## NAME:

This quiz contains 3 problems worth 30 points. You may not use books, notes, or a calculator. You have 30 minutes to take the quiz.

- 1. (12 points) Let  $X = \{1, 2, 3, 4, 5\}$  and let R be a relation on X defined by the rule  $(x, y) \in R$  if  $x + y \le 6$ .
  - (a) List the elements of R.
  - (b) Is R reflexive? Explain.
  - (c) Is R symmetric? Explain.
  - (d) Is R antisymmetric? Explain.
  - (e) Is R transitive? Explain.
  - (f) Is R a partial order? Explain.
  - (g) Is  $R = R^{-1}$ ? Explain.

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- 2. (10 points) Let  $X = \{1, 2, 3, 4, 5, 6, 7, 8, 9, 10\}$  and let R be a relation on  $X \times X$  by (a, b)R(c, d) if a + d = b + c. Note that R is an equivalence relation on  $X \times X$ .
  - (a) Give an example of two elements from  $X \times X$  that relate to (3, 2).
  - (b) Give an example of two elements for  $X \times X$  that do **not** relate to (3, 2).
  - (c) Show that R is symmetric.
  - (d) List all members of the equivalence class [(8, 1)].
- 3. (8 points)
  - (a) Write the matrix  $A_1$  of the relation  $R_1 = \{(1, a), (2, a), (2, b), (3, c)\}$  with orderings: 1,2,3; a,b,c.
  - (b) Write the matrix  $A_2$  of the relation  $R_2 = \{(a, y), (b, y), (b, z), (c, z)\}$  with orderings: a,b,c;x,y,z.
  - (c) List the ordered pairs in the relation  $R_2 \circ R_1$ .
  - (d) (2pts Extra Credit) Find the matrix product  $A_1A_2$  and explain what its entries tell you about the relation  $R_2 \circ R_1$ .