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| **P2-1.** | Convert the following binary numbers to decimal without using a calculator, showing your work:   1. (01101)2 = 13 **c.** (011110.01)2 = 24 2. (1011000)2 = 88 **d.** (111111.111)2 = 35 |
| **P2-2.** | Convert the following hexadecimal numbers to decimal without using a calculator, showing your work:   1. (AB2)16 = 2738 **c.** (ABB)16 = 2747 2. (123)16 = 291 **d.** (35E.E1)16 = (862.87890625)10 |
| **P2-3.** | Convert the following octal numbers to decimal without using a calculator, showing your work:   1. (237)8 = 159 **c.** (617.7)8 = 399.875 2. (2731)8 = 1497 **d.** (21.11)8 = 17.140625 |
| **P2-4.** | Convert the following decimal numbers to binary without using a calculator, showing your work:   1. 1234 = 10011010010 **c.** 124.02 = 1111100.000001010001111011 2. 88 = 1011000 **d.** 14.56 = 1110.10001111010111000011 |

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| **P2-5.** | Convert the following decimal numbers to octal without using a calculator, showing your work:   1. 1156 = 2204 **c.** 11.4 = 13.31463146314631463146 2. 99 = 143 **d.** 72.8 = 110.63146314631463146315 |
| **P2-6.** | Convert the following decimal numbers to hexadecimal without using a calculator, showing your work:   1. 567 **c.** 12.13 2. 1411 **d.** 16 |
| **P2-7.** | Convert the following octal numbers to hexadecimal without using a calculator, showing your work:   1. (514)8 **c.** (13.7)8 2. (411)8 **d.** (1256)8 |
| **P2-8.** | Convert the following hexadecimal numbers to octal without using a calculator, showing your work:   1. (51A)16 **c.** (BB.C)16 2. (4E1)16 **d.** (ABC.D)16 |
| **P2-9.** | Convert the following binary numbers to octal without using a calculator, showing your work:   1. (01101)2 **c.** (011110.01)2 2. (1011000)2 **d.** (111111.111)2 |
| **P2-10.** Convert the following binary numbers to hexadecimal without using a calculator, showing your work:   1. (01101)2 **c.** (011110.01)2 2. (1011000)2 **d.** (111111.111)2   **P2-11.** Convert the following decimal numbers to binary using the alternative method discussed in Example 2.17, showing your work:   1. 121 **c.** 255 2. 78 **d.** 214   **P2-12.** Change the following decimal numbers into binary using the alternative method discussed in Example 2.18, showing your work:   1. 3 5⁄8 **c.** 4 13*⁄*64 2. 12 3*⁄*32 **d.** 12 5*⁄*128   **P2-13.** In a positional number system with base b, the largest integer number that can be represented using *K* digits is b*K* **−** 1. Find the largest number in each of the following systems with *six* digits:   1. Binary **c.** Hexadecimal 2. Decimal **d.** Octal   **P2-14.** Without converting, find the minimum number of digits needed in the destination system for each of the following cases:   1. Five-digit decimal number converted to binary. 2. Four-digit decimal converted to octal. 3. Seven-digit decimal converted to hexadecimal. | |

**P2-15.** Without converting, find the minimum number of digits needed in the destination system for each of the following cases:

* 1. 5-bit binary number converted to decimal.
  2. Three-digit octal number converted to decimal.
  3. Three-digit hexadecimal converted to decimal.

**P2-16.** The following table shows how to rewrite a fraction so the denominator is a power of two (1, 4, 8, 16, and so on).

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| *Original* | *New* | *Original* | *New* |
| 0.5 | 1⁄2 | 0.25 | 1⁄4 |
| 0.125 | 1⁄8 | 0.0625 | 1⁄16 |
| 0.03125 | 1⁄32 | 0.015625 | 1⁄64 |

However, sometimes we need a combination of entries to find the appropriate fraction. For example, 0.625 is not in the table, but we know that 0.625 is 0.5 1

0.125. This means that 0.625 can be written as 1⁄2 1 1⁄8, or 5⁄8. Change the following decimal fractions to a fraction with a power of 2.

* 1. 0.1875 **c.** 0.40625
  2. 0.640625 **d.** 0.375

**P2-17.** Using the results of the previous problem, change the following decimal numbers to binary numbers.

* 1. 7.1875 **c.** 11.40625
  2. 12.640625 **d.** 0.375

**P2-18.** Find the maximum value of an integer in each of the following cases:

* 1. b 5 10, *K* 5 10 **c.** b 5 8, *K* 5 8
  2. b 5 2, *K* 5 12 **d.** b 5 16, *K* 5 7

**P2-19.** Find the minimum number of required bits to store the following integers:

* 1. less than 1000
  2. less than 100 000
  3. less than 64
  4. less than 256

**P2-20.** A number less than b*K* can be represented using *K* digits in base b. Show the number of digits needed in each of the following cases. **a.** Integers less than 214 in binary

* 1. Integers less than 108 in decimal
  2. Integers less than 813 in octal
  3. Integers less than 164 in hexadecimal

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| **P2-22.** Internet addresses described in the previous problem are also represented as patterns of bits. In this case, 32 bits are used to represent an address, eight bits for each symbol in dotted decimal notation. For example, the address 10.200.14.72 can also be represented as 00001010 11001000 00001110 01001000. Show the bit representation of the following Internet addresses:   1. 17.234.34.14 **c.** 110.14.56.78 2. 14.56.234.56 **d.** 24.56.13.11   **P2-23.** Write the decimal equivalent of the following Roman numbers:   1. XV **c.** VLIII 2. XXVII **d.** MCLVII   **P2-24.** Convert the following decimal numbers to Roman numbers:   1. 17 **c.** 82 2. 38 **d.** 999   **P2-25.** Find which of the following Roman numerals are not valid: | |
|  | 1. MMIM **c.** CVC 2. MIC **d.** VX |
| **P2-26.** | Mayan civilization invented a positional vigesimal (base 20) numeral system, called the *Mayan numeral system*. They use base 20 probably because they used both their fingers and toes for counting. This system has 20 symbols that are constructed from three simpler symbols. The advanced feature of the system is that it has a symbol for zero, which is a shell. The other two symbols are a circle (or a pebble) for one and a horizontal bar (or a stick) for five. To represent a number greater than nineteen, numerals are written vertically. Search the Internet to answer the following: what are the decimal numbers 12, 123, 452, and 1256 in the Mayan numeral system? |
| **P2-27.** | The *Babylonian* civilization is credited with developing the first positional numeral system, called the *Babylonian numeral system*. They inherited the Sumerian and Akkadian numeral system and developed it into positional sexagesimal system (base 60). This base is still used today for times and angles. For example, one hour is 60 minutes and one minute is 60 seconds: similarly, one degree is 60 minutes and one minute is 60 seconds. As a positional system with base b requires b symbols (digits), we expect a positional sexagesimal system to require 60 symbols. However, the Babylonians did not have a symbol for zero, and produced the other 59 symbols by stacking two symbols, those for one and ten. Search the Internet to answer the following questions:   1. Express the following decimal numbers in Babylonian numerals: 11 291, 3646, 3582. 2. Mention problems that might arise from not having a symbol for 0. Find how the Babylonian numeral system addresses the problem. |