Worksheet: Conversions Between Binary, Octal, and Hexadecimal (Example 7)

Part A — Worked Example

Problem. Find the octal and hexadecimal expansions of $(11\ 1110\ 1011\ 1100)_2$ and the binary expansions of $(765)_8$ and $(A8D)_{16}$.

Step 1: Convert $(11\ 1110\ 1011\ 1100)_2$ **to octal.**
- Group binary digits into blocks of 3 (add leading zeros if needed):

$$011,\ 111,\ 010,\ 111,\ 100$$

- Convert each block to octal: $3, 7, 2, 7, 4$.

$$(11\ 1110\ 1011\ 1100)_2 = (37274)_8$$

Step 2: Convert $(11\ 1110\ 1011\ 1100)_2$ **to hexadecimal.**
- Group binary digits into blocks of 4:

$$0011,\ 1110,\ 1011,\ 1100$$

- Convert each block: $3, E, B, C$.

$$(11\ 1110\ 1011\ 1100)_2 = (3EBC)_{16}$$

Step 3: Convert $(765)_8$ **to binary.**
- Each octal digit becomes 3 binary digits:

$$7 = 111,\ 6 = 110,\ 5 = 101$$

$$(765)_8 = (111110101)_2$$

Step 4: Convert $(A8D)_{16}$ **to binary.**
- Each hex digit becomes 4 binary digits:

$$A = 1010,\ 8 = 1000,\ D = 1101$$

$$(A8D)_{16} = (101010001101)_2$$

Final Answers: $(37274)_8$, $(3EBC)_{16}$, $(111110101)_2$, $(101010001101)_2$

Part B — Easier Practice Problems

1. Convert $(101101)_2$ to octal. 2. Convert $(47)_8$ to binary.

Part C — Harder Challenge

Convert $(111011110101)_2$ into both octal and hexadecimal.