

①

TWOS COMPLEMENT NUMBERS

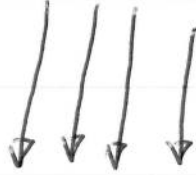
4 BIT PATTERN

| | |
|------|----|
| 0000 | 0 |
| 0001 | 1 |
| 0010 | 2 |
| 0011 | 3 |
| 0100 | 4 |
| 0101 | 5 |
| 0110 | 6 |
| 0111 | 7 |
| 1000 | 8 |
| 1001 | 9 |
| 1010 | 10 |
| 1011 | 11 |
| 1100 | 12 |
| 1101 | 13 |
| 1110 | 14 |
| 1111 | 15 |

(2)

2 : 0010

INVERT



1101

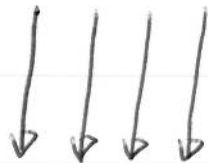
$$\begin{array}{r} 1 + \\ \hline 1110 \end{array}$$

ADD 1

← -2

1 : 0001

INVERT



1110

$$\begin{array}{r} 1 + \\ \hline 1111 \end{array}$$

ADD 1

← -1

(3)

4 BIT PATTERN (TWO'S COMPLEMENT FORMAT)

| | | |
|------|------|----|
| 0000 | 0000 | 0 |
| 001 | 0001 | +1 |
| 010 | 0010 | +2 |
| 011 | 0011 | +3 |
| 000 | 0100 | +4 |
| 001 | 0101 | +5 |
| 010 | 0110 | +6 |
| 011 | 0111 | +7 |
| 00 | 1000 | -8 |
| 01 | 1001 | -7 |
| 10 | 1010 | -6 |
| 11 | 1011 | -5 |
| 00 | 1100 | -4 |
| 01 | 1101 | -3 |
| 10 | 1110 | -2 |
| 11 | 1111 | -1 |

④

$$\begin{array}{r} 2: \quad 0010 \\ + 2: \quad \underline{0010} \quad (+) \\ + 4: \quad 0100 \end{array}$$

$$\begin{array}{r} 2: \quad 0010 \\ - 2: \quad \underline{\textcircled{1}1110} \quad (+) \\ 0: \quad 0000 \end{array}$$

↑
IGNORE

$$\begin{array}{r} 2: \quad 0010 \\ - 5: \quad \underline{1011} \quad (+) \\ - 3: \quad 1101 \end{array}$$

(5)

EXTEND THE IDEA TO 16 BITS

X: 15213

→ (A) EXPRESS AS A 16 BIT TWO'S

Y: -15213

COMPLEMENT NUMBER

(A)

2 | 15'213

2 | 7606 R 1

2 | 3803 R 0

2 | 19'01 R 1

2 | 9'50 R 1

2 | 47'5 R 0

2 | 23'7 R 1

2 | 11'8 R 1

2 | 5'9 R 0

2 | 2'9 R 1

2 | 1'4 R 1

2 | 7 R 0

2 | 3 R 1

2 | 1 R 1

0 R 1

(B) EXPRESS AS A 16 BIT TWO'S
COMPLEMENT NUMBER

← 14 BITS →

11101101101101

ANSWER (A) →

0011101101101101

← 16 BITS →

(6)

15213: 0011101101101101

INVERT



1100010010010010

1 + ADD 1

ANSWER FOR

(B)

1100010010010011



16 BIT
-15213 (TWO'S
COMPLEMENT
FORMAT)

+15213: 0011101101101101

-15213: (i) 1100010010010011

(+)

0000000000000000

IGNORE

(7)

| Weight | 15213 | |
|--------|-------|-----------------|
| 1 | 1 | 1 |
| 2 | 0 | 0 |
| 4 | 1 | 4 |
| 8 | 1 | 8 |
| 16 | 0 | 0 |
| 32 | 1 | 32 |
| 64 | 1 | 64 |
| 128 | 0 | 1280 |
| 256 | 1 | 256 |
| 512 | 1 | 512 |
| 1024 | 0 | 0 |
| 2048 | 1 | 2048 |
| 4096 | 1 | 4096 |
| 8192 | 1 | 8192 |
| 16384 | 0 | 0 |
| -32768 | 0 | 0 + |
| | | <u>15213</u> |

(8)

Weight

-15213

| | | |
|--------|---|--------|
| 1 | 1 | 1 |
| 2 | 1 | 2 |
| 4 | 0 | 0 |
| 8 | 0 | 0 |
| 16 | 1 | 16 |
| 32 | 0 | 0 |
| 64 | 0 | 0 |
| 128 | 1 | 128 |
| 256 | 0 | 0 |
| 512 | 0 | 0 |
| 1024 | 1 | 1024 |
| 2048 | 0 | 0 |
| 4096 | 0 | 0 |
| 8192 | 0 | 0 |
| 16384 | 1 | 16384 |
| -32768 | 1 | -32768 |
| | | <hr/> |
| | | -15213 |

(EIGHT BIT)

TWO'S COMPLEMENT ⁽⁹⁾ NO.

1 1 0 1 0 1 1 0

WHAT IS ITS VALUE IN DECIMAL?

Weight

| | | | |
|------|---|---|-------------|
| 1 | x | 0 | 0 |
| 2 | x | 1 | 2 |
| 4 | x | 1 | 4 |
| 8 | x | 0 | 0 |
| 16 | x | 1 | 16 |
| 32 | x | 0 | 0 |
| 64 | x | 1 | 64 |
| -128 | x | 1 | <u>-128</u> |
| | | | -42 |

42: 0 0 1 0 1 0 1 0

-42: ① 1 1 0 1 0 1 1 0

IGNORE ↗

0 0 0 0 0 0 0 0

⊕

← ANSWER

