Conversion to NASA 4 byte float format

d) $49.1875 = 49 + .1875$

$49/2 = 24 \; r1$

$24/2 = 12 \; r0$

$12/2 = 6 \; r0$

$6/2 = 3 \; r0$

$3/2 = 1 \; r1$

$1/2 = 0 \; r1$

$\rightarrow 110001_2$

bit

$.1875 \cdot 2 = .375 \rightarrow 0$

$.375 \cdot 2 = .75 \rightarrow 0$

$.75 \cdot 2 = 1.5 \rightarrow 1$

$.5 \cdot 2 = 1 \rightarrow 1$ exact

$.0011_2$

110001.0011_2

Binary → octal (base 8)

$110001 \rightarrow 110 \; 001 \rightarrow 110_2 = 6_8, \; 001_2 = 1_8 \rightarrow 61_8$

$.0011 \rightarrow .001 \; 100 \rightarrow 001_2 = 1_8$

$100_2 = 4_8 \rightarrow .14_8$

61.14_8

Binary → hex (base 16)

$110001 \rightarrow 0011 \; 0001 \rightarrow 0011_2 = 3_{16} \quad 0001_2 = 1_{16} \rightarrow 31_{16}$

$.0011 \rightarrow 0011_2 = 3_{16} \rightarrow .3_{16}$

31.3_{16}

float

$110001.0011_2 = (.110001001 1)_2 \cdot 2^6$

$.110001001 1 \; 000000000 \; 00000$

Sign = 0 $\quad$ +6 in 8

$E = +6 \quad 0000 \; 0110_2 = 0X06$

0110 0010 0110 0000 0000 0000 0000 0110

6 2 6 0 0 0 0 6 $_{16}$

3.02421875

3 + .02421875

3/2 = 1 r 1

1/2 = 0 r 1 → 11_2

$\boxed{11.0001001 1_2}$

bit

.02421875 · 2 = .1484375 → 0

.1484375 · 2 = .296875 → 0

.296875 · 2 = .59375 → 0

.59375 · 2 = 1.1875 → 1

.1875 · 2 = .375 → 0

.375 · 2 = .75 → 0

.75 · 2 = 1.5 → 1

.5 · 2 = 1 → 1 exact

= $.0001001 1_2$

Binary → octal

group in 3

011 → 3_8

.000 100 110 → 0, 4, 6 → $.046_8$

→ 3.046_8

Binary → hex

group in 4s

11 → 0011 → $0011_2 = 3_{16}$

.0001001 1 → 0001 0011 → 1, 3 → $.13_{16}$

→ 3.13_{16}

Float

$11.0001001 1_2 = (.11000100 11)_2 \cdot 2^2$

Sign = 0

E = +2 = 0000 0010$_2$ = 0X 02

.11000100 11 000 000000000

0110	0010	0110	0000	0000	0000	0000	0010
6	2	6	0	0	0	0	2

$_{16}$

.2

bit

$.2 \cdot 2 = .4 \to 0$

$.4 \cdot 2 = .8 \to 0$

$.8 \cdot 2 = 1.6 \to 1$

$.6 \cdot 2 = 1.2 \to 1$

$.2 \cdot 2 = .4 \to 0$ repeating

$.2_{10} = .0011\ 0011\ 0011\ldots_2$

Binary → hex

digit

$.2 \cdot 16 = 3.2 \to 3$

$.2 \cdot 16 = 3.2 \to 3$ repeats

$.2_{10} = .333\ldots_{16}$

binary → octal

digits

$.2 \cdot 8 = 1.6 \to 1$

$.6 \cdot 8 = 4.8 \to 4$

$.8 \cdot 8 = 6.4 \to 6$

$.4 \cdot 8 = 3.2 \to 3$ repeating

$.2 = .1463\ 1463\ldots_8$

Float

$.0011\ 0011\ 0011 \to (.1100\ 1100\ 1100\ldots_2) \cdot 2^{-2}$

6 6

Sign = 0

$E = -2 \Rightarrow 256 - 2 = 254$

$1111\ 1110_2$ 0xFE

$666666FE_{16}$

B)

-49.1875

From a)

$+49.1875 = 110001.0011_2 = 61.14_8 = 31.3_{16} \Rightarrow 62600006_{16}$

Thus

-49.1875

Binary $= -110001.0011_2$

Octal $= -61.14_8$

Hex $= -31.3_{16}$

Float: Sign = 1 (negative)

E byte = 0x06

$0 \mid 110 \rightarrow 1 \mid 110$: $0110_2 (6) \rightarrow 1110_2$

E

$E2600006_{16}$

-3.02421875

Binary: -11.00010011_2

Octal: -3.046_8

Hex: -3.13_{16}

Float

Sign = 1 E = 0x02

$1110_2 \rightarrow E$

Original Float: $62600002 \rightarrow E2600002_{16}$

$-.2$

Original Float: 666666FE

Binary: $-.0011\ 0011\ldots_2$

Octal: $-0.14631463\ldots_8$

Hex: $-.333\ldots_{16}$

Float:

E = 0xFE

First 6 → E

$E66666FE_{16}$

c)

6999902

69 99 99 02

sign bit

0x02 = 0000 0010$_2$ E = +2

First nibble → 6 = 0110$_2$

Sign: 0 (positive)

9/2 = 4 r 1

4/2 = 2 r 0

2/2 = 1 r 0

1/2 = 0 r 1

↓ = 1001$_2$ → nibbles

$$\frac{6920601}{2^{23}} \approx .824999 \cdot 2^{2}$$

↓

4 ≈ 3.3

Thus,

110 1001 1001 1001 1001 1001

→ 11010011001100110011001$_2$

1.2^{23}

$+ 1.2^{21}$

$+ \cancel{0.2^{20}}$

$+ 1.2^{19}$

$+ \cancel{0.2^{18}}$

$+ \cancel{0.2^{17}}$

$+ 1.2^{16}$

$+ 1.2^{15}$

$+ \cancel{0.2^{14}}$

$+ \cancel{0.2^{13}}$

$+ 1.2^{12}$

$+ 1.2^{11}$

$+ \cancel{0.2^{10}}$

$+ \cancel{0.2^{9}}$

$+ 1.2^{8}$

$+ 1.2^{7}$

$+ \cancel{0.2^{6}}$

$+ \cancel{0.2^{5}}$

$+ 1.2^{4}$

$+ 1.2^{3}$

$+ \cancel{0.2^{2}}$

$+ \cancel{0.2^{1}}$

$+ 1.2$

→ 6920601

6999903 — E = +3

Everything is same fraction and sign

Only exponent changes

$$\frac{6920601}{2^{23}} \cdot 2^{+3} \approx 6.6$$

9666671FF

1001$_2$

Sign: 1 (negative)

001

→ E = 1111 1111$_2$ → −1

001 0110 0110 0110 0110 0111

↓

$$\frac{1468007}{2^{23}} \approx .175$$

$$-1 \cdot .175 \cdot 2^{-1} \approx -.0875$$

6/2 = 3 r 0

3/2 = 1 r 1

1/2 = 0 r 1

0/2 = 0 r 0

7/2 = 3 r 1

3/2 = 1 r 1

1/2 = 0 r 1

0/2 = 0 r 0

6 = 0110$_2$ 7 = 0111$_2$