(10)

$$\underline{x \in dom\ \rho \qquad \rho(x) = 99}$$

$$\underline{\langle VAR(x), \xi, \phi, \rho \rangle \Downarrow \langle 99, \xi, \phi, \rho \rangle}$$

$$\underline{\langle set(x\ 3), \xi, \phi, \rho \rangle \Downarrow \langle 3, \xi, \phi, \rho\{x \mapsto 3\} \rangle}$$

$$\underline{\langle VAR(x), \xi, \phi, \rho' \rangle \Downarrow \langle 3, \xi, \phi, \rho' \rangle}$$

$$\langle begin((set\ x\ 3)\ x), \xi, \phi, \rho \rangle \Downarrow \langle 3, \xi, \phi, \rho' \rangle$$

(11) Case 1:

$$\frac{\begin{array}{c}\langle VAR(x), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi, \phi, \rho \rangle \\ v_1 = 0 \\ \langle LITERAL(0), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi, \phi, \rho \rangle \\ v_1 = 0\end{array}}{\langle IF(VAR(x), VAR(x), LITERAL(0)), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho \rangle}$$

Case 2:

$$\frac{\begin{array}{c}\langle VAR(x), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi, \phi, \rho \rangle \\ v_1 \neq 0 \\ \langle VAR(x), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle\end{array}}{\langle IF(VAR(x), VAR(x), LITERAL(0)), \xi, \phi, \rho \rangle \Downarrow \langle v_1, \xi', \phi, \rho' \rangle}$$

In cases 1 & 2, v_1 is the result of the expression

$$\langle VAR(x), \xi, \phi, \rho \rangle \Downarrow \langle v_2, \xi, \phi, \rho \rangle$$

Therefore $v_1 = v_2$

(13)

a. $$\frac{x \notin \mathrm{dom}\,\rho \quad x \notin \mathrm{dom}\,\xi \quad x \notin \mathrm{dom}\,\phi}{\langle \mathrm{VAR}(x), \xi, \phi, \rho \rangle \Downarrow \langle v, \xi\{x \mapsto 0\}, \phi, \rho \rangle}$$

b. $$\frac{x \notin \mathrm{dom}\,\rho \quad x \notin \mathrm{dom}\,\xi \quad x \notin \mathrm{dom}\,\phi}{\langle \mathrm{VAR}(x), \xi, \phi, \rho \rangle \Downarrow \langle v, \xi, \phi, \rho'\{x \mapsto 0\} \rangle}$$

c. I prefer Icon-like behavior as it does not propagate globals; the variable is set within the current scope.

(16)

false; for any expression,

$$\frac{}{\langle e, \xi, \phi, \rho \rangle \Downarrow \langle v, \xi\{it \mapsto v\}, \phi, \rho \rangle}$$

(17) $\underset{\xi}{\mathrm{fer}}(e_1; e_2; e_3)$

$\underset{\xi}{e_4}$

$$\frac{\begin{array}{l}\langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi', \phi, \rho'\rangle \\ \langle e_2, \xi', \phi, \rho'\rangle \Downarrow \langle v_2, \xi'', \phi, \rho''\rangle \\ v_2 \neq 0 \\ \langle e_4, \xi'', \phi, \rho''\rangle \Downarrow \langle v_4, \xi''', \phi, \rho'''\rangle \\ \langle e_3, \xi''', \phi, \rho'''\rangle \Downarrow \langle v_3, \xi'''', \phi, \rho''''\rangle \\ \langle \mathrm{fer}(0; e_2, e_3, e_4), \xi'''', \phi, \rho''''\rangle \Downarrow \langle v_3, \xi'''', \phi, \rho''''\rangle\end{array}}{\langle \mathrm{for}(e_1, e_2; e_3, e_4), \xi, \phi, \rho\rangle \Downarrow \langle v_3, \xi'''', \phi, \rho''''\rangle}$$

$$\frac{\begin{array}{l}\langle e_1, \xi, \phi, \rho\rangle \Downarrow \langle v_1, \xi', \phi, \rho'\rangle \\ \langle e_2, \xi', \phi, \rho'\rangle \Downarrow \langle v_2, \xi'', \phi, \rho''\rangle \\ v_2 = 0\end{array}}{\langle \mathrm{fer}(e_1, e_2, e_3, e_4), \xi, \phi, \rho\rangle \Downarrow \langle v_2, \xi'', \phi, \rho''\rangle}$$