CS 341, Spring 2007
Solutions for Midterm 2

1. (a) True, see slide 4-54.
   (b) True, see slide 4-54.
   (c) False by Theorem 3.16.
   (d) True, by Theorems 3.13 and 3.16.
   (e) False. Suppose that A is decidable, which implies that it is also Turing-recognizable. But since A is decidable, it is recognized by a Turing machine that never loops.
   (f) False. This is just A_{TM}, which is undecidable by Theorem 4.11.
   (g) False, since $\overline{A_{\text{TM}}}$ is not Turing-recognizable by Corollary 4.23.
   (h) False, by Theorem 5.2.
   (i) True, by Theorem 4.4.
   (j) True, by Theorem 4.8.

2. (a) A language L_1 that is Turing-recognizable has a Turing machine M_1 that may loop forever on a string $w \notin L_1$. A language L_2 that is Turing-decidable has a Turing machine M_2 that always halts.
   (b) The informal notion of an algorithm corresponds exactly to a Turing machine that always halts.

3. Homework 9, problem 1.

4. This is basically Homework 7, problem 1.

   (a) $q_1 00 \quad \sqcup q_2 0 \quad \sqcup x q_3 \sqcup \quad \sqcup q_5 x \quad q_5 \sqcup x \quad \sqcup q_2 x \quad \sqcup x q_2 \sqcup \quad \sqcup x \sqcup q_{\text{accept}}$

   (b) $q_1 000 \quad \sqcup q_2 00 \quad \sqcup x q_3 0 \quad \sqcup x 0 q_4 \sqcup \quad \sqcup x 0 \sqcup q_{\text{reject}}$

5. Homework 8, problem 1.

6. This is Theorem 5.1, whose proof is given on slide 5-8.