

## 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

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

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

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.**

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.  $\pi$  (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.  $8 * 10^2 + 9 * 10 + 1$
  - B. Can't be shown as a polynomial in base 8.
  - C.  $8 * 12^2 + 9 * 12 + 1$
  - D.  $8 * 13^2 + 9 * 13 + 1$
  - E.  $8 * 16^2 + 9 * 16 + 1$
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.

<i>binary</i>	<i>octal</i>	<i>decimal</i>
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.

<i>binary</i>	<i>octal</i>	<i>decimal</i>	<i>hexadecimal</i>
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.