Test 1 Mathematical Structures TW1010
Wednesday October 3, 2018, 9:00-10:00

TU Delft

No calculators allowed. Write the solutions in the fields provided. The grade is (score+4)/4.

Exercise [ ] continued (extra space)

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1a Write down the truth table for the expression $(p \vee q) \Rightarrow (p \wedge q)$. 3

1b Is this expression a tautology? (Yes/No, because ...) 1

2 Write down the negation of 4

$$\forall \epsilon > 0 : \exists \delta > 0 : \forall y \in \mathbb{R} : |y - 1| < \delta \Rightarrow |y^2 - 1| < \epsilon$$

in simplified form (the negation symbol itself is not allowed in your answer).
You only have to give your anwer, no explanation required.

3 Let A, B, and C be sets. Show that $(A \cap B) \setminus C = A \cap (B \setminus C)$. 9

4 We define the relation on $\mathbb{N} \times \mathbb{N}$ as $(a, b)R(c, d)$ iff $ab - cd = 2k$ for some $k \in \mathbb{Z}$.

4a Show that R is an equivalence relation. 8

4b Determine the equivalence class $E_{(3,2017)}$ (that is, describe the elements of the class in as simple a way as possible). 2

5 Give the definition of the Cartesian product $A \times B$ of two sets A and B. 2

6 Give an example of a surjective function $f : \mathbb{R} \to [3, \infty)$. Be sure to show this is a good example, by showing that the values of the function are always in the codomain, and that the function is indeed surjective. 5

7 Write $\bigcup_{n=1}^{\infty} [1/n^2, 3 + 1/n]$ in the form of either a singleton set (a set containing one element), an interval, or a union of a finite number of singleton sets and intervals. 2
You only have to give the answer, no explanation required.

Examiner resposible: Fokko van de Bult
Examination reviewer: Wolter Groenevelt, Emiel Lorist, Rik Versendaal.