1. (10 x 3 = 30 points) Prove the following languages are not recursive:
   a. $L_1 = \{ M \mid L(M) \text{ accepts only even length strings} \}$
   b. $L_2 = \{ M \mid M \text{ accepts all strings of length less than 5} \}$
   c. $L_3 = \{ M_x \# M_y \mid L(M_x) = (L(M_y))^* \}$

2. (15 points) Show $L_4 = \{ M_x \# M_y \mid L(M_x) \cap L(M_y) \neq \phi \}$ is re but not co-re.

3. (15 points) Show $L_5 = \{ M_x \# M_y \mid L(M_x) \subseteq L(M_y) \}$ is co-re but not re.

4. (5 points) Show $L_6 = \{ M_x \# M_y \mid M_x \text{ takes fewer steps than } M_y \text{ on } \epsilon \}$ is re.