

THEME B: COMPUTATIONAL THINKING · B2.2

Data structures

Original practice questions · 34 marks · about 55 minutes · covers B2.2.1–B2.2.4

Instructions. Answer all questions. The maximum mark for this paper is [34 marks]. The marks available are shown in brackets. Parts badged **HL** assess higher level only content; standard level students may leave these out. Questions that ask you to construct code may be answered in **either Java or Python**. State which language you are using. Marks are for the logic, not for perfect syntax.

1**Total: 5 marks**

Programs may use either static or dynamic data structures.

- (a)** Compare static and dynamic data structures, referring to how memory is allocated and how each is resized. **[4]**

- (b)** State **one** advantage of using a static array rather than a dynamic list. **[1]**

A weather station stores the rainfall in millimetres for each day of one week.

JAVA

```
int[] rainfall = {3, 0, 12, 7, 0, 21, 5};
```

PYTHON

```
rainfall = [3, 0, 12, 7, 0, 21, 5]
```

- (a) Construct a program that finds and prints the highest rainfall recorded that week. [4]

- (b) Construct a statement that adds a new reading of 8 to the end of a dynamic list of rainfall values. [2]

3

Total: 6 marks

A school stores test marks for five students. Each student sits four tests. The marks are held in a two-dimensional structure, with students as rows and tests as columns.

JAVA

```
int[][] marks = new int[5][4]; // 5 students, 4 tests each
```

PYTHON

```
marks = [[0] * 4 for _ in range(5)] # 5 students, 4 tests each
```

- (a) State the code that accesses the mark of the **fourth** student in the **second** test. [1]

- (b)** Construct a program that counts and prints how many of the marks are below 40. **[5]**

4

Total: 6 marks

A web browser uses a stack to support its back button. Each time the user follows a link, the page they are leaving is pushed onto the stack. Pressing back pops the top page and returns to it.

- (a)** Explain why a stack, rather than a queue, is the appropriate structure for this purpose. **[3]**

- (b)** The user starts on page A, follows a link to page B, then follows a link to page C. State the contents of the stack, top item first. **[2]**

- (c) Identify the stack operation that inspects the top item without removing it. [1]

An office printer holds a queue of jobs. Three jobs are sent to it in this order: Report, Poster, Invoice.

- (a) Explain why a queue, rather than a stack, is the appropriate structure for a print queue. [3]

- (b) State which job is removed by the first call to `dequeue()`. [1]

- (c) Outline what `front()` returns and how it differs from `dequeue()`. [2]

Choosing the right data structure affects both performance and memory use.

- (a) Outline why adding and removing items on a stack is faster than searching a list for a particular value. [3]

- (b) Suggest an appropriate data structure for the undo feature of a text editor, and justify your choice. [2]

END OF QUESTIONS