Quiz 2

Your name: ____________________

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Problem	Points	Grade	Grader
1	40		
2	30		
3	30		
Total	100		

Problem 1 (40 points). *Hint:* Read both parts (a) and (b) before trying to solve either.

(a) (15 points) Give an example of an $\langle$expression$\rangle$, M, and a $\langle$syntactic-value$\rangle$, V, such that $M[x := \texttt{+}]$ is an $\langle$immediate-redex$\rangle$, but $M[x := V]$ is not.

(b) (15 points) Suppose $M[x := \texttt{+}]$ is an $\langle$immediate-redex$\rangle$. Explain why $M[x := L]$ is also an $\langle$immediate-redex$\rangle$ for any $\langle$lambda-expression$\rangle$, L. (Don't get tangled in a complicated structural induction based on the BNF grammars for $\langle$syntactic-value$\rangle$ and $\langle$immediate-redex$\rangle$. Just explain clearly what ¡properties(s) of the grammar(s) ensure the result.)

(c) (10 points) Suppose

$$M[x := \texttt{+}] \rightarrow N[x := \texttt{+}].$$

Does it follow that

$$M[x := \texttt{(lambda (y) (+ y))}] \rightarrow N[x := \texttt{(lambda (y) (+ y))}]?$$

Prove or give a counterexample.

Problem 2 (30 points). Prove that observational equivalence, $\equiv$, (the definition is in an appendix in case you don't remember it) is a congruence relation on Scheme expressions, that is,

1. it is a reflexive, symmetric, and transitive relation, and
2. $M \equiv N$ implies $C[M] \equiv C[N]$ for any context, C.

Problem 3 (30 points). Prove that if $M =_\alpha N$, then $M \equiv N$. (You may cite any of the facts in Notes 7.)

A Observational Equivalence

Definition 3.1. Two Scheme expressions, M and N, are said to be *observationally distinguishable* iff there is a context, C, such that exactly one of $C[M]$ and $C[N]$ converges. Such a context is called a *distinguishing context* for M and N. If M and N are not observationally distinguishable, they are said to be *observationally equivalent*, written $M \equiv N$.