Midterm #6

a) Convert the following 2 Numbers to binary, octal, & hex

2.875_{10} & $0.179687\overline{5}_{10}$

$2.875_{10} = 10.111_2 = 2.7_8 = 2.E_{16}$

0.875	0.875	0.875
* 2	* 8	* 16
1.750	7.000	5.250
0.750		8.750
2		+ 14.000
1.500		↓
0.5		E
2		
1.0		

$10.111_2 = 2.875_{10} = 2.7_8 = 2.E_{16}$

$1*2^1 + 0*2^0 + 1*2^{-1} + 1*2^{-2} + 1*2^{-3}$

$= 2 + 0 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8}$

$= 2 + \frac{4}{8} + \frac{2}{8} + \frac{1}{8}$

$= 2 + \frac{7}{8} = \frac{23}{8}$

$= 2.875_{10}$ ✓

.875

8 | 7.000

6.4

0.60

0.56

40

010.111

2.7 ✓

$2*8^0 + 7*8^{-1}$

$= 2 + \frac{7}{8} = \frac{23}{8}$

$= 2.875_{10}$ ✓

0010.1110

2.E ✓

$2*16^0 + E*16^{-1}$

$= 2*16^0 + 14*16^{-1}$

$= 2 + \frac{14}{16}$

$= 2 + \frac{7}{8} = \frac{23}{8}$

$= 2.875_{10}$ ✓

Now do the next one

$0.179675_{10} = 0.0010111_2 = 0.134_8 = 0.2E_{16}$

0.179675_{10}

$0*2^0 = 0$
$+0*2^{-1} = 0$
$+0*2^{-2} = 0$
$+1*2^{-3} = \frac{1}{8}$
$+0*2^{-4} = 0$
$+1*2^{-5} = \frac{1}{32}$
$+1*2^{-6} = \frac{1}{64}$
$+1*2^{-7} = \frac{1}{128}$

$= \frac{1}{8} + \frac{1}{32} + \frac{1}{64} + \frac{1}{128}$

$= \frac{16}{128} + \frac{4}{128} + \frac{2}{128} + \frac{1}{128}$

$= \frac{23}{128}$ ✓

≈ 0.796875 ✓

0.179675_{10}

0.179675
$* \quad 2$
0.3593750
$* \quad 2$
0.7187500
$* \quad 2$
1.4375000
0.4375
$* \quad 2$
0.875
$* \quad 2$
1.750
0.75
$* \quad 2$
1.50
0.50
$* \quad 2$
1.00

$0.0 \; 0 \; 1 \; 0 \; 1 \; 1 \; 1$

$0. \quad 2 \quad 7$

$0. \quad 2 \quad 7$ ✓

0.179675_{10}

0.179675
$* \quad 8$
1.4375000
0.4375
$* \quad 8$
3.5000
0.5
$* \quad 8$
4.0

$0*8^0 = 0$
$1*8^{-1} = \frac{1}{8}$
$+3*8^{-2} = \frac{3}{64}$
$+4*8^{-3} = \frac{4}{512}$

$= \frac{11}{64} + \frac{1}{128}$

$= \frac{22}{128} + \frac{1}{128}$

$= \frac{23}{128}$ ✓

0.179675_{10}

0.179675
16
$1.078|250$
$1.796875\,0$
2.8750000
0.875
$* \quad 16$
5.250
8.750
14.000
E

$0*16^0 = 0$
$2*16^{-1} = \frac{2}{16}$
$14*16^{-2} = \frac{14}{256}$

$= \frac{16}{128} + \frac{7}{128} = \frac{23}{128}$ ✓

a part 1

$2.875_{10} = 10.111_2 = 2.7_8 = 2.E_{16}$

$0.179675_{10} = 0.0010111_2 = 0.134_8 = 0.2E_{16}$

a part 2) When Done, Convert the following to a float representation by the definition in class. In other words, an 8 digit Hex representation using the 4 byte float specification defined in class.

$2.875_{10} = 2 + \frac{7}{8} = \frac{16}{8} + \frac{7}{8} = \frac{23}{8} = 23 * 8^{-1} = 23 * 2^{-3}$

$23_{10} = 10111_2 \rightarrow 0.10111 * 2^5 * 2^{-3} = 0.10111 * 2^2$

5 4 3 2 1

Now Represent in 32 Bits

$0.10111_2 * 2^2$

0 1 0 1 1 1 0 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 1 0

Hex: 5 C 0 0 0 0 0 2

$2.875_{10} = 5C000002_{16}$

$0.179685_{10} = \frac{23}{128} = 23_{10} * 128^{-1} = 10111_2 * 2^{-7} = 0.10111_2 * 2^{-2}$

Now Represent in 32 Bits

$0.10111_2 * 2^{-2}$

0 0 0 0 0 0 1 0

1 1 1 1 1 1 0 1 +1

0 1 0 1 1 1 0 0 | 0 0 0 0 0 0 0 0 | 0 0 0 0 0 0 0 0 | 1 1 1 1 1 1 1 0

15 14

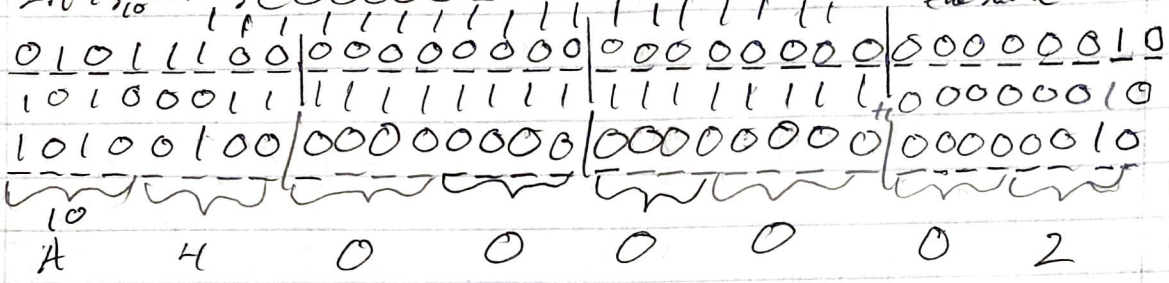
Hex: 5 C 0 0 0 0 F E

$0.179685_{10} = 5C00000FE_{16}$

b) Do the same for a) given they are negative values.
Flip the bits. All of the ones in the mantissa/fractional part

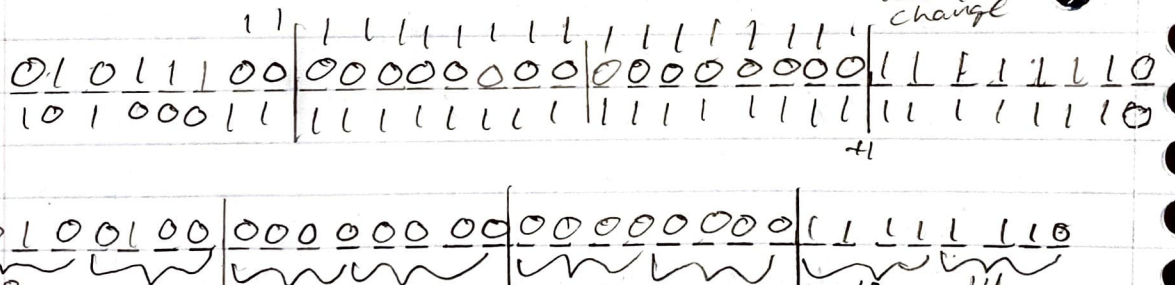
2.875_{10} or 5C000002

Power stays the same



$-2.875_{10} = A4000002_{16}$

Power does not change



$-0.179687_{10} = A40000FE$

C) Convert the Float Representations of the following into the decimal number given the definition in class
5999901 & 59999902 & AGGG7FE

5999901:

5 9 9 9 9 9 0 1

0101 1001 | 1001 1001 | 1001 1001 | 0000 0001

Find where it Repeats

$= 0.1011001_2 * 2^1 = 1.011001_2$

$= 1*2^0 + 0*2^{-1} + 1*2^{-2} * 1*2^{-3} + 0*2^{-4} + 0*2^{-5} + 1*2^{-6}$

$= 1 + \frac{1}{4} + \frac{1}{8} + \frac{1}{64} = \frac{64}{64} + \frac{16}{64} + \frac{8}{64} + \frac{1}{64} = \frac{89}{64} = 1.390625_{10}$

59999902

5 9 9 9 9 9 0 2

0101 1001 | 1001 1001 | 1001 1001 | 0000 0010

Find where it repeats

$0.1011001_2 * 2^2 = 10.11001_2$

$1*2^1 + 0*2^0 + 1*2^{-1} + 1*2^{-2} + 0*2^{-3} + 0*2^{-4} + 1*2^{-5}$

$= 2 + \frac{1}{2} + \frac{1}{4} + \frac{1}{32}$

$= \frac{64}{32} + \frac{16}{32} + \frac{8}{32} + \frac{1}{32} = \frac{89}{32} = 2.78125_{10}$

AGGG6 7FE

A G G G 6 7 F E

1010 0110 | 0110 0110 | 0110 0111 | 1111 1110

1010 0110 | 0110 0110 | 0110 0111 | 1111 1101

0101 1001 | 1001 1001 | 1001 1001 | 0000 0010

$-0.1011001 * 2^{-2}$

$(0*2^0 + 1*2^{-1} + 0*2^{-2} + 1*2^{-3} + 1*2^{-4} + 0*2^{-5} + 1*2^{-6}) * 2^{-2}$

$= \left(\frac{1}{2} + \frac{1}{8} + \frac{1}{16} + \frac{1}{128}\right) * \frac{1}{4} = \left(\frac{64}{128} + \frac{16}{128} + \frac{8}{128} + \frac{1}{128}\right)\frac{1}{4}$

$= -\left(\frac{89}{128}\right) * \frac{1}{4} = -\frac{89}{512} = -0.173828125_{10}$