1. (20%) Do *slowly* and *lovely* share a morpheme? Why? Why not?

> **Solution:** They do not. Because the *-ly* suffix has different functions in the two words. In *slowly*, it makes an adverb out of an adjective, while in *lovely*, it makes an adjective out of a noun.

2. (30%) State as true or false:
   (a) $\{\varepsilon\}^* = \{\varepsilon\}$
   (b) $\emptyset^* = \{\varepsilon\}$
   (c) For any alphabet Σ, any L defined over Σ is such that $L \in \mathscr{P}(\Sigma^*)$. ($\mathscr{P}(X)$ denotes the power set of X.)
   (d) For any language L, $\emptyset L = L\emptyset = L$
   (e) For any language L, $\{\varepsilon\}L = \emptyset$
   (f) $abcd \in (a(cd)^*b)^*$

> **Solution:** (a) T; (b) T; (c) T; (d) F, $\emptyset$; (e) F, L; (f) F.

3. (25%) Give a regular expression for the set of strings over the alphabet $\{0,1,2\}$ such that every 0 is followed by exactly two 1's and every 2 is followed either by 10 or 01.

> **Solution:** $1^*(011 \cup 21011 \cup 2011)^*$

4. (25%) Give a regular expression for the set of strings over $\{a,b\}$ with exactly one occurrence of the string *aaa*. (Hint: the rule does NOT say possible *a*'s in a string are limited to that one occurrence of *aaa*.)

> **Solution:** $((a \cup aa \cup \varepsilon)b)^*aaa(b(a \cup aa \cup \varepsilon))^*$