Name ______________________________

Student number ______________________________

SE 2A04 Fall 2001

Surprise Quiz 1 Answer Key

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Revised: 5 November 2001

You have 20 minutes to complete this quiz consisting of 3 pages and 10 questions. You may use your notes and textbooks. Circle the *best* answer for the multiple choice questions. Recall that the $\supset$ symbol denotes implication. Each question is worth 10 points. Good luck!

(1) Let a denote an integer. What is the value of

$$\mathsf{if}(a > 2 \supset a > 0, 17, 19) \quad ?$$

(a) 2.
(b) 0.
(c) $\boxed{17.}$
(d) 19.

(2) Let r denote a real number. What is the value of

$$(\lambda\, x : \mathbf{R} \,.\, x^2)(r) \quad ?$$

(a) $(\lambda\, x : \mathbf{R} \,.\, r^2)$.
(b) $(\lambda\, r : \mathbf{R} \,.\, r^2)$.
(c) $\boxed{r^2.}$
(d) x^2.

(3) Let `Push`, `Top`, `Pop` be members of the Stacks interface (as given in class); i, j be of type `Integer`; and s be of type `Stack`. What is the value of

$$\mathtt{Top}(\mathtt{Push}(j, \mathtt{Pop}(\mathtt{Push}(i, s)))) \quad ?$$

(a) `Push`.
(b) s.
(c) i.
(d) $\boxed{j.}$

Test continues on next page.

(4) Let x and y denote real numbers. Which expression denotes the minimum of x and y?

(a) $-\mathsf{max}(x, y)$.

(b) $\mathsf{if}(x \leq y, y, x)$.

(c) $\mathsf{if}(x \geq y, x, y)$.

(d) $\boxed{\mathsf{if}(x \leq y, x, y).}$

(5) Let a be a real number and S be a set of real numbers. Which statement says that a is an upper bound of S?

(a) $\forall x : \mathbf{R} \,.\, x \leq a$.

(b) $\boxed{\forall x : \mathbf{R} \,.\, x \in S \supset x \leq a.}$

(c) $\exists x : \mathbf{R} \,.\, x \in S \wedge x \leq a$.

(d) $\mathrm{I}\, x : \mathbf{R} \,.\, x \in S \wedge x < a$.

(6) Which statement says that Push is a one-to-one function?

(a) $\boxed{\begin{array}{l}\forall i_1, i_2 : \mathtt{INTEGER}, s_1, s_2 : \mathtt{Stack} \,. \\ \quad \mathtt{Push}(i_1, s_1) = \mathtt{Push}(i_2, s_2) \supset (i_1 = i_2 \wedge s_1 = s_2).\end{array}}$

(b) $\forall i_1, i_2 : \mathtt{INTEGER}, s_1, s_2 : \mathtt{Stack} \,.$
$(i_1 = i_2 \wedge s_1 = s_2) \supset \mathtt{Push}(i_1, s_1) = \mathtt{Push}(i_2, s_2)$.

(c) $\forall t : \mathtt{Stack} \,.\, \exists i : \mathtt{INTEGER}, s : \mathtt{Stack} \,.\, t = \mathtt{Push}(i, s)$.

(d) $\exists i : \mathtt{INTEGER}, s : \mathtt{Stack} \,.\, \mathtt{Push}(i, s)$.

(7) Which relation describes a function from the integers to the real numbers?

(a) $\{(x, y) \in \mathbf{Z} \times \mathbf{R} \mid x \leq y\}$.

(b) $\{(x, y) \in \mathbf{R} \times \mathbf{R} \mid y = x * x\}$.

(c) $\boxed{\{(x, y) \in \mathbf{Z} \times \mathbf{R} \mid y = x + 17\}.}$

(d) $\{(x, y) \in \mathbf{Z} \times \mathbf{R} \mid 19 = 19\}$.

(8) Let $\mathtt{N}$ denote the natural numbers. Which statement defines

$$f : \mathtt{N} \times \mathtt{N} \to \mathtt{N}$$

by recursion to be natural number multiplication?

(a) $\forall x, y : \mathtt{N} \,.\, f(x, y) = f(x - 1, y + 1)$.

(b) $f = \lambda\, x, y : \mathtt{N} \,.\, \mathsf{if}(x = 0, x, y)$.

(c) $\boxed{\forall x, y : \mathtt{N} \,.\, f(x, y) = \mathsf{if}(x = 0, 0, y + f(x - 1, y)).}$

(d) $\forall x, y : \mathtt{N} \,.\, x * y$.

Test continues on next page.

(9) Let m be an Oberon array of type **REAL** indexed from 0 to 999. Which statement says exactly that the members of m indexed from 17 to 313 (inclusive) are ordered from greatest to least?

(a) $\boxed{\begin{array}{l} \forall\, i, j : \texttt{INTEGER} \,. \\ \quad (17 \leq i \wedge i \leq 313 \wedge 17 \leq j \wedge j \leq 313 \wedge i \leq j) \supset m[i] \geq m[j]. \end{array}}$

(b) $\forall\, i : \texttt{INTEGER} \,.\, (17 \leq i \wedge i \leq 313) \supset m[i] \geq m[i+1]$.

(c) $\forall\, i : \texttt{INTEGER} \,.\, m[i] \geq m[i+1]$.

(d) $\forall\, i : \texttt{INTEGER} \,.\, m[i-1] \geq m[i+1]$.

(10) Which expression denotes the cubic root of 139?

(a) $139 * 139 * 139$.

(b) $\forall\, x, y : \mathbf{R} \,.\, x < 139^3 < y$.

(c) $\exists\, x : \mathbf{R} \,.\, x * x * x = 139$.

(d) $\boxed{\mathrm{I}\, x : \mathbf{R} \,.\, x * x * x = 139.}$