UNIVERSITY OF LONDON

BSc EXAMINATION

COMPUTER SCIENCE

Computational Mathematics

Release date: Monday 5 September 2022 at 12:00 midday British Summer Time

Submission date: Tuesday 6 September 2022 by 12:00 midday British Summer 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**.

You may use any calculator for any appropriate calculations, but you may not use computer software to obtain solutions. 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) Find the maxima and minima for the following function:
$y = x^3 - 6x^2 + 12x - 5$
Show your working and plot the graph. [6]

(b) Show whether the function f is continuous or not at $x = -2$:

$$f(x) = \begin{cases} \frac{x^2-4}{x+2} & \text{if } x \neq -2 \\ 0 & \text{if } x = -2 \end{cases}$$

[6]

(c) Find the solution for the following questions: [6]

    i. Solve for $x : 20^x 9^{-x} = 1000$

    ii. Given $10^{0.69897} = 5$, evaluate $\log 500$

    iii. Given $6^{0.8982} = 5$, evaluate $\log_6 180$

(d) Find the value of x that makes the following two vectors parallel to each other:
$\vec{a} = -x\mathbf{i} + 3\mathbf{j}$
$\vec{b} = 3\mathbf{i} - \mathbf{j}$
Show your working. [6]

(e) If $f(x)$ is continuous at $x = 0$, then what is the value of n:

$$f(x) = \begin{cases} \frac{2x^3-x}{3x} & \text{if } x \neq 0 \\ n & \text{if } x = 0 \end{cases}$$

[6]

Question 3

(a) One of the nine one-pound coins below is a fake. If you start counting from the coin A on the left hand side and wind back and forth while counting (A, B, C, D, E, F, G, H, I, H, G, F, . . .), then the fake coin would be the 10015th one that you count. Which one is the fake coin? Explain your answer. [6]

A   B   C   D   E   F   G   H   I

(b) Which of the following graphs describe an object motion with constant acceleration. Explain why. [6]

(i)   (ii)   (iii)
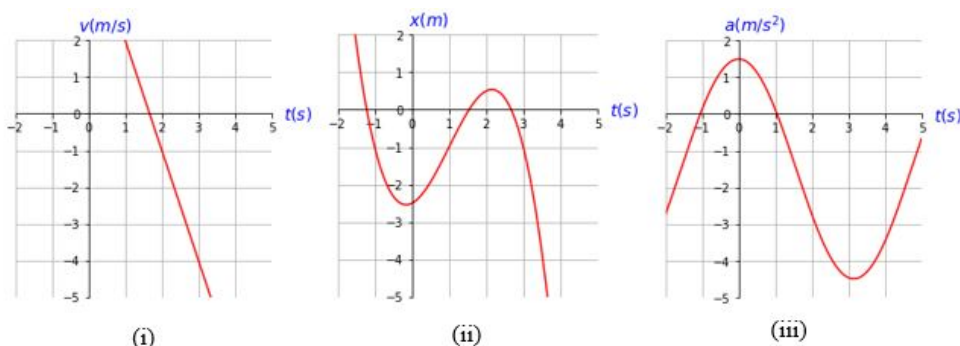
(c) i. Find the domain of $sin^{-1}(2 - 3x^2)$. [4]

ii. Find the value of $cos^{-1}(cos(\frac{7\pi}{6}))$, select the correct answer, show your work. [2]
1. $7\pi/6$
2. $\pi/6$
3. $5\pi/6$
4. none of the above answers is correct.

(d) Six faced die with the numbers 1-6 is rolled two times.

i. What is the probability of rolling a 9? [3]

ii. What is the probability of getting a sum greater than or equal to 10? [3]

(e) A racing car can travel a straight line from a dead stop to 48.3 km/h in 3.80 seconds. It takes an additional 3 seconds to reach 80.5 km/h and 16.7 more seconds to attain 161 km/h. What is the magnitude of its average acceleration in m/s^2 during each of these intervals? [6]

Question 4

(a) Using your knowledge about Permutations/ Combinations, find the answers for the following questions:

    i. How many different 3-letter words can be made by using all of the letters in the word "car"? Do not use the same letter more than one time.

    ii. How many different 4-letter words can be made by using all of the letters of the word "door"?

    iii. How many 7-letter words can be made by using all of the letters in the word "Mission"? [6]

(b) Assume the moon moves in a circular orbit around the Earth with an average radius R of $3.84 \times 10^8 m$. If it takes 27.3 days for it to complete one revolution, determine its average orbital speed in m/s. [6]

(c) Find the inverse of the following one-to-one function:

    i. $(-3, 27), (-2, -8), (-1, -1), (0, 0), (1, 1), (2, 8), (3, 27)$ [3]

    ii. State the domain and the range of the function and its inverse. [3]

(d) i. Calculate the inverse of the matrix: [2]

$$A = \begin{pmatrix} 1 & 1 & 3 \\ 0 & 2 & 5 \\ 3 & 0 & 1 \end{pmatrix}$$

    ii. What is the unknown matrix X for the following matrix equation: [4]

$$\begin{pmatrix} 1 & 2 & 3 \\ 7 & 0 & -1 \\ 0 & 2 & -2 \end{pmatrix} - \begin{pmatrix} 1 & 1 & 3 \\ 0 & 2 & 5 \\ 3 & 0 & 1 \end{pmatrix} X = \begin{pmatrix} -1 & 2 & 2 \\ 6 & -1 & 1 \\ 2 & -2 & 0 \end{pmatrix}$$

Show your working.

(e) i. For an exponential function $f(x) = Ca^x$ where $a > 0$ and $a \neq 1$, if x is any real number, then show that [3]

$$\frac{f(x+1)}{f(x)} = a$$

    ii. Solve the following exponential equation: [3]
$4^{2x-1} = 8^{x+3}$

<div align="center">END OF PAPER</div>