1. Match:
   (a) Command
   (b) Declaration
   (c) Expression

   with

   (a) Is evaluated to yield a value.
   (b) Is executed to change the value of a variable or to change the input
       or output streams.
   (c) Is elaborated to produce a binding, usually to allocate memory, and
       sometimes to initialize variables.

   **Answer**: 1-2, 2-3, 3-1.

2. Recall that, in denotational semantics, the *state* is a triple <mem, i, o>.
   (a) Which component(s) of the state are changed by a *read* instruction?
   **Answer**: i, mem
   (b) Which component(s) of the state are changed by a *write* instruction?
   **Answer**: o (only)
   (c) Which component(s) of the state are changed by an assignment?
   **Answer**: mem

3. What is the denotational semantics of the following program, where the
   initial input stream contains only the integer *z*?
   ```
   read(n);
   i := n+1;
   write(i);
   ```

   Hint: it is a very short answer! **Answer**: <z+1>. Also acceptable: *z + 1*,
   although technically the answer is a sequence.

4. Consider the following grammar:
Give a derivation of $b := 9; c := 9$. from the start symbol <prog>.

<prog> ::= <stats>.
<stats> ::= <stat> | <stat>; <stats>
<stat> ::= <ass-stat>
<ass-stat> ::= <ident> := <expr>
<ident> ::= a | b | c
<expr> ::= 9

$\Rightarrow b := 9; c := 9$. 