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CS3113 AI

1) d) 8.5

$$8 = (1000)_2$$

$$\begin{array}{cccc} 2^3 & 2^2 & 2^1 & 2^0 \\ 8 & 4 & 2 & 1 \\ 1 & 0 & 0 & 0 \end{array}$$

$$8 - 8 = 0$$

$$0.5 \times 2 = 1.0 \quad 1$$

$$0.5 = (1)_2$$

$$8.5 = (1000.1)_2$$

Floating,
rounding, &
truncating

$$1.0001 \times 2^3 \Rightarrow 1.0001 \Rightarrow 1.001 \times 2^3$$

$$RRE = \frac{|x_c - x|}{|x|}$$

$$1.001 \times 2^3 \rightarrow 1001 = 2^3 + 2^0 = (9)_6$$

$$\frac{|9 - 8.5|}{8.5} = \frac{|0.5|}{8.5} = 0.05882$$

c) 3.375

$$3 = (11)_2$$

$$3 - 2 = 1$$

$$1 - 1 = 0$$

$$0.375 = (011)_2$$

$$0.375 \times 2 = 0.75 \quad 0$$

$$0.75 \times 2 = 1.50 \quad 1$$

$$0.50 \times 2 = 1.00 \quad 1$$

$$3.375 = (11.011)_2$$

$$1.1011 \times 2^1 \Rightarrow 1.1011 \Rightarrow 1.110 \times 2^1$$

$$1.110 \times 2^1 \rightarrow 11.10 = 2^1 + 2^0 \cdot 2^{-1} = 3.5$$

$$RRE = \frac{|3.5 - 3.375|}{3.375} = \frac{0.125}{3.375} = 0.03704$$

a) 3.9 $2^1 \ 2^0$
 $2 \ 1$

$$3 = (11)_2$$

$$3 - 2 = 1$$

$$1 - 1 = 0$$

$$0.9 = (0.11100)_2$$

$$0.9 \times 2 = 1.8 \quad 1$$

$$0.8 \times 2 = 1.6 \quad 1$$

$$0.6 \times 2 = 1.2 \quad 1$$

$$0.2 \times 2 = 0.4 \quad 0$$

$$0.4 \times 2 = 0.8 \quad 0$$

$$0.8 \times 2 = 1.6 \quad 1$$

$$3.9 = (11.11100)_2$$

$$1.111100 \times 2^1 \Rightarrow 1.11111 \Rightarrow 10.00 \Rightarrow 1.000 \times 2^2$$

$$1.000 \times 2^2 \rightarrow 100.0 = 2^2 = 4$$

$$RRE = \frac{|4 - 3.9|}{3.9} = \frac{0.1}{3.9} = 0.02564$$

b) 0.9

$$0.9 = (0.11100)_2$$

$$0.9 \times 2 = 1.8 \quad 1$$

$$0.8 \times 2 = 1.6 \quad 1$$

$$0.6 \times 2 = 1.2 \quad 1$$

$$0.2 \times 2 = 0.4 \quad 0$$

$$0.4 \times 2 = 0.8 \quad 0$$

$$0.8 \times 2 = 1.6 \quad 1$$

$$1. \overline{1100} \times 2^{-1}$$

$$\cancel{1. \overline{1100} \times 2^{-1}} \rightarrow \cancel{0.1 \overline{1100}} = \cancel{2^{-1} + 2^{-2} + 2^{-3}} = 0.875$$

$$\text{RRE} = \frac{|0.875 - 0.9|}{|0.9|} = 0.02778$$

1) b) 0.19

$$0.19 = (0.0010000101\dots)_2$$

$$0.19 \times 2 = 0.38 \quad 0$$

$$0.38 \times 2 = 0.76 \quad 0$$

$$0.76 \times 2 = 1.52 \quad 1$$

$$0.52 \times 2 = 1.04 \quad 1$$

$$0.04 \times 2 = 0.08 \quad 0$$

$$0.08 \times 2 = 0.16 \quad 0$$

$$0.16 \times 2 = 0.32 \quad 0$$

$$0.32 \times 2 = 0.64 \quad 0$$

$$0.64 \times 2 = 1.28 \quad 1$$

$$0.28 \times 2 = 0.56 \quad 0$$

$$0.56 \times 2 = 1.12 \quad 1$$

$$1.10000101 \times 2^{-3} \Rightarrow 1.100 \times 2^{-3}$$

$$1.100 \times 2^{-3} \rightarrow 0.001100 = 2^{-3} + 2^{-4} = 0.1875$$

$$\text{RRE} = \frac{|0.1875 - 0.19|}{|0.19|} = \frac{0.0025}{0.19} = 0.01316$$