Captivate
EDUCATION

SAMPLE QUESTIONS
One question from each section of this exam, with its marking scheme, so teachers can see what the full paper is like. Full exam and solutions: captivateeducation.com.au/trial-exams

Algorithmics (HESS)

Question and Answer Book

Practice examination 1 – 2027

- Reading time is 15 minutes
- Writing time is 2 hours

Approved materials

- One scientific calculator

Materials supplied

- Question and Answer Book
- Multiple-Choice Answer Sheet

Instructions

- Follow the instructions on your Multiple-Choice Answer Sheet.
- At the end of the examination, place your Multiple-Choice Answer Sheet inside the front cover of this book.

Students are not permitted to bring mobile phones and/or any unauthorised electronic devices into the examination room.

Contents

Section A (20 questions, 20 marks)

Section B (15 questions, 80 marks)

Practice material in the layout of the 2025 VCAA paper – generated 2027. Not a VCAA examination.

SAMPLE

Section A – Multiple-choice questions

Instructions

- Answer **all** questions in pencil on your Multiple-Choice Answer Sheet.
- Choose the response that is correct or that best answers the question.
- A correct answer scores 1; an incorrect answer scores 0.
- Marks will not be deducted for incorrect answers.
- No marks will be given if more than one answer is completed for any question.
- Use the Master Theorem to solve recurrence relations of the form shown below.

Sample – Question 1 of the 20 questions in this section.

$$T(n) = \begin{cases} a \cdot T(n/b) + k\, n^c & \text{if } n > 1 \\ d & \text{if } n = 1 \end{cases} \quad \text{where } a > 0,\ b > 1,\ c \geq 0,\ d \geq 0,\ k > 0$$

$$\text{and its solution } T(n) = \begin{cases} O(n^c) & \text{if } a < b^c \\ O(n^c \log n) & \text{if } a = b^c \\ O(n^{\log_b(a)}) & \text{if } a > b^c \end{cases}$$

Question 1

A veterinary clinic's after-hours service records each arriving animal with a triage level from 1 (most urgent) to 5 (least urgent). The next animal treated is always one with the most urgent triage level present; animals with the same level are treated in order of arrival.

Which one of the following abstract data types (ADTs) is most appropriate for storing the animals that are waiting?

A. stack

B. queue

C. priority queue

D. set

End of Section A

SAMPLE

Section B

Instructions

- Answer **all** questions in the spaces provided.
- Write your responses in English.
- Use the Master Theorem to solve recurrence relations of the form shown below.

Sample – Question 1 of the 15 questions in this section.

$$T(n) = \begin{cases} a \cdot T(n/b) + k\, n^c & \text{if } n > 1 \\ d & \text{if } n = 1 \end{cases} \quad \text{where } a > 0,\ b > 1,\ c \geq 0,\ d \geq 0,\ k > 0$$

$$\text{and its solution } T(n) = \begin{cases} O(n^c) & \text{if } a < b^c \\ O(n^c \log n) & \text{if } a = b^c \\ O(n^{\log_b(a)}) & \text{if } a > b^c \end{cases}$$

Question 1 (3 marks)

Tamsin manages the Wattle Street Tool Library. Each tool has a unique tool code, such as `"DR-04"`. The tools currently on loan are stored in a dictionary in which each key is a tool code and each value is the name of the member who has borrowed that tool, for example

```
{"DR-04": "Hamish", "LM-11": "Priya", "SW-02": "Hamish"}
```

a. Explain why a dictionary is more suitable than a list of (tool code, member) pairs for finding out who has borrowed a particular tool. 1 mark

b. The operation `lend` takes the loans dictionary, a tool code and the name of a member, and returns the updated loans dictionary. Write the signature specification for `lend`. 2 marks

End of sample questions

SAMPLE

Marking scheme for the sample questions

Section A

Question	Key	Question	Why
1	**C**	A veterinary clinic's after-hours service records each arriving animal with a triage level from 1 (most urgent) to 5 (least urgent). The next animal treated is always one with the most urgent triage level present; animals with the same level are treated in order of arrival. Which one of the following abstract data types (ADTs) is most appropriate for storing the animals that are waiting?	A priority queue removes the element with the highest priority (here the most urgent triage level) first, with ties served in arrival order. A queue is incorrect because it serves animals strictly in arrival order and ignores the triage level. A stack serves the most recent arrival first. A set has no order at all.

Section B

Question 1a. (1 mark)

Explain why a dictionary is more suitable than a list of (tool code, member) pairs for finding out who has borrowed a particular tool.

To be awarded full marks, students were required to:

- link the dictionary's key-based lookup to the task of finding the borrower of one tool code

Common errors: Describing what a dictionary is without saying why it helps with this lookup.

Mark allocation: 1 mark for explaining that the tool code is the key, so the borrower is retrieved directly by its key rather than by searching through the pairs.

Sample full-mark response

> The tool code is the key of the dictionary, so Tamsin can look up the borrower of "DR-04" directly, whereas with a list she would have to search through the pairs one by one until she found that code.

Question 1b. (2 marks)

The operation `lend` takes the loans dictionary, a tool code and the name of a member, and returns the updated loans dictionary. Write the signature specification for `lend`.

SAMPLE

To be awarded full marks, students were required to:

- name the operation and give the argument types in order, joined by ×
- give the result type after →

Common errors: Writing variable names (loans × code × member) instead of types; giving boolean as the result type.

Mark allocation: 1 mark for the three argument types in order (dictionary × string × string); 1 mark for the result type (→ dictionary).

Sample full-mark response

> lend: dictionary × string × string → dictionary

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