### 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:

|  | $\times 2$ | 25 |  |
| :---: | :---: | :---: | :---: |
|  |  | 4 | 5 |
|  |  | 25 |  |
| + 1 | 10 | 0 |  |
|  | 2 | 2 |  |

multiply the ones 5.9 ones
multiply the tens $5 \cdot 5$ tens
multiply the hundreds $5 \cdot 2$ hundreds

Example 1: Multiply integers: 67 and 8.

$$
\begin{array}{r}
67 \\
\times \quad 8 \\
\hline 536
\end{array} \begin{array}{r}
8 \\
\times 67 \\
\hline 56 \\
\\
\hline 48 \\
\hline 536
\end{array}
$$

Practice 1: Calculate:

$$
\begin{array}{r}
65 \\
\times \quad 34 \\
\times \quad 4 \\
\hline 195
\end{array} \begin{array}{r}
19 \\
\times \quad 5 \\
\hline 95
\end{array} \begin{array}{r}
36 \\
\times \quad 5 \\
\hline 180
\end{array} \begin{array}{r}
18 \\
\times \quad 7 \\
\hline 126
\end{array}
$$

| 2 | 4 | 3 | 3 | 3 |
| ---: | ---: | ---: | ---: | ---: |
| $\times 56$ |  |  |  |  |
| 12 | $\frac{\times 12}{8}$ | $\frac{\times 99}{27}$ | $\frac{\times 45}{15}$ | $\frac{\times 61}{3}$ |
| $\frac{10}{112}$ | $\frac{4}{48}$ | $\frac{27}{297}$ | $\frac{12}{135}$ | $\frac{18}{183}$ |

Example 2: Multiply 619 and 7 using long multiplication.

| 6199 |
| ---: |
| $\times$ |
|  |
| $43{ }^{1} 3$ |

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:

| 215 |
| ---: |
| $\times \quad 2$ |
| 430 | | 216 |
| ---: |
| $\times \quad 270$ |
| 432 |$\frac{308}{30}$| 450 |
| ---: |
| 1110 | | $9 \quad 3$ |
| ---: |
| 924 |


| 601 |
| ---: |
| $\times \quad 9$ |
| 5409 | | 430 |
| ---: |
| $\times \quad 8$ |
| 3440 | | 304 |
| ---: |
| $\times \quad 5$ |
| 1520 | | 904 |
| ---: |
| $\times \quad 9$ |
| 8109 |

Example 3: Multiply 342 and 37 using long multiplication.

|  |  |  |  | 4 | 2 |
| :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | $\times$ |  | 3 | 7 |
|  |  | 2 | 3 | 9 | 4 |
| + | 1 | 0 | 2 | 6 |  |
|  | 1 | 2 | 6 | 5 | 4 |

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.
164
$\begin{array}{r}164 \\ \times \quad 12 \\ \hline 328\end{array}$
235
$\begin{array}{r}\times \quad 15 \\ \hline 1175\end{array}$
705
$\begin{array}{r}\times \quad 35 \\ \hline 3525\end{array}$
$\frac{164}{1968}$
$\frac{235}{3525}$
$\frac{2115}{24675}$

| 214 | 221 | 453 |
| ---: | ---: | ---: |
| $\times 13$ |  |  |
| 642 | $\times 64$ |  |
| 214 |  |  |
| 2782 | $\frac{13264}{14144}$ | $\frac{906}{1359}$ |
| 10419 |  |  |

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

$$
\begin{array}{r}
4 \\
4 \begin{array}{r}
31 \\
\frac{12}{24} \\
\hline 04 \\
\frac{4}{0}
\end{array}
\end{array}
$$

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

$$
\begin{array}{r}
7 \longdiv { 1 7 5 } \\
\begin{array}{c}
14 \\
\hline 35 \\
\frac{35}{0}
\end{array}
\end{array}
$$

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

a) $328 \div 8=41$
b) $295 \div 5=59$
$8 \longdiv { 3 2 8 }$
$5 \longdiv { 5 9 }$
$\frac{32}{08}$
$\frac{25}{45}$
$\frac{8}{0}$
$\frac{45}{0}$
c) $426 \div 6=71$
$6 \longdiv { 7 2 6 }$
$\frac{42}{06}$
$\frac{6}{0}$
d) $576 \div 8=72$
$\quad 72$
576 $\frac{56}{16}$
$\frac{16}{0}$

