Answer the questions in the box provided.

1. (5 points) The following lettuce program is written in the form of:

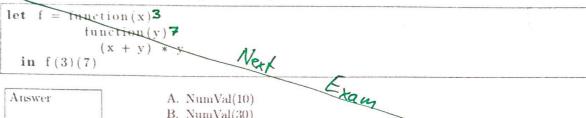
$$\begin{array}{ccc}
\mathbf{let} & \mathbf{x} = 5 \\
\mathbf{in} & \mathbf{x} + \mathbf{x}
\end{array}$$

Answer

Concrete Syntax

- Inference Rules C. Abstract Syntax
- D. Proof Tree

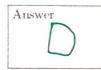
2. (5 points) What does the following Lettuce expression evaluate to?



Answer

- A. NumVal(10)
- B. NumVal(30)
- C. Closure(y, (x + y) \* y),  $\sigma$ )
- D. Closure(x, function(y) (x + y) \* y),  $\sigma$ )

3. (5 points) What is the data structure that was used to implement evaluation environments( $\sigma$ )?



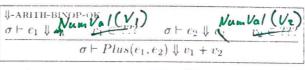
- A. Binary Trees
- B. Abstract Syntax Trees
- C. Lists
- D. Dictionaries

4. (5 points) What is the name of the property we defined which describes programs which only use identifiers that have already been declared?

Answer

- A. Well-Formedness
- B. Well-Typedness
- C. Declaration-Safe
- D. Totality

5. (5 points) What should replace the question marks in the following inference rule?



Answer

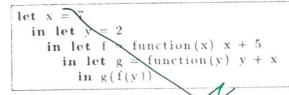
Different this Semester

		$ \begin{array}{c ccccccccccccccccccccccccccccccccccc$	4	
	Answer	A. FunCall  (B) Let		
	B	C. IfThenElse D. Ident		
7.	(5 points) What	are operational semantics?		
	Answer	A. A process for reducing an expression to some normal B. Interpreting syntax as a process to be performed on a C. A procedure for turning a program in a language into D Rules for evaluating some program(an expression) to	stack machine o machine code	
8. (5 points) What is the name of the strategy of nesting single-argument functions in order to simulate a multi-argument function?				
	Answer	A. $\beta$ -Reduction B. Higher-Ordered Functions C. Currying D. $\lambda$ -nesting		
9.	(5 points) What	are the three parts of a closure?		
	Answer	A. Advenent, Function Body, and Environment B. Paralleller, Evaluation, and Environment C. Argument, Bindings, and Dictionary D. Parameter, Function B. O. and Types	•	
10.	(5 points) Which	is not an expression in Lettuce?		
	Answer	B. Bin Ap. Sea		
		B. Bin (Art) C. Phy (Lake) C. Plus (Ident(x), Ident(y))  D. Pow (Ident(x), Ident(y))		

6. (5 points) Which constructor/lettuce expression is this inference rule written for? What should  ${\bf C}$  be

replaced with?

11. (5 points) What is the closure generated by evaluating the function definition g on the fourth line below?

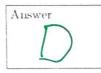


Answer

A. Closure  $(y, y + x, [x \mapsto 7, y \mapsto 2, y \mapsto \text{Closure}(x, x + 5, [x \mapsto 7, y \mapsto 2]))$ B. Closure  $(x, x + 5, [x \mapsto 7, y \mapsto 2])$ 

D. Closure $(y, y + x, [x \mapsto 7,$  $(x \mapsto 7, f \mapsto \text{Closure}(x, x + 5, [x \mapsto 7, y \mapsto 2]))$ 

12. (5 points) The inference rules we have written in class describe what property of our language?

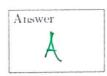


A. Concrete Syntax

B. Abstract Syntax

Parsing D. Semantics

13. (5 points) What is Well-Formedness?



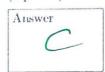
The property of a program which only uses identifiers that are already declared and in scope

B. The property that whenever a program is run it will produce a valid out-

C. The property that a program is only constructed of valid syntactic con-

D. The property that a program is well defined for all possible inputs

14. (5 points) Which is the proper form of an inference rule?



15. (5 points) Semantics are...



A. the evaluations of programs

B. he meaning of a program C. the symbols of a program

D. the parsing of a program

16. (5 points) Which is not a value in Lettuce?

A. Numbers
B. Functions
C. Closure Next
Rooleans Answer

17. (5 points) What is the type of the following function?

$$\begin{aligned} \text{bar } f \ x \ y &= y \text{ match} \\ \text{True} &\to f \ x \\ \text{False} &\to (\text{Suce (Suce } \mathbf{x})) \end{aligned}$$

Answer

A. Higher-Order

B. Polymorphic

 $(\mathbb{N} \to \mathbb{N}) \to \mathbb{N} \to \mathbb{B} \to \mathbb{N}$ D. Binary Operation

18. (5 points) What does the following lettuce program evaluate to?

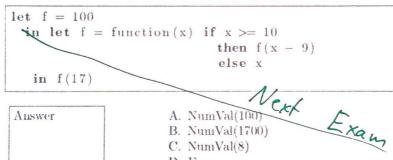


A. NumVal(7) B. NumVal(10)

C. BinVal(False)

D. Error

19. (5 points) What does the following lettuce program evaluate to?



Answer

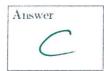
A. NumVal(100)

B. NumVal(1700)

C. NumVal(8)

D. Error

20. (5 points) What data structure describes Syntax of programming languages?



A. Lists

B. Networks

Trees

D. Graphs