Question 1:

a: $(-124.3)_{10} = (?)_2$

Negative/Positive bit: 1

$(124)_{10} = (1111100)_2$ $\qquad$ $(0.3)_{10} =$ 0.010011001...1001

124 % 2 = 0	$0.3 \times 2 = 0.6 \to 0$
62 % 2 = 0	$0.6 \times 2 = 1.2 \to 1$
31 % 2 = 1	$0.2 \times 2 = 0.4 \to 0$
15 % 2 = 1	$0.4 \times 2 = 0.8 \to 0$
7 % 2 = 1	$0.8 \times 2 = 1.6 \to 1$
3 % 2 = 1	$0.6 \times 2 = 1.2 \to 1$
1 % 2 = 1	$0.2 \times 2 = 0.4 \to 0$
	$0.4 \times 2 = 0.8 \to 0$
	$0.8 \times 2 = 1.6 \to 1$

looping

Therefore: $124.3 = 1111100.010011001...1001 = 1.111100010011001...1001 \times 2^{\boxed{6}}$

Answer: (using cut method described in class)

Exponent: $6 + 127 = 133$

$133 = 10000101$

Sign	exponent	Fraction
1	10000101	11110001001100110011001

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b: $(72.12)_{10} = (?)_2$

Sign bit: 0

$(72)_{10} = (1001000)_2$ $\qquad$ $(0.12)_{10} = 0.00011110101110000...$

72 % 2 = 0	2 % 2 = 0	$0.12 \times 2 = 0.24 \to 0$	$0.84 \times 2 = 1.68 \to 1$	$0.88 \times 2 = 1.76 \to 1$
36 % 2 = 0	1 % 2 = 1	$0.24 \times 2 = 0.48 \to 0$	$0.68 \times 2 = 1.36 \to 1$	$0.76 \times 2 = 1.52 \to 1$
18 % 2 = 0		$0.48 \times 2 = 0.96 \to 0$	$0.36 \times 2 = 0.72 \to 0$	$0.52 \times 2 = 1.04 \to 1$
9 % 2 = 1		$0.96 \times 2 = 1.92 \to 1$	$0.72 \times 2 = 1.44 \to 1$	$0.04 \times 2 = 0.08 \to 0$
4 % 2 = 0		$0.92 \times 2 = 1.84 \to 1$	$0.44 \times 2 = 0.88 \to 0$	$0.08 \times 2 = 0.16 \to 0$

$0.16 \times 2 = 0.32 \to 0$ next page

$0.32 \times 2 = 0.64 \to 0$

⋮

Therefore: $72.12 = 1001000.00011110101110000\ldots = 1.00100000011110101110000\ldots \, 2^{\boxed{6}}$

$6+127=133$

$133 = \cancel{10000101}\ 10000101$

Answer: (using cut method discussed in class)

sign	exponent	fraction
0	10000101	00100000011110101110000

Question 2:

a: $(0\ 01111101\ 00000000000000000000000)_2 = (?)_{10}$

indicates Positive — 125 — no decimal for multiplier

$+1.0 \times 2^{125-127} = (0.01)_2 = (0 + 2^{-2})_{10} = \boxed{(0.25)_{10}}$

b: $(1\ 10000000\ 11000000000000000000000)_2 = (?)_{10}$

indicates Negative — 128 — 0.11

$-(1.11 \times 2^{128-127}) = (-11.1)_{10} = (-(2^1 + 2^0 + 2^{-1}))_{10} = (-3.5)_{10}$

Question 3:

a: $(-120)_{10} = (?)_2 \rightarrow (120)_{10} \rightarrow (01111000)_2 \xrightarrow{\text{2's complement}} \boxed{(10001000)_2}$

b: $(65)_{10} = (?)_2 \rightarrow (01000001)_2 \rightarrow$ 2's complement leaves it the same

Question 4:

a: $(11110111)_2 = (?)_{10}$ First bit is 1 so we know it's negative

↓ flip all until the last bit that is 1

$(00001001)_2 = 9 \rightarrow \boxed{-9}$

b: $(10111100)_2 = (?)_{10}$ First bit is 1 so we know it's negative

↓ flip all until the last bit is 1

$(01000100)_2 = 68 \rightarrow \boxed{-68}$

Question 5:

If n is the number of bits available, the range of signed numbers that can be represented is -2^{n-1} through $2^{n-1}-1$, so the largest positive signed number would be 31.

31 as:

Binary: ~~[illegible]~~ 011111 Decimal: 31 Hex: 1F

31 % 2 = 1
15 % 2 = 1
7 % 2 = 1
3 % 2 = 1
1 % 2 = 1

31 % 16 = F
1 % 16 = 1