Name: ____

1. (1 pt.)
   - ○ **Read all material carefully.**
   - ○ *If in doubt whether something is allowed, ask, don't assume.*
   - ○ You may refer to your **books, papers, and notes** during this test.
   - ○ **E-books** may be used *subject to the restrictions* noted in class.
   - ○ **Computers** (including smart phones, tablets, etc.) **are not permitted**, except when used strictly as e-books or for viewing ones own notes.
   - ○ **Network access** of any kind (cell, voice, text, data, ...) is **not permitted**.
   - ○ Write, and draw, carefully. **Ambiguous or cryptic answers receive zero credit.**
   - ○ Use **class and textbook conventions** for notation, algorithmic options, etc.
   - ○ **Do not attach or remove any pages.**

   Write your name in the space provided above.

WAIT UNTIL INSTRUCTED TO CONTINUE TO REMAINING QUESTIONS.

Do not write on this page.
(It is for use in grading only.)

Q	Full	Score
1	1	
2	10	
3	4	
4	10	
5	10	
6	15	
7	15	
total	65	

2. (10 pts.) For each of the following *Standard ML* expressions, provide the response when that expression is evaluated by the `sml` REPL (read-eval-print loop). Assume that the expressions are evaluated in the order listed. In your response, *draw a **box** around the **type** and `oval` around the **value**.* (If there is an error then clearly explain the error.)

   (a) (2 pts.) `42.42 / 2.0;`

   (b) (2 pts.) `"My name is nil.";`

   (c) (2 pts.) `42 / 2;`

   (d) (2 pts.) `fun f101(x) = x + 101;`

   (e) (2 pts.)

```
fun f201 (nil) = nil
  | f201 (h::t) = h :: f201(t);
```

3. (4 pts.) Provide *Standard ML* expressions for each of the following.

   (a) (2 pts.) Bind the identifier `score` to the integer 42.

   (b) (2 pts.) Multiply the integer bound to `score` by 2.

4. (10 pts.)

   (a) Define a recursive function (of your choice) that is **not** *tail recursive*, using Standard ML.

   (b) Define another recursive function (also of your choice) that is *tail recursive*, using Standard ML.

   (c) **Explain your answers**.

5. (10 pts.) Provide the *Standard ML* definition of a recursive function `f301` that takes a list of integers as argument and returns a similar list with each element incremented by 100. For instance, when invoked on the list `[3, 1, 4]`, the list `[103, 101, 104]` should be returned. Explain why your answer is correct. Trace the operation of your function on the list `[3, 1, 4]`.

6. (15 pts.) Provide a **complete JCoCo assembly language program** that

   (a) Reads two newline-terminated strings from *standard input*.

   (b) Writes the sum of the lengths of those two strings to *standard output*.

   (c) **Explain why your program is correct.**

[additional space for earlier material]

7. (15 pts.) Provide a **complete JCoCo assembly language program** that

   (a) Reads a newline-terminated string from *standard input*.

   (b) Writes this string to *standard output* but with all characters converted to upper case. (For instance, if the input string is `Hello, World!` then the output should be `HELLO, WORLD!`.) [Hint: A Python string object has a method `upper` that returns an upper-case version of that string.]

   (c) **Explain why your program is correct.**

[additional space for earlier material]

[additional space for earlier material]