

Multi-Digit and Decimal Operations: math lesson, Grade 6 – download the PDF

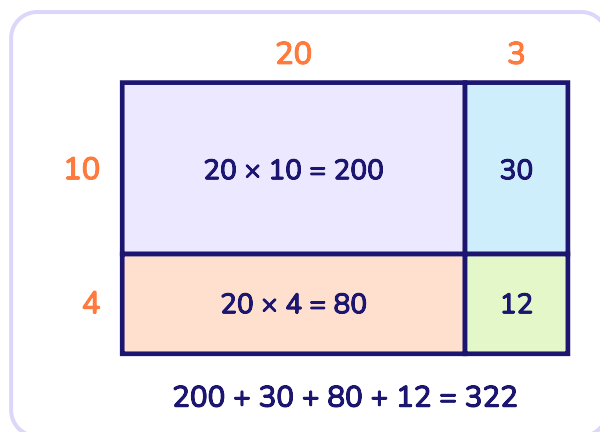
Every time you split a pizza bill, measure ingredients, or compare prices at a store, you work with big whole numbers and decimals. In this chapter you will sharpen the standard algorithms for multiplying and dividing multi-digit numbers, then extend every operation to decimals. You will also learn to estimate first, so that you can tell at a glance whether an answer is reasonable.

1. Multi-digit multiplication

The standard algorithm multiplies the top number by each digit of the bottom number, one place value at a time, and then adds the results. Each row is called a *partial product*. The area model shows the same idea in a picture: you break each factor into tens and ones, multiply the pieces, and add.

D Definition: partial product

A partial product is the result of multiplying one factor by one digit (or one place value part) of the other factor. The product is the sum of all the partial products.



E Example 1: the standard algorithm

Compute 346×27 .

Multiply by the 7 ones: $346 \times 7 = 2,422$. Multiply by the 2 tens, which means $346 \times 20 = 6,920$. Add the two partial products: $2,422 + 6,920 = 9,342$.

So $346 \times 27 = 9,342$.

⚠ Common mistake

When you multiply by the tens digit, do not forget the zero placeholder in the ones place. Writing 692 instead of 6,920 makes your answer far too small.

2. The long division algorithm

Long division splits a number into equal groups, one digit at a time. You repeat four steps: **divide**, **multiply**, **subtract**, **bring down**. When the numbers do not divide evenly, what is left over is the remainder.

M**Method: long division**

1. Look at the first digits of the dividend until you have a number at least as big as the divisor.
2. Divide: decide how many times the divisor fits, and write that digit above.
3. Multiply that digit by the divisor and subtract from the digits you are working on.
4. Bring down the next digit and repeat until no digits are left.
5. Check: quotient $\times$ divisor + remainder = dividend.

E**Example 2: with a remainder**

Compute $5,309 \div 17$.

17 goes into 53 three times ($17 \times 3 = 51$), and $53 - 51 = 2$. Bring down 0 to get 20: 17 goes in once, and $20 - 17 = 3$. Bring down 9 to get 39: 17 goes in twice (34), and $39 - 34 = 5$.

The quotient is 312 with remainder 5, so $5,309 = 17 \times 312 + 5$. Check:
 $17 \times 312 = 5,304$ and $5,304 + 5 = 5,309$.

3. Adding and subtracting decimals

The one big rule is to **line up the decimal points**. That way tenths sit above tenths and hundredths above hundredths. If one number has fewer decimal places, you can add zeros on the right without changing its value, for example $20 = 20.00$.

E**Example 3: adding and subtracting**

Compute $14.7 + 8.356$. Write 14.700 and 8.356 with the points lined up:

$$14.700 + 8.356 = 23.056.$$

Now compute $20 - 7.48$. Write 20 as 20.00 so the places match:

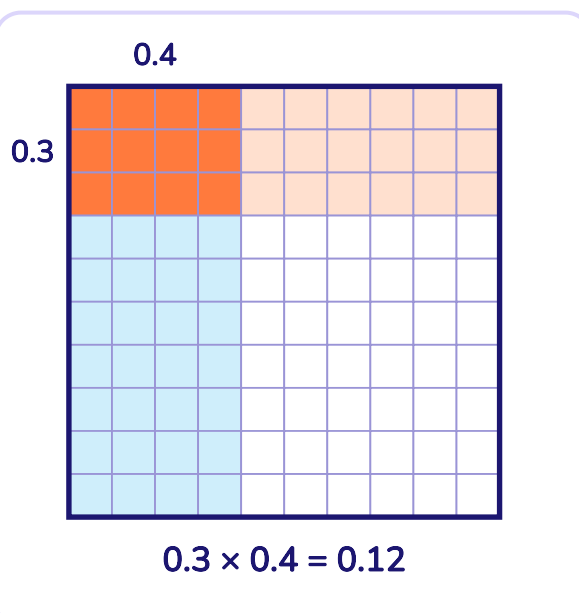
$$20.00 - 7.48 = 12.52.$$

**Common mistake**

Do not line up the digits on the right edge. In $6.4 + 0.85$, the 5 is in the hundredths place, not the tenths place. The correct sum is 7.25, not 14.9.

4. Multiplying decimals

To multiply decimals, first ignore the decimal points and multiply like whole numbers. Then count the total number of decimal places in both factors and put that many decimal places in the product. A grid of 100 squares makes this visible: a rectangle that is 0.3 of the height and 0.4 of the width covers $3 \times 4 = 12$ of the 100 squares, which is 0.12.



P**Rule: decimal places in a product**

The number of decimal places in the product equals the number of decimal places in the first factor plus the number in the second factor.

E**Example 4: multiplying decimals**

Compute 3.2×0.15 .

Ignore the points: $32 \times 15 = 480$. The factors have 1 and 2 decimal places, so the product has 3 decimal places: 0.480 . Drop the last zero: $3.2 \times 0.15 = 0.48$.

5. Dividing decimals

You cannot easily divide by a decimal, so you first turn the divisor into a whole number. Multiply *both* the divisor and the dividend by the same power of 10 (10, 100, 1,000, and so on). The quotient does not change, because you are scaling both numbers by the same amount, just like

$$\frac{6}{3} = \frac{60}{30}.$$

M**Method: dividing by a decimal**

1. Count the decimal places in the divisor.
2. Move the decimal point that many places to the right in both numbers, adding zeros if needed.
3. Divide as usual with long division, placing the decimal point in the quotient directly above the one in the dividend.
4. If a remainder is left, add zeros after the decimal point and keep dividing.

E**Example 5: dividing decimals**

Compute $7.35 \div 0.15$. Move the point two places in both numbers: $735 \div 15 = 49$.
So $7.35 \div 0.15 = 49$.

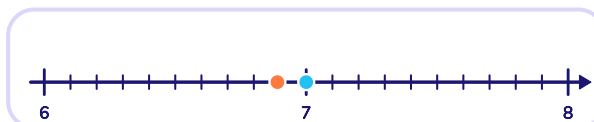
Compute $3 \div 8$. Write 3 as 3.000: $3.000 \div 8 = 0.375$.

!**Zyro's tip**

On my home planet we say: dividing by a number smaller than 1 makes the answer bigger. Check: $9.6 \div 0.4 = 24$, which is larger than 9.6!

6. Estimating with decimals

Estimating means rounding the numbers to easy values, then calculating in your head. Use it before you compute (to know what to expect) and after (to catch slips with the decimal point). A number line helps: 6.89 is very close to 7, so it rounds to 7.

**E****Example 6: a quick estimate**

Estimate 6.89×4.12 . Round 6.89 to 7 and 4.12 to 4: $7 \times 4 = 28$. The exact product is **28.3868**, which is very close to 28, so a result like 2.83 or 283 would be clearly wrong.

7. Decimal word problems

Most real-life decimals are money, lengths, and masses. Read the problem twice, decide which operations you need, estimate, compute, and answer in a full sentence with units.

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Example 7: shopping

Lena buys 3 notebooks at 2.35 dollars each and 2 pens at 1.45 dollars each, then pays with a 20-dollar bill. How much change does she get?

Notebooks: $3 \times 2.35 = 7.05$. Pens: $2 \times 1.45 = 2.90$. Total: $7.05 + 2.90 = 9.95$.
Change: $20 - 9.95 = 10.05$.

Lena gets 10.05 dollars in change.

Key takeaways

- Multi-digit multiplication adds partial products; keep the zero placeholder for tens, hundreds, and so on.
- Long division repeats divide, multiply, subtract, bring down; check with quotient $\times$ divisor + remainder.
- To add or subtract decimals, line up the decimal points and fill gaps with zeros.
- To multiply decimals, multiply as whole numbers, then count the decimal places of both factors.
- To divide by a decimal, move the decimal point the same number of places in both numbers until the divisor is a whole number.
- Estimate with rounded numbers to check that an answer is reasonable.



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