AP COMPUTER SCIENCE A • EXERCISE SHEET

2.12 Informal Run-Time Analysis

Name: _____ Class: _____ Date: _____ **Total: 8 marks**

KEY WORDS run-time analysis 运行时间分析 • nested loop 嵌套循环

Objective

Build the skills to answer exam questions on **informal run-time analysis**.

You must be able to:

- count how many times a statement executes as a measure of a program's work
- understand that a loop over n items runs its body about n times
- explain why a **nested loop** over n items runs its inner body about n^2 times

1 Worked examples

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

■ Counting executions

We estimate a program's work by counting how many times a statement runs.

- A single loop over n items runs its body about n times.
- A **nested loop** over n items runs its inner body about $n \times n = n^2$ times.

So nested loops grow much faster than single loops as n increases.

■ Worked count

For a loop that runs n times **inside** a loop that runs n times, the inner statement runs n^2 times. If $n = 5$ that is 25 executions; if n doubles to 10 it jumps to 100 – four times the work. A single loop would only double.

2 Practice

2.1 State roughly how many times a single loop over n items runs its body. [1]

2.2 State roughly how many times a nested loop over n items runs its inner body. [1]

2.3 A single loop runs over 100 items. State roughly how many times its body runs. [1]

3 Exam-style questions

3.1 A single loop over n items runs its body about [1]

- **A** 1
- **B** n
- **C** n^2
- **D** 2^n

times.

3.2 A nested loop over n items runs its inner body about [1]

- **A** n
- **B** n^2
- **C** $\log n$
- **D** 1

times.

3.3 A nested loop processes $n = 10$ items.

(a) State roughly how many inner-body runs there are. [1]

(b) State whether this grows faster than a single loop. [1]

(c) State roughly how many runs a single loop over 10 items has. [1]

Solutions

2.1 about n times.

2.2 about n^2 times.

2.3 about 100 times.

3.1 B.

3.2 B.

3.3 (a) about 100 (10^2). (b) yes. (c) about 10.