Bases

Place values

Base x (general format)

_____	_____	_____	_____	_____	_____	.
x^5	x^4	x^3	x^2	x^1	x^0	decimal point
$x \cdot x \cdot x \cdot x \cdot x$	$x \cdot x \cdot x \cdot x$	$x \cdot x \cdot x$	$x \cdot x$	x	1	

Examples

Base Ten (x = 10)

_____	_____	_____	_____	_____	_____	.
10^5	10^4	10^3	10^2	10^1	10^0	decimal point
100000	10000	1000	100	10	1	

Base Two (x = 2)

_____	_____	_____	_____	_____	_____	.
2^5	2^4	2^3	2^2	2^1	2^0	decimal point
32	16	8	4	2	1	

Digits used in each place value

Useful Vocabulary

binary--pertaining to a numbering a system that has 2 as a base, using digits 0 and 1.

hexadecimal--pertaining to a numbering system that uses 16 as the base, using the numerals 0 through 9 and representing digits greater than 9 with the letters A through F.

Base	Usable digits	# of digits
Base x	0 through x-1	x digits
Base 10	0 through 9	10 digits
Base 2	0 and 1	2 digits

Converting examples

Example 1:

What does 14_{ten} equal in base two?

Recall:

2^4	2^3	2^2	2^1	2^0
16	8	4	2	1

We need 0 sixteens, 1 eight, 1 four, 1 two and 0 ones. So, $14_{ten} = 1110_{two}$.

Example 2:

What does 194_{ten} equal in base five?

Note:

5^4	5^3	5^2	5^1	5^0
625	125	25	5	1

We need 1 one hundred twenty-five, 2 twenty-fives, 3 fives, and 4 ones = 125 + 50 + 15 + 4 = 194. So, $194_{ten} = 1234_{five}$.

Example 3:

What does 12403_{five} equal in base ten?

Note:

1	2	4	0	3
5^4	5^3	5^2	5^1	5^0
625	125	25	5	1

Since the number is in base 5, we write each digit in the appropriate place value. We have 1 six hundred twenty-five, 2 one hundred twenty-fives, 4 twenty-fives, 0 fives, and 3 ones = 625 + 250 + 100 + 0 + 3 = 978. So, $12403_{five} = 978_{ten}$

Converting Bases Name

1. What digits are used in the base six number system?

2.What are the first 4 place values in the base six number system?

3. What does 542_{six} equal in base ten?

4. What does 1053_{six} equal in base ten?

5. What does 99_{ten} equal in base six?

6. What does 275_{ten} equal in base six?

7. What is the largest 5 digit base 2 (or binary) number?

8.What is the 6th number in the binary number system (or what does 6_{ten} equal in base two)?

9. What does 11010_{two} equal in base ten?

10. What base is the hexadecimal system?