

## 1.7. Long Multiplication and Division Review

Multiplication of large numbers is done using the distributive property of multiplication over addition. The numbers are first split into ones, tens, hundreds, etc.

$$259 \cdot 5 = (200 + 50 + 9) \cdot 5 = 200 \cdot 5 + 50 \cdot 5 + 9 \cdot 5$$

An algorithm known as **long multiplication** is used to simplify writing:

5		
× 2 5 9		
4 5	multiply the <b>ones</b>	5 · 9 ones
2 5	multiply the <b>tens</b>	5 · 5 tens
+ 1 0	multiply the <b>hundreds</b>	5 · 2 hundreds
1 2 9 5		

**Example 1:** Multiply integers: 67 and 8.

6 7	8
× 8	× 6 7
5 3 6	5 6
	4 8
	5 3 6

**Practice 1:** Calculate:

$$\begin{array}{r} 65 \\ \times 3 \\ \hline 195 \end{array}$$

$$\begin{array}{r} 24 \\ \times 4 \\ \hline 96 \end{array}$$

$$\begin{array}{r} 19 \\ \times 5 \\ \hline 95 \end{array}$$

$$\begin{array}{r} 36 \\ \times 5 \\ \hline 180 \end{array}$$

$$\begin{array}{r} 18 \\ \times 7 \\ \hline 126 \end{array}$$

$$\begin{array}{r} 23 \\ \times 6 \\ \hline 138 \end{array}$$

$$\begin{array}{r} 2 \\ \times 56 \\ \hline 12 \\ 10 \\ \hline 112 \end{array}$$

$$\begin{array}{r} 4 \\ \times 12 \\ \hline 8 \\ 4 \\ \hline 48 \end{array}$$

$$\begin{array}{r} 3 \\ \times 99 \\ \hline 27 \\ 27 \\ \hline 297 \end{array}$$

$$\begin{array}{r} 3 \\ \times 45 \\ \hline 15 \\ 12 \\ \hline 135 \end{array}$$

$$\begin{array}{r} 3 \\ \times 61 \\ \hline 3 \\ 18 \\ \hline 183 \end{array}$$

$$\begin{array}{r} 4 \\ \times 82 \\ \hline 8 \\ 32 \\ \hline 328 \end{array}$$

**Example 2:** Multiply 619 and 7 using long multiplication.

$$\begin{array}{r} 619 \\ \times 7 \\ \hline 431363 \end{array}$$

multiply the ones  $619 \cdot 7$  ones

Start by multiplying ones  $9 \cdot 7 = 63$ . Write ones (3) at ones spot, and carry the 6.

Multiply tens and add the 6 that was carried over  $1 \cdot 7 + 6 = 7 + 6 = 13$ . Write tens (3) at the tens spot and carry the 1.

Multiply hundreds and add the 1 that was carried over  $6 \cdot 7 + 1 = 42 + 1 = 43$ . Write hundreds (3) at the hundreds spot and carry the 4.

There are no thousands in this problem, so just use the 4 that was carried over to the thousand column.

**Practice 2:** Calculate:

$$\begin{array}{r} 215 \\ \times 2 \\ \hline 430 \end{array}$$

$$\begin{array}{r} 216 \\ \times 2 \\ \hline 432 \end{array}$$

$$\begin{array}{r} 370 \\ \times 3 \\ \hline 1110 \end{array}$$

$$\begin{array}{r} 308 \\ \times 3 \\ \hline 924 \end{array}$$

$$\begin{array}{r} 450 \\ \times 5 \\ \hline 2250 \end{array}$$

$$\begin{array}{r} 601 \\ \times 9 \\ \hline 5409 \end{array}$$

$$\begin{array}{r} 430 \\ \times 8 \\ \hline 3440 \end{array}$$

$$\begin{array}{r} 304 \\ \times 5 \\ \hline 1520 \end{array}$$

$$\begin{array}{r} 504 \\ \times 3 \\ \hline 1512 \end{array}$$

$$\begin{array}{r} 901 \\ \times 9 \\ \hline 8109 \end{array}$$

**Example 3:** Multiply 342 and 37 using long multiplication.

$$\begin{array}{r}
 \phantom{+} \phantom{1} \phantom{0} \phantom{2} \phantom{6} \\
 \phantom{+} \phantom{1} \phantom{0} \phantom{2} \phantom{6} \\
 \times \phantom{1} \phantom{0} \phantom{2} \phantom{6} \\
 \hline
 \phantom{+} 2 \phantom{1} \phantom{0} \phantom{2} \phantom{6} \\
 + 1 \phantom{0} \phantom{2} \phantom{6} \phantom{5} \phantom{4} \\
 \hline
 1 \phantom{0} \phantom{2} \phantom{6} \phantom{5} \phantom{4}
 \end{array}$$

multiply with **ones**  $342 \cdot 7$  ones  
 multiply with **tens**  $342 \cdot 3$  tens

Start by multiplying the first factor, 342, by the ones digit of the second factor, 7, and write the result underneath the line:

$$342 \cdot 7 = (2 + 40 + 300) \cdot 7 = 14 + 280 + 2100 = 2394$$

Multiply 342 by the number of tens of the second factor, 3. Write the result aligned with the tens column.

$$342 \cdot 3 = (2 + 40 + 300) \cdot 3 = 6 + 120 + 900 = 1026$$

Finally add the two rows in order to get the final result of **12654**.

**Practice 3:** Multiply.

$$\begin{array}{r}
 164 \\
 \times 12 \\
 \hline
 328 \\
 164 \\
 \hline
 1968
 \end{array}$$

$$\begin{array}{r}
 235 \\
 \times 15 \\
 \hline
 1175 \\
 235 \\
 \hline
 3525
 \end{array}$$

$$\begin{array}{r}
 705 \\
 \times 35 \\
 \hline
 3525 \\
 2115 \\
 \hline
 24675
 \end{array}$$

$$\begin{array}{r}
 214 \\
 \times 13 \\
 \hline
 642 \\
 214 \\
 \hline
 2782
 \end{array}$$

$$\begin{array}{r}
 221 \\
 \times 64 \\
 \hline
 884 \\
 1326 \\
 \hline
 14144
 \end{array}$$

$$\begin{array}{r}
 453 \\
 \times 23 \\
 \hline
 1359 \\
 906 \\
 \hline
 10419
 \end{array}$$

**Example 4:** Divide  $124 \div 4$  using long division.

$$\begin{array}{r} 31 \\ 4 \overline{)124} \\ \underline{12} \phantom{0} \\ 04 \\ \underline{4} \\ 0 \end{array}$$

**Example 5:** Divide  $175 \div 7$  using long division.

$$\begin{array}{r} 25 \\ 7 \overline{)175} \\ \underline{14} \phantom{0} \\ 35 \\ \underline{35} \\ 0 \end{array}$$

**Practice 4:** Divide the following integers. Use long division.

a)  $328 \div 8 = 41$

$$\begin{array}{r} 41 \\ 8 \overline{)328} \\ \underline{32} \phantom{0} \\ 08 \\ \underline{8} \\ 0 \end{array}$$

b)  $295 \div 5 = 59$

$$\begin{array}{r} 59 \\ 5 \overline{)295} \\ \underline{25} \phantom{0} \\ 45 \\ \underline{45} \\ 0 \end{array}$$

c)  $426 \div 6 = 71$

$$\begin{array}{r} 71 \\ 6 \overline{)426} \\ \underline{42} \phantom{0} \\ 06 \\ \underline{6} \\ 0 \end{array}$$

d)  $576 \div 8 = 72$

$$\begin{array}{r} 72 \\ 8 \overline{)576} \\ \underline{56} \phantom{0} \\ 16 \\ \underline{16} \\ 0 \end{array}$$