**Midterm: (100 pts)**

**Student Name:**

**KSU ID:**

**1. (20pts)**

1. Define the Cartesian product of two sets and explain its properties.
2. Provide an example of a binary relation and discuss how it can be represented both as pairs and a rule.

**2. (20pts)**

* 1. Describe what a function is, including the terms domain, codomain, and range.
  2. Explain the difference between partial and total functions.
  3. Give examples of injective, surjective, and bijective functions.

**3. (30pts)**

a. Permutation with Repetition

A password consists of 5 characters, where each character can be any digit from 0 to 9.

* How many different possible passwords can be formed?
* If the first character of the password must be an odd digit (1, 3, 5, 7, or 9), how many different possible passwords can be formed?

b. Combination with Repetition

A fruit shop offers 4 different types of fruits: apples, bananas, cherries, and dates. A customer wants to buy 7 fruits, and the selection can include any combination of these 4 types of fruits.

* How many different combinations of 7 fruits can the customer choose?
* If the customer must buy at least 2 apples, how many different combinations of 7 fruits can the customer choose?

**4. (30pts):**

Consider the binomial expansion of (1+x)10..

1. Find the binomial coefficient of the term containing x4 .
2. Express the general term of the expansion of (1+x)10 using binomial coefficients.
3. Using your result from part b, determine the value of x for which the coefficient of x4 in the expansion of (1+x)10 is equal to 210.
4. Verify if the value of x obtained in part c is correct by substituting it back into the binomial coefficient expression.