

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

سُواعِيْر الْكَتْنَة :-

الثُّدُود : (٤٠٣٠ : ٢٠٣٠) ↗ بـ

البِعَاوَة

الثُّدُود : (٧ : ٩) ↗ بـ فـ

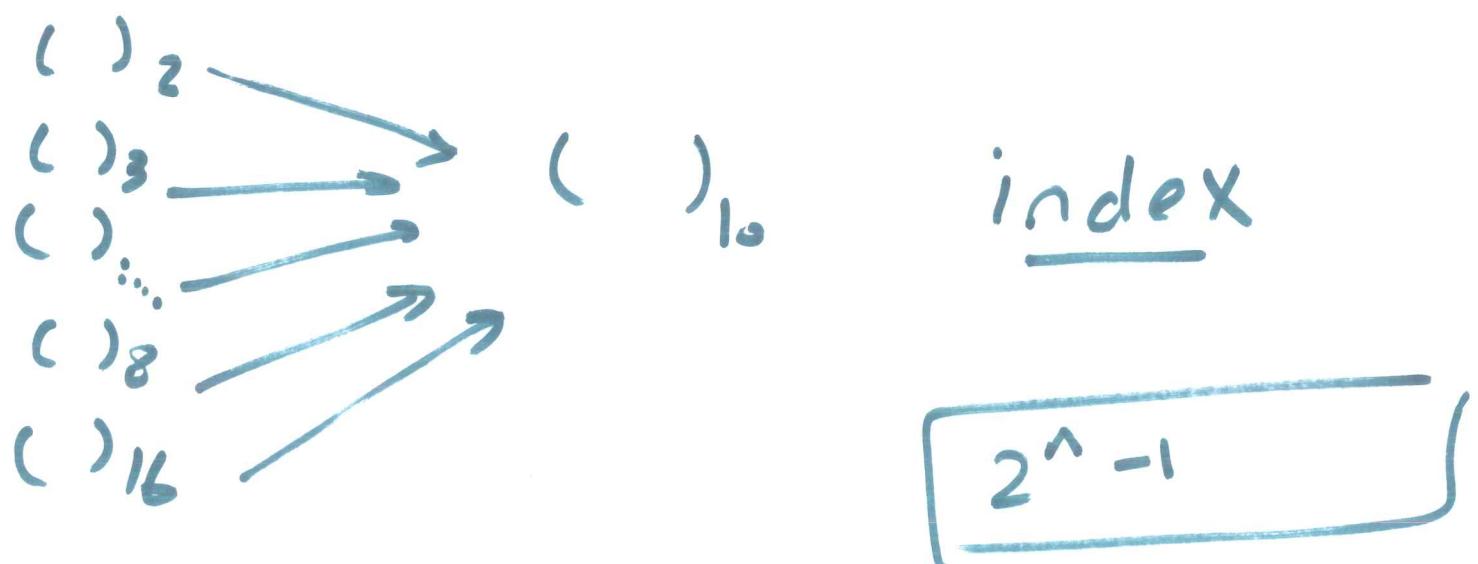
ابْنَاء ادَد سـ لـ سـ بـ عـ المـ قـ دـ مـ .

— — —

Number Systems.

Name	Base / radius	Symbols	Ex.
1) Decimal عُصَمَةٌ	$10 \ (-)_{10}$	0, 1, ..., 9	(192.37) ₁₀
2) Binary بِنَيْرِي	$2 \ (-)_{2}$	0, 1	(110.10) ₂
3) Ternary تِرْنَارِي	$3 \ (-)_{3}$	0, 1, 2	(211.01) ₃
4) Base 4 جَسَدٌ 4	$4 \ (-)_{4}$	0, 1, 2, 3 ↓ $0 \rightarrow 4$ $1 \rightarrow 5$ $2 \rightarrow 6$	(123.11) ₄
8) Octal جَسَدٌ 8	$8 \ (-)_{8}$	0, ..., 7	(761.00) ₈
16) Hexa Decimal جَسَدٌ 16	$16 \ (-)$ ↓ 10, 11, 12, 13, 14, 15	0 → 9 A → 10 B → 11 C → 12 D → 13 E → 14 F → 15	(98E.4F) ₁₆ (2)

* Conversions:



Ex:

$$(1110.11)_2 \rightarrow (?)_{10}$$

digit integer fraction

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

$$(8 + 4 + 2 + 0 + \frac{1}{2} + \frac{1}{4})$$

$$= (\underline{\underline{14 \cdot 75}})_{10} \quad (3)$$

Ex 2:

$$(\overset{3}{\underset{2}{\overset{2}{\mid}} \overset{1}{\underset{1}{\overset{1}{\mid}} \overset{0}{\underset{\uparrow}{\cdot}} \overset{-1}{\underset{2}{\overset{-2}{\mid}}})_3 \rightarrow (?)_{10}$$

$$(2 * 3^3) + (1 * 3^2) + (1 * 3^1) + (0 * 3^0)$$

$$+ (2 * 3^{-1}) + (1 * 3^{-2})$$

$$- + - + - \dots$$

$$= (- \cdot -)_{10}$$



Ex 3:

$$(\overset{3}{\underset{4}{\overset{5}{\mid}} \overset{2}{\underset{1}{\overset{1}{\mid}} \overset{0}{\underset{\uparrow}{\cdot}} \overset{-1}{\underset{3}{\overset{-2}{\mid}}} \overset{-3}{\underset{2}{\overset{-1}{\mid}}})_6 \rightarrow (?)_{10}$$

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

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

$$- + - + \dots \dots$$

$$(- \cdot -)_{10}$$

(4)

$$\underline{E \times 4} \cdot (\overset{\frac{3}{2}}{7} \overset{2}{1} \overset{1}{2} \overset{0}{1})_8 \rightarrow (?)_{10}$$

$$(7 * 8^3) + (1 * 8^2) + (2 * 8^1) + (1 * 8^0)$$

$$= \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}$$

$$= (\underline{\quad \text{integer}} \quad)_{10}$$

$$\underline{E \times 5} \cdot (0.\overset{-1}{1} \overset{-2}{6} \overset{-3}{7} \overset{-4}{3})_8 \rightarrow (?)_{10}$$

$$(1 * 8^{-1}) + (6 * 8^{-2}) + (7 * 8^{-3}) + (3 * 8^{-4})$$

$$= \underline{\quad} + \underline{\quad} + \underline{\quad} + \underline{\quad}$$

$$= (0.\underline{\quad \quad})_{10}$$

Ex 6.

$$(E^3 A^2 F^1 3^0 \bar{7}^{\text{-}1} \bar{6}^{\text{-}2} \bar{B}^{\text{-}3})_{16} \rightarrow (?)_{10}$$

$$(14 * 16^3) + (10 * 16^2) +$$

$$(15 * 16^1) + (3 * 16^0) +$$

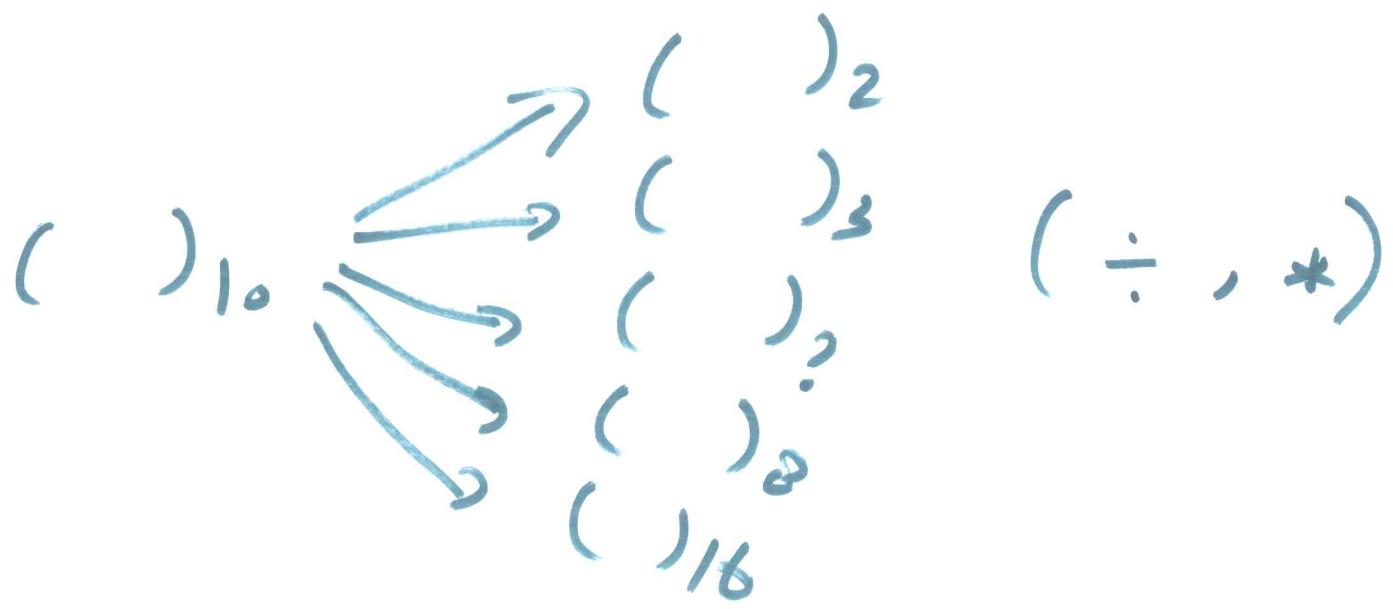
$$(7 * 16^{-1}) + (6 * 16^{-2}) + \\ (11 * 16^{-3})$$

A	10
B	11
C	12
D	13
E	14
F	15

$$\underline{\hspace{1cm}} + \underline{\hspace{1cm}} + \underline{\hspace{1cm}} \dots$$

$$= (\underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}})_{10}$$

~~~~~



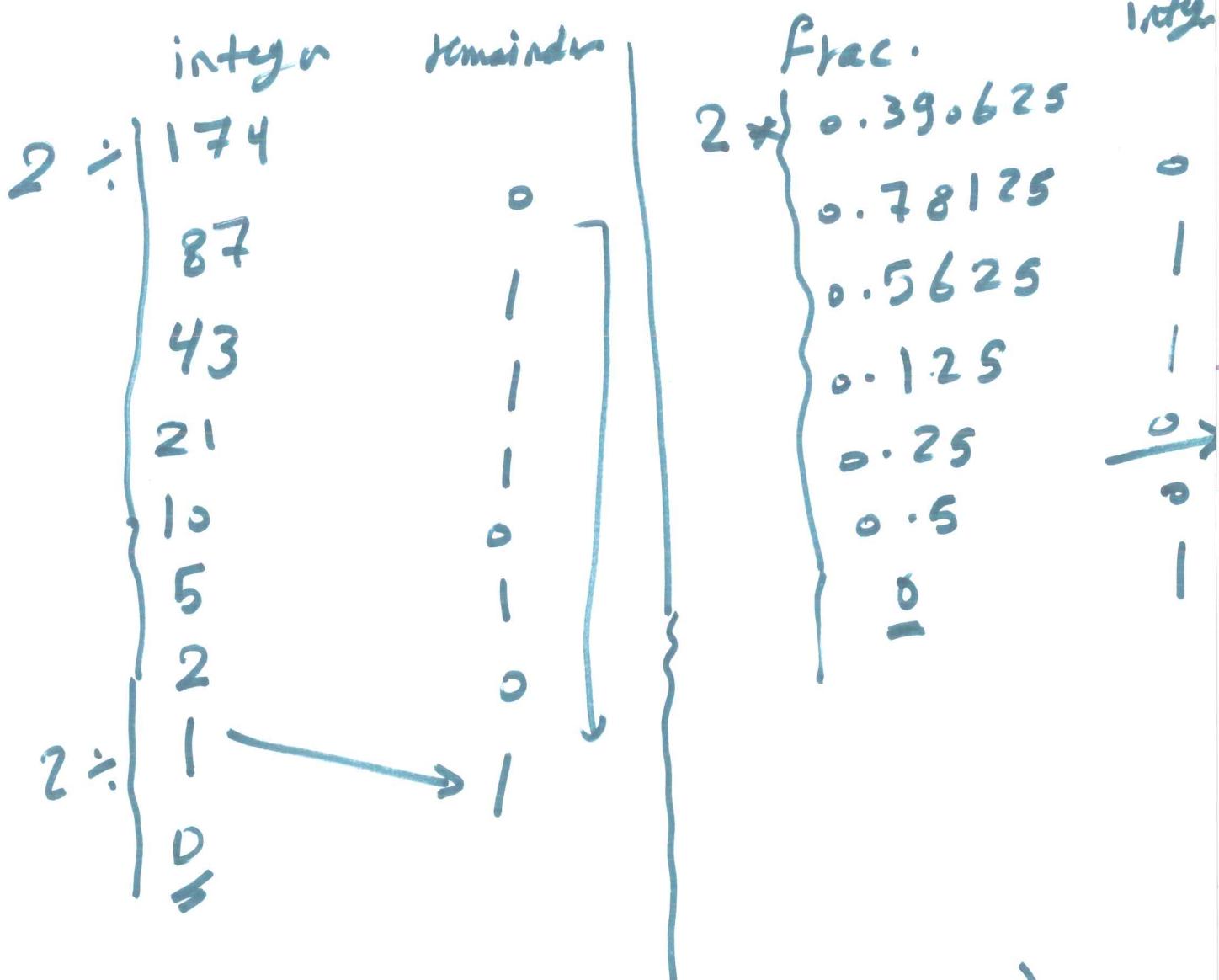
$$\begin{array}{c}
 (\underline{21} \cdot \underline{25})_{10} \\
 \text{integer} \qquad \text{fraction}
 \end{array} \rightarrow (\ ?)_2$$

10 · 5

|                                                                                                |                                               |                              |                                      |
|------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------|--------------------------------------|
| $2 \div   21$<br>$2 \div   10$<br>$2 \div   5$<br>$2 \div   2$<br>$2 \div   1$<br>$2 \div   0$ | integer    remainder    }<br>↓              ↓ | $2 *   0.25$<br>$0.5$<br>$0$ | frac.    integr.<br>↓              ↓ |
|------------------------------------------------------------------------------------------------|-----------------------------------------------|------------------------------|--------------------------------------|

$$\begin{array}{ccc}
 (0.5) & (1.0101.01)_2 & (1)
 \end{array}$$

$$(174.\overline{390625})_b \rightarrow (?)_2$$



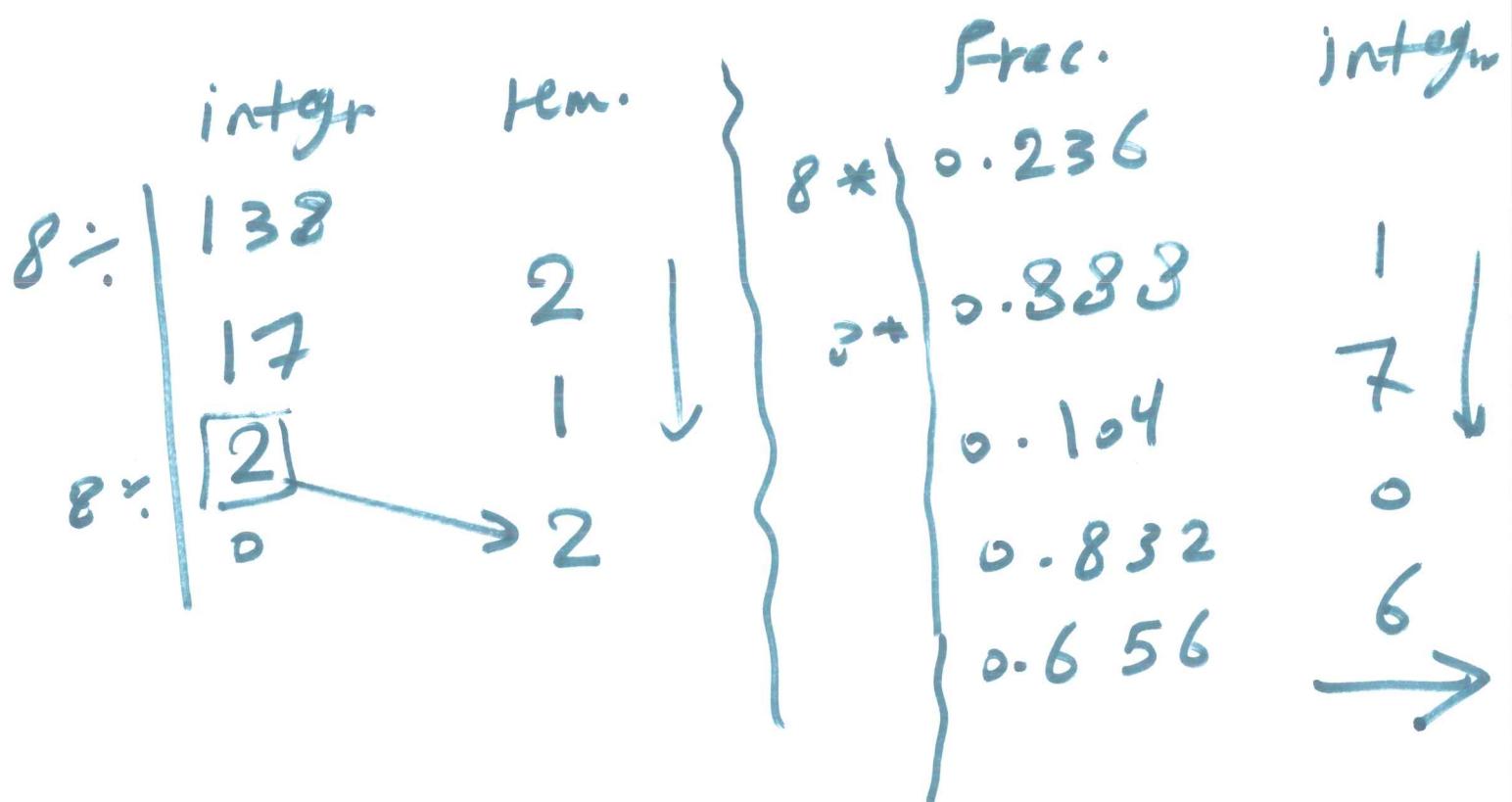
$$(10101110.\overline{011001})_2$$

\* a precision up to 4 digits.

0.5625

$$(138.236)_{10} \rightarrow (?)_8 \quad (\div -+)$$

with a precision up to 4 of decimal digits.



$$(212.1706)_8$$

$$\overline{138 \div 8} \quad \boxed{17.25}$$

$$(0.25) * 2$$

$$\overbrace{\begin{array}{r} 2 \\ 0.833 * 2 \\ \hline \boxed{7.104} \end{array}}^{\text{---}} \rightarrow 0.104 * 2 - \dots -$$

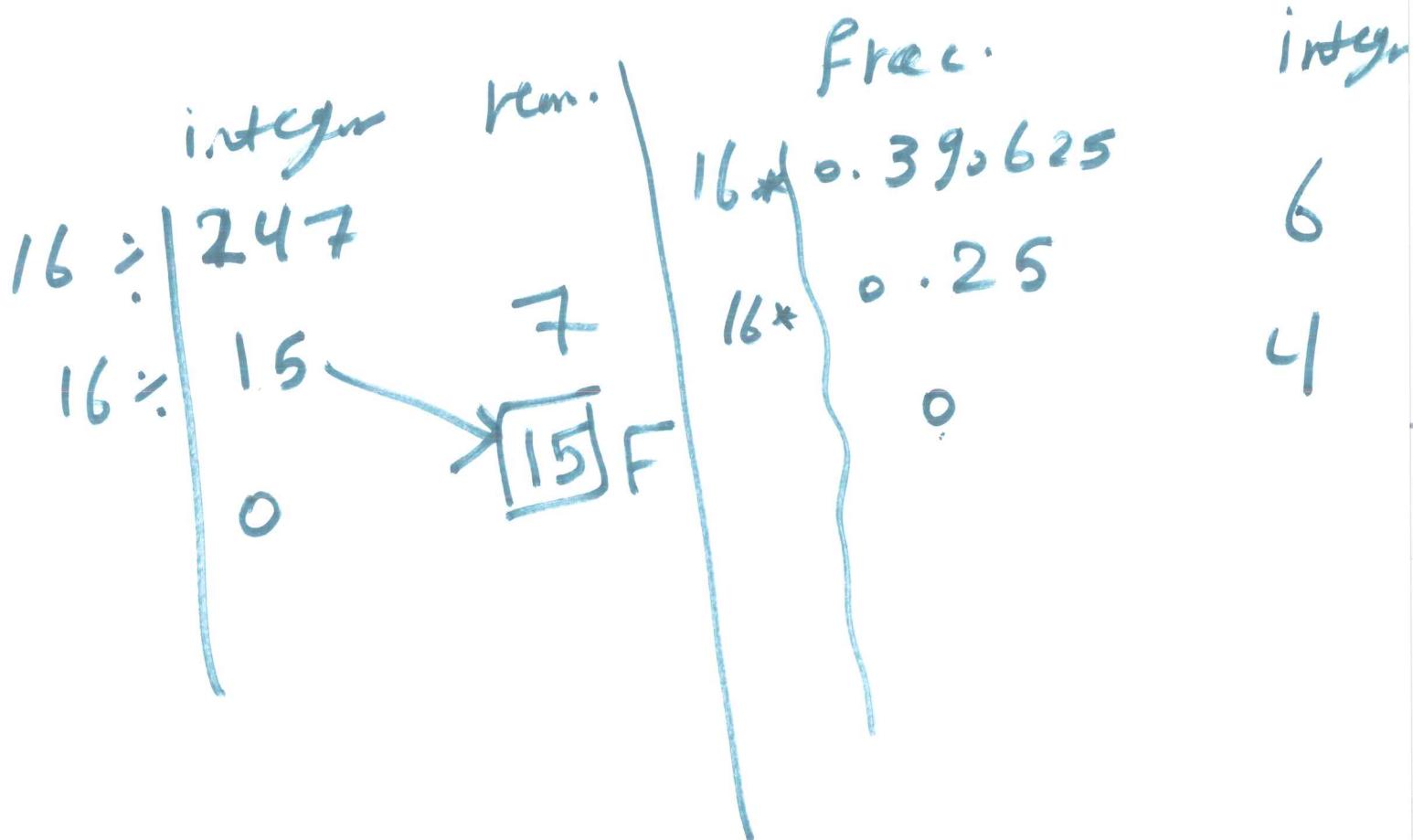
$$\overline{17 \div 8} \quad \boxed{2.125}$$

$$0.125 * 8$$

$$\frac{2}{8}$$

⑨

$$(247.390625)_{10} \rightarrow (?)_{16}$$



$$(F7.64)_{16}$$

Hexadecimal

$$0 \rightarrow g \quad 10/A \quad 11/B \quad 12/C$$

$$13/D \quad 14/E \quad 15/F$$

$$\frac{15}{16}$$

$$247 \div 16$$

$$\boxed{15.4375}$$

$$(0.4375 * 16) = 7$$

(1)

4 2 1

1)  $\begin{pmatrix} 0 & 0 & 1 \end{pmatrix}_{10}$

2)  $\begin{pmatrix} 0 & 1 & 0 \end{pmatrix}_{10}$

$4 \rightarrow \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}$

$5 \rightarrow \begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$

$6 \rightarrow \begin{pmatrix} 1 & 1 \\ 1 & 0 \end{pmatrix}$

$\begin{pmatrix} 2 & 1 \\ 2^1 & 2^2 \\ 1 & 0 \end{pmatrix}_2 \rightarrow$

| $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
|-------|-------|-------|-------|-------|-------|
| 32    | 16    | 8     | 4     | 2     | 1     |
| 1     | 0     | 0     |       | 0     | 0     |
|       | 1     | 1     |       | 0     | 0     |
|       | 1     | 1     | 1     | 1     | 1     |
|       | 1     | 1     | 1     | 1     | 1     |
|       | 1     | 1     | 1     | 0     | 1     |
|       | 1     | 0     | 1     | 0     | 0     |
|       | 1     | 1     | 0     | 0     | 1     |

$\leftarrow (16)_{10}$

$\leftarrow (12)_{10}$

$\leftarrow (15)_{10}$

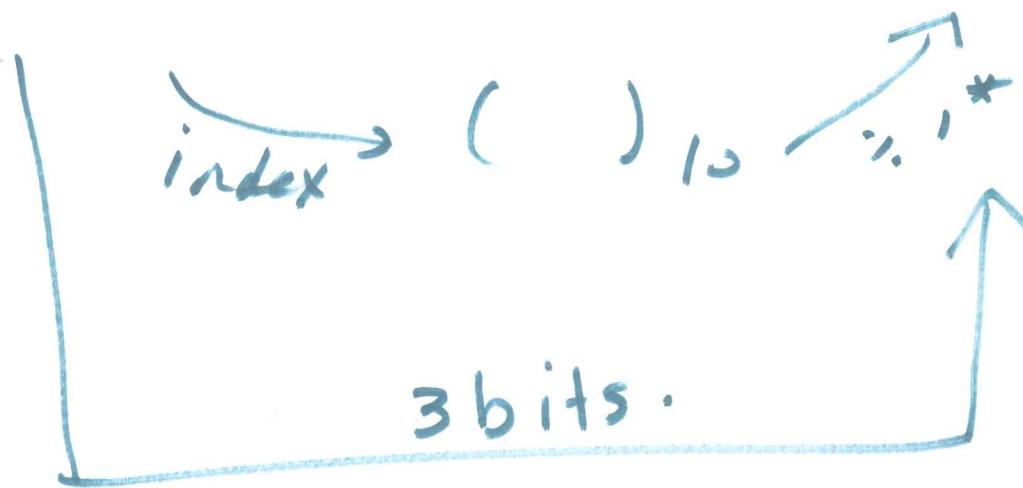
$\leftarrow (13)_{10}$

$\leftarrow (20)_{10}$

$\leftarrow (25)_{10}$

$$\left( \begin{matrix} 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \\ 1 & 0 & 0 & 0 & 0 \end{matrix} \right)_2 \rightarrow (?)_{10}$$

$$16 + 0 + 0 + 0 + 0$$

$(\ )_2 \dots (\ )_8$ 

~~(10)~~  
 $(\ )_8$   
0 → 7

1 1 1 1

weight

↳ 4 2 1  
2 2 2  
1 1 1  
 $(1111)_2 \rightarrow (?)_{10}$

13

$$( )_2 \xrightarrow{3\text{ bits}} \begin{array}{r} \boxed{18} \\ -0 \end{array} \rightarrow 7$$

3bits  $\leftarrow$  | | |

|                 |   |   |   |
|-----------------|---|---|---|
| 0 $\rightarrow$ | 0 | 0 | 0 |
| 1 $\rightarrow$ | 0 | 0 | 1 |
| 2 $\rightarrow$ | 0 | 1 | 0 |
| 3 $\rightarrow$ | 0 | 1 | 1 |
| 4 $\rightarrow$ | 1 | 0 | 0 |
| 5 $\rightarrow$ | 1 | 0 | 1 |
| 6 $\rightarrow$ | 1 | 1 | 0 |
| 7 $\rightarrow$ | 1 | 1 | 1 |

(14)

$$(732)_{10} \cdot (64)_{10} \rightarrow (?)_2$$

$$\left( \frac{111}{7} \right) \frac{011}{3} \frac{010}{2} \cdot \left( \frac{110}{6} \right) \frac{100}{4} \quad ?$$

5 bits

|     | 4 | 2 | 1    |
|-----|---|---|------|
| (4) | 1 | 0 | 0    |
| 6   | 1 | 1 | 0    |
| 2   | 0 | 1 | 0    |
| 3   | 0 | 1 | 1    |
| 7   | 1 | 1 | 1    |
|     |   |   | (15) |

(11011110110110111)  $\rightarrow$  (?)<sub>3</sub>

↓ ↓ ↓ ↓ ↑ ↓ ↓ ↓  
15 7 3 3 . 3 4 )<sub>3</sub>



(16)

Hexadecimal  $(\underline{\quad})_{16} \rightarrow (\underline{\quad})_2$   
4 bits.

0 → ~~15~~  
F

16 8 4 2 1  
4 bits → 1 1 1 1  $\leftarrow (15)_{10}$

0 → 0 0 0 0  
1 → 0 0 0 1  
2 → 0 0 1 0

⋮  
⋮  
⋮  
⋮  
11 → | 0 1 1  
12 → | 0 0 0  
14 → | 1 1 0

(17)

$(E\ 4\ F\ 9\cdot D\ 7\ C)_{16} \rightarrow (?)_2$

$\left( \begin{array}{c} \overline{1101010} \\ \overline{111} \\ \overline{E} \\ \hline 14 \end{array} \right) \cdot \left( \begin{array}{c} \overline{1001} \\ \overline{110} \\ \overline{D} \\ \hline 13 \end{array} \right) \cdot \left( \begin{array}{c} \overline{0111} \\ \overline{1100} \\ \overline{C} \\ \hline 12 \end{array} \right)$

~~~~~

$12 \rightarrow 1 \ 1 \ 0 \ 0$ $8 \ 4 \ 2 \ 1$ { A 10
7 \rightarrow 0 1 1 1 B 11
D \rightarrow 1 1 0 1 C 12
13

9 \rightarrow 1 0 0 1 D 13
F \rightarrow 1 1 1 1 E 14
15

(14) E \rightarrow 1 1 1 0 F 15
(18)

$(AB8 \cdot D6E)_{16} \rightarrow (?)_2$

$\underbrace{10101011}_{A} \underbrace{1000}_{B} \underbrace{8} \cdot \underbrace{11^{\circ}}_{D} \underbrace{0111^{\circ}}_{E} \underbrace{111^{\circ}}_{2}$

	8	4	2	1	
14 E →	1	1	1	0	A 10
6 →	0	1	1	0	B 11
13 D →	1	1	0	1	C 12
8 →	1	0	0	0	D 13
11 B →	1	0	1	1	E 14
10 A →	1	0	1	0	F 15

(19)

$$()_8 \longleftrightarrow ()_2$$

3 bits

$$()_{16} \longleftrightarrow ()_2$$

4 bits.

$$()_4 \longleftrightarrow ()_2$$

2 bits.

$$0 \rightarrow 3$$

\downarrow

$$\dots 84 \sqrt{21}$$

2 bits

$$\begin{array}{r} 2 & 1 \\ 2 \rightarrow 1 & 0 \\ 1 \rightarrow 2 & 1 \\ 0 \rightarrow 0 & 0 \end{array}$$

$$(2310 \cdot 1^2)_4 \rightarrow (?)_2$$

$$(1\overset{0}{\underset{2}{\mid}}1\overset{0}{\underset{3}{\mid}}0\overset{0}{\underset{1}{\mid}}0\cdot0\overset{0}{\underset{1}{\mid}}1\overset{0}{\underset{2}{\mid}}0)_2$$

(20)

$$(1100110111 \cdot 011)_2 \rightarrow$$

↑
 $(?)_4 \leftarrow 2\text{ bits}$

$$(3 \ 3 \ 1 \ 3 \cdot 1^2)_4$$

(21)

$(\quad)_2 \rightarrow (?)_{16}$

4 bits

$\begin{array}{c} 101 \\ | \\ 10 \\ | \\ 11 \\ \downarrow \\ 1 \\ B \end{array} \quad \begin{array}{c} 101 \\ | \\ 10 \\ | \\ 13 \\ \downarrow \\ 1 \\ D \end{array} \quad \begin{array}{c} 000 \\ | \\ 000 \\ | \\ 8 \\ \downarrow \\ 8 \end{array} \quad \begin{array}{c} 111 \\ | \\ 111 \\ | \\ 15 \\ \uparrow \\ F \end{array} \quad \begin{array}{c} 010 \\ | \\ 010 \\ | \\ 6 \\ \downarrow \\ 6 \end{array} \end{array} \quad (?)_{16}$

8 4 2 1

A 10
B 11
C 12
D 13
E 14
F 15

(22)

()₄

Base 4

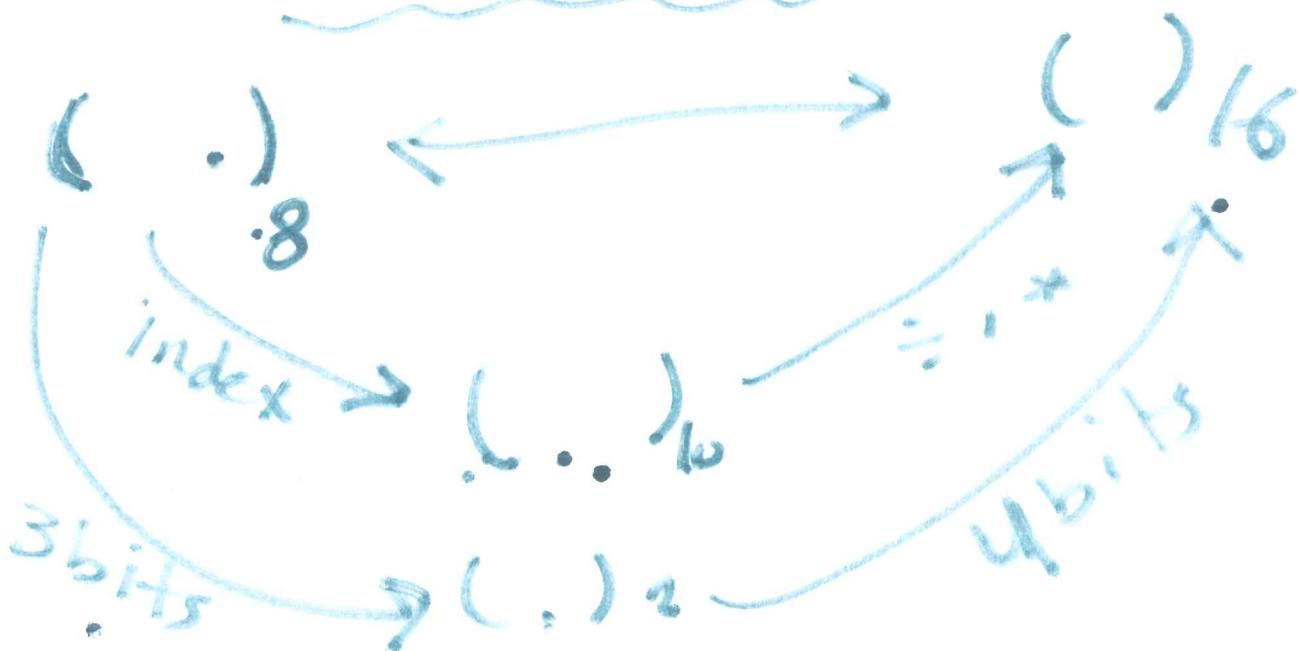
0 → 3
=

... 32 16 8 4 2 1

1 1

2 bits

0 → 0 0



(23)