AP COMPUTER SCIENCE PRINCIPLES • EXERCISE SHEET

2.1 Binary Numbers

Name: _____ Class: _____ Date: _____ **Total: 10 marks**

Objective

Build the skills to answer exam questions on **binary numbers**.

You must be able to:

- explain why computers represent all data using **bits** 位, each a 0 or 1
- convert a whole number between **binary** 二进制 and **decimal** 十进制
- describe how a fixed number of bits can cause an **overflow error** 溢出错误
- relate 8 bits to one **byte** 字节

1 Worked examples

Study these first. Each one shows the method for a question type used later.

Bits and bytes

A computer stores everything as **bits** (0 or 1). **8 bits = 1 byte**.

Binary to decimal

Each bit has a place value $1, 2, 4, 8, 16, \ldots$ (powers of 2). Add the place values where the bit is 1:

$$1101_2 = 8 + 4 + 0 + 1 = 13.$$

Decimal to binary

Subtract the largest powers of 2 that fit: $6 = 4 + 2 = 110_2$.

2 Practice

2.1 Convert the binary number 1010 to decimal. [2]

2.2 Convert the decimal number 6 to binary. [2]

2.3 State how many bits are in one byte. [1]

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3 Exam-style questions

3.1 The binary number 1000 in decimal is [1]

- **A** 4
- **B** 8
- **C** 16
- **D** 2

3.2 A value too large for the available bits causes an [1]

- **A** logic error
- **B** overflow error
- **C** syntax error
- **D** case with no error

3.3 Convert between the two bases.

(a) Binary 1111 to decimal. [1]

(b) Decimal 10 to binary. [2]

4 Go further

- work through the **2.1 Binary Numbers** lesson on the **Learn** page;
- read the **Data** section of the AP Computer Science Principles handout on the **Know** page.

Solutions

2.1 $1010_2 = 8 + 0 + 2 + 0 = 10$.

2.2 $6 = 4 + 2 = 110_2$.

2.3 8.

3.1 B.

3.2 B.

3.3 (a) $1111_2 = 8 + 4 + 2 + 1 = 15$. (b) $10 = 8 + 2 = 1010_2$.