Name of the Student: _____

5 questions in 120 minutes

Question 1 (10%)

Give the `C..R` expression, or the open form as sequences of car's and cdr's, needed to get `x` in the following:

(a) `(a b x d)`

(b) `(a (b (x d)))`

(c) `(a (b (d) x))`

(d) `(((a (b (x) d))))`

Question 2 (20%)

Evaluate the following:

(a) `(cons NIL NIL)`

(b) `(cons (1 2) NIL)`

(c) `(cons ('A 'B) NIL)`

(d) `(cons '(A B) '(C D))`

(e) `(cons (list 'A 'B) (append '(C D) NIL))`

(f) `(list (append (list nil) nil))`

(g) `(append (list 'A 4) 'B)`

(h) `(and (defun x (x) x) (x 1))`

(i) `(* (or 2 4) (and (defvar k) (setf k 3)))`

(j) `(if (if '(nil) nil 'knew)  nil 'a)`

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Question 3 (20%)

Assume you have entered the following expressions one by one at the top-level.

```
(defvar k)
(defvar j)
(defvar i)
(setf k '(a b))
(setf j '(c))
(setf i (append k j))
```

Draw the resulting situation in terms of cons cell diagrams, indicating where `i`, `j` and `k` are pointing to.

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Question 4 (30%)

Write recursive functions for the tasks below. Do not use built-in list functions like `LAST` and `MEMBER`. For the third task, you may use `LENGTH`, if you like.

(a) `FIRSTN`: takes an integer `n` and a list, and returns the list of first `n` elements; it returns `NIL` if `N` is out of the range of the list.

(b) `NTHCDR`: takes an integer `n` and a list, returns the `n`th cdr of the list.

(c) `TRIM-LAST`: takes an integer `n` and a list, removes the last `n` elements.

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Question 5 (20%)

Write a recursive function `COUNT` taking an object and a list and returns the number of times the object occurs in the second. You need to count embedded occurrences as well, no matter how deep it is. For instance `(count 'x '(a (b (x)) c x)` should return 2.