# Chapter 2 Exercises and Answers

Answers are in blue.

**For Exercises 1-5, match the following numbers with their definition.**

**A. Number**

**B. Natural number**

**C. Integer number**

**D. Negative number**

**E. Rational number**

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| 1. | A unit of an abstract mathematical system subject to the laws of arithmetic.  A |
| 2. | A natural number, a negative of a natural number, or zero.  C |
| 3. | The number zero and any number obtained by repeatedly adding one to it.  B |
| 4. | An integer or the quotient of two integers (division by zero excluded).  E |
| 5. | A value less than zero, with a sign opposite to its positive counterpart.  D |

**For Exercises 6-11, match the solution with the problem.**

**A. 10001100**

**B. 10011110**

**C. 1101010**

**D. 1100000**

**E. 1010001**

**F. 1111000**

|  |  |
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| 6. | 1110011 + 11001 (binary addition)  A |
| 7. | 1010101 + 10101 (binary addition)  C |
| 8. | 1111111 + 11111 (binary addition)  B |
| 9. | 1111111 – 111 (binary subtraction)  F |
| 10. | 1100111 – 111 (binary subtraction)  D |
| 11. | 1010110 – 101 (binary subtraction)  E |

**For Exercises 12 -17, mark the answers true and false as follows:**

**A. True**

**B. False**

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| 12. | Binary numbers are important in computing because a binary number can be converted into every other base.  B |
| 13. | Binary numbers can be read off in hexadecimal but not in octal.  B |
| 14. | Starting from left to right, every grouping of four binary digits can be read as one hexadecimal digit.  B |
| 15. | A byte is made up of six binary digits.  B |
| 16. | Two hexadecimal digits can be stored in one byte.  A |
| 17. | Reading octal digits off as binary produces the same result whether read from right to left as left to right.  A |

**Exercises 18- 45 are problems or short answer questions.**

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| 18. | Distinguish between a natural number and a negative number.  A natural number is 0 and any number that can be obtained by repeatedly adding 1 to it. A negative number is less than 0, and opposite in sign to a natural number. Although we usually do not consider negative 0. |
| 19. | Distinguish between a natural number and a rational number.  A rational number is an integer or the quotient of integer numbers. (Division by 0 is excluded.) A natural number is 0 and the positive integers. (See also definition in answer to Exercise 1.) |
| 20. | Label the following numbers natural, negative, or rational.  A. 1.333333  rational  B. – 1/3  negative, rational  C. 1066  natural  D. 2/5  rational  E. 6.2  rational  F. π (pi)  not any listed |
| 21. | If 891 is a number in each of the following bases, how many 1s are there?  A. base 10  891  B. base 8  Can't be a number in base 8,  C. base 12  1261  D. base 13  1470  E. base 16  2193 |
| 22. | Express 891 as a polynomial in each of the bases in Exercise 1.  A. 8 \* 102 + 9 \* 10 + 1  B. Can't be shown as a polynomial in base 8.  C. 8 \* 122 + 9 \* 12 + 1  D. 8 \* 132 + 9 \* 13 + 1  E. 8 \* 162 + 9 \* 16 + 1 |
| 23. | Convert the following numbers from the base shown to base 10.  A. 111 (base 2)  7  B. 777 (base 8)  511  C. FEC (base 16)  4076  D. 777 (base 16)  1911  E. 111 (base 8)  73 |
| 24. | Explain how base 2 and base 8 are related.  Because 8 is a power of 2, base-8 digits can be read off in binary and 3 base-2 digits can be read off in octal. |
| 25. | Explain how base 8 and base 16 are related.  8 and 16 are both powers of two. |
| 26. | Expand Table 2.1 to include the numbers from 10 through 16.  *binary octal decimal*  000 0 0  001 1 1  010 2 2  011 3 3  100 4 4  101 5 5  110 6 6  111 7 7  1000 10 8  1001 11 9  1010 12 10  1011 13 11  1100 14 12  1101 15 13  1110 16 14  1111 17 15  10000 20 16 |
| 27. | Expand the table in Exercise 26 to include hexadecimal numbers.  *binary octal decimal hexadecimal*  000 0 0 0  001 1 1 1  010 2 2 2  011 3 3 3  100 4 4 4  101 5 5 5  110 6 6 6  111 7 7 7  1000 10 8 8  1001 11 9 9  1010 12 10 A  1011 13 11 B  1100 14 12 C  1101 15 13 D  1110 16 14 E  1111 17 15 F  10000 20 16 20 |
| 28. | Convert the following binary numbers to octal.  A. 111110110  766  B. 1000001  101  C. 10000010  202  D. 1100010  142 |
| 29. | Convert the following binary numbers to hexadecimal.  A. 10101001  A9  B. 11100111  E7  C. 01101110  6E  D. 01121111  This is not a binary number |
| 30. | Convert the following hexadecimal numbers to octal.  A. A9  251  B. E7  347  C. 6E  156 |
| 31. | Convert the following octal numbers to hexadecimal.  A. 777  1FF  B. 605  185  C. 443  123  D. 521  151  E. 1  1 |
| 32. | Convert the following decimal numbers to octal.  A. 901  1605  B. 321  501  C. 1492  2724  D. 1066  2052  E. 2001  3721 |
| 33. | Convert the following decimal numbers to binary.  A. 45  101101  B. 69  1000101  C. 1066  10000101010  D. 99  1100011  E. 1  1 |
| 34. | Convert the following decimal numbers to hexadecimal.  A. 1066  42A  B. 1939  793  C. 1  1  D. 998  3E6  E. 43  2B |
| 35. | If you were going to represent numbers in base 18, what symbols might you use to represent the decimal numbers 10 through 17 other than letters?  Any special characters would work or characters from another alphabet. Let's use # for 16 and @ for 17. |
| 36. | Convert the following decimal numbers to base 18 using the symbols you suggested in Exercise 15.  A. 1066  354  B. 99099  #@F9  C. 1  1 |
| 37. | Perform the following octal additions  A. 770 + 665  1655  B. 101 + 707  1010  C. 202 + 667  1071 |
| 38. | Perform the following hexadecimal additions  A. 19AB6 + 43  19AF9  B. AE9 + F  AF8  C. 1066 + ABCD  BC33 |
| 39. | Perform the following octal subtractions.  A. 1066 – 776  70  B. 1234 – 765  247  C. 7766 – 5544  2222 |
| 40. | Perform the following hexadecimal subtractions.  A. ABC – 111  9AB  B. 9988 – AB  98DD  C. A9F8 – 1492  9566 |
| 41. | Why are binary numbers important in computing?  Data and instructions are represented in binary inside the computer. |
| 42. | A byte contains how many bits?  8 |
| 43. | How many bytes are there in a 64-bit machine?  8 |
| 44. | Why do microprocessors such as pagers have only 8-bit machines?  Pagers are not general-purpose computers. The programs in pagers are small enough to be represented in 8-bit machines. |
| 45. | Why is important to study how to manipulate fixed-sized numbers?  It is important to understand how to manipulate fixed-sized numbers because numbers are represented in a computer in fixed-sized format. |
| 46. | How many ones are there in the number AB98 in base 13?  ((13\*13\*13\*10) + (13\*13\*11) + 13\*9) + 8) = 23954 |
| 47. | Describe how a bi-quinary number representation works.  There are seven lights to represent ten numbers. The first two determine the meaning of the next five. If the first light is on, the next five represent 0, 1, 2, 3, and 4 respectively. If the second is on, the next five represent 5, 6, 7, 8, and 9 respectively. |