theorem begın

Foundations 1
Class Test 2013

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Exercise 1

(a) Show using a calculation that
$\neg(P \Leftrightarrow Q) \overset{val}{=\!=} (P \wedge \neg Q) \vee (\neg P \wedge Q)$.
State precisely at each step which equivalences you use.
You do not need to mention the steps of substitution or of Leibniz. [4]

(b) What can you deduce (using (a) above) about
$\neg(P \Leftrightarrow Q) \Leftrightarrow (P \wedge \neg Q) \vee (\neg P \wedge Q)$? [1]

Exercise 2

(a) Remove as many parenthesis as possible
from the following expression without changing its meaning: [3]
$(\lambda x.(\lambda y.(\lambda z.(((((xy)z)(\lambda x.x))(\lambda x.((xz)(yz))))(\lambda x.(((xx)y)y)))))))$

(b) Insert the full amount of parenthesis in the expression [3]
$(\lambda yz.(\lambda x.xx)yz)(\lambda x.x)x$

(c) β-reduce the following term until there are no more β-redexes showing all the reduction steps and all the possible reduction paths (note that there are four paths depending on the orders you choose for inside/outside redexes):
$(\lambda xyz.xyz)(\lambda x.xx)(\lambda x.x)x$ [4]