

Due: Friday, March 24, 2023

Name 1(Print) \_\_\_\_\_ CSE Login \_\_\_\_\_

Name 2(Print) \_\_\_\_\_ CSE Login \_\_\_\_\_

Problem	Page	Notes	Points	Score
2.3:2	161	Yes/No answers	3	
2.3:22 a,c	162		2	
2.3:36	163		6	
2.3:42	163		8	
(Bonus) 2.3:78	164		2	
Problem A	n/a	See Below	9	
Problem B	n/a	See Next Page	8	
Problem C	n/a	See Next Page	8	
(Optional) 2.3:20	162		0	
(Optional) 2.3:72	164		0	
Typesetting (bonus)			4	
Total			44	

**Problem A (2.3:10)**Let  $f : \{a, b, c, d\} \rightarrow \{a, b, c, d\}$ , for each of function  $f$  defined below

1.  $f(a) = b, f(b) = a, f(c) = c, f(d) = d.$
2.  $f(a) = b, f(b) = b, f(c) = d, f(d) = c.$
3.  $f(a) = d, f(b) = a, f(c) = c, f(d) = d.$

Determine whether each  $f$  is

- a. one-to-one (injective)
- b. onto (surjective)
- c. one-to-one correspondence (bijective)

**Problem B (2.3.12)**

Consider the following functions  $f : \mathbb{Z} \rightarrow \mathbb{Z}$

- $f(n) = n - 1$ .
- $f(n) = n^2 + 1$ .
- $f(n) = n^3$ .
- $f(n) = \lceil \frac{n}{2} \rceil$ .

For *each* of the above functions, answer each of the following questions:

1. Determine whether each  $f$  is one-to-one (injective).
2. Determine whether each  $f$  is onto (surjective).
3. Determine whether each  $f$  is one-to-one correspondence (bijective).
4. Determine whether each  $f$  is invertible. If so, give  $f^{-1}$ .

**Problem C**

For functions  $f(x) = x^2 + x$  and  $g(x) = x - 2$  from  $\mathbb{R}$  to  $\mathbb{R}$ , find:

1.  $f \circ g$
2.  $g \circ f$
3.  $f \circ f$
4.  $g \circ g$

**Note:** we have  $\text{range}(f) = \text{range}(g) = \text{domain}(f) = \text{domain}(g)$ .

**Instructions** Follow instructions *carefully*, failure to do so may result in points being deducted.

- The homework must be submitted on paper. Homework *neatly* formatted in  $\text{\LaTeX}$  will receive a 10 percent bonus. When formatting in  $\text{\LaTeX}$ , submit both the .tex and .pdf files via handin, in addition to the hard copy. You will not receive the bonus points if you work with a partner (see below).
- Clearly label each problem and submit answers *in order*.
- Staple this cover page to the front of your assignment for easier grading.
- Late submissions *will not be accepted*.
- When you are asked to prove something, you must give a formal, rigorous, and complete a proof as possible. Each step in your proof must contain explanation that would allow us to understand what theorem/logic you have applied to arrive at that step.
- You are to work individually, and all work should be your own. Check partner policy below.
- The CSE academic dishonesty policy is in effect (see [http://cse.unl.edu/ugrad/resources/academic\\_integrity.php](http://cse.unl.edu/ugrad/resources/academic_integrity.php)).

**Partner Policy** You may work in pairs, but you must follow these guidelines:

1. You must work *all* problems *together*. You may not simply partition the work between you.
2. You must use  $\text{\LaTeX}$  and you may divide the typing duties however you wish.
3. You may not discuss the problems with other groups or individuals.
4. Hand in only one hard copy with both author's names.