

The Multiplication Algorithm

An *algorithm* is a step-by-step method for solving a particular kind of problem.

In this lesson we practice **the standard multiplication algorithm**, which you already know from 4th grade.

This algorithm is based on multiplying in parts. For example, 7×648 is done in three parts: 7×600 , 7×40 , and 7×8 . At each step, you may need to regroup and add.

$$\begin{array}{r} 648 \\ \times 7 \\ \hline \end{array}$$

$$7 \times 8 = 56$$

$$\begin{array}{r} 648 \\ \times 7 \\ \hline \end{array}$$

$$7 \times 40 + 5 = 33$$

$$\begin{array}{r} 648 \\ \times 7 \\ \hline \end{array}$$

$$7 \times 600 + 30 = 450$$

1. Review your multiplication skills.

a.
$$\begin{array}{r} 415 \\ \times 8 \\ \hline \end{array}$$

b.
$$\begin{array}{r} 877 \\ \times 8 \\ \hline \end{array}$$

c.
$$\begin{array}{r} 1752 \\ \times 7 \\ \hline \end{array}$$

d.
$$\begin{array}{r} 2615 \\ \times 4 \\ \hline \end{array}$$

The process is the same with more digits. Study the example.

$$\begin{array}{r} 61359 \\ \times 5 \\ \hline \end{array}$$

$$5 \times 9 = 45$$

$$\begin{array}{r} 61359 \\ \times 5 \\ \hline \end{array}$$

$$5 \times 5 + 4 = 29$$

$$\begin{array}{r} 61359 \\ \times 5 \\ \hline \end{array}$$

$$5 \times 3 + 2 = 17$$

$$\begin{array}{r} 61359 \\ \times 5 \\ \hline \end{array}$$

$$5 \times 1 + 1 = 6$$

$$\begin{array}{r} 61359 \\ \times 5 \\ \hline \end{array}$$

$$5 \times 6 = 30$$

2. Multiply 5- and 6-digit numbers.

a.
$$\begin{array}{r} 17552 \\ \times 7 \\ \hline \end{array}$$

b.
$$\begin{array}{r} 27805 \\ \times 3 \\ \hline \end{array}$$

c.
$$\begin{array}{r} 144123 \\ \times 5 \\ \hline \end{array}$$

d.
$$\begin{array}{r} 270814 \\ \times 3 \\ \hline \end{array}$$

e.
$$\begin{array}{r} 51620 \\ \times 9 \\ \hline \end{array}$$

f.
$$\begin{array}{r} 239313 \\ \times 4 \\ \hline \end{array}$$

Estimate before you multiply. Then compare your estimated result with the final result, and that way you may catch some gross errors.

$$3 \times 21,578 = ?$$

Round 21,578 in such a way that you can easily multiply in your head. It makes sense to round it to 22,000.

Estimate: $3 \times 22,000 = 66,000$

The exact result is 64,734. The estimate is quite close.

$$\begin{array}{r} 1 \ 2 \ 2 \\ 2 \ 1 \ 5 \ 7 \ 8 \\ \times \qquad \qquad 3 \\ \hline 6 \ 4 \ 7 \ 3 \ 4 \end{array}$$

3. First estimate, by rounding the number in such a way that you can multiply in your head. Then multiply. Check that your final answer is reasonably close to your estimate.

a. Estimate: $5 \times 8,871 \approx$ _____

Calculate exactly:

$$\begin{array}{r} 8 \ 8 \ 7 \ 1 \\ \times \qquad \qquad 5 \\ \hline \end{array}$$

b. Estimate: $4 \times 22,399 \approx$ _____

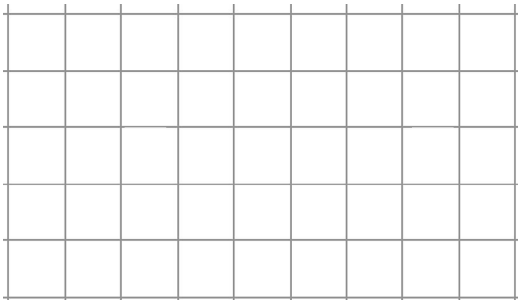
Calculate exactly:

$$\begin{array}{r} 2 \ 2 \ 3 \ 9 \ 9 \\ \times \qquad \qquad 4 \\ \hline \end{array}$$

c. Estimate: $7 \times 87,240$

\approx _____

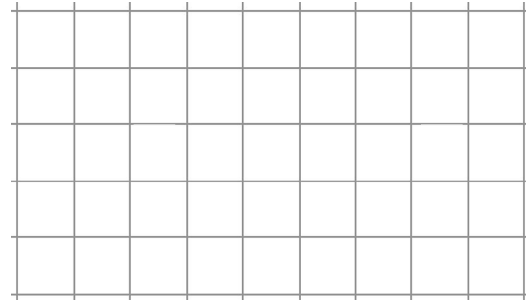
Calculate exactly:



d. Estimate: $4 \times 212,788$

\approx _____

Calculate exactly:



4. Jenny's estimate for the problem $3 \times 173,039$ is quite far from her final answer. Figure out where Jenny makes an error or errors.

Jenny's estimate:

$$\begin{aligned} &3 \times 173,039 \\ &\approx 3 \times 170,000 \\ &= 510,000 \end{aligned}$$

Jenny's calculation:

$$\begin{array}{r} 1 \ 2 \\ 1 \ 7 \ 3 \ 0 \ 3 \ 9 \\ \times \qquad \qquad 3 \\ \hline 4 \ 2 \ 9 \ 0 \ 1 \ 7 \end{array}$$