

**CS24 Elementary Computer Organization
Floating Point and Karnaugh Map Problems**

1. Give the float (32 bit) representation of the following values. Your final answer should be in hexadecimal.

a) 14.125

Divide Whole Num by 2	Result	Remainder?
$14/2$	7.0	0
$7/2$	3.5	1
$3/2$	1.5	1
$1/2$	0.5	1

Whole Number Binary Representation:

1110

Multiply Decimal by 2	Result	Whole number?
0.125×2	0.25	0
0.25×2	0.5	0
0.5×2	1.0	1

Decimal Binary Representation:

001

Fixed Point Notation:

1110.001

=

1.11000×2^3

Exponent = $127 + 3 = 130 = 10000010$

Mantissa = 110001

Sign = 0 (Positive Decimal)

Fit the following values into the following format:

Sign (1 bit)	Exponent (8 bits)	Mantissa (23 bits)
0	10000010	10000010000000000000000

$14.125 = 01000010100001000000000000000000$

In Hexadecimal:

=

0X41620000

b) **-7.53125**

Divide Whole Num by 2	Result	Remainder?
$7/2$	3.5	1
$3/2$	1.5	1
$1/2$	0.5	0

Whole Number Binary Representation:

111

Multiply Decimal by 2	Result	Whole number?
0.53125×2	1.0625	1
0.0625×2	0.125	0
0.125×2	0.25	0
0.25×2	0.5	0
0.5×2	1.0	1

Decimal Binary Representation:

10001

Fixed Point Notation:

111.10001

=

1.1110001×2^2

Exponent = $127 + 2 = 129 = 10000001$

Mantissa = 1110001

Sign = 1 (Negative Decimal)

Fit the following values into the following format:

Sign (1 bit)	Exponent (8 bits)	Mantissa (23 bits)
1	10000001	11100010000000000000000

$-7.53125 = 11000000111100010000000000000000$

In Hexadecimal:

=

0XC0F10000

c) **8675.309**

Divide Whole Num by 2	Result	Remainder?
$8675/2$	4337.5	1
$4337/2$	2168.5	1
$2168/2$	1084.0	0
$1084/2$	542.0	0
$542/2$	271.0	0
$271/2$	135.5	1
$135/2$	67.5	1
$67/2$	33.5	1
$33/2$	16.5	1
$16/2$	8.0	0
$8/2$	4.0	0
$4/2$	2.0	0
$2/2$	1.0	0
$1/2$	0.5	1

Whole Number Binary Representation:
1000111100011

Multiply Decimal by 2	Result	Whole number?
0.309×2	0.618	0
0.618×2	1.236	1
0.236×2	0.472	0
0.472×2	0.944	0
0.944×2	1.888	1
0.888×2	1.776	1
0.776×2	1.552	1
0.552×2	1.104	1
0.104×2	0.208	0
0.208×2	0.416	0
0.416×2	0.832	0
0.832×2	1.664	1
0.664×2	1.328	1
0.328×2	0.656	0
0.656×2	1.312	1
0.312×2	0.624	0

Decimal Binary Representation:
010011110001101

Fixed Point Notation:
10000111100011.0100111100

=

1.00001111000110100111100 $\times 2^{13}$

Exponent = $127 + 13 = 140 = 10001100$

Mantissa = 00001111000110100111100

Sign = 0 (Positive Decimal)

Fit the following values into the following format:

Sign (1 bit)	Exponent (8 bits)	Mantissa (23 bits)
0	10001100	00001111000110100111100

8675.309 = 01000110000001111000110100111100

In Hexadecimal:

=

0X46078D3C

2. Give the decimal representation of the following 32bit float values.

a) 00111111100000100000000000000000

Exponent = 01111110 - 127 = 126 - 127 = -1

Mantissa = 00001

Sign = 0 (Positive Decimal)

Use the following formula to convert to decimal representation:

$$\begin{aligned}
 & (-1)^{sign} \times (1 + mantissa) \times 2^{exponent} \\
 & = \\
 & (-1)^0 \times (1 + .00001) \times 2^{-1} \\
 & = \\
 & (-1)^0 \times (1.03125) \times 2^{-1} \\
 & = \\
 & \boxed{0.515625}
 \end{aligned}$$

b) 01000010110111100000000000000000

Exponent = 10000101 - 127 = 133 - 127 = 6

Mantissa = 101111

Sign = 0 (Positive Decimal)

Use the following formula to convert to decimal representation:

$$\begin{aligned}
 & (-1)^{sign} \times (1 + mantissa) \times 2^{exponent} \\
 & = \\
 & (-1)^0 \times (1 + .101111) \times 2^6 \\
 & = \\
 & (-1)^0 \times (1.7343) \times 2^6 \\
 & = \\
 & \boxed{110.99}
 \end{aligned}$$

c) 11000010111110100100000000000000

Exponent = 10000101 - 127 = 133 - 127 = 6

Mantissa = 111101001

Sign = 1 (Negative Decimal)

Use the following formula to convert to decimal representation:

$$\begin{aligned}
 & (-1)^{sign} \times (1 + mantissa) \times 2^{exponent} \\
 & \quad = \\
 & (-1)^1 \times (1 + .111101001) \times 2^6 \\
 & \quad = \\
 & (-1)^1 \times (1.953125) \times 2^6 \\
 & \quad = \\
 & \boxed{-125.0}
 \end{aligned}$$

3. Give the equation (In Sum-Of-Products form) for this truth table, then use a Karnaugh map to simplify. Show your table and final equation

a)

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

Sum-Of-Products form based upon the truth table:

$$f(A, B, C) = \overline{A}BC + A\overline{B}C + ABC$$

Karnaugh Map based upon the truth table:

		C
AB	0	1
00	0	0
01	0	1
11	0	1
10	0	1

Boolean expression based upon the Karnaugh Map:

$$f(A, B, C) = BC + AC$$

4. Give the equation (In Sum-Of-Products form) for this truth table, then use a Karnaugh map to simplify. Show your table and final equation

a)

A	B	C	D	X
0	0	0	0	0
0	0	0	1	1
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	1
1	0	1	1	0
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

Sum-Of-Products form based upon the truth table:

$$f(A, B, C) = \overline{A}\overline{B}\overline{C}D + \overline{A}\overline{B}CD + \overline{A}B\overline{C}D + \overline{A}BC\overline{D} + \overline{A}BCD + A\overline{B}\overline{C}D + A\overline{B}C\overline{D} + ABC\overline{D}$$

Karnaugh Map based upon the truth table:

	CD			
AB	00	01	11	10
00	0	1	1	0
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

Boolean expression based upon the Karnaugh Map:

$$f(A, B, C) = \overline{C}D + \overline{A}\overline{B}D + B\overline{C}\overline{D} + A\overline{C}\overline{D}$$