Number Bases – 2

Convert to a base from base 10

Here are three more examples of converting from base 10 to a different number base. In each case we will convert the base ten value 2,140. Our first example will convert that value to base 8. We can start by sketching out the base 8 place value system. From the right we have 8 to the 0 power, 8 to the first power, 8 squared, 8 cubed and 8 to the fourth. That is, from the right, we have the 1’s place, the 8’s place the 64’s place, the 512’s place and the 4096’s place. We do not need any 4096’s to make up our goal 2140. However we do need some 512’s. How many do we need? We divide 512 into 2140. It goes 4 times with a remainder of 92. Thus, we need 4 groups of 512. We still need to make up the remaining 92. How many groups of 64 are there in 92? We divide 64 into 92. It goes 1 time with a remainder of 28. Thus, we need 1 group of 64. Then we are left with the 28. How many groups of 8 are there in 28? Divide 8 into 28. It goes 3 times with a remainder of 4. We fill in the 3 groups of 8. We still need to account for the remaining 4 and we do that by using 4 groups of 1. Thus, 2140 base ten is equal to 4134 base eight.

Next we will convert 2140 base ten to base twelve. Again we create a base twelve place value system, writing out, from the right, twelve to the 0 power, twelve to the first power, twelve squared, and twelve cubed. That is, we have the 1’s place, the 12’s place, the 144’s place, and the 1728’s place. How many 1728’s do we need to build up our goal 2140? We divide 1728 into 2140. It goes 1 time with a remainder of 412. We need 1 group of 1728. How many groups of 144 will we need to build up to the remaining 412? Divide 144 into 412. It goes 2 times with a remainder of 124. We note the 2 required groups of 144. How many groups of 12 do we need to build up to 124? Divide 12 into 124. It goes 10 times with a reminder of 4. We want to note that we need 10 groups of twelve but we need to do so using just one character. We can do this because in base twelve we have the characters 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, T, and E. The “T” is the symbol for ten in base twelve. Therefore we note the ten groups of 12 with a T. Again, we have to deal with the remaining 4 and we do this by using 4 groups of 1. Thus, 2140 base ten is 12T4 base 12.

Finally, let us convert 2140 base ten to hexadecimal, that is, to base sixteen. Remember that base sixteen uses the sixteen symbols 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, and F, where A represents ten, B represents eleven, C represents twelve, D represents thirteen, E represents fourteen, and F represents fifteen. We create our base 16 place value chart starting from the right with 16 to the 0, 16 to the first, 16 squared, and 16 cubed, or, the 1’s place, the 16’s place, the 256’s place and the 4096’s place. We will not need any 4096’s to make up our 2140. How many 256’s do we need? We find out by dividing 2140 by 256. This gives us 8 with a remainder of 92. We note the 8 groups of 256. Then we find the number of 16’s needed for our remaining 92. Divide 16 into 92. It goes 5 times with a remainder of 12. We note the need for 5 groups of 16. This leaves us with the remaining 12. We can make up this 12 by using 12 ones, but we need to represent that with one character. We use the character C, as noted before, for that. Thus, 2410 base ten is equal to 85C base sixteen.