



BSc EXAMINATION

COMPUTER SCIENCE

Computational Mathematics

Release date: Tuesday 7 March 2023 at 12:00 midday Greenwich Mean Time

Submission date: Wednesday 8 March 2023 by 12:00 midday Greenwich Mean Time

Time allowed: 24 hours to submit

INSTRUCTIONS TO CANDIDATES:

Section A of this assessment consists of a set of **TEN** Multiple Choice Questions (MCQs) which you will take separately from this paper. You should attempt to answer **ALL** the questions in Section A. The maximum mark for Section A is **40**.

Section A will be completed online on the VLE. You may choose to access the MCQs at any time following the release of the paper, but once you have accessed the MCQs you must submit your answers before the deadline or within **4 hours** of starting whichever occurs first.

Section B of this assessment is an online assessment to be completed within the same 24-hour window as Section A. We anticipate that approximately **1 hour** is sufficient for you to answer Section B. Candidates must answer **TWO** out of the **THREE** questions in Section B. The maximum mark for Section B is **60**.

Calculators are permitted in this examination. Credit will only be given if all workings are shown.

You should complete Section B of this paper and submit your answers as **one document**, if possible, in Microsoft Word or a PDF to the appropriate area on the VLE. Each file uploaded must be accompanied by a coversheet containing your **candidate number**. In addition, your answers must have your candidate number written clearly at the top of the page before you upload your work. Do not write your name anywhere in your answers.

SECTION A

Candidates should answer the **TEN** Multiple Choice Questions (MCQs) quiz, **Question 1** in Section A on the VLE.

SECTION B

Candidates should answer any **TWO** questions from Section B.

Question 2

- (a) i. The weights in kg of 10 students are given below :
29, 33, 26, 28, 36, 41, 23, 34, 34, 33. Work out the median, show your work. [2]
- ii. 99 people take a test. Their scores out of 100 are :
56, 79, 77, 48, 90, 68, 79, 92, 71, 56, 79, 77, 48, 90, 68, 79, 92, 71
Work out the mean, median, and mode of their scores, show your work. [3]
- (b) evaluate $\lim_{x \rightarrow +\infty} f(x)$ and $\lim_{x \rightarrow -\infty} f(x)$ for $f(x) = \frac{x}{\sqrt{x^2+1}}$. Sketch the graph, show your working. [6]
- (c) Angle θ is $-\frac{2}{3}$ radians. θ is in the second quadrant. Find the values of $\sin \theta$, $\cos \theta$, $\csc \theta$, $\sec \theta$, $\cot \theta$. First, sketch the second quadrant angle, show your work. [7]
- (d) Solve $3 \tan 2x = -3$ in the interval $[0, 2\pi)$, show your work. [6]
- (e) i. Use the quotient rule to find the derivative of
 $R(w) = \frac{3w+w^4}{2w^2+1}$. [3]
- ii. Find the domain and the range for $f(x) = \frac{6x-2}{3x-4}$, show your work. [3]

Question 3

(a) Expand each of the following expression

i. $\log_4 5x^3y$

ii. $\ln \frac{\sqrt{3x-5}}{7}$

[4]

(b) Sketch the following functions on the same graph for the range $x < 3$, label the axes :

i. $f(x) = \log x$

ii. $g(x) = \log(x - 1)$

iii. $h(x) = 2 + \log(x)$

[3]

(c) The 4^{th} term of a geometric sequence is 125, and the 10^{th} term is $125/64$. Find the 14^{th} term. (Assume that the terms of the sequence are positive). Show your working

[5]

(d) Find the answer for each of the following, show your work

i. How many ways are there to permute the letters in the word HAHAAHAAA ?

ii. How many ways are there to permute the letters in the word STATISTICS ?

[6]

(e) An investor deposits \$50 on the first day of each month in an account that pays 3% interest, compounded monthly. What is the balance at the end of 2 years ? Show your working

[6]

(f) Find the limit of $f(x)$ as x approaches 0 from the left and from the right where $f(x) = \frac{[2x]}{x}$, show your work.

[6]

Question 4

- (a) A cyclist travels down a hill in a straight line with constant acceleration. She starts with speed 1.5 m/s and finishes with speed 9.5 m/s. The length of the hill is 22 m. Show your working.

- i. Find the time taken
- ii. Find the acceleration of the cyclist.

[5]

- (b) Using matrices and determinants, solve the following system if possible, Show your working. If not possible, show why not.

$$f(x) = \begin{cases} -x + 2y - 3z = 1 \\ 2x + z = 0 \\ 3x - 4y + 4z = 2 \end{cases}$$

[5]

- (c) Show that all functions of the form $f(x) = a(x - h)^2 + k$ are one to one functions for $x \geq h$, where a , h and k are real numbers such that $a \neq 0$.

[5]

- (d) Find the points of local maxima and local minima for the function $f(x) = x^3 - 6x^2 + 9x + 15$, using the first derivative test.

[5]

- (e) If

$$A = \begin{pmatrix} 2 & 1 \\ 7 & 2 \end{pmatrix}$$

Show that $(A^{-1})^{-1} = A$.

[4]

- (f) A die is rolled twice. Let all the elementary events in $\Omega = (i, j) : i, j = 1, 2, \dots, 6$ be assigned the same probability. Let A be the event that the first throw shows a number ≤ 2 , and B , the event that the second throw shows at least 5. Find $A \cap B$, and $P(A \cup B)$. Explain your answer.

[6]

END OF PAPER