Assignment 6

Name:_____

Write or type solutions on a separate paper. If written, write legibly.

1. Identify each of following relations on $\mathbb{N}^2$ as one-to-one, one-to-many, many-to-one, or many-to-many
   a. $x \rho\, y \leftrightarrow \big|x\big| = y$
   b. $\rho = \big\{(2,5),(5,4),(6,3),(7,2),(4,6)\big\}$
   c. $x \rho\, y \leftrightarrow x = y^2$
   d. $\rho = \big\{(1,1),(1,4),(1,6),(2,3),(4,3)\big\}$

2. Identify the properties of each of the following relations on $\mathbb{N}^2$
   a. $x \rho\, y \leftrightarrow 2 \mid (x+y)$
   b. $x \rho\, y \leftrightarrow x \leq y$
   c. $\rho = \big\{(1,1),(1,4),(3,4),(4,3),(4,1),(3,3),(4,4)\big\}$
   d. $x \rho\, y \leftrightarrow \gcd(x,3) > \gcd(y,3)$

3. Given $\mathbf{A} = \big\{1,2,3,4,5,6\big\}, \mathbf{B} = \big\{2,4,6,8,10\big\}$ and $\mathbf{C} = \big\{1,3,5,7,9\big\}$, state if each of the following is not a function, a many-to-one function, surjection, injection, or bijection.
   a. $f\colon \mathbf{A} \to \mathbf{B} = \big\{(1,4),(2,2),(4,6),(3,8),(6,10)\big\}$
   b. $f\colon \mathbf{B} \to \mathbf{A} = \big\{(2,1),(4,2),(6,3),(8,4),(10,5)\big\}$
   c. $f\colon \mathbf{C} \to \mathbf{B} = \big\{(1,10),(3,8),(5,2),(9,4),(7,6)\big\}$
   d. $f\colon \mathbf{A} \to \mathbf{C} = \big\{(1,1),(2,9),(3,3),(4,7),(6,9),(5,5)\big\}$

4. If
$$f = \big\{(1,2),(2,5),(3,6),(4,1),(5,3),(6,8),(7,7),(8,4)\big\}$$
$$g = \big\{(1,7),(2,3),(3,4),(4,5),(5,6),(6,8),(7,1),(8,2)\big\},$$
   find
   a. $f \circ g$
   b. $g \circ f$
   c. f^{-1}
   d. $g \circ g$

5. Rewrite the program below and define the function `Mult2()` and `Print()`. The function `Mult2` stores the product of A and B in R where A, B, and R represent 2×2 matrices. The function `Print()` displays A in matrix form without braces.

   You are allowed to make additional functions, but you cannot include additional libraries.

```
#include <iostream>
#include <string>
using namespace std;

void Mult2(int* A,int* B,int* R);
void Print(int* A);
int main()
{
 int A[4], B[4], C[4];
 cout << "Enter the elements of matrix A\n";
 for(int i = 0;i < 4;i += 1)
 {
  cin >> A[i];
 }
 cout << "Enter the elements of matrix B\n";
 for(int i = 0;i < 4;i += 1)
 {
  cin >> B[i];
 }
 cout << "The product of\n";
 Print(A);
 cout << "and\n";
 Print(B);
 cout << "is\n";
 Mult2(A,B,C);
 Print(C);
 return 0;
}
```

Extra Credit Given $\mathbf{A} = \{x \in \mathbb{N} \colon 1 \leq x \leq 4\}, \mathbf{B} = \{x \in \mathbb{N} \colon 1 \leq x \leq 200\}$ and

$$f \colon \mathbf{A} \to \mathbf{B} = \{(1, 6), (2, 30), (3, 84), (4, 180)\}$$

find a third degree polynomial function, g(n), with integer coefficients that is equivalent to f for $n \in \mathbf{A}$.