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 = 01000001010000100000000000000000

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) 00111111000001000000000000000000

Exponent = 01111110 - 127 = 126 - 127 = -1
Mantissa = 00001
Sign = 0 (Positive Decimal)

Use the following formula to convert to decimal representation:

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

b) 01000010110111100000000000000000

Exponent = 10000101 - 127 = 133 - 127 = 6
Mantissa = 101111
Sign = 0 (Positive Decimal)

Use the following formula to convert to decimal representation:

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

c) 11000010111110100100000000000000

Exponent = 10000101 - 127 = 133 - 127 = 6
Mantissa = 111101001
Sign = 1 (Negative Decimal)

Use the following formula to convert to decimal representation:

$$(-1)^{sign} \times (1 + mantissa) \times 2^{exponent}$$
$$=$$
$$(-1)^1 \times (1 + .111101001) \times 2^6$$
$$=$$
$$(-1)^1 \times (1.953125) \times 2^6$$
$$=$$
$$\boxed{\textbf{-125.0}}$$

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:

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

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:

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