UNIVERSITY OF LONDON

CM1015

BSc EXAMINATION

COMPUTER SCIENCE

Computational Mathematics

Release date: Monday 14 September 2020: 12.00 midday British Summer Time

Time allowed: 24 hours to submit

Submission date: Tuesday 15 September 2020: 12.00 midday British Summer Time

INSTRUCTIONS TO CANDIDATES:

Part A of this assessment consists of a set of 10 Multiple Choice Questions (MCQs) which you will take separately from this paper. You should attempt to answer **ALL** the questions in Part A. The maximum mark for Part A is **40**.

Part 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. Candidates only have **ONE** attempt at Part A.

Part B of this assessment is an online assessment to be completed within the same 24-hour window as Part A. We anticipate that approximately **1 hour** is sufficient for you to answer Part B. Candidates must answer **TWO** out of the **THREE** questions in Part B. The maximum mark for Part 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 **Part 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. You are permitted to upload 30 documents. However, we advise you to upload as few documents as possible. 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 before you upload your work. Do not write your name anywhere in your answers.

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PART B

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

Question 1

(a) Consider the following function:

$$f(x) = \begin{cases} 2x+1 & x < 3 \\ 5 & x = 3 \\ 6 & x > 3 \end{cases}$$

i. Draw a graph of the function. [3]

ii. Compute $\lim_{x\to 0^+} f(x)$ [1]

iii. Compute $\lim_{x\to 0^-} f(x)$ [1]

iv. Compute $\lim_{x\to 0} f(x)$ [2]

v. Compute $\lim_{x\to 3^+} f(x)$ [1]

vi. Compute $\lim_{x\to 3^-} f(x)$ [1]

vii. Compute $\lim_{x\to 3} f(x)$ [2]

Study the graph you drew for part (i) and state whether the function is:

viii. one-to-one (injective) [1]

ix. onto (surjective) [1]

x. bijective function. [1]

xi. continuous at 0? [2]

xii. continuous at 3? [2]

(b) Solve the following system of linear equations using the inverse matrix method: [2]

$7x + 2y = 12$
$3x + y = 5$

(c) Consider the following matrices:

$$A = \begin{pmatrix} 2 & 5 \\ 2 & -1 \\ 7 & -9 \end{pmatrix}, B = \begin{pmatrix} 12 & 2 & 1 \\ 3 & -5 & 0 \end{pmatrix}, C = \begin{pmatrix} 4 & -7 \\ -5 & -2 \\ 3 & -3 \end{pmatrix}$$

i. Which two matrices can be added together? What is their sum? [2]

ii. Which two matrices can be multiplied? State all the possible combinations. Show your multiplication for one of the combinations? [2]

(d) Answer the following and show your work:

i. What is x in $\log_3(x) = 5$ [1]
ii. Calculate y in $y = \log_4(1/4)$ [1]
iii. Simplify $\log 2 + 2\log 3 - \log 6$ [1]

(e) Find the trigonometric ratios (sin, cos, tan) for the angle made between the x axis and the segment going from (0,0) to (-3,-4). [3]

Question 2

(a) Find the maximum and minimum of $f(x) = x^3 - 6x^2 + 9x + 1$ on the interval $[0, 5]$. [6]

(b) Consider a triangle with angles A, B and C and sides a, b and c, where a is the side opposite angle A, b is the side opposite angle B and c is the side opposite angle C. $C = 42°$, $c = 15\,cm$ and $b = 11\ cm$. Solve the triangle, writing your answers to 2 decimal places. [6]

(c) For each of the following definitions of y, state the number of cycles of y in $360°$.

i. $y = 3\sin 4x$ [1]

ii. $y = 4\cos 3x$ [1]

iii. $y = 7\tan 2x$ [1]

(d) Use the trigonometric identities to show:

i. $\cos(A)tan(A) = \sin(A)$ [2]

ii. $\cos(-\theta) = cos(\theta)$, using the identity $\cos(A - B)$ with $A = 0$ and $B = \theta$ [2]

(e) A key is dropped from a tower which is 310m high. What is the key's velocity when it hits the ground? How long does it take to get there? Note that the equation which describes this motion is: [6]

$y(t) = -\frac{gt^2}{2}$ and $g = -9.8m/s^2$

(f) A machine consists of 50 manufactured parts. The parts of the machine need to be tested during their manufacture for quality assurance purposes. There is only limited time for testing, so only 6 parts can be checked for each machine. The sample of 6 parts is selected at random from the 50 possible parts. Each tested part is unique as the same part cannot be picked more than once. A particular machine has 48 working parts and 2 defective parts. How many of the possible set of 6 part samples would detect these 2 defective parts?

[5]

Question 3

(a) Compute the following statistics for this list of stock prices: £10, £7, £20, £12, £5, £15, £9, £18, £4, £12, £8, £14 :

i. the mean, to 2 decimal places [3]

ii. the median [3]

iii. the mode [3]

(b) How many different 3-letter sequences can be made using the letters in the word "car"? You can only use each letter once. [5]

(c) How many different 4-letter sequences can be made using the letters in the word "door"? You can only use each letter once, noting that the letter 'o' appears twice and can therefore be used twice. [5]

(d) Given a sequence with first term $a = 13$, common ratio $r = 3$ and the sum = 4732, find the number of terms. [5]

(e) A basket contains 4 red apples and 3 green apples. A second basket contains 2 red apples and 4 green apples. One basket is selected at random. From the selected basket, one apple is drawn. Find the probability that the apple drawn is red. [6]

END OF PAPER

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