**1. Convert the following decimal fractions to binary with a maximum of six places to the right of the binary point:**

a) 27.59375 = 16+8+2+1+++

= 0001 1011.1001 1

b) 105.59375 = 64 +32+8+1+++

= 0110 1001.1001 1

c) 241.53125 = 128+64+32+16+1+++

= 1111 0001.1000 1

d) 327.78125 = 256+64+4+2+1+++

= 0001 0100 0111.1100 1

**2. Convert the following binary fractions to decimal:**

a) 0010 0001.1110 = +++1+32

= 33.875

b) 0011 1111.1001 1 = 32+16+8+4+2+1+++

= 63.59375

c) 0100 1100.1011 = 64+8+4+0.5+0.125+0.0625

= 76.6875

d) 1000 1001.0111 = 0.25+0.125+0.0625+1+8+128

= 137.4375

**3. Convert the hexadecimal number DEAD BEEF16 to binary.**

1 2 3 4 5 6 7 8 9 A B C D E F

0001 0010 0011 0100 0101 0110 0111 1000 1001 1010 1011 1100 1101 1110 1111

D E A D B E E F

1101 1110 1010 1101 1011 1110 1110 1111

DEAD BEEF16 = 1101 1110 1010 1101 1011 1110 1110 1111

**4. Represent the following decimal numbers in binary using 8-bit signed magnitude, one's complement, and two's complement representation:**

a) 77 = 64+8+4+1

= 0100 1101

one's complement = 0100 1101

two's complement = 0100 1101

b) -42 = -32-8-2

=

one's complement =

two's complement =

**5. What decimal value does the 8-bit binary number 1011 0100 have if:**

**a) it is interpreted as an unsigned number?**

1011 0100 = 128+32+16+4

= 180

**b) it is on a computer using signed-magnitude representation?**

1011 0100 = 32+16+4 ( not with signed-magnitude)

= 52 ( not with signed-magnitude)

= – 52 (with signed-magnitude)

**c) it is on a computer using one’s complement representation?**

1011 0100 = -75

**d) it is on a computer using two’s complement representation?**

1011 0100 = -76

**6. Given a (very) tiny computer that has a word size of 4 bits, what are the smallest negative numbers and the largest positive numbers that this computer can represent in each of the following representations?**

[-2(n-1), 2(n-1)-1]

[-23, 23-1]

[-8, 7]

[1000, 0111]2

**a) One's complement**

7 = 01112

-8 = -

**b) Two's complement**

7 = 01112

-8 = 10002

**7. Add the following unsigned binary numbers as shown.**

a) 01000100

10111011 +

11111111

b) 10101100

00100100 +

11010000

**8. Subtract the following signed binary numbers as shown using 2's complement arithmetic.**

a) 11000100 11000100

00111011 - 🡪 01000101 +

10001001

b) 01011011 01011011

00011111 - 🡪 01100001 +

00111100

**9. Perform the following binary multiplications, assuming unsigned integers:**

a) 10011

1011 x

10011

100110 +

10011000

11010001

b) 11010

1011 x

11010

110100 +

11010000

100011110

**10. Perform the following binary multiplications using Booth’s algorithm, assuming signed two’s complement integers:**

note

A) 1011 01 + 11, 00 shift

x 0101 10 –

-00001011 🡪 11110101 (2’)

+00010110 🡪 00010110 +

-00101100 🡪 11010100 (2’)

+01011000 🡪 01011000

~~10~~00110111

note

11110101 (2’) 11010100 (2’) 100001011

00010110 + 01011000 + 100101100 +

100001011 100101100 1000110111

Ans. 0011 0111

b) 0011

1011 x

- 00000011 🡪 11111101 (2’)

0 (shift) 🡪 00000000 +

00001100 🡪 00001100

- 00011000 🡪 11101000 (2’)

~~1~~11110001

Ans. 1111 0001