Let set $A$ be non-empty recursive, $B$ be non-recursive and $C$ be non-re. Using the terminology (REC) recursive, (RE) non-recursive recursively enumerable, (NR) non-re, categorize each set below, saying whether or not the set can be of the given category and justifying each answer. You may assume, for any set $S$, the existence of comparably hard sets $S_E = \{2x|x \in S\}$ and $S_D = \{2x+1|x \in S\}$. The following is a sample of the kind of answer I require:

**Sample.)** $A \cap C = \{ x \mid x \in A \text{ and } x \in C \}$

**REC:** Yes. If $A = \{0\}$ then $A \cap C = \emptyset$ or $\{0\}$, each of which is in REC.

**RE:** Yes. Let $A = \mathcal{N}_E = \{ 2x \mid x \in \mathcal{N} \}$; let $C = \text{TOT}_D \cup \text{HALT}_E$ then $A \cap C = \text{HALT}_E$ which is in RE.

**NR:** Yes. If $A = \mathcal{N}$ then $A \cap C = C$, which is in NR.

a.) $A - B = \{ x \mid x \in A \text{ and } x \not\in B \}$ // Set difference

b.) $\min(A, B) = \{ \min(x, y) \mid x \in A \text{ and } y \in B \}$ // Minimum

c.) $A \oplus C = \{ x \mid x \in A \text{ or } x \in C \text{ but } x \not\in A \cap C \}$ // Set exclusive union

Be careful: Some may not be possible. If so, you must justify why this is so.

**Note:**
- $\text{TOT} = \{ x \mid \forall \varphi_x(y) \downarrow \}$. These are the indices of the set of algorithms.
- $\text{HALT} = \{ <x, y> \mid \varphi_x(y) \downarrow \}$. This is the set of pairs of procedures and input for which the given procedure halts.

The set $S_E$, for any set $S$, is defined as $\{2x \mid x \in S\}$
The set $S_D$, for any set $S$, is defined as $\{2x+1 \mid x \in S\}$.
The complexities of $S$, $S_E$ and $S_D$ are the same. That is, all three are either in REC, RE or NR.