Dividing decimals by powers of ten

A model rocket is built 100 times smaller than the real one. How do you divide a number by 10, 100 or 1,000 without long division? Place value does all the work.

WORDS TO KNOW

Power of ten: 10, 100, 1,000 and so on: $10^1 = 10$, $10^2 = 100$, $10^3 = 1{,}000$.

Place value chart: a chart with one column for each place. The decimal point sits just right of the ones column.

Undo: division by 100 undoes multiplication by 100, and gets you back to where you started.

Exponent: the small raised number in 10^2. It counts the tens multiplied together.

Placeholder zero: a 0 written in an empty place so the other digits stay in their places.

KEY IDEAS

1. Dividing by ten moves every digit one place right

Each place is worth one tenth of the place to its left. So dividing by 10 makes every digit worth one tenth as much: 5 tens become 5 ones, and 3 tenths become 3 hundredths. Every digit moves one place to the right. The digits and their order stay the same, and the point stays put.

Divide by 10: every digit moves 1 place right. By 100: 2 places. By 1,000: 3 places.

Divide by 10^n: every digit moves n places right.

2. Zeros hold empty places

To find 9 ÷ 1,000, the 9 moves from the ones place three places right, to the thousandths. The tenths and hundredths are now empty, so each gets a 0. A 0 also goes in the ones place so the point is easy to see.

$$9 \div 1{,}000 = 0.009$$

Zeros at the far right after the point can be dropped: 72.40 = 72.4. Zeros between the point and a digit, or between two digits, must stay.

ones		tenths	hundredths	thousandths
9	•			
0	•	0	0	9

÷1,000

3. A tenth of a tenth is a hundredth

Cut a strip into 10 equal parts, then cut one part into 10 again. Each small piece is one hundredth of the strip, because dividing by 10 and then by 10 again is dividing by 100.

Dividing by 10 twice is dividing by 100.

Division undoes multiplication. If a number times 1,000 is N, the number is $N \div 1{,}000$.

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WATCH OUT

- **Count the places, then fill.** 38 ÷ 100 is 0.38, not 0.038. The 3 moves two places, from tens to tenths.
- **Keep zeros in the middle.** 40.08 ÷ 10 = 4.008. Dropping a middle zero gives 4.08, a different number.
- **"Take zeros off the end" is not the rule.** It only works for a whole number that ends in enough zeros, like 7,200 ÷ 100 = 72. Moving every digit works for every number.

WORKED EXAMPLES

Example 1. Find 8,150 ÷ 10, 8,150 ÷ 100 and 8,150 ÷ 1,000.

1. A whole number has its point after the ones, even when it is not written.
2. Divide by 10: one place right. The 0 ones become 0 tenths: 815.0 = 815.
3. Divide by 100: two places right. Now the 5 is in the tenths: 81.50 = 81.5.
4. Divide by 1,000: three places right. The 8 is in the ones: 8.150 = 8.15.

Answer: 815, 81.5 and 8.15. **Check:** 8.15 × 1,000 = 8,150.

Example 2. Find 6.3 ÷ 100 and $57 \div 10^3$.

1. In 6.3, the 6 moves two places from ones to hundredths, and the 3 moves from tenths to thousandths.
2. The tenths place is now empty, so it gets a 0: 0.063.
3. 10^3 means three places. In 57, the 5 moves from tens to hundredths and the 7 from ones to thousandths.
4. The tenths place is empty and gets a 0: 0.057.

Answer: 6.3 ÷ 100 = 0.063 and $57 \div 10^3 = 0.057$. **Check:** 0.063 × 100 = 6.3.

Example 3. Tanvi multiplies a number by 1,000 and gets 4,120. What was her number?

1. Multiplying by 1,000 moved every digit three places left.
2. To get back, move every digit three places right. That is dividing by 1,000.
$$4{,}120 \div 1{,}000 = 4.120 = 4.12$$
3. The end zero is after the point and at the far right, so it may be dropped.

Answer: 4.12. **Check:** 4.12 × 1,000 = 4,120.

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