Multiplying Whole Numbers

Lecture Notes

Prerequisite: Your Multiplication Facts Must Be Mastered

- We will work with **multi-digit multiplication**.
  - I will not review single-digit multiplication.
- By now, you should have already mastered recalling the multiplication facts.
  - The ideal **accuracy** is **100%** correct recall.
  - The ideal **speed** is a **2 second** recall, maximum.
- If you have not yet mastered the multiplication facts, multi-digit multiplication will be extremely difficult, if not impossible, for you to complete.
  - In fact, it will likely be impossible.
- Review the Multiplication Facts Workbook if necessary.

Chain Multiplication

Find the product $6 \cdot 4 \cdot 0$.

The product is ☐.

- This type of multiplication is called **chain multiplication** because each factor acts as a link on a chain. Here we have three factors. You can multiply in any order that you like because of the *Commutative Property of Multiplication*.
- Zero times any number is zero, even if there are other numbers being multiplied.
- Therefore, the product is 0.

Find the product $8 \times 7 \times 8$.

The product is ☐.

- Multiply the first two numbers (8 x 7). Then multiply that answer with the other number (8).

Find the product $8 \times 8 \times 3$.

The product is ☐.

Multiplying with Ending Zeros

Notes

- We will do multi-digit multiplication when one, or two, of the two factors end with zeros.
- Make sure to keep each column vertically aligned as you work out the problem on paper.
- Use plenty of space between each digit to avoid crowding the digits. It will also make it easier to vertically align your digits.
- Using commas are optional. However, if you do use them, they must be placed correctly, or the answer will be considered incorrect.

Multiply.

$$\begin{array}{r} 300 \\ \times \quad 5 \\ \hline \end{array}$$

- We can multiply by using the longer method, or the quicker method.
- I recommend using the quicker way to multiply when one, or two, of the factors end with zeros.
- **Caution:** if a zero is not to the right of the number but instead is somewhere within the number, we cannot use the quick way to multiply.
  - Ex: 6,**00**5 x 12. Here, we can only use the longer method to multiply.

Multiply.

$$\begin{array}{r} 4188 \\ \times \quad 20 \\ \hline \end{array}$$

Multiply.

$$\begin{array}{r} 22000 \\ \times \quad 4000 \\ \hline \end{array}$$

Find the product.

$$\begin{array}{r} 145 \\ \times 100 \\ \hline \end{array}$$

Find the product.

$$\begin{array}{r} 600 \\ \times 200 \\ \hline \end{array}$$

Multiplying with No Ending Zeros

Notes

- We will do multi-digit multiplication where neither of the two factors end with zeros.
- Make sure you have enough space on your paper, to the left of the problem, because multi-digit multiplication problems are written from right to left.
    - You want to avoid running out space on your paper when doing these problems.

Multiply.

$$\begin{array}{r} 1167 \\ \times \quad 2 \\ \hline \end{array}$$

- Because each column can hold only one digit, we must carry the left-hand digit at the top of the next column to the left.

Multiply.

$$\begin{array}{r} 57{,}981 \\ \times \qquad 9 \\ \hline \end{array}$$

Multiply.

$$\begin{array}{r} 45 \\ \times 99 \\ \hline \end{array}$$

- We do not need to put the bigger number on top. We can multiply the problem as is.
- If we left the 99 on the bottom, how can this be beneficial?
    - It can act as a check because we are multiplying by 9 two times. Therefore, both rows will have the same number.
- After you finish multiplying all digits of the top number by the *ones* digit of the bottom number, put a slash through the carries at the top of the columns.
    - This is to avoid being confused by the carries from the *ones* digit with the new carries that will be placed there when multiplying by the *tens* digit of the bottom number.
- Notice the **pattern** of multiplying the digits.
    - We take turns multiplying by each digit of the *bottom number*.
    - Start by multiplying with the *ones* digit of the bottom number.
        - Each digit of the top number is multiplied from *right to left*.
    - Then multiply with the *tens* digit of the bottom number.
        - Each digit of the top number is multiplied from *right to left*.
    - Etc.

Multiply.

(25)(73)

- Change horizontal format to vertical format.
- Due to the **Commutative Property of Multiplication**, it does not matter which number goes on top.

Multiply.

$$\begin{array}{r} 1036 \\ \times \quad 95 \\ \hline \end{array}$$

- Notice what happens when we multiply with 0 and there is a carry on top.

Multiply.

(844)(73)

- I recommend that you place the number with the most digits at the top.
- Having the number with fewer digits on the bottom means that there will be fewer rows when working out the problem.
    - Writing fewer rows means that the computations will be less confusing.

Multiply.

$$\begin{array}{r} 587 \\ \times\ 253 \\ \hline \end{array}$$

- This is the hardest type of multi-digit multiplication problem that we will do in this course.
- Each number is 3 digits long and there are no ending zeros.
- Therefore, we must use the longer way to multiply.