Question 2)

(1) Represent -76.678595 as an IEE single precision floating point number

1) convert 76 to binary

1 2 4 9 19 38 76

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1001100 → 76 in binary

2) convert the fraction part:

$0.678595 \times 2 = 1.35719$

$0.35719 \times 2 = 0.71438$

$0.71438 \times 2 = 1.42876$

$0.42876 \times 2 = 0.85752$

$0.85752 \times 2 = 1.71504$

$0.71504 \times 2 = 1.43008$

$0.43008 \times 2 = 0.86016$

$0.86016 \times 2 = 1.72032$

$0.72032 \times 2 = 1.44064$

$0.44064 \times 2 = 0.88128$

$0.88128 \times 2 = 1.76256$

$0.76256 \times 2 = 1.52512$

$0.52512 \times 2 = 1.05024$

$0.05024 \times 2 = 0.10048$

$0.10048 \times 2 = 0.20096$

$0.20096 \times 2 = 0.40192$

$0.40192 \times 2 = 0.80384$

Question 2 continues:

$-100110.10101101101110000$

EXPONENT = 6

ADD BIAS 127 = 133

∵ is a negative number

∴ SIGN = 1

133 in binary: 128 64 32 16 8 4 2 1

1 0 0 0 0 1 0 1

1 | 10000101 | 00101101101110000

sign | exponent | significand

∴ it's 11000010 00101101101110000

in hexad. 12 2 9 9 5 11 7 0

C 2 9 9 5 B 7 0

∴ in hexadecimal, it's 0XC2995B70

Q2)② 19.459931 in IEEE single precision floating pt. #

1) 19 in binary: 10011

1 2 4 9 19

✓ ✓ ✓ ✓

1 0 0 1 1

2) the fraction part:

0.459931 × 2 = 0.919862

0.919862 × 2 = 1.839724

0.839724 × 2 = 1.679448

0.679448 × 2 = 1.358896

0.358896 × 2 = 0.717792

0.717792 × 2 = 1.435584

0.435584 × 2 = 0.871168

0.871168 × 2 = 1.742336

0.742336 × 2 = 1.484672

Q2 continues....

$0.484672 \times 2 = 0.969344$

$0.969344 \times 2 = 1.938688$

$0.938688 \times 2 = 1.877376$

$0.877376 \times 2 = 1.754752$

$0.754752 \times 2 = 1.509504$

$0.509504 \times 2 = 1.019008$

$0.019008 \times 2 = 0.038016$

$0.038016 \times 2 = 0.076032$

$0.076032 \times 2 = 0.0152064$

$0.0152064 \times 2 = 0.304128$

$0.304128 \times 2 = 0.608256$

1.0011.0111010111011110000 Significand

EXPONENT = 4

+BIAS → 4 + 127 = 131

131 in binary: 1 0 0 0 0 0 1 1 (exponent)

128 64 32 16 8 4 2 1

is positive → sign bit = 0

∴ Put it together: 01000011 00110111010110111110000

to hexad. 4 1 9 B A D F 0

∴ it's 0X419BADF0 in hexadecimal.

Q2 ③ add signed binary fixed pt. versions of the above two numbers

Question 2) 3)

Add the signed binary fixed point versions of the above two numbers

from i) 76.678595 in binary is

1001100.1010110101110000

and the 2 following bits are 11

Pad it into a signed 32-bit binary, add 0s on the left.

0000 0000 0000 0000 0000 0000 0100.1100.1010110101110011

negate the number by taking 2's compliment

flip the bits → 1111 1111 1111 1111 1111 1111 1011 0011.0101001001000111100

\+ 1

add 1: 1111 1111 1111 1111 1111 1111 1011 0011.0101001001000111101

↳ −76.678593 in binary

from ii) 19.459931 in binary is

10011.0111010110111110000

and the following bit is 0

to 32-bit:

0000 0000 0000 0000 0000 0000 0001 0011.0111010110111110000

Add up the 2 numbers:

1111 1111 1111 1111 1111 1111 1011001.0101 0010 0010 0011 1101

\+ 0000 0000 0000 0000 0000 0000 0001 0011.0111 0101 1011 1110 0000

1111 1111 1111 1111 1111 1111 1100 0110.1100 0111 1110 0001 1101

∴ The sum is 1111 1111 1111 1111 1111 1111 1000 110.1100 0111 1110 0001 1101