1)

a) 18.25 ➜   **18**   **+**   **0.25**

                    2^4x**1** =16   0.25x2 = 0.50   **0**

                    2^3x**0** = 0   0.50x2= 1.00   **1**

                    2^2x**0** = 0

                    2^1x**1** = 2

                    2^0x**0** = 0

$18.25_{10} = 10010.01_2$

b) 57.9 ➜   **57**   **+**   **0.9**

                 2^5x**1** = 32   0.9x2 = 0.8   **1**

                 2^4x**1** = 16   0.8x2 = 0.6   **1**

                 2^3x**1** = 8   0.6x2 = 0.2   **1**

                 2^2x**0** = 0   0.2x2 = 0.4   **0**

                 2^1x**0** = 0   0.4x2 = 0.8   **0**

                 2^0x**1**= 1   0.8x2 = 0.6   **1**

                                      0.6x2 = 0.2   **1**

                                      0.2x2 = 0.4   **0**

                                      0.4x2 = 0.8   **0**

                                      0.8x2 = 0.6   **1**

$57.9_{10} = 111001.1\overline{1100}_2$

c) 100101.11_2

$2^5 \times 1 = 32$ $2^{-1} \times 1 = 0.5$

$2^4 \times 0 = 0$ $2^{-2} \times 1 = 0.25$

$2^3 \times 0 = 0$

$2^2 \times 1 = 4$

$2^1 \times 0 = 0$

$2^0 \times 1 = 1$

100101.11_2 ➔ 37.75_{10}

d) $1101.1\overline{10}_2$

$2^3 \times 1 = 8$ $0.110 = x$

$2^2 \times 1 = 4$ $1101.010 = 2^4 x$

$2^1 \times 0 = 0$ $2^4 x - x = 15x = 1101.1$ ➔ $15x = 12.5$ ➔ $x = 0.8\overline{3}$

$2^0 \times 1 = 1$

$1101.1\overline{10}_2$ ➔ $13.8\overline{3}_{10}$

Given,

IEEE-754 standard where,

Sign(1 bit)	Exponent(6 bits)	Mantissa(7 bits)

Since we have 6 bits for the exponent field we have to use Excess-31 encoding. Thus, we need to subtract 31 from the exponent field value for the decoding.

For the denormalized number, we have to use -30 as the exponent value. The encoding will be as follows:

sign	000000	mantissa

a) Smallest positive subnormal number will have the following encoding:

0	000000	0000001

Value = 0.0000001 x 2^-30 = 2^-37

b) Largest negative subnormal number will have the following encoding:

1	000000	0000001

Value = -0.0000001 x 2^-30 = -2^-37

c) Largest positive subnormal number will have the following encoding:

0	000000	1111111

Value = 0. 1111111 x 2^-30 = (1- 1/2^7) x2^-30

d) Smallest negative subnormal number will have the following encoding:

1	000000	1111111

Value = -0. 1111111 x 2^-30 = - (1- 1/2^7) x2^-30

e) Smallest positive normalized number will have the following encoding:

0	000001	0000000

Value = 1. 0000000 x 2^(1-31) = 1. 0000000 x 2^-30 = 2^-30

f) Largest negative normalized number will have the following encoding:

1	000001	0000000

Value = -1. 0000000 x 2^(1-31) = -1. 0000000 x 2^-30 = -2^-30

g) Largest positive normalized number will have the following encoding:

0	111110	1111111

Value = 1. 1111111 x 2^(62-31) = 1. 1111111 x 2^31 = (2 -2^-7) x 2^31

h) Smallest negative normalized number will have the following encoding:

1	111110	1111111

Value = -1. 1111111 x 2^(62-31) = -1. 1111111 x 2^31 = -(2 -2^-7) x 2^31

i) Smallest number greater than 1 will have the following encoding:

0	011111	0000001

Value = 1. 0000001 x 2^(31-31) = 1. 0000001 x 2^0 = 1+ 2^-7

j) Largest number smaller than 1 will have the following encoding:

0	011110	1111111

Value = 1. 1111111 x 2^(30-31) = 1. 1111111 x 2^-1 = 1- 2^-8

Sign	Exp	Frac	Value	Comment
0	000000	0000001	2^-37	The smallest positive subnormal number
1	000000	0000001	-2^-37	The largest negative subnormal number
0	000000	1111111	(1-1/2^7)x2^-30	The largest positive subnormal number
1	000000	1111111	-(1-1/2^7)x2^-30	The smallest negative subnormal number
0	000001	0000000	2^-30	The smallest positive normalized number
1	000001	0000000	-2^-30	The largest negative normalized number
0	111110	1111111	(2 -2^-7) x 2^31	The largest positive normalized number
1	111110	1111111	-(2 -2^-7) x 2^31	The smallest negative normalized number
0	011111	0000001	1+ 2^-7	The smallest number greater than 1.
0	011110	1111111	1- 2^-8	The largest number smaller than 1.