Decoding the Digital World: A Binary Challenge

1. The two digits are 0 and 1. They represent tiny light switches that are either off (0) or on (1). (2 marks)

Working: Refer to the passage: 'only uses two digits: 0 and 1. These act like tiny light switches that are either off (0) or on (1).'

1 mark for identifying 0 and 1; 1 mark for explaining they represent on/off switches.

2. 00001101 (3 marks)

Working: 8+4+1 = 13. Columns: 8(1), 4(1), 2(0), 1(1). Total 8-bit: 00001101.

3 marks for correct 8-bit sequence.

3. 44 (4 marks)

Working: 32 + 8 + 4 = 44. (0*128 + 0*64 + 1*32 + 0*16 + 1*8 + 1*4 + 0*2 + 0*1)

4 marks for correct calculation.

4. Computers use binary because it is easier for electronic circuits to exist in only two states: on or off. Using base-10 would require circuits to distinguish between ten different voltage levels, which is much more difficult and prone to errors. (4 marks)

Look for: Mention of electronic circuits/switches and the simplicity of two states vs ten.

Good: Computers use binary because they only have two states, on and off.

Better: Computers use binary because electronic circuits work best with two states, on and off, which represents 0 and 1.

Best: Computers use binary because it is reliable for electronic circuits to distinguish between two states (on/off). Using base-10 would be too complex for hardware to manage accurately.

What moves an answer up: The 'best' answer explains the technical limitation of hardware compared to the simplicity of binary.

5. 0010 (3 marks)

Working: 2s column = 1, 1s column = 0. 4-bit system: 0010.

3 marks for correct 4-bit sequence and working.

6. To store the letter 'A', the computer converts the denary number 65 into binary (01000001). Standardisation is vital because every computer needs to use the same code for the same letter. If different computers used different codes for 'A', they would not be able to share information or read each other's files correctly. This shared system ensures that data remains consistent across all digital devices. (9 marks)

Look for: Conversion of 65 to binary (01000001) and the concept of universal communication/compatibility.

Good: The computer turns 65 into binary. Standardisation is important so all computers understand the same letters.

Better: The computer stores 'A' as 65, which is 01000001 in binary. Standardisation is important so that every computer uses the same code to represent the same character.

Best: The computer stores 'A' as 65, represented as 01000001 in binary. Standardisation is essential because it creates a universal language for computers. Without it, computers could not communicate or share data, as one machine's 'A' might be another machine's 'Z'.

What moves an answer up: The 'best' answer provides the specific binary code and explains the consequence of a lack of standardisation.

7. 255. Calculation: 128+64+32+16+8+4+2+1 = 255. (2 marks)

Working: Sum of all place values in an 8-bit system.

2 marks for correct number and explanation.

What a secure answer looks like

A secure answer demonstrates an understanding that binary is a base-2 system where each position represents a power of two. Pupils should be able to map denary values to these positions accurately.

If your child is stuck

Suggest they draw a table with 8 columns labelled 128, 64, 32, 16, 8, 4, 2, 1. Remind them to start from the left and subtract the largest possible value first.

Common mistakes to watch for

Forgetting to include leading zeros in an 8-bit sequence (e.g., writing 1101 instead of 00001101) and confusing the place value order (starting from the left instead of the right).