

Multi-Digit Arithmetic

This guide provides a step-by-step explainer on how to solve multi-digit arithmetic problems by hand, followed by practice exercises for each operation.

1. Addition

How to Add Multi-Digit Numbers

To add large numbers, align them vertically by their place values (ones, tens, hundreds, etc.). Starting from the rightmost column (the ones place) and moving left:

1. Add the digits in the current column.
2. If the sum is 9 or less, write it below the line.
3. If the sum is 10 or greater, write the rightmost digit below the line and “carry over” the left digit to the top of the next column to the left.

Example: $587 + 645$

$$\begin{array}{r} 11 \quad (\text{carries}) \\ 587 \\ + \underline{645} \\ 1232 \end{array}$$

($7+5=12$, write 2 carry 1. $1+8+4=13$, write 3 carry 1. $1+5+6=12$.)

Practice Problems

- a) $4,812 + 739$
- b) $835 + 16,421$
- c) $5,283 + 914$
- d) $1,057 + 23,892$
- e) $642 + 8,315$
- f) $9,999 + 123$
- g) $45,210 + 6,789$
- h) $8,406 + 3,957$

2. Subtraction

How to Subtract Multi-Digit Numbers

Align the numbers vertically by their place values (ones, tens, hundreds, etc.). Start subtracting from the rightmost column (ones place) and move left:

1. If the top digit is larger than or equal to the bottom digit, simply subtract.
2. If the top digit is smaller than the bottom digit, you must “borrow” (or regroup) from the next column to the left. Decrease the next column’s top digit by 1, and add 10 to your current top digit.

Example: $814 - 352$

$$\begin{array}{r} \overset{\cdot}{8}14 \quad (\text{dot on 8 signifies borrow}) \\ - \quad \underline{352} \\ 462 \end{array}$$

($4 - 2 = 2$. In the next column, $1 - 5$ requires borrowing: place a dot on the 8 to turn it into a 7 and give 10 to the 1, making it 11. $11 - 5 = 6$. Finally, $7 - 3 = 4$. Result: 462.)

Practice Problems

- a) $2,584 - 726$
- b) $7,042 - 819$
- c) $4,152 - 837$
- d) $9,005 - 1,246$
- e) $15,482 - 3,915$
- f) $6,310 - 482$
- g) $8,204 - 5,618$
- h) $12,000 - 8,431$

3. Multiplying by a Single-Digit Number

Before multiplying large numbers together, let's look at how to multiply a multi-digit number by a single digit.

1. Align the numbers vertically on the right.
2. Multiply the bottom digit by the ones digit of the top number.
3. If the result is 9 or less, write it below the line. If it is 10 or greater, write down the ones digit of your result and "carry" the tens digit to the top of the next column to the left.
4. Multiply the bottom digit by the next top digit to the left, **then add** your carried number to that result. Write it down, carrying again if necessary.
5. Repeat this moving left until you run out of top digits.

Example: $326 \cdot 4$

$$\begin{array}{r} \overset{12}{} \quad (\text{carries}) \\ 326 \\ \times \quad \underline{ 4} \\ 1304 \end{array}$$

($6 \times 4 = 24$: write 4, carry 2. Next, $2 \times 4 = 8$, plus the carried 2 = 10: write 0, carry 1. Finally, $3 \times 4 = 12$, plus the carried 1 = 13: write 13.)

Practice Problems (Single-Digit)

- a) $87 \cdot 5$
- b) $314 \cdot 6$
- c) $908 \cdot 7$

- d) $5,271 \cdot 4$
- e) $8,039 \cdot 9$
- f) $14,256 \cdot 2$
- g) $35,092 \cdot 3$
- h) $72,483 \cdot 8$

4. Multiplication

How to Multiply Multi-Digit Numbers

When multiplying by a multi-digit number, you calculate “partial products” and then add them together:

1. Multiply the top number by the ones digit of the bottom number. Write this result down.
2. Multiply the top number by the tens digit of the bottom number. Because this digit represents tens, write a 0 as a placeholder at the end of this line before calculating.
3. If there is a hundreds digit, write two 0s as placeholders on the next line, and so on.
4. Add all the partial products together.

Example: $234 \cdot 45$

$$\begin{array}{r}
 234 \\
 \times \quad 45 \\
 \hline
 1170 \quad (\text{This is } 234 \times 5) \\
 + \quad 9360 \quad (\text{This is } 234 \times 40) \\
 \hline
 10530
 \end{array}$$

(First, multiply 234 by 5: $4 \times 5 = 20$, write 0 carry 2; $3 \times 5 = 15 + 2 = 17$, write 7 carry 1; $2 \times 5 = 10 + 1 = 11$. This gives 1170. Next, add a 0 placeholder and multiply 234 by 4: $4 \times 4 = 16$, write 6 carry 1; $3 \times 4 = 12 + 1 = 13$, write 3 carry 1; $2 \times 4 = 8 + 1 = 9$. This gives 9360. Finally, add $1170 + 9360 = 10530$.)

Practice Problems

- a) $417 \cdot 52$
- b) $913 \cdot 248$
- c) $526 \cdot 84$
- d) $709 \cdot 415$
- e) $834 \cdot 92$
- f) $618 \cdot 307$
- g) $295 \cdot 63$
- h) $481 \cdot 529$

5. Division

How to Divide Multi-Digit Numbers (Long Division)

Long division follows a repeating cycle: **Divide, Multiply, Subtract, Bring down** (DMSB).

1. **Divide:** See how many times the divisor fits into the first part of the dividend. Write that number to the right of the equals sign.
2. **Multiply:** Multiply that new digit by the divisor.
3. **Subtract:** Subtract that result from the current part of the dividend.
4. **Bring down:** Bring down the next digit of the dividend.
5. Repeat the process until there are no more digits to bring down.

Example: $4,212 \div 12$

$$\begin{array}{r} 4212 \div 12 = 351 \\ \underline{-36} \\ 61 \\ \underline{-60} \\ 12 \\ \underline{-12} \\ 0 \end{array}$$

(First, see how many 12s fit into 42: $12 \times 3 = 36$. Write 3 in the answer, subtract 36 from 42 to get 6. Bring down the 1 to make 61. Next, see how many 12s fit into 61: $12 \times 5 = 60$. Write 5 in the answer, subtract 60 from 61 to get 1. Bring down the 2 to make 12. Finally, see how many 12s fit into 12: $12 \times 1 = 12$. Write 1 in the answer and subtract 12 to get 0.)

Practice Problems

- a) $7,130 \div 31$
- b) $32,136 \div 156$
- c) $6,090 \div 42$
- d) $39,750 \div 125$
- e) $7,812 \div 93$
- f) $109,568 \div 214$
- g) $14,076 \div 68$
- h) $133,215 \div 321$

Answer Key

Addition a) 5,551 b) 17,256 c) 6,197 d) 24,949 e) 8,957 f) 10,122 g) 51,999 h) 12,363

Subtraction a) 1,858 b) 6,223 c) 3,315 d) 7,759 e) 11,567 f) 5,828 g) 2,586 h) 3,569

Multiplication (Single-Digit) a) 435 b) 1,884 c) 6,356 d) 21,084 e) 72,351 f) 28,512 g) 105,276 h) 579,864

Multiplication a) 21,684 b) 226,424 c) 44,184 d) 294,235 e) 76,728 f) 189,726 g) 18,585 h) 254,449

Division a) 230 b) 206 c) 145 d) 318 e) 84 f) 512 g) 207 h) 415