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# Assessment Coversheet

Complete this coversheet and read the instructions below carefully.

**Candidate Number**:

DP0669

**Degree Title**:

BSc Computer Science

**Course/Module Title**:

Computational Mathematics

**Course/Module Code:**

CM1015

**Enter the numbers, and sub-sections, of the questions in the order in which you have attempted them:**

**Question 1: a (i-xii), b, c(i,ii), d(i-iii), e**

**Question 3: a(i-iii), b, c, d, e**

**Date**: 14.09.2020

**Instructions to Candidates**

1. Complete this coversheet and begin typing your answers on the page below, or, submit the coversheet with your handwritten answers (where handwritten answers are permitted or required as part of your online timed assessment).
2. Clearly state the question number, and any sub-sections, at the beginning of each answer and also note them in the space provided above.
3. For typed answers, use a plain font such as Arial or Calibri and font size 11 or larger.
4. Where permission has been given in advance, handwritten answers (including diagrams or mathematical formulae) must be done on light coloured paper using blue or black ink.
5. Reference your diagrams in your typed answers. Label diagrams clearly.

**The Examiners will attach great importance to legibility, accuracy and clarity of expression.**

**Begin your answers on this page**

**PART B**

**Question 1**

1. Consider the following function:
2. Draw a graph of the function: Graph of this function is presented on fig.1

Изображение выглядит как текст, группа, кухня

Автоматически созданное описание

Figure 1 – f(x) graph

1. Compute
2. Compute
3. Compute
4. Compute
5. Compute
6. Compute

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

1. one-to-one (injective)

The function f(x) is not injective, because there are exist x1 and x2, such that f(x1) = f(x2). For example: y(2) = 2 \* 2 + 1 = 5 and y(3) = 5

1. onto (surjective)

The function f(x) is not surjective, because there are exist y in the codomain of f(x), such that, there are no elements x that f(x)=y. For f(x) biggest value of y is ≈ 7 (when x -> 3-) so, for example, there are no x-s such that f(x) = 8.

1. bijective function.

The function f(x) is not bijective, because to be bijective it must be injective and surjective at the same time, and we proved that that not the case (viii and ix).

1. continuous at 0?

Yes, function f(x) is continuous at 0, because we showed in (ii, iii and iv) that:

And this is a definition of continuity.

1. continuous at 3?

No, for the same reason function f(x) is not continuous at 3, because we showed in (v, vi and vii) that:

And this is a definition of discontinuity. We can also add, that because both limits are finite, but not equal this is jump discontinuity.

1. Solve the following system of linear equations using the inverse matrix method

First, we can rewrite this system using matrices:

In matrix form system is looks like A ∙ X = C or:

To solve this equation, we can use the fact that if matrix has and inverse (det ≠0), then M ∙ M-1 = I (or Identity matrix):

Let us check determinant of A and find, if inverse matrix even exists: Det(A) = 7\*1 – 2\*3 = 1, Det(A) ≠ 1 => We can find the Inverse matrix:

Now we multiply both sides of (\*) by A-1

Now we can solve it, using the fact that M ∙ I = M, and find variables:

Therefore x = 2 and y = -1

1. Consider the following matrices
2. Which two matrices can be added together? What is their sum?

We can sum or subtract only matrices with same dimensions, so we can sum only A and C, such that:

1. Which two matrices can be multiplied? State all the possible combinations. Show your multiplication for one of the combinations?

We can multiply matrices when number of rows in the second matrix is equal to the number of the columns in the first one. (m\*n ∙ n\*p = m\*p) We also should state that matrix multiplication is not commutative, so A∙B ≠ B∙A, and both are different.

Dimensions of matrices are: A = 3 \* 2, B = 2 \* 3 and C = 3 \* 2, so combinations are:

|  |  |
| --- | --- |
| For A | A ∙ B |
| For B | B ∙ A, B ∙ C |
| For C | C ∙ B |

Example:

1. Answer the following and show your work:
2. What is x in

We can transform this statement to the following form: 35 = x, so x = 243.

1. Calculate y in

We can transform this statement to the following form: 4y = ¼ => y = -1.

1. Simplify

To simplify this, we will use following properties of the logarithm:

1. 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).

Изображение выглядит как фотография, сидит, грузовик, много

Автоматически созданное описание

Figure 2 – The angle ᵠ

To better visualize we will use figure 2, where sought angle is depicted.

Let’s also use some notations: we will call segment between (-3, -4) and (-3, 0) – “a”, segment between (0, 0) and (-3, 0) – “b” and segment between (-3,-4) and (0, 0) – “c”. Therefore, / (length cannot be <0), same way:

and

Now we describe and evaluate trigonometric ratios for the angle ᵠ:

**Question 3**

1. Compute the following statistics for this list of stock prices: £10, £7, £20, £12, £5, £15, £9, £18, £4, £12, £8, £14:
2. the mean, to 2 decimal places

The mean is the usual arithmetic average of the set, so we can evaluate it as:

1. the median

The median is the middle element of the set, and if there are even number of elements, than the median is the arithm.average of two middle elements:

1. the mode

The mode is the element that repeated the most, so: Mode = 12£ (with 2 entries).

1. How many different 3-letter sequences can be made using the letters in the word "car"? You can only use each letter once.

If we allowed to use each letter only once and use only 3 letters from the word “car” (all unique letters) than the number of unique words is the permutation. We can use three letters for the first position, after that two letters for the second and only one for the last, therefore: P3 = 3 \* 2 \* 1 = 3! = 6

1. 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.

We use the same logic and can get the number of permutations P4 = 4! = 24 permutations, BUT this way we will count all words with 2 “o” – s twice. But these sequences will appear the same, so we must not count them. In this case we can just divide P4 by 2: N = 12.

1. Given a sequence with first term a = 13, common ratio r = 3 and the sum = 4732, find the number of terms.

Geometric series is the type of sequence where each next element is equal to the previous one multiplied by the same ration (called common ratio - r). We can describe geometric series as: {a, a2 (=a\*r), a3(=a2\*r), … an(=an-1\*r)}. To find the Sum of series: (1) we can multiply both sides by r:

, we can then replace sum in the brackets for the (Sn – a) (from 1), and rewrite as: \*r, and solve with the respect to an:

We know from the definition that an = a \* r(n-1) => =>

, therefore n = 5+1 = 6.

1. 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.

Let us first deduct the probabilities to draw a red apple from these baskets:

In the first basket there are 7 apples total, and 4 of them are red. The probability to draw a red apple from the first basket is:

Analogically, for the second basket:

Now, we just need to adjust for the random baskets – there are only two possible outcomes, and probabilities to pick a basket are equal so P1 = P2 and P1 + P2 = 1, we can therefore say that probability to pick 1-st basket is 50% or 0.5, same goes for second. Now, we can say that total number of positive outcomes is equal to:

We sum the probabilities when events when they connected through “OR” (we always pick one basket), and multiply when they connected through “AND” (we can get red apple from the first basket ONLY if we picked it at random).