**Extra Credit: 0040006A – 00400020 = 4A hex = 74 dec, can be represented by 8 bit unsigned 01001010 , can be assumed to use 1 byte**

1. In an 8-bit binary number, which is the most significant bit (MSB)?

Leftmost bit. 00110101

2. What is the decimal representation of each of the following unsigned binary integers?

a. 00110101 = 53

b. 10010110 = 150

c. 11001100 = 204

3. What is the sum of each pair of binary integers?

a. 10101111 + 11011011 = 1.10001010 = 394

b. 10010111 + 11111111 = 1.10010110 = 406

c. 01110101 + 10101100 = 1.00100001 = 289

4. Calculate binary 00001101 minus 00000111.

00001101 13

-00000111 7

00000110 6

5. How many bits are used by each of the following data types?

a. word = 16

b. doubleword = 32

c. quadword = 64

d. double quadword = 128

6. What is the minimum number of binary bits needed to represent each of the following unsigned decimal integers?

a. 4095 = 1111 1111 1111, 12 bits

b. 65534 1111 1111 1111 1110, 16 bits

c. 42319 1010 0101 0100 1111, 16 bits

7. What is the hexadecimal representation of each of the following binary numbers?

a. 0011 0101 1101 1010 done in 4 bit sections: 0011 = 3, 0101 = 5, 1101 = 13 = D, 1010 = 10 = A

35DA

b. 1100 1110 1010 0011, 4bits 1100 = 12 = C, 1110 = 14 = E, 1010 = 10 = A, 0011 = 3

CEA3

c. 1111 1110 1101 1011, 4bits 1111 = 15 = F, 1110 = 14 = E, 1101 = 13 = D, 1011 = 11 = B

FEDB

8. What is the binary representation of the following hexadecimal numbers?

a. 0126F9D4 4 + 13\*16 + 9\*16^2 + 15\*16^3 + 6\*16^4 + 2\*16^5 + 16^6 = 19331540 =

0001 0010 0110 1111 1001 1101 0100

b. 6ACDFA95 = 0110 1010 1100 1101 1111 1010 1001 0101

c. F69BDC2A = 1111 0110 1001 1011 1101 1100 0010 1010

9. What is the unsigned decimal representation of each of the following hexadecimal integers?

a. 3A 10 + 3\*16 = 58

b. 1BF 15 + 11\*16 + 16^2 = 447

c. 1001 = 1 + 16 ^ 3 = 4097

10. What is the unsigned decimal representation of each of the following hexadecimal integers?

a. 62 = 2 + 16\*6 = 98

b. 4B3 3 + 11\*16 + 4\*16^2 = 1203

c. 29F 15 + 9\*16 + 2\*16^2 = 671

11. What is the 16-bit hexadecimal representation of each of the following signed decimal integers?

a. –24 16 + 8 24 = 0018, FFE7 + 1 = FFE8

b. –331 331 = 014B, FEB4 + 1 = FEB5

12. What is the 16-bit hexadecimal representation of each of the following signed decimal integers?

a. –21 21 = 0015, FFEB

b. –45 45 = 16\*2 + 13, 002D, FFD3

13. The following 16-bit hexadecimal numbers represent signed integers. Convert each to decimal.

a. 6BF9 = 6\*16^3 + 11\*16^2 + 15\*16 + 9 = 27641

b. C123 = -(3EDD) = -(3\*16^3 + 14\*16^2 + 13\*16 + 13) = -16093

14. The following 16-bit hexadecimal numbers represent signed integers. Convert each to decimal.

a. 4CD2 = 4\*16^3 + 12\*16^2 + 13\*16 + 2 = 19666

b. 8230 = -(7DCF + 1) = -(7DD0) = -32208

15. What is the decimal representation of each of the following signed binary numbers?

a. 10110101 = -(01001011) = -(64+8+2+1) = -75

b. 00101010 = 2 + 8 + 32 = 42

c. 11110000 = -(00010000) = -16

16. What is the decimal representation of each of the following signed binary numbers?

a. 10000000 = -(10000000) = -128

b. 11001100 = -(00110100) = -(4+16+32) = -52

c. 10110111 = -(01001001) = -(64+8+1) = -73

17. What is the 8-bit binary (two’s-complement) representation of each of the following signed decimal integers?

a. –5 = -(00000101) = 11111011

b. –42 = -(00101010) = 11010110

c. –16 = -(00010000) = 11101111 + 1 = 11110000

18. What is the 8-bit binary (two’s-complement) representation of each of the following signed decimal integers?

a. –72 = 10111000

b. –98 =

c. –26 = 11100110

19. What is the sum of each pair of hexadecimal integers?

a. 6B4 + 3FE

b. A49 + 6BD

20. What is the sum of each pair of hexadecimal integers?

a. 7C4 􏰁 3BE

b. B69 􏰁 7AD

21. What are the hexadecimal and decimal representations of the ASCII character capital B?

Hex: 42 Dec: 66

22. What are the hexadecimal and decimal representations of the ASCII character capital G?

Hex: 47 Dec: 71

23. Challenge: What is the largest decimal value you can represent, using a 129-bit unsigned

integer?

(2 ^ 129) – 1 = 6.8 \* 10^38 – 1 ~= 6.8 \* 10^38

24. Challenge: What is the largest decimal value you can represent, using a 86-bit signed integer?

((2 ^ 86) – 1) / 2) - 1 ~= ((7.74 \* 10^25) / 2) – 1 ~= 3.868 \* 10^25

25. Create a truth table to show all possible inputs and outputs for the boolean function described by ¬(A ∨ B).

Not(A OR B)

|  |  |  |  |
| --- | --- | --- | --- |
| A | B | A ∨ B | ¬(A ∨ B) |
| T | T | T | F |
| F | T | T | F |
| T | F | T | F |
| F | F | F | T |

26. Create a truth table to show all possible inputs and outputs for the boolean function described by (¬A ∧ ¬B). How would you describe the rightmost column of this table in relation to the table from question number 25? Have you heard of De Morgan’s Theorem?

(NOT A) And (NOT B)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A | B | ¬A | ¬B | (¬A ∧ ¬B) |
| T | T | F | F | F |
| F | T | T | F | F |
| T | F | F | T | F |
| F | F | T | T | T |

Each of the rightmost columns are identical. I’ve heard of De Morgan’s theorem in the logic section of my philosophy course before starting computer science.

27. If a boolean function has four inputs, how many rows are required for its truth table?

2^n, 2^4 = 16

28. How many selector bits are required for a four-input multiplexer?

2 selector bits, combinations of 00, 01, 10, and 11 give 4 combinations