Long Division Review

QUICK NOTE! In long division, most of the time, we'll end up with remainders.

In elementary school you probably notated remainders with the letter R—for example, $7 \div 2 = 3$ R 1—and I'll use remainders here.

In this book, however, you'll learn to express remainders as fractions and decimals.

Sample problem 1:

When you see a problem like $432 \div 9$ or, equivalently, $9\overline{)432}$, here's how you go about solving it:

Remember, 9 is called the *divisor* (see p. 126 for a tip on how to remember the name). The divisor is the number that is *dividing into* the bigger number, which is called the *dividend*.

divisor ↗ $9\overline{)432}$ ↖ dividend

Let's divide!

$9\overline{)432}$

First, let's see if the divisor goes into the first digit. Nope, 9 doesn't divide into 4, because 4 is smaller than 9, so we can just move on and check the first *two* digits, together.

$4 \div 9 = ?$

$9\overline{)432}$

How many times does 9 go into **43**? Think about your times tables. And find the biggest one that doesn't get bigger than 43.

$9 \times 4 = 36$

$9 \times 5 = 45$ (too big)

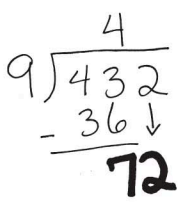
$$\begin{array}{r} 4 \\ 9\overline{)432} \\ -36 \\ \hline 7 \end{array}$$

So use $9 \times \mathbf{4} = 36$. Be sure to put the **4** on top, directly over the last digit of the number you divided the divisor into (in this case, the 4 goes right over the 3 of the number 43). Then subtract 36 from the 43 underneath, and we get 7.

$43 - 36 = 7$

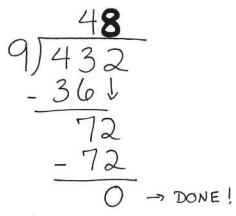
$$\begin{array}{r} 4 \\ 9\overline{)432} \\ -36\downarrow \\ \hline 72 \end{array}$$

Now look at the next digit in the dividend—in this case **2**. Draw an arrow down from the **2** and have it join the 7.



Now ask, "How many times does 9 go into **72**?" Our times tables tell us that 9 times 8 equals 72.

$9 \times 8 = 72$



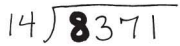
Write the **8** directly above, and now subtract 72 from 72.

$72 - 72 = 0$

There are no more numbers to draw arrows from, and, in fact, there is no remainder. We're done!

Answer:
$432 \div 9 = \mathbf{48}$

Sample problem 2:
Often there will be a remainder, so let's do a division problem that has one: 8371 ÷ 14, which is equivalent to: $14\overline{)8371}$.



First, let's see if the divisor goes into the first digit. Nope, 14 doesn't divide into **8** because 8 is smaller than 14, so we can move on and check the first *two* digits, together.

$8 \div 14 = ?$

$14\overline{)8371}$

How many times does 14 go into **83**? Let's test some numbers to find out.

$14 \times 5 = 70$

$14 \times 6 = 84$ (too big)

$$\begin{array}{r} 5 \\ 14\overline{)8371} \\ -70 \\ \hline 13 \end{array}$$

So use $14 \times 5 = 70$. Be sure to put the **5** on top, directly over the last digit of the number you divided the divisor into (in this case, the **5** goes right over the 3 of the number 83). Then subtract 70 from the 83 underneath, and we get 13.

$83 - 70 = 13$

$$\begin{array}{r} 5 \\ 14\overline{)8371} \\ -70\downarrow \\ \hline 137 \end{array}$$

Now look at the next digit in the dividend, in this case **7**. Draw an arrow down from the **7** and have it join the 13.

$$\begin{array}{r} 5 \\ 14\overline{)8371} \\ -70\downarrow \\ \hline \mathbf{137} \end{array}$$

Now ask, "How many times does 14 go into **137**?" Let's test some numbers to find out. We'll use $14 \times 9 = 126$.

$14 \times 8 = 112$
$14 \times 9 = 126$
$14 \times 10 = 140$ (too big, and it should be a single digit anyway—if 14 times 10 had been smaller than 137, that would mean you had made a mistake earlier and should go back and check your work.

(it will always be a single digit: 0-9)

```
   59
14)8371
  -70↓
   137
  -126
    11
```

Write the **9** directly above, and now subtract 126 from 137 and get 11.

$137 - 126 = \mathbf{11}$

```
   59
14)8371
  -70↓
   137
  -126
   111
```

Now look at the next digit in the dividend—in this case **1**. Draw an arrow down from the **1** and have it join the 11.

```
   59
14)8371
  -70↓
   137
  -126↓
   111
```

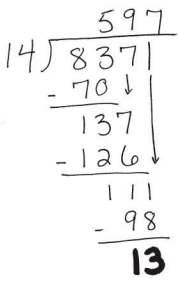
Now ask, "How many times does 14 go into **111**?" Let's test some numbers to find out.

$14 \times 7 = 98$

$14 \times 8 = 112$ (too big)

```
   597
14)8371
  -70↓
   137
  -126
   111
   -98
    13
```

So use $14 \times \mathbf{7} = 98$. Be sure to put the **7** directly overhead. Then subtract 98 from the 111 underneath, and we get 13.



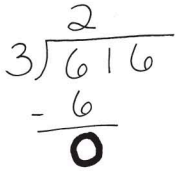
There are no more numbers to draw arrows from, so the number on the bottom must be our **remainder**. Write the answer, and then add "R 13" for the remainder. We're done!

Answer: 8371 ÷ 14 = **597 R13**

Sample Problem 3:
Let's do one more example, to demonstrate how *zeros* can pop up in the middle of long division: 616 ÷ 3.

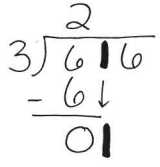
First try dividing the divisor, 3, into the first digit of the dividend, **6**. How many times does 3 go into 6? We'll use $3 \times 2 = 6$. Make sure to put the **2** directly over the last digit (in this case, the only digit) of the number we're dividing into.

$3 \times 2 = 6$

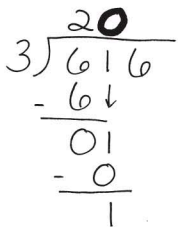


Now subtract 6 from the 6 in the dividend and get **0**. Don't panic, just keep going as if it were any other number.

$6 - 6 = 0$



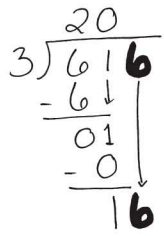
The next step, as always, is to draw an arrow from the **next digit** in the dividend, and bring it down.



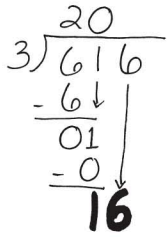
Since 1 is smaller than 3, we can't divide 3 into 1. So how many times does 3 "go into" 1? **None.** So we use $3 \times 0 = 0$ and put a **0** up top. It works exactly the same way as with nonzero numbers.

$3 \times 0 = 0$

$3 \times 1 = 3$
(too big)



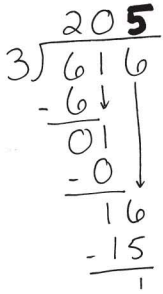
Now draw an arrow down from the next digit in the dividend, **6**, and have it join the 1 to get 16.



Now ask, "How many times does 3 go into **16**?" Test some numbers.

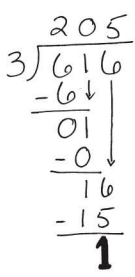
$3 \times 5 = 15$

$3 \times 6 = 18$
(too big)



So we use $3 \times \mathbf{5} = 15$, and subtract 15 from the 16, to get 1.

$16 - 15 = 1$



There are no more digits in the dividend to draw arrows from, so the number on the bottom must be the **remainder.** Write the answer and then "R 1" for the remainder. We're done!

Answer: 616 ÷ 3 = 205 R1