

4.16 Recursion

Name: _____ Class: _____ Date: _____

Total: 9 marks

KEY WORDS base case 基准情形 • recursion 递归 • recursive case 递归情形

Objective

Build the skills to answer exam questions on **recursion**.

You must be able to:

- understand that a **recursive** 递归 method calls itself
- identify the **base case** 基准情形 that stops the recursion
- identify the **recursive case** 递归情形 that moves toward the base case

1 Worked examples

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

■ Recursion

A **recursive** method calls **itself**. It needs:

- a **base case** that stops the recursion, and
- a **recursive case** that moves the problem toward the base case.

```
int fact(int n) {
    if (n <= 1) return 1;      // base case
    return n * fact(n - 1);    // recursive case
}
```

Without a base case, the recursion never stops.

■ Unwinding the calls

fact(3) calls **fact(2)**, which calls **fact(1)**. The base case returns 1, then the waiting calls finish in reverse: **fact(2)** = $2 * 1 = 2$, then **fact(3)** = $3 * 2 = 6$. Each call pauses until the one below it returns.

2 Practice

2.1 Define a recursive method. [1]

2.2 State the purpose of a base case. [1]

2.3 For the **fact** example above, state the value of **fact(3)**. [2]

3 Exam-style questions

3.1 A recursive method is one that [1]

- **A** never returns
- **B** calls itself
- **C** always uses a loop
- **D** must be **static**

3.2 The part that stops the recursion is the [1]

- **A** recursive case
- **B** base case
- **C** parameter
- **D** return type

3.3 `int f(int n) { if (n == 0) return 0; return n + f(n - 1); }`.

(a) State `f(0)`.

[1]

(b) State `f(3)`.

[1]

(c) Name the case where `n == 0`.

[1]

Solutions

2.1 a method that calls itself.

2.2 it stops the recursion so it does not run forever.

2.3 $3 \times 2 \times 1 = 6$.

3.1 B.

3.2 B.

3.3 (a) 0. (b) $3 + 2 + 1 + 0 = 6$. (c) the base case.