

Formal Reasoning 2015
Test 1: Propositional logic
(09/09/15)

Before you read on, write your name, student number and study on the answer sheet!

The mark for this test is the number of points divided by ten. The first ten points are free. Good luck!

In the first three exercises we use the following interpretation of the atomic propositions:

R it rains
 S the sun shines
 RB there is a rainbow

1. Give two propositions that respectively resemble the meaning of the following two sentences:

- (a) *There is a rainbow, because the sun shines and it rains.*
(b) *There is only a rainbow if the sun shines and it rains.*

If you think that for these sentences multiple interpretations are ‘defendable’, then please provide those different options in your answer, and indicate which one of these options is your preferred solution. (10 + 10 points)

2. Give a correct English sentence that resembles the meaning of the following proposition as well as possible:

(15 points)

$$(\neg R \rightarrow R) \rightarrow R$$

3. Is the proposition from exercise 2 logically true? Explain your answer. (10 points)

4. Give the full truth table of the proposition: (15 points)

$$(a \rightarrow b) \leftrightarrow (\neg a \wedge \neg b) \vee (\neg a \wedge b) \vee (a \wedge b)$$

5. Write the proposition (10 points)

$$\neg(a \wedge (a) \wedge a)$$

according to the official grammar in the course notes.

6. Give a model v in which the following proposition is true: (10 points)

$$(a \wedge (b \rightarrow c)) \leftrightarrow \neg a$$

7. Let f and g be arbitrary propositions. If it holds that $\not\models f$, or $\models g$, or both, does it imply that $\models (\neg f \vee g)$ always holds? Explain your answer. (10 points)