1. Undecidable problems:
   (a) Given a TM $M$, does $M$ halt on the empty tape?
   (b) Given a TM $M$, is there any string at all on which $M$ halts?
   (c) Given a TM $M$, does it enter a particular state $q$ on input $w$?
   (d) Given a grammar $CFG G$, is it ambiguous?

2. Decidable problems:
   (a) Given a pushdown automaton $M$ with one state, whether $L(M) = \Sigma^*$?
   (b) Given a DFA $M$, does it accept $\phi$?

3. Consider two problems $A$ and $B$ such that $A$ “reduces” to $B$. If $A$ is
   undecidable, what can you say about the decidability of the following
   (a) $B$  (b) $\bar{B}$  (c) $A$ (take home!)

4. Useful definitions:
   (a) $L$ is said to recursive if there exists a TM $M$ such that $L = L(M)$
       and $M$ halts on every input.
   (b) $L$ is said to be recursively enumerable if there exists a TM $M$ such
       that $L = L(M)$.
   (c) A problem is said to decidable if the associated language is recursive.
   (d) $L_{halt} = \{(enc(M), w) \text{ such that } M \text{ halts on } w\}$.
   (e) $L_{accept} = \{(enc(M), w) \text{ such that } M \text{ accepts } w\}$.
   (f) Let $\Sigma$ be an alphabet with $|\Sigma| \geq 2$. Given $u_1, \ldots, u_n, v_1, \ldots, v_n \in \Sigma^*$,
       decide whether there exist $i_1, \ldots, i_K$ (with possible repetitions!) such
       that $u_{i_1} \ldots u_{i_K} = v_{i_1} \ldots v_{i_K}$.
   (g) $A$ reduces to $B$ if there is a turing computable function $f$ such that
       $w \in A \iff f(w) \in B$. 