

Octal addition is like decimal addition, except that it operates in base-8 rather than base-10. In octal, the digits range from 0 to 7. When adding two octal numbers, if the sum of the digits is 8 or greater, it is necessary to "carry" to the next higher place value, just like when the sum exceeds 9 in decimal addition.

Rules for Octal Addition:

1. If the sum of two digits is less than 8, write down the sum.
2. If the sum is 8 or more, subtract 8 from the sum and carry 1 to the next higher place.

Example 1: Simple Octal Addition

Let's add two octal numbers: 54_8 and 25_8 .

$$\begin{array}{r} 54_8 \\ + 25_8 \\ \hline \end{array}$$

Step-by-step process:

1. Add the rightmost digits: $4 + 5 = 9$. Since 9 is greater than 7, subtract 8, which gives $9 - 8 = 1$, and carry 1 to the next higher place.
2. Add the next left digits: $5 + 2 = 7$, and add the carry 1 from the previous step: $7 + 1 = 8$. Since 8 equals 8, subtract 8, which gives $8 - 8 = 0$, and carry 1 to the next place.
3. The result is: 101_8 .

Example 2: Larger Octal Addition

Now, let's add two larger octal numbers: 675_8 and 137_8 .

$$\begin{array}{r} 675_8 \\ + 137_8 \\ \hline \end{array}$$

Step-by-step process:

1. Add the rightmost digits: $5 + 7 = 12$. Since 12 is greater than 7, subtract 8, which gives $12 - 8 = 4$, and carry 1 to the next place.
2. Add the next digits: $7 + 3 = 10$, plus the carry 1: $10 + 1 = 11$. Since 11 is greater than 7, subtract 8, which gives $11 - 8 = 3$, and carry 1 to the next place.
3. Add the next digits: $6 + 1 = 7$, plus the carry 1: $7 + 1 = 8$. Subtract 8, which gives $8 - 8 = 0$, and carry 1 to the next place.
4. The result is: 1034_8 .

Practice Problem

Add the octal numbers 725_8 and 157_8 .

$$\begin{array}{r} 725_8 \\ + 157_8 \\ \hline \end{array}$$

Solution:

1. Add the rightmost digits: $5 + 7 = 12$, subtract 8 \rightarrow write down 4, carry 1.
2. Add the next digits: $2 + 5 = 7$, plus carry 1 $\rightarrow 8 \rightarrow$ write down 0, carry 1.
3. Add the next digits: $7 + 1 = 8$, plus carry 1 $\rightarrow 9$.

Final result: 904_8 .

Summary

Octal addition follows the same principles as decimal addition, but the carry occurs when the sum reaches 8 or more.

This process simplifies binary arithmetic and is particularly useful when working with legacy systems, file permissions, or low-level computing operations.