|  |  |  |
| --- | --- | --- |
| Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | **Number Systems** | Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

1. What are the first 15 binary numbers (starting from zero)?

|  |  |  |  |
| --- | --- | --- | --- |
| **Decimal** | **Binary** | **Decimal** | **Binary** |
| 0 |  | 8 |  |
| 1 |  | 9 |  |
| 2 |  | 10 |  |
| 3 |  | 11 |  |
| 4 |  | 12 |  |
| 5 |  | 13 |  |
| 6 |  | 14 |  |
| 7 |  | 15 |  |

2. Convert the following binary (base-2) numbers into decimal (base-10)

**Example:** convert 1101(bin) to decimal

**How to do it:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Place Value | 23 | 22 | 21 | 20 |
| Binary Number | 1 | 1 | 0 | 1 |
| What each place means | 8 | 4 | 0 | 1 |

**Answer:** 8 + 4 + 0 + 1 = 13

a. 10000 b. 10101

c. 101010 d. 1011101

2. Convert the following decimal numbers to binary.

**Example:** convert 612(dec) into binary.

**How to do it:** Subtract the largest power of 2 from 612 that does not go below zero. Repeat this process until you get to zero. The powers of 2 that you used will be ones, the powers of 2 that you did not use will be zeroes.

612 - **512** = 100  
100 - **64** = 36   
36 – **32** = 4  
4 – **4** = 0

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 512 | 256 | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| 1 | 0 | 0 | 1 | 1 | 0 | 0 | 1 | 0 | 0 |

**Answer:** 612(dec) = 1001100100(bin)

a. 18 b. 92

c. 599 d. 1025

3. Convert from Hexadecimal to Binary:

**Example:** Convert CA7(hex) to binary.

**How to do it**: Convert each hex digit separately into a 4 digit binary number. Combine the binary numbers together into a single number at the end:

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Hex | C | | | | A | | | | 7 | | | |
| Dec | 12 | | | | 10 | | | | 7 | | | |
| Bin | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |

**Answer:** CA7(hex) = 1100 1010 0111(bin)

a. AB(hex) b. 71(hex)

c. FAD(hex) d. BFF(hex)

4. Rewrite each hexadecimal number in decimal.

**Example:** convert CA7(hex) to decimal

**How to do it:**

|  |  |  |  |
| --- | --- | --- | --- |
| Place Value | 162 | 161 | 160 |
| Hexadecimal Number | C | A | 7 |
| What each place means | 256 x 12 = 3072 | 16 x 10 = 160 | 1 x 7 = 7 |

**Answer:** 3072 + 160 + 7 = 3239

a. AB(hex) b. 71(hex)

c. FAD(hex) d. BFF(hex)

5. Convert the following binary numbers to hexadecimal.

**Example:** convert 1101 0001(bin) to hexadecimal

**How to do it:** Convert each group of 4 binary digits (starting from the right) into a single hexadecimal digit:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Bin | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 |
| Dec | 10 | | | | 7 | | | |
| Hex | A | | | | 7 | | | |

**Answer:** A7

a. 1111 b. 1001 1110

c. 100 1000 d. 1100 1110 0011

6. Arbitrary number systems: A good test of your understanding of how number systems work is to try converting to and from something like base 7 or base 3

a. Write 940(dec) in base-3

b. 1643 is a number in base 7. What is that number in base 10?