# What are Binary Numbers?

Worksheet

A binary number represents a value using only the digits 0 and 1, where each position stands for a power of 2 (1, 2, 4, 8, 16...), and computers use it because a digit's two states map directly to electronic on/off signals.

$$@sum_{i=0}^{n-1} b_i @cdot 2^i$$

## Questions

1. What is binary 1010 in decimal?

A) 8
B) 10
C) 12
D) 5

2. Which digits are allowed in binary?

A) 0-9
B) 0 and 1 only
C) 1-9
D) 0, 1, and 2

3. What decimal value does the leftmost bit represent in the 4-bit number 1000?

A) 1
B) 2
C) 4
D) 8

4. Why is binary the language of computer hardware?

A) It uses fewer symbols to type
B) Each digit maps directly to an electrical on/off state
C) It's easier for humans to read
D) It uses base 10 internally

5. Convert binary 1011 to decimal.

6. Convert binary 1101 to decimal.

7. Convert decimal 9 to binary using powers of 2.

8. Define: What is a binary number?

9. Define: Why do computers use binary?

10. Define: What is a bit?

# Answer Key

1. B) 10 - 18 + 04 + 12 + 01 = 10.

2. B) 0 and 1 only - Binary is base-2, so it only uses the digits 0 and 1.

3. D) 8 - The leftmost bit in a 4-bit number is the 2 place, worth 8.

4. B) Each digit maps directly to an electrical on/off state - Transistors are naturally two-state (on/off), matching binary's two digits perfectly.

5. Digits from left: d3=1, d2=0, d1=1, d0=1 N = 12 + 02 + 12 + 12 N = 8 + 0 + 2 + 1 N = 11

6. Digits: d3=1, d2=1, d1=0, d0=1 N = 18 + 14 + 02 + 11 N = 8 + 4 + 0 + 1 N = 13

7. Largest power of 2 9 is 8 (2): 9 8 = 1, so bit3 = 1 Next, 2 = 4 doesn't fit into 1: bit2 = 0 Next, 2 = 2 doesn't fit into 1: bit1 = 0 Last, 2 = 1 fits exactly: bit0 = 1 binary 1001

8. A number written using only the digits 0 and 1, where each position represents a power of 2.

9. Because each binary digit maps directly to one of two electronic states: on (1) or off (0).

10. A bit is a single binary digit - either 0 or 1 - the smallest unit of digital data.