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1. Perform a multiplication of two binary numbers (multiplicand 0101 and multiplier 0101) by creating a table to show steps taken, multiplicand register value, multiplier register value and product register value for each iteration by following the steps described in the following document.

Iteration	Step	Multiplicand Register Value	Multiplier Register Value	Product Register Value
0	Initial Values	0101	0101	0
1st Iteration	1a. Prod = Prod + Multiplicand 2. Sll Multiplicand by 1 3. Srl Multiplier by 1	0101 01010 01010	0101 0101 10101	0101 0101
2nd Iteration	2. Sll Multiplicand by 1 3. Srl Multiplier by 1	10100 10100	10010 01001	0101 0101
3rd Iteration	1a. Prod = Prod + Multiplicand 2. Sll Multiplicand by 1 3. Srl Multiplier by 1	10100 01001 01001	01001 01001 10100	11001 11001 11001
4th Iteration	2. Sll Multiplicand by 1 3. Srl Multiplier by 1	10010 10010	10100 01010	11001 11001
5th Iteration	2. Sll Multiplicand by 1 3. Srl Multiplier by 1	00101 00101	01010 00101	11001 11001 ↑ Final Product

2. Perform a division of two binary numbers (divide 0010 1011 by 0011) by creating a table to show steps taken, quotient register value, divisor register value and remainder register value for each iteration by following the steps described in the following document.

from lecture note

Iteration	Step	Quotient	Divisor	Remainder
0	Initial Value	~~0010~~ 0000	0011 0000 (Sll to be 8 bit)	0010 1011
1	1. Rem = Rem - Div	~~0010~~ 0000	0011 0000	0010 1011 − 0011 0000 = 1111 1011
	2b. Rem < 0 Rem+ = Div, sll Q, Q0 = 0	~~0010~~ 0000	0011 0000	0010 1011
	3. Srl Div	0000	0001 1000	0010 1011
2	1. Rem = Rem - Div	0000	0001 1000	0010 1011 − 0001 1000 = 0001 0011
	2a. Rem >= 0, sll Q, Q0 = 1	0001	0001 1000	0001 0011
	~~2b. Rem < 0 Rem+ = Div, sll Q, Q0 = 0~~			0010 1011
	3. Srl Div	0001	0000 1100	0010 1011
3	1. Rem = Rem - Div	~~0001~~ 0000	0000 1100	0010 1011 − 0000 1100 = 0001 0111
	2a. Rem >= 0, sll Q, Q0 = 1	~~0011~~ 0010	0000 1100	0001 0111
	3. Srl Div	~~0011~~ 0010	0000 0110	0010 1011
4	1. Rem = Rem - Div	~~0011~~ 0010	0000 0110	0010 1011 − 0000 0110 = 0010 0101
	2a. Rem >= 0, sll Q, Q0 = 1	0101	0000 0110	0010 1011
	3. Srl Div	0101	0000 0011	0010 1011
5	1. Rem = Rem - Div	0101	0000 0011	0010 1011 − 0000 0011 = 0010 1000
	2b. Rem < 0, Rem+ = Div, sll Q, Q0 = 1	0101	0000 0011	0010 1011
	3. Srl Div	0101	0000 0001	0010 1011

3. -1776 — pad for 32 bits
- negate the numbers by inverting
- add 1

```
   111
16|-1776
  -1776
     0
```

convert to hex ✓

1111 1111 1111 1111 1111 1001 0001 0000 two

4. 1111 1111 1111 1111 1111 1100 0110 1110 two
negative because it starts with 1

```
  1111 1111 1111 1111 1111 1100 0110 1110
  0000 0000 0000 0000 0000 0011 1001 0001
                                        1
+ ---------------------------------------
  0000 0000 0000 0000 0000 0011 1001 0010
                     2^9 2^8 2^7 2^4 2^3 2^2 2^1 2^0
```

$2^9 + 2^8 + 2^7 + 2^4 + 2^1 = -914_{ten}$

5. (a), b, c, d

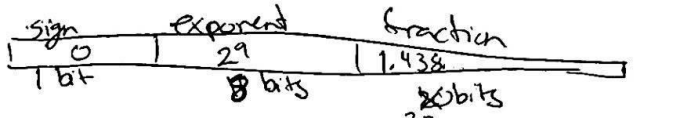
sign bit = 0

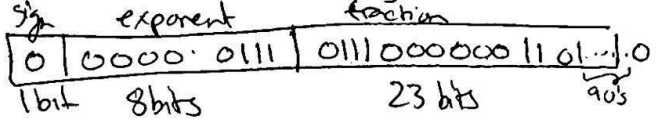
$0.40625/2^{-1} = 0.8125$

$0.40625/2^{-2} = 1.625$

$0.40625 = 1.625 \times 2^{-2}$

2^{-2}





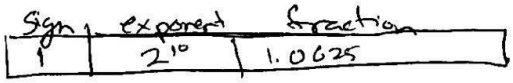
binary:
0100 0100 0011 1000 0001 1010 0000 0000 ⇒ hex:
4 4 3 8 1 A 0 0
0x44381A00

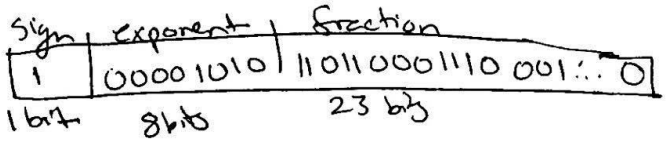
6. a, b, c, d

sign bit = 1

$.53125/1^1 = 1.0625$

$.53125/1^2 = 2.125$





binary:
1100 0100 1110 1100 0111 0001 0000 0000
C 4 E C 7 1 0 0
hex:
0xC4EC7100

7. 0xC3F2B800

1|00	0011	1|11	0010	1011	1000	0000	0000
C	3	F	2	B	8	0	0

$1.11\ldots \times 2^{\text{exponent}}$

$135 = \_\_ \times 2^{-}$

$\_\_ \times 2^{8} \rightarrow$ solve for blanks ~~-284.96~~

$\boxed{-485.43750 \times 10^{-4}}$ but the format needs to be in $\_\_ \times 10^{n}$

8. (a) $0.011_{two} \times 2^{-5}$

(b) 1011011

(c) Normalizes to 127 with no overflow

(d) 0.85938 (approximately)

9. $1.011_{two} \times 2^{-7}$ and $10.10_{two} \times 2^{-5}$

$(-7) + (-5) = -12$

$$\begin{array}{r} 1.011 \\ \times 10.100 \\ \hline \end{array} \Rightarrow \begin{array}{r} 1.011 \\ \times 10.100 \\ \hline 0000 \\ +\ 00000 \\ +\ 101100 \\ 0 \\ +\ 10110000 \\ \hline 1.1011100 \end{array}$$

1.1011100×2^{-12}

$-126 \leq -12 \leq 127$

Hence it would be $\boxed{1.101 \times 2^{-12}}$

10. $3.19_{ten} \times 10^{9}$ to $6.28_{ten} \times 10^{8}$

(a) $6.28 \times 10^{8} \rightarrow 0.628 \times 10^{9}$

$$\begin{array}{r} 3.19 \\ +\ 0.628 \\ \hline 3.818 \times 10^{9} \end{array}$$

rounding to two digits $= \boxed{3.82 \times 10^{9}}$

(b) $6.28 \times 10^{8} \rightarrow 0.628 \times 10^{9}$

$$\begin{array}{r} 3.19 \\ +\ 0.62 \\ \hline 3.81 \times 10^{9} \end{array}$$

Hence, the answer would be $\boxed{3.81 \times 10^{9}}$