

①

Ex. 10. CONVERT  $12483.046875_{10}$  TO  
BINARY

2	12483		
2	6241	R	1
2	3120	R	0
2	1560	R	0
2	780	R	0
2	390	R	0
2	195	R	0
2	97	R	1
2	48	R	0
2	24	R	0
2	12	R	0
2	6	R	0
2	3	R	0
2	1	R	1
	0	R	1

$$.046875 \times 2 = 0.09375$$

$$.09375 \times 2 = 0.1875$$

$$.1875 \times 2 = 0.375$$

$$.375 \times 2 = 0.75$$

$$.75 \times 2 = 1.5$$

$$.5 \times 2 = 1.0$$

04

$11000011000011.000011_2$

(2)

EXAMPLE 11. CONVERT  $0.1_{10}$  TO BINARY

$$0.1 \times 2 = \boxed{0}.2$$

\*  $\uparrow$   $.2 \times 2 = \boxed{0}.4$

$\uparrow$   $.4 \times 2 = \boxed{0}.8$

$\uparrow$   $.8 \times 2 = \boxed{1}.6$

\*  $\downarrow$   $.6 \times 2 = \boxed{1}.2$

\*  $\uparrow$   $.2 \times 2 = \boxed{0}.4$

$\uparrow$   $.4 \times 2 = \boxed{0}.8$

$\uparrow$   $.8 \times 2 = \boxed{1}.6$

\*  $\downarrow$   $.6 \times 2 = \boxed{1}.2$

$.000\underline{110011}$

THE UNDERLINED PART REPEATS FOREVER

HOW CAN YOU HAVE SOMETHING REPEAT FOREVER  
IN A MACHINE THAT IS FINITE?

(3)

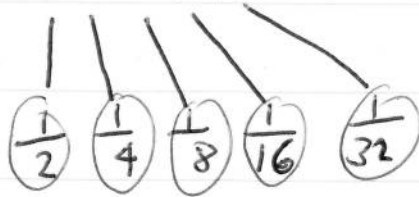
EXERCISE

~~.000~~

~~.001~~

CONVERT  $.00011_2$  TO DECIMAL

$.00011$



$$\frac{1}{2} = 0.5$$

$$\frac{1}{4} = 0.25$$

$$\frac{1}{8} = 0.125$$

$$\frac{1}{16} = 0.0625$$

$$\frac{1}{32} = 0.03125$$

$$1 \times \frac{1}{16} = 1 \times 0.0625 = 0.0625$$

$$1 \times \frac{1}{32} = 1 \times 0.03125 = \frac{0.03125}{+} \\ 0.09375$$

$$0.00011_2 = 0.09375_{10}$$

$$0.09375_{10} = 93.75\% \text{ OF THE VALUE} \\ \text{OF } 0.1$$

(4)

### EXERCISE 12

MULTIPLY ~~12483~~

1234.5678<sub>10</sub> By 10<sub>10</sub> 100<sub>10</sub> 1000<sub>10</sub> 10000<sub>10</sub> AND  
100000<sub>10</sub>

$$\times 10 = 12345.678$$

$$\times 100 = 123456.78$$

$$\times 1000 = 1234567.8$$

$$\times 10000 = 12345678 \leftarrow \text{IMPLIED POINT}$$

$$\times 100000 = 123456780 \leftarrow \text{IMPLIED POINT}$$

### EXERCISE 13

DIVIDE 1234.5678<sub>10</sub> By 10<sub>10</sub> 100<sub>10</sub> 1000<sub>10</sub>  
10000<sub>10</sub> AND 100000<sub>10</sub>

$$/ 10 = 123.45678$$

$$/ 100 = 12.345678$$

$$/ 1000 = 1.2345678$$

$$/ 10000 = 0.12345678$$

$$/ 100000 = 0.012345678$$

(5)

## Example 14A

### ADDITION IN BINARY

				1
0	0	1	1	1
<u>0+</u>	<u>1+</u>	<u>0+</u>	<u>1+</u>	<u>1+</u>
0	1	1	10	11

### MULTIPLICATION IN BINARY

① MULTIPLY  $10001_2$  BY  $101_2$

$$\begin{array}{r} 10001 \\ \times 101 \\ \hline 10001 \\ 0 \\ 10001 \end{array}$$

$$\begin{array}{r} 1000100 + \\ \hline 1010101_2 \end{array}$$

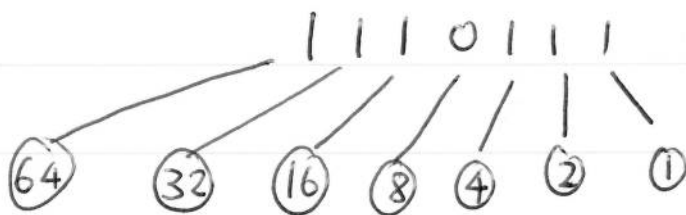
(6)

(B) Multiply  $1000_2$  by  $11_2$

$17_{10}$  by  $7_{10} = 119_{10}$

$$\begin{array}{r} 10001 \\ 111 \\ \hline 10001 \\ 100010 \\ 1000100 + \\ \hline 1110111 \end{array}$$

NOW VERIFY THAT  $1110111_2 = 119_{10}$



$$1 \times 1 = 1$$

$$1 \times 2 = 2$$

$$1 \times 4 = 4$$

$$0 \times 8 = 0$$

$$1 \times 16 = 16$$

$$1 \times 32 = 32$$

$$1 \times 64 = \frac{64}{119_{10}}$$

⑦

③ Multiply  $11111_2$  By  $11111_2$

$31_{10}$  By  $31_{10} = 961_{10}$

$11111$   
 $11111 \times$   
 $11111$

$111110$

← SHIFT AND ADD

$1011101$

$1111100$

← SHIFT TWO " "

$110110001$

$111110000$

← SHIFT THREE " "

$1110100001$

$1111100000$

← SHIFT FOUR " "

$11110000001$

VERIFY THAT  $1111000001_2 = 961_{10}$

$512$   $256$   $128$   $64$   $1$

$1$   
 $64$   
 $128$   
 $256$   
 $512$   $+$   
 $961_{10}$

(8)

Example 14 B

MULTIPLY  $110001.101_2$  BY  $10000_2$

(EASY WAY IS TO MOVE POINT TO THE RIGHT BASED ON THE NUMBER OF ZEROS YOU HAVE)

$110001.101$

$$\times 1 = 110001.101$$

$$\times 10 = 110001101$$

$$\times 100 = 110001101$$

$$\times 1000 = 110001101$$

$$\times 10000 = 1100011010$$

$$\times 100000 = 11000110100$$

← IMPLIED.

← EXTRA 0

← TWO  
EXTRA  
ZEROS