Spring 2009 **CMSC 452: Homework 4** Clyde Kruskal

Due at the start of class Tuesday, May 12, 2009.

Problem 1. Write a DFA for the following sets (using the conventions in Dr. Gasarch's lecture):

1. $\{(x, y) \mid x = y + 1\}$
2. $\{(x, X) \mid x + 2 \in X\}$

Problem 2. Which of the following problems are decidable, Turing enumerable (semi-decidable), or undecidable. Justify directly.

a. To determine, given a Turing machine M, a state q, and a string w, whether M ever reaches state q, when started on input w.

b. To determine, given a Turing machine M and a symbol a, whether M ever writes the symbol a when started on the empty input.

c. To determine, given a Turing machine M, whether M ever writes a nonblank symbol when started on the empty input.

d. To determine, given a Turing machine M and a string w, whether M ever moves the tape head to the left when started with input w.

e. To determine, given two Turing machines, whether one accepts the complement of the language of the other.

f. To determine, given two Turing machines, whether there is any string on which each halts.

g. To determine, given a Turing machine M, whether the language accepted by M is finite.