

1/

a)

23 \rightarrow

$$\begin{array}{l} 23 \div 2 \rightarrow 11 \text{ r } 1 \\ 11 \div 2 \rightarrow 5 \text{ r } 1 \\ 5 \div 2 \rightarrow 2 \text{ r } 1 \\ 4 \div 2 \rightarrow 2 \text{ r } 0 \\ 2 \div 2 \rightarrow 1 \text{ r } 0 \\ 1 \div 2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$\begin{array}{l} 23 \div 2 \rightarrow 11 \text{ r } 1 \\ 11 \div 2 \rightarrow 5 \text{ r } 1 \\ 5 \div 2 \rightarrow 2 \text{ r } 1 \\ 2 \div 2 \rightarrow 1 \text{ r } 0 \\ 1 \div 2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$(23)_{10} = (110111)_2$$

b/

$$\begin{array}{l} 31 \div 2 \rightarrow 15 \text{ r } 1 \\ 15 \div 2 \rightarrow 7 \text{ r } 1 \\ 7 \div 2 \rightarrow 3 \text{ r } 1 \\ 3 \div 2 \rightarrow 1 \text{ r } 1 \\ 1 \div 2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$(31)_{10} = (11111)_2$$

$$\begin{array}{lcl}
 67 \div 2 & \rightarrow & 33 \text{ r } 1 \\
 33 \div 2 & \rightarrow & 16 \text{ r } 1 \\
 16 \div 2 & \rightarrow & 8 \text{ r } 0 \\
 8 \div 2 & \rightarrow & 4 \text{ r } 0 \\
 4 \div 2 & \rightarrow & 2 \text{ r } 0 \\
 2 \div 2 & \rightarrow & 1 \text{ r } 0 \\
 1 \div 2 & \rightarrow & 0 \text{ r } 1
 \end{array}$$

$$(67)_{10} = (1000011)_2$$

⑧

$$\begin{array}{lcl}
 129 \div 2 & \rightarrow & 64 \text{ r } 1 \\
 64 \div 2 & \rightarrow & 32 \text{ r } 0 \\
 32 \div 2 & \rightarrow & 16 \text{ r } 0 \\
 16 \div 2 & \rightarrow & 8 \text{ r } 0 \\
 8 \div 2 & \rightarrow & 4 \text{ r } 0 \\
 4 \div 2 & \rightarrow & 2 \text{ r } 0 \\
 2 \div 2 & \rightarrow & 1 \text{ r } 0 \\
 1 \div 2 & \rightarrow & 0 \text{ r } 1
 \end{array}$$

$$(10000001)_2$$

2/

$$a) (00110011)_2 = ()_{10} / ()_{16}$$

$$\Rightarrow 0 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$\Rightarrow 32 + 16 + 2 + 1$$

$$\Rightarrow (51)_{10}$$

$$\frac{0011}{3} \quad \frac{0011}{3}$$

$$\Rightarrow (33)_{16}$$

$$b) (10110111)_2 =$$

$$\Rightarrow 1 \times 2^7 + 0 \times 2^6 + 1 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$\Rightarrow 128 + 32 + 16 + 4 + 2 + 1$$

$$\Rightarrow (183)_{10}$$

$$\frac{1011}{B} \quad \frac{0111}{7}$$

$$= (B7)_{16}$$

$$c) (00010000)_2 =$$

$$0 \times 2^7 + 0 \times 2^6 + 0 \times 2^5 + 1 \times 2^4 + 0 \times 2^3 + 0 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$$

$$\Rightarrow 16 + 0$$

$$= 16$$

$$\frac{0001}{1} \quad \frac{0000}{0}$$

$$= (10)$$

$$d) 11101111$$

$$\Rightarrow 1 \times 2^7 + 1 \times 2^6 + 1 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 1 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$$

$$\Rightarrow 128 + 64 + 32 + 8 + 4 + 2 + 1$$

$$= (239)_{10}$$

$$\frac{1110}{1111}$$

$$\Rightarrow (EF)_{16}$$

$$3.a) \quad (AAA)_{16}$$

$$\Rightarrow (10 \ 10 \ 10)$$

$$\Rightarrow 10 \times 16^2 + 10 \times 16^1 + 10 \times 16^0$$

$$\Rightarrow 2560 + 160 + 10$$

$$= (2730)_{10}$$

$$\begin{array}{ccc} A & A & A \\ \hline 1010 & 1010 & 1010 \end{array} \bigg|_2$$

$$(1010 \ 1010 \ 1010)_2$$

$$\Rightarrow 2730|2 \rightarrow 1365 \text{ r } 0$$

$$1365|2 \rightarrow 682 \text{ r } 1$$

$$682|2 \rightarrow 341 \text{ r } 0$$

$$341|2 \rightarrow 170 \text{ r } 1$$

$$170|2 \rightarrow 85 \text{ r } 0$$

$$85|2 \rightarrow 42 \text{ r } 1$$

$$42|2 \rightarrow 21 \text{ r } 0$$

$$21|2 \rightarrow 10 \text{ r } 1$$

$$10|2 \rightarrow 5 \text{ r } 0$$

$$5|2 \rightarrow 2 \text{ r } 1$$

$$2|2 \rightarrow 1 \text{ r } 0$$

$$1|2 \rightarrow 0 \text{ r } 1$$

$$(2730)_{10} = (101010101010)_2$$

$$3.b) (FFF)_{16}$$

$$\Rightarrow (15 \ 15 \ 15)_{16}$$

$$= 15 \times 16^2 + 15 \times 16^1 + 15 \times 16^0$$

$$\Rightarrow 3840 + 240 + 15$$

$$\Rightarrow 4095$$

$$F \ F \ F$$

$$(1111 \ 1111 \ 1111)_2$$

$$3.c) (1A7)_{16}$$

$$\Rightarrow (1 \ 10 \ 7)_{16}$$

$$= 1 \times 16^2 + 10 \times 16^1 + 7 \times 16^0$$

$$= 256 + 160 + 7$$

$$= 423$$

$$(1 \ A \ 7)_{16}$$

$$= (1 \ 10 \ 7)_{16}$$

$$\Rightarrow (0001 \ 1010 \ 0111)_2$$

3.D/ $(ABC)_{16}$

$$\Rightarrow (10 \ 11 \ 12)_{16}$$

$$= (10 \times 16^2 + 11 \times 16^1 + 12 \times 16^0)_{16}$$

$$\Rightarrow 2560 + 176 + 12$$

$$= (2748)_{16}$$

$$\begin{array}{c} A \ B \ C \\ 10 \ 11 \ 12 \\ \Rightarrow (1010 \ 1011 \ 1100)_2 \end{array}$$

3.E/ $(AO)_{16}$

$$\Rightarrow (10 \ 0)_{16}$$

$$\Rightarrow 10 \times 16^1 + 0 \times 16^0$$

$$\Rightarrow 160$$

=

$$\begin{array}{c} A \ 0 \\ (10 \ 0)_{16} \\ = (1010 \ 0000)_2 \end{array}$$

3.F/ $(FF19)_{16}$

$$\Rightarrow (15 \ 15 \ 1 \ 9)_{16}$$

$$= 15 \times 16^3 + 15 \times 16^2 + 1 \times 16^1 + 9 \times 16^0$$

$$= 61440 + 3840 + 16 + 9$$

$$= (65305)_{16}$$

$$\begin{array}{c} F \ F \ 1 \ 9 \\ 15 \ 15 \ 1 \ 9 \\ (1111 \ 1111 \ 0001 \ 1001)_2 \end{array}$$

6)

a) -128

$\Rightarrow 128 \div 2 \rightarrow 63 \text{ r } 1$

$63 \div 2 \rightarrow 31 \text{ r } 1$

$31 \div 2 \rightarrow 15 \text{ r } 1$

$15 \div 2 \rightarrow 7 \text{ r } 1$

$7 \div 2 \rightarrow 3 \text{ r } 1$

$3 \div 2 \rightarrow 1 \text{ r } 1$

$1 \div 2 \rightarrow 0 \text{ r } 1$

(27) $(01111111)_2$

$\Rightarrow \begin{array}{r} 10000000 \\ +1 \end{array} \begin{array}{l} 15' \\ 25' \end{array}$

$\hline 10000001 \quad 25' = -128$

b) $128 \Rightarrow$

$(128)_{10} = (1000\ 0000)_2$

$16' \rightarrow 01111111$

$\begin{array}{r} 25' \qquad \qquad +1 \\ \hline 11111110 \end{array}$

c) -31

$$\begin{array}{l} 31/2 \rightarrow 15 \text{ r } 1 \\ 15/2 \rightarrow 7 \text{ r } 1 \\ 7/2 \rightarrow 3 \text{ r } 1 \\ 3/2 \rightarrow 1 \text{ r } 1 \\ 1/2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$(31)_{10} = (11111)_2$$

$$\begin{array}{r} 15' \quad (11100000) \\ + 1 \\ \hline 25' \quad 11100001 \end{array}$$

$$\begin{array}{l} 63/2 \rightarrow 31 \text{ r } 1 \\ 31/2 \rightarrow 15 \text{ r } 1 \\ 15/2 \rightarrow 7 \text{ r } 1 \\ 7/2 \rightarrow 3 \text{ r } 1 \\ 3/2 \rightarrow 1 \text{ r } 1 \\ 1/2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$(111111)_2$$

$$= (11000000)_{15'} + 1 = +63$$

$$(-63)_{10} = 11000001_{25'}$$

$$\begin{array}{l} 16/2 \rightarrow 8 \text{ r } 0 \\ 8/2 \rightarrow 4 \text{ r } 0 \\ 4/2 \rightarrow 2 \text{ r } 0 \\ 2/2 \rightarrow 1 \text{ r } 0 \\ 1/2 \rightarrow 0 \text{ r } 1 \end{array}$$

$$10000$$

$$(11101111)_{15'} + 1$$

$$= (11111110)_{25'} = -16$$

27

31 \rightarrow 11111 \rightarrow 00011111

$16 \rightarrow 10000 \rightarrow 00010000$

$-16 \rightarrow \rightarrow 11101111$

$$\begin{array}{r} 31 \\ - 16 \\ \hline 15 \end{array}$$

$$\begin{array}{r} 0001111 \\ 1110111 \\ \hline \cancel{11}00001110 \\ 716 \\ 111 \end{array}$$

$\therefore 16 \rightarrow 10000 \rightarrow 00010000$

$+63 \rightarrow 11111111 \rightarrow 00111111$

-63 → 11 00 0000

|| o | o o o o

1000 \rightarrow 00001000 \rightarrow 11110111

10000 → 0001 0000 → 1110 1111

$$\begin{array}{r} 11010110 \\ + \\ 11010110 \\ \hline \end{array}$$

$11100 \rightarrow 00011100$
 $1100100 \rightarrow 01100100$

 $10011000 - 100$

range

$$-(2^{n-1}-1) \rightarrow 2^{n-1}-1 \quad | \quad 1s'$$

$$-(2^{n-1}) \rightarrow 2^{n-1}-1 \quad | \quad 2s'$$

$$\Rightarrow n=8, \quad -(2^7-1) \rightarrow 2^7-1 \quad | \quad 1s' =$$

$$-(2^7) \rightarrow 2^7-1 \quad | \quad 2s' =$$

$$n=16 \quad -(2^{15}-1) \rightarrow 2^{15}-1 \quad |$$

$$-2^{15} \rightarrow 2^{15}-1 \quad |$$

$$n=32 \quad -(2^{31}-1) \rightarrow 2^{31}-1 \quad |$$

$$-(2^{31}) \rightarrow 2^{31}-1 \quad |$$