**Number Systems**

**Exercise 1** What is the largest 32-bit binary number that can be represented with

(a) unsigned numbers?

(b) two’s complement numbers?

(c) sign/magnitude numbers?

[(a) 4,294,967,295; (b) 2,147,483,647; (c) 2,147,483,647]

**Exercise 2** What is the smallest (most negative) 16-bit binary number that can be represented with

(a) unsigned numbers?

(b) two’s complement numbers?

(c) sign/magnitude numbers?

[(a) 0; (b) -32768; (c) -32767]

**Exercise 3** What is the smallest (most negative) 32-bit binary number that can be represented with

(a) unsigned numbers?

(b) two’s complement numbers?

(c) sign/magnitude numbers?

[(a) 0; (b) -2,147,483,648; (c) -2,147,483,647;]

**Exercise 4** Convert the following unsigned binary numbers to **decimal** and to **hexadecimal**:

(a) 11102

(b) 1001002

(c) 110101112

(d) 0111010101001002

(e) 01102

(f) 1011012

(g) 100101012

(h) 1101010010012

[(a) 14; (b) 36; (c) 215; (d) 15,012; (A) E; (B) 24; (C) D7; (D) 3AA4]

[(e) 6; (f) 45; (g) 149; (h) 3,401; (E) 6; (F) 2D; (G) 95; (H) D49]

**Exercise 5** Convert the following hexadecimal numbers to **decimal** and to **unsigned binary**:

(a) 4E16

(b) 7C16

(c) ED3A16

(d) 403FB00116

(e) 2B16

(f) 9F16

(g) 42CE16

(h) E34F16

[(a) 78; (b) 124; (c) 60,730; (d) 1,077,915,649]

[(A) 100 1110; (B) 111 1100; (C) 1110 1101 0011 1010; (D) 100 0000 0011 1111 1011 0000 0000 0001]

[(e) 43; (f) 159; (g) 17,102; (h) 58,191]

[(E) 10 1011; (F) 1001 1111; (G) 100 0010 1100 1110; (H) 1110 0011 0100 1111]

**Exercise 6** Convert the following two’s complement binary numbers to **decimal**.

(a) 11102

(b) 1000112

(c) 010011102

(d) 101101012

(e) 10012

(f) 1101012

(g) 011000102

(h) 101110002

[(a) -2; (b) -29; (c) 78; (d) -75; (e) -7; (f) -11; (g) 98; (h) -72]

**Exercise 7** Convert the following decimal numbers to **unsigned binary numbers** and to **hexadecimal**.

(a) 4210

(b) 6310

(c) 22910

(d) 84510

(e) 5610

(f) 7510

(g) 18310

(h) 75410

[(a) 10 1010; (b) 11 1111; (c) 1110 0101; (d) 11 0100 1101]

[(A) 2A; (B) 3F; (C) E5; (D) 34D]

[(e) 11 1000; (f) 100 1011; (g) 1011 0111; (h) 10 1111 0010]

[(E) 38; (F) 4B; (G) B7; (H) 2F2]

**Exercise 8** Convert the following decimal numbers to 8-bit two’s complement numbers or indicate that the decimal number would overflow the range.

(a) 2410

(b) −5910

(c) 12810

(d) −15010

(e) 12710

(f) 4810

(g) −3410

(h) 13310

(i) −12910

(j) −12810

[(a) 0001 1000; (b) 1100 0101; (c) overflow; (d) overflow; (e) 0111 1111]

[(f) 0011 0000; (g) 1101 1110; (h) overflow; (i) overflow; (j) 1000 0000]

**Exercise 9** How many bytes are in a 32-bit word? How many nibbles are in the 32-bit word?

[4; 8]

**Exercise 10** How many bytes are in a 64-bit word? How many nibbles are in the 64-bit word?

[8; 16]

**Exercise 11** How many bits are in 2 bytes? How many bits are in 6 bytes?

[16; 48]

**Exercise 12** A particular DSL modem operates at 768 kbits/sec.How many bytes can it receive in 1 minute?

[5,760,000]

**Exercise 13** USB 3.0 can send data at 5 Gbits/sec. How many bytes can it send in 1 minute?

[(5 × 109 bits/second)(60 seconds/minute)(1 byte/8 bits) = 3.75 × 1010]