

A) Convert the following to binary, octal and hex. Then convert to float representation

Base 10	Base 2	Base 8	Base 16
49.1875	110001.0011 ₂	61.148	31.3 ₁₆
3.07421875	11.00010011 ₂	3.0468	3.13 ₁₆
0.2	0.0011 ₂	0.14638	0.3 ₁₆

$$49.1875_{10} \Rightarrow 49 + 0.1875$$

$$49 - (2^5) = 17 \quad 1 - (2^1) = 1 \quad 110001_2$$

$$17 - (2^4) = 1 \quad 1 - (2^0) = 0$$

$$1 - (2^3) = \cancel{1}$$

$$1 - (2^2) = \cancel{1}$$

$$0.1875 \times 2 = 0.375 \quad 0$$

$$0.375 \times 2 = 0.75 \quad 0 \quad .0011_2$$

$$0.75 \times 2 = 1.5 \quad 1$$

$$0.5 \times 2 = 1.0 \quad 1 \Rightarrow 110001.0011_2$$

$$110001.0011_2 \Rightarrow 110 \ 001 \ . \ 001 \ 100$$

$$1 \ 1 \ . \ 1 \ 4 \Rightarrow 61.148$$

$$110001.0011_2 \Rightarrow 0011 \ 0001 \ . \ 0011$$

$$3 \ 1 \ . \ 3 \Rightarrow 31.3_{16}$$

$$3.07421875 \Rightarrow 3 + 0.07421875$$

$$3 - (2^1) = 1 \quad 11_2$$

$$1 - (2^0) = 0$$

$$0.07421875 \times 2 = 0.1484375 \quad 0 \quad ,375 \times 2 = 0.75 \quad 0$$

$$.1484375 \times 2 = 0.296875 \quad 0 \quad ,75 \times 2 = 1.50 \quad 1$$

$$.296875 \times 2 = 0.59375 \quad 0 \quad ,50 \times 2 = 1.00 \quad 1$$

$$.59375 \times 2 = 1.1875 \quad 1$$

$$.1875 \times 2 = 0.375 \quad 0 \Rightarrow 11.00010011_2$$

$$11.00010011_2 \Rightarrow 011 . 000 100 110$$

$$3 . 046 \Rightarrow 3.0468$$

$$11.00010011_2 \Rightarrow 0011 . 0001 0011$$

$$3 . 13 \Rightarrow 3.1316$$

$$0.2 \Rightarrow 0.2 \times 2 = 0.4 \quad 0 \quad 0.8 \times 2 = 1.6 \quad 1 \quad 0.2 \times 2 = 0$$

$$0.4 \times 2 = 0.8 \quad 0 \quad 0.6 \times 2 = 1.2 \quad 1$$

$$\Rightarrow \underline{.0011} \underline{1}_2$$

$$0.00110011_2 \Rightarrow 0.001 100 110 011 001$$

$$1 \quad 4 \quad 6 \quad 3 \quad 1 \Rightarrow 0.\overline{1463} \underline{8}$$

$$0.0011_2 \rightarrow 0.0011$$

$$3 \Rightarrow 0.\overline{3} \underline{16}$$

Convert to Floating Representation

Base 10

Base 2

NASA

44.1875

110001.0011₂

0xC4C00006

3.07421875

11.00010011₂

0xC4C0000Z

0.2

0.0011₂

0xCCCCCFFE

$$110001.0011_2 \Rightarrow 0.1100010011_2 \times 2^6$$

$$\begin{array}{r|l} 1100 \ 0100 \ 1100 \ 0000 \ 0000 \ 0000 & 0000 \ 0110 \\ C \quad 4 \quad C \quad 0 \quad 0 \quad 0 & 0 \quad 6 \end{array} \Rightarrow C400006$$

$$11.00010011_2 \Rightarrow 0.1100010011_2 \times 2^2$$

$$\begin{array}{r|l} 1100 \ 0100 \ 1100 \ 0000 \ 0000 \ 0000 & 0000 \ 0010 \\ C \quad 4 \quad C \quad 0 \quad 0 \quad 0 & 0 \quad 2 \end{array} \Rightarrow C4C6000Z$$

$$0.\overline{001}_2 \rightarrow 0.11001100\overline{1100}_2 \times 2^{-2}$$

$\begin{array}{ccccccc} 1100 & 1100 & 1100 & 1100 & 1100 & 1100 \\ C & C & C & C & C & C \end{array}$		$\begin{array}{cc} F & E \end{array} \Rightarrow \text{CCCCCCFE}$
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$$2^{-2} \Rightarrow 00000010 \quad \text{flip} \quad \begin{array}{r} 11111101 \\ + 1 \\ \hline 11111110 \end{array}$$

B) Do the same for A) given they are negative values

Base 10	Base 2	Base 8	Base 16	NASA
-49.1875	-11001.0011 ₂	-61.148	-31.3 ₁₆	0x3B400006
-3.07421875	-11.0010011 ₂	-3.0468	-3.13 ₁₆	0x3B400002
-0.2	-0.0011 ₂	-0.14638	-0.3 ₁₆	0x333334FE

Negative Base 2 floats are reverse signed Base 2 conversions

\Leftrightarrow Same with Base 8 and 16

$$11001.0011_2 \Rightarrow 0.110010011 \times 2^6 = 0xC4C000|06$$

$$\begin{array}{r} \text{C4C000} \end{array} \quad \text{flip} \quad \begin{array}{r} 3B3FFF \\ + 1 \\ \hline 3B4000 \end{array}$$

$$11.0010011_2 \rightarrow 0xC4C000|02$$

$$\begin{array}{r} \text{C4C000} \end{array} \quad \text{flip} \quad \begin{array}{r} 3B3FFF \\ + 1 \\ \hline 3B4000 \end{array}$$

$$0.0011_2 \rightarrow 0xCCCC|FE$$

$$\begin{array}{r} \text{CCCCCC} \end{array} \quad \text{flip} \quad \begin{array}{r} 333333 \\ + 1 \\ \hline 333334 \end{array}$$

c) Convert float representation to decimal (Base_{10})

Float	Base 2	Base 10
699999902	0110100100100110011001 ₂	3,29688 ₁₀
699999903	011010011001100110011001 ₂	6.59376 ₁₀
966667FF	011010011001100110011001 ₂	-0.2062499 ₁₀

699999902 \Rightarrow

6 9 9 9 9 9 0 2
0110 1001 1001 1001 1001 1001 0000 0010

$$= .011010011001100110011001_2$$

$$= .0110\overline{1001}_2 \times 2^2$$

Should now $\xrightarrow{\text{L}}$ $z^{-2} + z^{-3} + z^{-5} + z^{-8} + z^{-9} = .41211_{10} \times 2^2$
be 0.

$$= 1.64844 \times 2^2 = 3.29688_{10}$$

$$699999903 \Rightarrow .41211_{10} \times 2^4 = 6.59376_{10}$$

966667FF \Rightarrow

9 6 6 -6 6 7 F F
-1001 -0110 -0110 -0110 -0110 0111 1111 1111

$$\begin{array}{r} 966667 \xrightarrow{\text{flip}} 6999998 \\ + \frac{1}{6999999} \end{array}$$

$$\begin{array}{r} 1111111 \xrightarrow{\text{flip}} 00000000 \\ + \frac{1}{00000001} \end{array}$$

$$- (6 \times 16^5 + 9 \times 16^4 + 9 \times 16^3 + 9 \times 16^2 + 9 \times 16^1 + 9 \times 16^0) = -1$$

$$- (6291456 + 589824 + 36864 + 2304 + 144 + 9) = -6920601$$

$$\frac{-6920601}{2^{24}} \times 2^{-1} = \frac{-6920601}{2^{25}} = -0.2062499$$