Name _____ ID No. _____

1. (40 pts.) Indicate whether true or false. Beware of guessing:

    correct answer +5pts.   incorrect answer −3pts.   no answer 0pts

   (a) ____ $\emptyset \subseteq \mathcal{P}(\{0,1\})$. (Recall that $\mathcal{P}(S)$ is the set of all subsets of S.)
   (b) ____ $\emptyset \in \mathcal{P}(\{0,1\})$.
   (c) ____   If Σ is an alphabet, $\epsilon \in \Sigma^*$.
   (d) ____   For any language L, $L \circ L \subseteq L^*$.
   (e) ____   If $S \subset \Sigma$ is a finite set, then S is a regular language.
   (f) ____   If R_1 and R_2 are regular expressions, then $R_1 \cap R_2$ is a regular expression.
   (g) ____   If R_1 and R_2 are regular expressions, then there is a regular expression that describes the same language as $R_1 \cap R_2^{\mathcal{R}}$. (Recall that $S^{\mathcal{R}}$ is the reverse of S.)
   (h) ____   If L_1 and L_2 are regular languages, then $L_1 \circ \overline{L_2}$ is a regular language.

2. (20 pts.) Let $L = (0^*1^*) \cup (01)^*$.
   (a) Indicate which of the following strings are in L and which are not in L

        0011   1100   00   11   1010.

   (b) Construct an NFA to recognize the language L.

MORE

3. (20 pts.) Either give an example of each of the following or explain why no example exists.

   (a) A language that is *not* recognized by any DFA but is recognized by some NFA.

   (b) A language that is *not* regular.

4. (20 pts.) If L is a language, define $\mathrm{tail}\,(L) = \{x \mid wx \in L \text{ for some string } w\}$. For example,

$$\mathrm{tail}\,\Big(\{011, 101\}\Big) = \{\epsilon, 1, 01, 11, 011, 101\}.$$

Prove the following: If L is regular, then $\mathrm{tail}\,(L)$ is regular.
Hint: Use NFAs.

END