

Number Base Subtraction and Simple Equations

LESSON

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Objective

In this lesson you'll learn how to do subtraction and some simple equations involving Base 2, 8, and 16.

Again, it is essentially the same concept as Base 10, just in a different base!

Review Base Ten Subtraction

In Base 10 subtraction, you learned a very simple process.

Look at this problem:

$$\begin{array}{r} 48 \\ -37 \\ \hline = 11 \end{array}$$

Review Base Ten Subtraction

$$\begin{array}{r} 48 \\ -37 \\ \hline = 11 \end{array}$$

Each column is subtracted to get an answer of 11...pretty easy, huh?

Subtraction, Base 10

Now look at this problem:

$$\begin{array}{r} 63 \\ -37 \\ \hline \end{array}$$

In this problem, you need to borrow.

Subtraction, Base 10

$$\begin{array}{r} 513 \\ \del{63} \\ \underline{-37} \end{array}$$

Borrowing means taking a value from the next column and adding it to the column you need.

Subtraction, Base 10

$$\begin{array}{r} 513 \\ \del{63} \\ \underline{-37} \end{array}$$

In this case, borrow from the 6, which becomes five, and add 10 to the 3, making 13.

Subtraction, Base 10

$$\begin{array}{r} 513 \\ \del{63} \\ \underline{-37} \end{array}$$

When you borrow 1 from a column, it becomes the **value of the base** in the next column, or 10 in this case.

Subtraction, Base 10

$$\begin{array}{r} 513 \\ \cancel{63} \\ -37 \\ \hline 26 \end{array}$$

Then you subtract the two columns with a result of 26.

Subtraction, Base 8

Now let's try base eight:

$$\begin{array}{r} 63 \\ -37 \\ \hline \end{array}$$

Again, in this problem, you need to borrow.

Subtraction, Base 8

$$\begin{array}{r} 511 \\ \cancel{63} \\ \hline -37 \end{array}$$

Borrow from the 6, which becomes five, and add 8 to the 3, making 11!

Subtraction, Base 8

$$\begin{array}{r} 511 \\ \del{63} \\ \underline{-37} \end{array}$$

When you borrow 1 from a column, it becomes the **value of the base** in the next column, or **8** in this case.

Subtraction, Base 8

$$\begin{array}{r} 511 \\ \cancel{63} \\ -37 \\ \hline 24 \end{array}$$

Then you subtract the two columns with a result of 24.

Now base 16: Subtraction, Base 16

$$\begin{array}{r} 63 \\ -37 \\ \hline \end{array}$$

Subtraction, Base 16

Now base 16:

$$\begin{array}{r} 519 \\ \cancel{63} \\ -37 \\ \hline \end{array}$$

Again, we borrow from the 6, which becomes five, and add 16 to the 3, making 19!

Subtraction, Base 16

$$\begin{array}{r} 519 \\ \del{63} \\ \underline{-37} \end{array}$$

When you borrow 1 from a column, it becomes the **value of the base** in the next column, or **16** in this case.

Subtraction, Base 16

$$\begin{array}{r} 519 \\ ~~63~~ \\ -37 \\ \hline 2C \end{array}$$

In the ones column, 19 minus 7 is 12, which is C in base sixteen, with 2 in the second column.

Subtraction, Base 16

Here's another in base 16

$$\begin{array}{r} \text{D6} \\ -\underline{\text{3B}} \end{array}$$

How is this one solved? Try it.

Subtraction, Base 16

$$\begin{array}{r} C22 \\ ~~D6~~ \\ -3B \\ \hline \end{array}$$

We must borrow from D, which becomes C, then add 16 to 6, which makes 22.

Subtraction, Base 16

$$\begin{array}{r} \text{C22} \\ \text{D6} \\ -3\text{B} \\ \hline 9\text{B} \end{array}$$

22 minus B (11) is B.

C minus 3 is 9.

Answer is 9B

Subtraction, Base 2

Now base 2:

$$\begin{array}{r} 11 \\ - 1 \\ \hline 10 \end{array}$$

This one's easy...answer is 10

Subtraction, Base 2

Another in base 2:

$$\begin{array}{r} 02 \\ ~~110~~ \\ - \quad 1 \\ \hline \end{array}$$

Here we need to borrow from the tens place...

Subtraction, Base 2

Another in base 2:

$$\begin{array}{r} 02 \\ 110 \\ - \quad 1 \\ \hline 101 \end{array}$$

Subtract to get the answer.

Subtraction, Base 2

still another in base 2:

$$\begin{array}{r} 02 \\ 110 \\ - 11 \\ \hline 1 \end{array}$$

Here you have to borrow twice...

Subtraction, Base 2

$$\begin{array}{r} 2 \\ 100 \\ - 11 \\ \hline 11 \end{array}$$

Final answer is 11, base 2

Simple Equations

Here an equation to solve:

$$x + 6 = 14$$

Simple Equations

Solution...subtract 6 from both sides

$$\begin{array}{r} x + 6 = 14 \\ \quad -6 \quad -6 \\ \hline x = 8 \end{array}$$

Simple Equations

Now do it in base 8:

$$x + 6 = 14$$

Simple Equations

Solution...subtract 6 from both sides

$$\begin{array}{r} x + 6 = 14 \\ \quad -6 \quad -6 \\ \hline x \quad = \quad ? \end{array}$$

Simple Equations

Answer is 6, base 8

$$\begin{array}{r} x + 6 = 14 \\ \quad -6 \quad -6 \\ \hline x = 6 \end{array}$$

Simple Equations

Here's an equation in base sixteen (remember, A and F are NOT variables, but base sixteen values):

$$x + 2A = F3$$

Simple Equations

Solution?

$$x + 2A = F3$$

Simple Equations

Subtract $2A$ from both sides:

$$\begin{array}{r} x + 2A = \cancel{F3} \\ \underline{-2A} \quad \underline{-2A} \\ x = C9 \end{array}$$

Exercises

1. $100_2 - 11_2 = \underline{\quad} 2$

2. $76_8 - 67_8 = \underline{\quad} 8$

3. $F_{16} - A_{16} = \underline{\quad} 16$

4. $15_8 - 6_8 = \underline{\quad} 8$

5. $49_{16} - 2B_{16} = \underline{\quad} 16$

6. $CC_{16} - AD_{16} = \underline{\quad} 8$

Exercises

7. $73_8 - 34_8 = \underline{\quad} 10$

8. $3E_{16} - 2F_{16} = \underline{\quad} 16$

9. $10_{10} - 10_8 = \underline{\quad} 2$

10. $1101_2 - 11_2 = \underline{\quad} 8$

11. $1010_2 - 111_2 = \underline{\quad} 2$

12. $716_8 - 364_8 = \underline{\quad} 10$

13. $776_8 - 337_8 = \underline{\quad} 8$

Exercises

14. $AE_{16} + 76_8 = \underline{\hspace{2cm}}_{10}$

15. $234_8 + 11011011_2 = \underline{\hspace{2cm}}_{16}$

16. $10110_2 - E_{16} + 76_8 = \underline{\hspace{2cm}}_{10}$

17. $37_8 + 37_{10} - 110111_2 = \underline{\hspace{2cm}}_{16}$

18. $1111_2 - F_{16} + 15_{10} = \underline{\hspace{2cm}}_{16}$

Exercises

19. $x_{16} + 76_{16} = AB_{16}$

20. $x_2 - 1011_2 = 101_2$

21. $x_8 + 56_8 = 72_8$

22. $x_2 + 25_{10} = 1F_{16}$

23. $37_8 + X_{10} = 1101111_2$

24. $x_{16} + 11111111100_2 - 656_8 = BAD_{16}$

ANSWERS

1. 1

2. 7

3. 5

4. 7

5. 1E

6. 255

7. 31

8. F

9. 10

10. 12

11. 11

12. 218

13. 437

14. 236

15. 177

16. 70

17. D

18. F

19. 35

20. 10000

21. 14

22. 110

23. 80

24. 55F