Name: 

PID: 

1. True or false? If true, give an algorithm. If false, what is the difficulty in constructing an algorithm? Let $R, S, R_i, \ldots$ be subsets of $\Sigma^*$ where $\Sigma^* = \{0, 1\}$ (or subsets of $\mathbb{N}$). Let $f, g : \Sigma^* \to \Sigma^*$ (or $f, g : \mathbb{N} \to \mathbb{N}$).

(a) If $R$ and $S$ are decidable, then $R \cup S$ is decidable.
(b) If $R$ and $S$ are c.e. (computably enumerable), then $R \cup S$ is c.e.
(c) If $R$ and $S$ are decidable, then $R \cap S$ is decidable.
(d) If $R$ and $S$ are c.e. (computably enumerable), then $R \cap S$ is c.e.
(e) If $R$ and $S$ are decidable, then $R \setminus S$ is decidable.
(f) If $R$ and $S$ are c.e. (computably enumerable), then $R \setminus S$ is c.e.
(g) If each $R_i$ is decidable, then $\bigcup \{i \times R_i\}$ is decidable.
(h) If each $R_i$ is decidable, then $\bigcup \{i \times R_i\}$ is c.e.

(i) If $f$ and $g$ are computable, is $f \circ g$ computable?
(j) If $f$ is computable and $R$ is decidable, is $\{w : R(f(w))\}$ decidable?
(k) If $f$ is computable and $R$ is c.e., is $\{w : R(f(w))\}$ c.e.

(2) If $R$ is decidable, then the complement is also decidable.

For (j) Problem given $(i, w)$: is $w \in R_i$?

Is this decidable? $\exists (i, w) : w \in R_i$?

It seems no.

Issue: Need a uniform algorithm which can take $i$ and run $R_i$ (run the algorithm for $R_i$)

By uniform: $(i, w) \mapsto R_i(w)$'s output