MCS287 Exam 2

Serial #:

This exam is a closed-book, individual-work exam. It is also closed notes, with the exception of one 8.5 × 11 inch handwritten sheet of notes (both sides OK). Please write your name only on this page. Do not turn the page until instructed, in order that everyone may have the same time. Then, be sure to look at all problems before deciding which one to do first. Some problems are easier than others, so plan your time accordingly. You have 50 minutes to work.

Write the answer to each problem on the page on which that problem appears. You may use the back of that same sheet if you need additional space. You may also request additional paper, which should be labeled with your test number and the problem number.

Name: ______________________________

Problem	Page	Possible	Score
1	2	12	
2	3	12	
3	4	12	
4	5	12	
5	6	12	
Total		60	

1. [**12 Points**] Suppose we do the following in Scheme:

```
(define a (list 1 2))
(define b (list 3 4))
(set-cdr! b a)
```

(a) Draw a diagram illustrating what happens. It should be a single diagram illustrating the situation both before and after the `set-cdr!`, with only one copy of each pair. When a pair is changed to point somewhere different than it used to, draw the old pointer dashed and the new pointer solid.

(b) Having done the above, what is the value of `(car (cdr b))`?

2. [**12 Points**] Write a Scheme expression equivalent to the following but without using `letrec` or `define`:

```
(letrec ((f (lambda (n)
              (if (= n 0)
                  1
                  (* (f (- n 1))
                     n)))))
  (f 52))
```

3. [**12 Points**] Consider the following Ted expression:

```
let p = proc(x) letarray b[2]
                 in begin
                      b[0] := 42;
                      x[0] := 13;
                      x := b
                    end
  in letarray a[2]
       in begin
            a[0] := 5;
            p(a);
            a[0]
          end
```

Assume the indirect array model is used.

(a) If call-by-value is used, what answer will result? Draw diagrams to illustrate why.

(b) If call-by-reference is used, what answer will result? Draw diagrams to illustrate why.

4. [**12 Points**] Write a Ted expression that evaluates to 7 under the direct array model and -7 under the indirect array model, assuming that call-by-reference is used in both cases. Draw diagrams to illustrate evaluation under each array model.

5. [**12 Points**] Assume `p`, `q`, and `r` have been defined as procedures that do not explicitly write out (or print) any output.

   (a) When `p(begin writeln(17); 2 end)` is evaluated, five copies of 17 are written out. Which of the following parameter passing mechanisms might have been used? (Circle all that might.) call-by-value, call-by-name, call-by-need

   (b) Ignore the information from part (a). When `q(begin writeln(17); 2 end)` is evaluated, one copy of 17 is written out. Which of the following parameter passing mechanisms might have been used? (Circle all that might.) call-by-value, call-by-name, call-by-need

   (c) Ignore the information from parts (a) and (b). When `r(begin writeln(17); 2 end)` is evaluated, no copies of 17 are written out. Which of the following parameter passing mechanisms might have been used? (Circle all that might.) call-by-value, call-by-name, call-by-need

   (d) Suppose the same definition of `p` is used as in part (a), but the parameter passing mechanism need not be the same. Suppose `p(begin writeln(17); 2 end)` is evaluated under call-by-need. How many copies of 17 are written out?