

HW4

Negative

a.) $1 \text{ } 010 \text{ } 11010 = 0\overset{64}{1}\overset{16}{0}\overset{8}{1} \text{ } 1010$
 $64+16+8+2 = 90 - 127 = -37$

$S = 1$

$E = -37$

$m = 1.0010 \text{ } 1000 \text{ } 0000 \text{ } 0000 \text{ } 000$
 $\begin{array}{r} -3 \\ -5 \\ \hline \end{array}$

$$\boxed{z^{-3} + z^{-5} = \begin{cases} -1,15625 \times 2^{-37} \\ = -8,41283 \times 10^{-12} \end{cases}}$$

b.) $S = 0$
 $e = 1\overset{64}{0}\overset{8}{0} \text{ } 1\overset{32}{0}1 = 128+8+4+1 = 141 - 127 = 14$

$m = 1001 \text{ } 0000 \text{ } 0000 \text{ } 0000 \text{ } 000$

$$= z^{-1} + z^{-4} = \frac{1}{z} + \frac{1}{16} = \frac{9}{16} = .5625$$

$$\boxed{\begin{aligned} &= 1.5625 \times 2^{14} \\ &= 25600 \end{aligned}}$$

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2. - 75,4

$$\frac{4}{10} = \frac{2}{5}$$

$$-75 = 75 = 0100\ 1011_2 \quad .4 = .0110_2$$

64 + 8 + 2 + 1

$$.4 \times 2 = 0.8 \quad .4 \times 2 = 0.8$$

$$.8 \times 2 = 1.6$$

$$.6 \times 2 = 1.2$$

$$.2 \times 2 = 0.4$$

$$75.4 = 100\overset{64}{\cancel{1}}011.0110 = 1,0010\overset{32}{\cancel{1}}1101\ 10 \times 2^6$$

q.) $6 + 127 = 133 = 1000\ 0101_2$

| | | |
|---|-----------|------------------------------|
| 1 | 1000 0101 | 0010 1101 1001 1001 1001 100 |
|---|-----------|------------------------------|

b) $6 + 1023 = 1029 = 0100\overset{104}{\cancel{0}}0\overset{8}{\cancel{0}}000\overset{7654}{\cancel{0}}0000\overset{3210}{\cancel{0}}$

1029 - 1024 = 5

$$= 100\ 0000\ 0101_2$$

| | | |
|---|---------------|---|
| 1 | 100 0000 0101 | 0010 1101 1001 1001 1001 1001 1001 1001 1001 1001 1001 1001 |
|---|---------------|---|

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3.

$$x = 1100 \ 0110 \ 1101 \ 1000 \ 0000 \ 0000 \ 0000 \ 0000$$

$$y = 0111 \ 1101 \ 1110 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000$$

$$e_x = 1000 \ 1101 = 128 + 8 + 4 + 1 = 141 - 127 = 14$$

$$e_y = 0111 \ 1101 = 64 + 32 + 16 + 8 + 4 + 1 = 125 - 127 = -2$$

$$x = -1.101 \times 1000 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000 \times 2^{14}$$

$$y = 1.110 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000 \ 0000 \times 2^{-2} \times 2^{16}$$

$$y = 0.000 \ 0000 \ 0000 \ 0000 \ 1110 \ 0000$$

$$x = 0.010 \ 1000 \ 0000 \ 0000 \ 0000 \ 0000$$

$$x+y = 0.010 \ 1000 \ 0000 \ 0000 \ 1110 \ 0000$$

$$= 1.101 \ 0111 \ 1111 \ 1111 \ 0001 \ 1111$$

$$= -1.101 \ 0111 \ 1111 \ 1111 \ 0010 \ 0000 \times 2^{14}$$

$$\boxed{= 1 | 1000 \ 1101 | 101 \ 0111 \ 1111 \ 1111 \ 0010 \ 0000}$$

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$$3. \text{ b) } x = 1.10110000000000000000$$

$$y = 1.11000000000000000000$$

$$x \cdot y = 1.1011 \times 2^{14}$$

$$\overbrace{\quad\quad\quad}^{\text{---}} \begin{array}{r} 1 \\ 1 \\ 1 \\ 1 \\ 1 \\ 1 \end{array} \times 2^{-2}$$

$$\begin{array}{r} | & | & | & | \\ 1 & 1 & 1 & 0 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ \hline 1 & 0 & 1 & 1 & 1 \end{array}$$

$$10.111101 \times 2^{12}$$

$$1.0111101 \times 2^{13}$$

$$13 + 127 = 140 = 10001100$$

$$x \cdot y = 1 | 10001100 | 0111101000000000000000000$$

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4. $x = 0|1011\ 1111|0111\ 1110\ 0100\ 0000\ 0000\ 0000\ 0000$

$y = 0|0111\ 1111|1111\ 0000\ 0000\ 0000\ 0000\ 0000\ 0000$

$$e_x = 128 + 32 + 16 + 8 + 4 + 2 + 1 = 191 - 127 = 64$$

$$e_y = 64 + 32 + 16 + 8 + 4 + 2 + 1 = 127 - 127 = 0$$

$$x = 1.01111100100000000000 \times 2^{64}$$

$$y = 1.11110000000000000000 \times 2^{64}$$

$$\hookrightarrow z = 0 \longrightarrow \times 2^{64}$$

a) $x+y = x = 1.011111001$

b) $x+y = 1.011111001$

$$z = -1.011111001$$

$$(x+y)+z = 0$$

c) this doesn't seem right because y isn't zero
however, we don't have the precision needed
so $(x+y)+z = 0$ instead of $(x+y)+z = y$

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5. a.) $16 - 1 = 15$

$$2^{15} - 1 = \boxed{32767}$$

b.) positive = $2 \times 2^{\frac{32767}{32768}} = 2^{\frac{32767}{32768}}$

negative = $1 \times 2^{\frac{-32766}{32768}} = 2^{\frac{-32766}{32768}}$

range = $[2^{\frac{-32766}{32768}}, 2^{\frac{32768}{32768}}]$

6. ~~10101000001010~~ = ~~10101110~~

~~00010101~~

~~$$\begin{array}{r}
 -0 \\
 -0 \\
 -0 \\
 -1010 \\
 \hline
 011100
 \end{array}$$~~

~~$$\begin{array}{r}
 -1110 \\
 -1010 \\
 \hline
 00001
 \end{array}$$~~

~~$$\begin{array}{r}
 -1010 \\
 1111 \\
 -1010 \\
 \hline
 0101
 \end{array}$$~~

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6. $1010 = 10$ $1101 \ 1001 = 128 + 64 + 16 + 8 + 1 = 217$

$$217/10 = 21.7$$

$$\begin{array}{r}
 & \overline{00010101} \\
 1010 & \overline{11011001} \\
 -0 & \hline
 11 & \\
 -0 & \hline
 110 & \\
 -0 & \hline
 1101 & \\
 -1010 & \hline
 111 & \\
 -0 & \hline
 1110 & \\
 -1010 & \hline
 1000 & \\
 -0 & \hline
 1101 & \\
 -1010 & \hline
 111 &
 \end{array}$$

$$Q = 00010101$$

$$R = 00000111$$

| | iter | R | Q | Diff |
|----|------|-------|----------|------|
| 1. | 1. | 1 | 10110010 | <0 |
| 2. | 2. | 11 | 01100100 | <0 |
| 3. | 3. | 110 | 11001000 | <0 |
| 4. | 4. | 1101 | 0101000 | 11 |
| 5. | 5. | 111 | 00100010 | <0 |
| 6. | 6. | 1110 | 01000100 | 100 |
| 7. | 7. | 1000 | 10001010 | <0 |
| 8. | 8. | 10001 | 10000100 | 111 |

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| 7. | iter | Mult | Sign | Hi | LO |
|----|---------|-----------|------|-----------|-----------|
| 0 | Init | 0010 1101 | | 0 | 1101 0110 |
| 1 | SR | | | 0 | 0110 1011 |
| 2 | LO[0]=1 | addi | 0 | 0010 1101 | 0110 1011 |
| 2 | SR | | | 0001 0110 | 1011 0101 |
| 3 | LO[0]=1 | addi | 0 | 0100 0011 | 1011 0101 |
| 3 | SR | | | 0010 0001 | 1101 1010 |
| 4 | SR | | | 0001 0000 | 1110 1101 |
| 5 | LO=1 | addi | 0 | 0011 1101 | 1110 1101 |
| 5 | SR | | | 0001 1110 | 1111 0110 |
| 6 | SR | | | 0000 1111 | 0111 1011 |
| 7 | LO=1 | addi | 0 | 0011 1100 | 0111 1011 |
| 7 | SR | | | 0001 1110 | 0011 1101 |
| 8 | LO=1 | subi | 1 | 1111 0001 | 0011 1101 |
| 8 | SR | | | 1111 1000 | 1001 1110 |

$\boxed{ = 1111 \ 1000 \ 1001 \ 1110_2 }$