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CS 3339.001
Homework 3

1.a)

Iteration	Step	Divisor	Remainder
1	Initialization	010101	000001 000101
2	Remainder (left) = Remainder (left) - Divisor	010101	101100 000101
	Remainder < 0 → Remainder + Divisor	010101	000001 000101
	Shift Remainder left ; Remainder (0)=0	010101	000010 001010
3	Remainder (left) = Remainder (left) - Divisor	010101	101101 001010
	Remainder < 0 → Remainder + Divisor	010101	000010 001010
	Shift Remainder left ; Remainder (0)=0	010101	000100 010100
4	Remainder (left) = Remainder (left) - Divisor	010101	101111 010100
	Remainder < 0 → Remainder + Divisor	010101	000100 010100
	Shift Remainder left ; Remainder (0)=0	010101	001000 101000
5	Remainder (left) = Remainder (left) - Divisor	010101	110011 101000
	Remainder < 0 → Remainder + Divisor	010101	001000 101000
	Shift Remainder left ; Remainder (0)=0	010101	010001 010000
6	Remainder (left) = Remainder (left) - Divisor	010101	111100 010000
	Remainder < 0 → Remainder + Divisor	010101	010001 010000
	Shift Remainder left ; Remainder (0)=0	010101	100010 100000
7	Remainder (left) = Remainder (left) - Divisor	010101	001101 100000
	Remainder > 0 → keep Remainder	010101	001101 100000
	Shift Remainder left ; Remainder (0)=1	010101	011011 000001
9	Remainder (left) = Remainder (left) - Divisor	010101	000110 000001
	Remainder > 0 → keep Remainder	010101	000110 000001
	Shift Remainder left ; Remainder (0)=1	010101	001100 000011
	At the end: shift Remainder (left) right	010101	000110 000011

1.b) $\frac{69}{21} = 3$ Remainder 6 → quotient = 3 = 000011   remainder = 6 = 000110

The process took 7 steps, excluding initialization, which
is n+1 iterations as our divisor was 6 bits

2.a) Convert 0.02875:

$0.02875 \cdot 2 = 0.0575$

$0.0575 \cdot 2 = 0.115$

$0.115 \cdot 2 = 0.23$

$0.23 \cdot 2 = 0.46$

$0.46 \cdot 2 = 0.92$

$0.92 \cdot 2 = 1.84$

$0.84 \cdot 2 = 1.68$

$0.68 \cdot 2 = 1.36$

$0.36 \cdot 2 = 0.72$

$0.72 \cdot 2 = 1.44$

$0.44 \cdot 2 = 0.88$

$0.88 \cdot 2 = 1.76$

$0.76 \cdot 2 = 1.52$

$0.52 \cdot 2 = 1.04$

$0.04 \cdot 2 = 0.08$

$0.08 \cdot 2 = 0.16$

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0 10110 1101011100
s   e       f
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The precision of this format is less accurate because only 10 bits are dedicated to the fraction instead of 23. This reduction can lead to less accurate fractions in situations where the fraction cannot be expressed in 10 bits.

2.b) Convert 37.125

$0.125 \cdot 2 = 0.25$

$0.25 \cdot 2 = 0.5$

$0.5 \cdot 2 = 1$

$1.0010100100 \cdot 2^5 + 1.0000110011 \cdot 2^{-1}$

$1.0010100100 \cdot 2^5 + 0.0000010000111 \cdot 2^5$

$= 1.0010110100111 \cdot 2^5$

$= 1.0010110110 \cdot 2^5 = 37.6875$

Convert 0.5250390625

$0.5250390625 \cdot 2 = 1.050078125$

$0.050078125 \cdot 2 = 0.10015625$

$0.10015625 \cdot 2 = 0.2003125$

$0.2003125 \cdot 2 = 0.400625$

$0.400625 \cdot 2 = 0.80125$

$0.80125 \cdot 2 = 1.6025$

$0.6025 \cdot 2 = 1.205$

$0.205 \cdot 2 = 0.41$

$0.41 \cdot 2 = 0.82$

$0.82 \cdot 2 = 1.64$

$0.64 \cdot 2 = 1.28$

2.c) Convert -7.3125   Convert .2203125

    0.3125·2 = 0.625   0.2203125·2 = 0.440625
    0.625·2 = 1.25   0.440625·2 = 0.88125
    0.25·2 = 0.5   0.88125·2 = 1.7625
    0.5·2 = 1   0.7625·2 = 1.525
                             0.525·2 = 1.05
                             0.05·2 = 0.1
                             0.1·2 = 0.2
                             0.2·2 = 0.4
                             0.4·2 = 0.8
                             0.8·2 = 1.6
                             0.6·2 = 1.2

$1.1101010000 \cdot 10^2 \cdot 1.110000110011 \cdot 10^{-3}$

$$
\begin{array}{r}
1.1101010000000 \\
\times 1.110000110011 \\
\hline
1110101000 0000 \\
11101010000 0000 \\
111010100000000 \\
1110101000000000 \\
1110101000000000 \\
1110101000000000 \\
1110101000000000 \\
1110101000000000 \\
1110101 0000000 \\
\hline
11.0011100011100010011 0000000 \cdot 10^{-1}
\end{array}
$$

16-bit floating format: 1100001001100100   Decimal: -1.611328125

There is no overflow as 16 ≥ -1 ≥ -15, and my answer is relatively
close to the correct answer of -1.6110351562 5