Discrete mathematics I. SAMPLE exam paper, Autumn 2019

Name:

Neptun code:

Scoring: Each question in Part 1 is worth **1 mark** and each proof question in Part 2 is worth **3 marks**.

Grade boundaries

In order to pass the exam (i.e. to achieve a **grade of at least 2**) you need to receive at least **6 marks** from **Part 1** and at least **4 marks from Part 2 (proof questions)**. For higher grades, **in addition to this**, you also need to achieve the following total scores:

grade 3: total score of at least **12**;
grade 4: total score of at least **15**;
grade 5: total score of at least **18**.

Part 1: Short questions

1. Write down three properties of set intersection. **(1 mark)**

2. Define what it means for a binary relation $R \subseteq X \times X$ to be anti-symmetric. **(1 mark)**

3. Define what an equivalence relation is. **(1 mark)**

4. What does it mean for a function to be bijective? **(1 mark)**

5. Write down De Moivre's formula for the *division of* complex numbers in polar form. **(1 mark)**

6. Write down the theorem about the number of k- variations without repetition of an n element set. (Beside the formula, please also write down what a k-variation without repetition of an n-element set is.)

(1 mark)

Write down the theorem 'Equivalent characterisations of trees using the numbers of edges ' (3 equivalent statements). **(1 mark)**

Define what a partial order is. **(1 mark)**

Write down four properties (in total) of the absolute value and/or the conjugate of complex numbers. **(1 mark)**

Write down the Binomial theorem. **(1 mark)**

Write down the definition of a spanning tree of a (connected) graph. **(1 mark)**

Write down the definition of what a forest is (among graphs). **(1 mark)**

Part 2: Proof questions

P1 Write down and prove the statement that the composition of binary relations is associative. (first statement in the theorem 'Properties of the composition of relations')
(3 marks)

P2 Write down and prove De Moivre's formula for the *multiplication of* complex numbers in polar form.
(3 marks)

P3 Write down and prove the theorem about the existence of a closed Euler-trail in a finite connected graph.
(3 marks)