3.01

**Know Your Number Bases**

***There are only 10 kinds of people in the world:   
those who understand binary and those who don’t.***

**A Little "Bit" of Theory**

At the hardware level, a computer is made up of integrated circuits that are composed of tiny transistor logic switches that are either open or closed. A closed switch allows electricity to flow through the circuit; an open switch does not. Since electricity either flows or it does not, a switch is a binary device and can be represented by bits (0 and 1).

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* An open switch is represented by 0 because no electricity flows.
* A closed switch is represented by 1 since electricity can flow.

Binary digits are therefore used to represent logic circuits which are either true (1 = electricity flows) or false (0 = no electricity flows). Consequently, all processing performed by the computer is done with the binary number system.

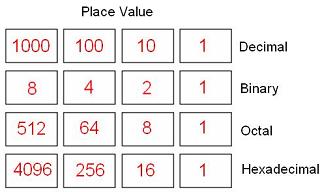
"On" is equal to **1**.

"Off" is equal to **0**.

The **0** and **1** in the **binary number system** are referred to as **binary digits**, or **BITs**. A computer uses these two choices to process all the information we give it.

A **BIT** … either a **0** or a **1** … is the smallest unit of data that a computer can handle.

Computers typically use three number systems: [binary](javascript:void(0);), [octal](javascript:void(0);), and [hexadecimal](javascript:void(0);). The following table shows the positional place value in base 2, base 8, and base 16 in relation to the more familiar decimal number system (base 10):

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**Decimal**

We humans use the **decimal number system (base 10)** to count with the 10 numbers … 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9 … also called **decimal digits**. With these 10 symbols, you can count forever. This system is comfortable to people because we have 10 digits (i.e., four fingers and one thumb) on our hands.

When you see a number like 542 in the **decimal number system**, how do you know what it is? Each position in the number has a specific **place value.** The "5" is in the **hundreds** position, the "4" is in the **tens** position, and the "2" is in the **ones** position. So you actually saw the number and understood 5 x **100** plus 4 x **10** plus 2 x **1** = 542.

Notice that the place values are powers of 10. For example, the third position is 100, or 10 to the second power (10^2). The second position is 10, or 10 to the first power (10^1). The first position is 1, or 10 to the zero power (10^0)

**Place value** is the key!

**Binary**

Computers use the **binary number system (base 2)** to count with *only* two numbers: **0** and **1**. With just these two symbols, you can *still* count forever! The decimal number 542 is represented by the binary number 1000011110. Because we don't normally use **base 2**, it is helpful to know how to convert between the **binary number system** and the **decimal number system**. Remember, the *key concept* in both number systems is **place value**.

**Hexadecimal**

Because the binary number system only has two digits, 0 and 1, binary numbers can be very long and awkward to work with. To solve this problem, computer programmers often use the **hexadecimal number system** as shorthand. Computer programmers like the **hexadecimal number system** for three reasons:

1. It has many of the advantages of binary.
2. It relates to the state of a transistor.
3. It is concise and easy for humans to understand.

These benefits may surprise you when you learn that the **hexadecimal number system** has 16 "digits" to work with. If you start counting … 0, 1, 2, 3, 4, 5, 6, 7, 8, 9 … you get 10 digits, but you are six short! The way to get around this is to use letters … A, B, C, D, E, F. The decimal number 542 is written as 21E in hexadecimal. Just remember, it is all about **place value**.

**Octal**

One last number system that programmers commonly use: the **octal number system**. This is also known as base 8. Octal values are written using 8 digits: 0, 1, 2, 3, 4, 5, 6, 7.

Because binary numbers get very large quickly, the octal number system and the hexadecimal number system are sometimes used as shorthand notation.

Which would you rather write? Binary 1000011110 or octal 1036 or hexadecimal 21E? Each of these represents the decimal value 542. Why not use decimal? Remember, computers are binary machines and naturally represent values using binary.

You can confirm that these pairs of values are equivalent using the calculator found on your computer. Switch the view to scientific or programmer mode.

#### **Converting between Binary and Decimal**

Did you say 10111011110110100101001110111011?

Here is a typical **binary number**: 0101. You would say this as zero-one-zero-one **base 2**. The easiest way to understand it is to convert from a **binary number** to a **decimal number**. To do that, all you need to know is the **place value** of each **binary digit**.

This table shows how to convert the **binary number** 0101 to its **decimal** equivalent.

Notice that the **binary number** 0101 is inserted in the third row of the table.

| **Powers of 2** | **2^3** | **2^2** | **2^1** | **2^0** |
| --- | --- | --- | --- | --- |
| **Binary Place Value** | 8 | 4 | 2 | 1 |
| **Binary Number** | 0 | 1 | 0 | 1 |
| **Decimal Equivalent** | 0 | 4 | 0 | 1 |

Directly above, in row 2, you see the **place value** of the first four digits in the **binary number system**. From right to left, they are 1, 2, 4, and 8. The **place values** increase by **powers of 2**, as shown in the first row.

Here’s the trick: If you multiply the **binary place value** times the **binary number** beneath it, you get the **decimal equivalent**. Then if you add the **decimal equivalents** up (0 + 4 + 0 + 1), you get the **decimal number** that the **binary number** 0101 is equal to: 5.

**Remember!** Any number to the zero power is always 1. So in the **binary number system**, 2^0 = 1.

Let's practice. Open these worksheets to work through samples of converting between the binary and decimal number systems:

* [Worksheet 03.01 Binary to Decimal](https://lti.flvsgl.com/flvs-cat-content/m74q72rl3uomk9aadhnoplqo45/flvs-cat-session/apcomputersciencea_v20/module03/lesson01/pop/04_01b/04_01b_popup01.htm)
* [Worksheet 03.01 Decimal to Binary](https://lti.flvsgl.com/flvs-cat-content/m74q72rl3uomk9aadhnoplqo45/flvs-cat-session/apcomputersciencea_v20/module03/lesson01/pop/04_01b/04_01b_popup02.htm)

#### **Converting between Hexadecimal and Decimal**

Remember two things, and you will understand **hexadecimal numbers** as well as any programmer.

1. The letters represent the next 6 numbers. For example, A=10, B=11, C=12, D=13, E=14, F=15.
2. The place values of the positions increase by powers of 16.

To convert from **hexadecimal** to **decimal**, you simply need to know the **place values** of the  
**hexadecimal number system**.

Let's practice. Open these worksheets to work through samples of converting between the hexadecimal   
and decimal number systems:

* [Worksheet 03.01 Hexadecimal to Decimal](https://lti.flvsgl.com/flvs-cat-content/m74q72rl3uomk9aadhnoplqo45/flvs-cat-session/apcomputersciencea_v20/module03/lesson01/pop/04_01b/04_01b_popup03.htm)
* [Worksheet 03.01 Decimal to Hexadecimal](https://lti.flvsgl.com/flvs-cat-content/m74q72rl3uomk9aadhnoplqo45/flvs-cat-session/apcomputersciencea_v20/module03/lesson01/pop/04_01b/04_01b_popup04.htm)

**Convert Base 2 (Binary) to Base 10 (Decimal)**

Converting a number in one base to another is easy if you have a plan. Follow along with the two examples below to review converting from base 2 to base 10. Then try the practice problems.

**Example 1: Convert the binary number 1011 to its decimal equivalent.**

1. Row 1 shows the powers of 2 from 23 down to 20.
2. Row 2 shows what each power equals and the place value it represents.   
   (Remember, something like 23 = 2 x 2 x 2 = 8).
3. In Row 3, we write the binary number that we want to convert.
4. In Row 4, we multiply the place value times the binary number.   
   (Multiply row 2 by row 4 in each column).
5. Finally, we add up the numbers in the last row (8+0+2+1) to get the decimal number 11.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Powers of 2 | 23 | 22 | 21 | 20 |
| Binary Place Value | 8 | 4 | 2 | 1 |
| **Binary Number** | **1** | **0** | **1** | **1** |
| Decimal Number | 8 | 0 | 2 | 1 |

An easy way to show your work for this kind of calculation is as follows. Notice that we use the carat symbol ^ to represent the powers of 2. The ^ symbol is found on top of the 6 key on the keyboard.

1011 = (1\*2^3)+(0\*2^2)+(1\*2^1)+(1\*2^0)  
= (1\*8)+(0\*4)+(1\*2)+(1\*1)  
= 8 + 0 + 2 + 1  
= 11

**Example 2: Convert the binary number 00110010 to its decimal equivalent.**

Notice that this is a bigger binary number and we have just added columns to the table to represent the higher powers of 2 (27 to 24) and their corresponding place values.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Powers of 2 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Binary Place Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| **Binary Number** | **0** | **0** | **1** | **1** | **0** | **0** | **1** | **0** |
| Decimal Number | 0 | 0 | 32 | 16 | 0 | 0 | 2 | 0 |

Adding up the numbers in the last row (0+0+32+16+0+0+2+0) = 50.

We can show our work as follows:

00110010 = (0\*2^7)+(0\*2^6)+(1\*2^5)+(1\*2^4)+(0\*2^3)+(0\*2^2)+(1\*2^1)+(0\*2^0)  
= (0\*128)+(0\*64)+(1\*32)+(1\*16)+(0\*8)+(0\*4)+(1\*2)+(0\*1)  
= 0 + 0 + 32 + 16 + 0 + 0 + 2 + 0  
= 50

Use this technique and you will be able to convert base 2 (binary) to base 10 (decimal) with ease!

**Test Yourself**

Test yourself with some practice problems. Check your answers with the key at the bottom of the page.

1. Convert the binary number 10101010 to its decimal equivalent. Fill in the third and fourth row in the table and then show your work below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Powers of 2 | 27 | 26 | 25 | 24 | 23 | 22 | 21 | 20 |
| Binary Place Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| **Binary Number** |  |  |  |  |  |  |  |  |
| Decimal Number |  |  |  |  |  |  |  |  |

1. 10101010 = (      \*2^7)+(      \*2^6)+(      \*2^5)+(      \*2^4)+(      \*2^3)+(      \*2^2)+(      \*2^1)+(      \*2^0)  
   = (      \*128)+(      \*64)+(      \*32)+(      \*16)+(      \*8)+(      \*4)+(      \*2)+(      \*1)  
   = \_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_+\_\_\_\_\_\_\_  
   = \_\_\_\_\_\_\_
2. Convert the binary number 01010101 to its decimal equivalent. Fill in the second, third, and fourth row in the table and then show your work below.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Powers of 2** | **27** | **26** | **25** | **24** | **23** | **22** | **21** | **20** |
| Binary Place Value |  |  |  |  |  |  |  |  |
| **Binary Number** |  |  |  |  |  |  |  |  |
| Decimal Number |  |  |  |  |  |  |  |  |

1. 0101010 =
2. Convert the binary number 1100111011 to its decimal equivalent. Fill in each row in the table and then show your work below. Notice that you have two additional place values in this number.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Powers of 2 |  |  |  |  |  |  |  |  |
| Binary Place Value |  |  |  |  |  |  |  |  |
| **Binary Number** |  |  |  |  |  |  |  |  |
| Decimal Number |  |  |  |  |  |  |  |  |

1. 1100111011 =

Answers:

1. The base 2 binary number 10101010 is equal to the base 10 decimal number 170.
2. The base 2 binary number 01010101 is equal to the base 10 decimal number 85.
3. The base 2 binary number 1100111011 is equal to the base 10 decimal number 827.

**Convert Base 10 (Decimal) to Base 2 (Binary)**

Converting a base 10 (decimal) number to a base 2 (binary) number is easy with the successive division method *algorithm*. Study the following examples. The numbers are color coded to help you keep track of what is happening.

**Example 1: Use successive division to convert the decimal number 56 to a binary number.**

**Explanation**

**Show Your Work**

Start with the highest binary place value (power of 2) that is *less than or equal* to the number you want to convert (56). In this case it is 25, or 32. Since you can divide 56 by 32, you record a 1 and you have a remainder of 24.

56/32 = 1 remainder 24

The next highest binary place value is 24, or 16. The remainder 24 can be divided by 16, so you record a 1 and you still have a remainder of 8.

24/16 = 1 remainder 8

The next highest binary place value is 23, or 8. The remainder 8 can be divided by 8, so you record a 1 and you have a remainder of 0.

8/8 = 1 remainder 0

The next highest place value is 22, or 4. The remainder 0 cannot be divided by 4, so you record a 0 and you have a remainder of 0.

0/4 = 0 remainder 0

The next highest place value is 21, or 2. The remainder 0 cannot be divided by 2, so you record a 0 and you still have a remainder of 0.

0/2 = 0 remainder 0

The last place value is 20, or 1. The remainder 0 cannot be divided by 1, so you record a 0.

0/1 = 0

This *algorithm* shows that the decimal number 56 is equivalent to the binary number 111000.

**Example 2: Use successive division to convert the decimal number 701 to a binary number.**

**Explanation**

**Show Your Work**

Start with the highest binary place value (power of 2) that is *less than or equal* to the number you want to convert (701). In this case it is 29, or 512. Since you can divide 701 by 512, you record a 1 and you have a remainder of 189.

701/512 = 1 remainder 189

The next highest binary place value is 28, or 256. The remainder 189 cannot be divided by 256, so you record a 0 and you still have a remainder of 189.

189/256 = 0 remainder 189

The next highest binary place value is 27, or 128. The remainder 189 can be divided by 128, so you record a 1 and you have a remainder of 61.

189/128 = 1 remainder 61

The next highest binary place value is 26, or 64. The remainder 61 cannot be divided by 64, so you record a 0 and you still have a remainder of 61.

61/64 = 0 remainder 61

The next highest binary place value is 25, or 32. The remainder 61 can be divided by 32, so you record a 1 and you still have a remainder of 29.

61/32 = 1 remainder 29

The next highest binary place value is 24, or 16. The remainder 29 can be divided by 16, so you record a 1 and you still have a remainder of 13.

29/16 = 1 remainder 13

The next highest binary place value is 23, or 8. The remainder 13 can be divided by 8, so you record a 1 and you have a remainder of 5.

13/8 = 1 remainder 5

The next highest place value is 22, or 4. The remainder 5 can be divided by 4, so you record a 1 and you still have a remainder of 1.

5/4 = 1 remainder 1

The next highest place value 21, or 2. The remainder 1 cannot be divided by 2, so you record a 0 and you still have a remainder of 1.

1/2 = 0 remainder 1

The last place value is 20, or 1. The remainder 1 can be divided by 1, so you record a 1.

1/1 = 1

This algorithm shows that the decimal number 701 is equivalent to the binary number 1010111101.

**Test Yourself**

1. Convert 28 in base 10 to base 2.  
     
    28/16 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/8 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/4 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/2 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/1 = \_\_\_\_\_\_\_\_\_ remainder
2. Convert 63 in base 10 to base 2.  
     
      63/32 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/16 = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/8   = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/4   = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/2   = \_\_\_\_\_\_\_\_\_ remainder  
   \_\_\_\_/1   = \_\_\_\_\_\_\_\_\_ remainder
3. Convert 100 in base 10 to base 2.
4. Convert 130 in base 10 to base 2.
5. Convert 212 in base 10 to base 2.
6. Convert 247 in base 10 to base 2.

Answers:

1. 11100
2. 111111
3. 1100100
4. 10000010
5. 11010100
6. 11110111

**Convert Base 16 (Hexadecimal) to Base 10 (Decimal)**

Converting a number in one base to another is easy if you have a plan. Follow along with the two examples below to review converting from base 16 to base 10. Then try the practice problems.

**Example 1: Convert the hexadecimal number 9B2F to its decimal equivalent.**

1. Row 1 shows the **powers of 16** from 16^3 down to 16^0.
2. Row 2 shows what each power equals and the **place value** it represents.
3. In Row 3, write the **hexadecimal number** that we want to convert.
4. In Row 4, write the **hexadecimal equivalent** number.
5. In Row 5, multiply the **place value** times the **hexadecimal equivalent**. (Multiply Row 2 x Row 4 in each column).
6. Finally, add up the numbers in the last row (36864+2816+32+15) to get the **decimal number** 39727.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Powers of 16 | 163 | 162 | 161 | 160 |
| Hexadecimal Place Value | 4096 | 256 | 16 | 1 |
| **Hexadecimal Number** | **9** | **B** | **2** | **F** |
| **Hexadecimal Equivalent** | **9** | **11** | **2** | **15** |
| Decimal Number | 36864 | 2816 | 32 | 15 |

An easy way to show your work for this kind of calculation is as follows:

9B2F

= (9\*16^3) + (B\*16^2) + (2\*16^1) + (F\*16^0)  
= (9\*16^3) + (11\*16^2) + (2\*16^1) + (15\*16^0)  
= (9\*4096) + (11\*256) + (2\*16) + (15\*1)  
= 36864 + 2816 + 32 + 15  
= 39727

**Example 2: Convert the hexadecimal number CDEA0 to its decimal equivalent.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Powers of 16 | 164 | 163 | 162 | 161 | 160 |
| Hexadecimal Place Value | 65536 | 4096 | 256 | 16 | 1 |
| **Hexadecimal Number** | **C** | **D** | **E** | **A** | **0** |
| **Hexadecimal Equivalent** | **12** | **13** | **14** | **10** | **0** |
| Decimal Number | 786432 | 53248 | 3584 | 160 | 0 |

Adding  up the numbers in the last row (786432 + 53248 + 3584 + 160 + 0) =  843424.

An easy way to show your work for this kind of calculation is as follows:

CDEA0

= (C\*16^4) + (D \*16^3) + (E\*16^2) + (A\*16^1) + (0\*16^0)  
= (12\*16^4) + (13\*16^3) + (14\*16^2) + (10\*16^1) + (0\*16^0)  
= (12\*65536) + (13\*4096) + (14\*256) + (10\*16) + (0\*1)  
= 786432 + 53248 + 3584 + 160 + 0  
= 843424

Use this technique and you will be able to convert base 16 (hexadecimal) to base 10 (decimal) with ease!

**Test Yourself**

Test yourself with some practice problems. Check your answers with the key at the bottom of the page.

1. Convert the hexadecimal number 9C3A to its decimal equivalent. Fill in the third, fourth, and fifth row in the table and then show your work below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Powers of 16 | 163 | 162 | 161 | 160 |
| Hexadecimal Place Value | 4096 | 256 | 16 | 1 |
| **Hexadecimal Number** |  |  |  |  |
| **Hexadecimal Equivalent** |  |  |  |  |
| Decimal Number |  |  |  |  |

1. 9C3A
2. = (       \*16^3) + (      \*16^2) + (      \*16^1) + (      \*16^0)  
   = (       \*16^3) + (      \*16^2) +        \*16^1) + (       \*16^0)  
   = (       \*4096) + (      \*256) + (      \*16) + (      \*1)  
   =                 +                 +                 +                   
   =
3. Convert the hexadecimal number F06D to its decimal equivalent. Fill in the second, third, fourth, and fifth row in the table and then show your work below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Powers of 16 | 163 | 162 | 161 | 160 |
| Hexadecimal Place Value |  |  |  |  |
| **Hexadecimal Number** |  |  |  |  |
| **Hexadecimal Equivalent** |  |  |  |  |
| Decimal Number |  |  |  |  |

1. F06D =
2. Convert the hexadecimal number AC0E to its decimal equivalent.  Fill in each row in the table and then show your work below. Notice that you have two additional place values in this number.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Powers of 16 | 163 | 162 | 161 | 160 |
| Hexadecimal Place Value | 4096 | 256 | 16 | 1 |
| **Hexadecimal Number** |  |  |  |  |
| **Hexadecimal Equivalent** |  |  |  |  |
| Decimal Number |  |  |  |  |

1. AC0E =

Answers:

1. The base 16 hexadecimal number 9C3A is equal to the base 10 decimal number 39994.
2. The base 16 hexadecimal number F06D is equal to the base 10 decimal number 61549.
3. The base 16 hexadecimal number AC0E is equal to the base 10 decimal number 44046.

**Convert Base 10 (Decimal) to Base 16 (Hexadecimal)**

Converting a base 10 (decimal) number to a base 16 (hexadecimal) number is easy with the **successive division method** *algorithm*. Study the following examples. The numbers are color coded to help you keep track of what is happening.

**Example 1: Use successive division to convert the decimal number 5843 to a hexadecimal number.**

|  |  |
| --- | --- |
| **Explanation** | **Show Your Work** |
| Start with the highest hexadecimal place value (power of 16) that is *less than or equal to* the number you want to convert (**5843**). In this case it is 163, or **4096**. When you divide **5843** by **4096**, you get a **1** and you have a remainder of **1747**. | **5843**/**4096** = **1** rem **1747** |
| The next highest hexadecimal place value is 162, or **256**. When you divide **1747** by **256**, you get a **6** and you have a remainder of **211**. | **1747**/**256** = **6** rem **211** |
| The next highest hexadecimal place value is 161, or **16**. When you divide **211** by **16**, you get **13** and you have a remainder of **3**. | **211**/**16** = **13** rem **3** |
| The next highest place value is 160, or **1**. When you divide **3** by **1**, you get **3** with no remainder. | **3**/**1** = **3** remainder **0** |
| The **13** in the third step is replaced by the hexadecimal equivalent of **13,** which is **D**. |  |
| So the decimal number **5843** is equal to the hexadecimal number **16D3**. | |

This *algorithm* shows that the decimal number **5843** is equivalent to the hexadecimal number **16D3**.

**Example 2: Use successive division to convert the decimal number 24256 to a hexadecimal number.**

|  |  |
| --- | --- |
| **Explanation** | **Show Your Work** |
| Start with the highest hexadecimal place value (power of 16) that is *less than or equal to* the number you want to convert (**24256**). In this case it is 163, or **4096**. When you divide **24256** by **4096**, you get a **5** and you have a remainder of **3776**. | **24256**/**4096** = **5** rem **3776** |
| The next highest hexadecimal place value is 162, or **256**. When you divide **3776** by **256**, you get a **14** and you have a remainder of **192**. | **2776**/**256** = **14** rem **192** |
| The next highest hexadecimal place value is 161, or **16**. When you divide **192** by **16**, you get **12** and you have a remainder of **0**. | **192**/**16** = **12** rem **0** |
| The next highest place value is 160, or **1**. When you divide **0** by **1**, you get **0** with no remainder. | **0**/**1** = **0** remainder **0** |
| The **14** in the second step is replaced by the hexadecimal equivalent of **14,** which is **E**. The **12** in the third step is replaced by the hexadecimal equivalent of **12** which is **C**. |  |
| So the decimal number **24256** is equal to the hexadecimal number **5EC0**. | |

This *algorithm* shows that the decimal number **24256** is equivalent to the hexadecimal number **5EC0**.

**Test Yourself**

Test yourself with some practice problems. Check your answers with the key provided.

1. Convert 398 in base 10 to base 16.
2. Convert 982 in base 10 to base 16.
3. Convert 2432 in base 10 to base 16.
4. Convert 3999 in base 10 to base 16.
5. Convert 5998 in base 10 to base 16.
6. Convert 48630 in base 10 to base 16.

Answers:

1. 18E
2. 3D6
3. 980
4. F9F
5. 176E
6. BDF6