmost digit of the dividend. We remove the largest group possible each time, using the placement of the digit to indicate the size of each group.

Here is an example of how to find $948 \div 3$ using long division.



- We start by dividing 9 hundreds into 3 groups, which means 3 hundreds in each group. Instead of writing 300, we simply write 3 in the hundreds place, knowing that it means 3 hundreds.
- There are no remaining hundreds, so we work with the tens. We can make 3 groups of 1 ten out of 4 tens, so we write 1 in the tens place above the 4 of 948. Subtracting 3 tens from 4 tens, we have a remainder of 1 ten.
- We know that 1 ten is 10 ones. Combining these with the 8 ones from 948, we have 18 ones. We can make 3 groups of 6 ones, so we write 6 in the ones place.

In total, there are 3 groups of 3 hundreds, 1 ten, and 6 ones in 948, so $948 \div 3 = 316$.