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 $x+y \leq 6$.
(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.
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: $1,2,3 ; \mathrm{a}, \mathrm{b}, \mathrm{c}$.
(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 $A_{1} A_{2}$ and explain what its entries tell you about the relation $R_{2} \circ R_{1}$.
