**Assignment #4; Due February 24 at start of class**

Choosing from among **(REC)** **recursive**, **(RE)** **re non-recursive, (coRE) co-re non-recursive**, **(NRNC)** **non-re/non-co-re**, categorize each of the sets in a) through d). Justify your answer by showing some minimal quantification of some known recursive predicate.

**a.) { < f, g > | domain(ϕf) ⊆ domain(ϕg) }**

 **Justification:**

Note: This allows equal domains, but even works if domain(**ϕf**) is Ø and domain(**ϕg**) is ℵ.

**b.) { f | no number appears more than once in range(ϕf) }**

 **Justification:**

Note: This can include functions whose ranges are empty and even those whose ranges do include all natural numbers.

**c.) { f | ϕf(f)↓ in at most f+1 steps }**

**Justification:**

Note: This is similar to the set **K** but involves an added twist.

**d.) { f | ϕf(f)↓ but takes at least f+1 steps to do so }**

 **Justification:**

Note: This is also similar to **K** but has a twist that differs from that in part (c).

**e.) { < f, x, y > | ϕf(x)↓ and ϕf(y)↓ but ϕf(x) takes longer to converge than does ϕf(y) }**

 **Justification:**

Note: Be careful to address the fact that **ϕf** converges on both **x** and **y**.