3. (a) Explain the role of *item grammars* in building bottom-up parsers and the role of the look-ahead input token in resolving conflicts. [8]

(b) Construct an LR(0) state machine for the following grammar, where S is the start symbol:

$$S \rightarrow A\,\$ \mid x\,b\,\$ \qquad A \rightarrow a\,A\,b \mid B \qquad B \rightarrow x$$

[8]

(c) Consider the following grammar:

$(1) E \rightarrow E\ ;\ D$
$(2) E \rightarrow D$
$(3) D \rightarrow T\ L$
$(4) T \rightarrow$ `int`
$(5) T \rightarrow$ `real`
$(6) L \rightarrow L\ ,$ `id`
$(7) L \rightarrow$ `id`

Extend the grammar with attribute rules, associating each identifier with an attribute to represent its *type* and placing this information in a simple symbol table. Assume that there is an external function that associates each identifier with an attribute s such that `id.s` contains the string value of `id`.

[9]